Literatur einschließlich Abstracts zu

"Konzept: Patient Blood Management"

(aus: Projekt „Fortsetzung der Studie betreffend Maßnahmen zur Optimierung des Verbrauchs von Blutkomponenten in fachlich und inhaltlicher Sicht“ -

Modul 2: „Schaffung von Exzellenzzentren in Patient Blood Management“, Abschlussbericht)


Abstract: The Serious Hazards of Transfusion (SHOT) scheme is a UK-wide, independent, professionally led hemovigilance system focused on learning from adverse events. SHOT was established in 1996 as a confidential reporting system for significant transfusion-related events, building an evidence base to support blood safety policy decisions, clinical guidelines, clinician education, and improvements in transfusion practice. Recommendations are formulated by an independent steering group drawn from medical royal colleges and professional bodies. Ten years after its inception, SHOT has analyzed 2630 transfusion safety events, published 8 annual reports with recommendations, and presented data nationally and internationally. These recommendations have underpinned key initiatives, in particular the UK Department of Health “Better Blood Transfusion” strategy. SHOT has encouraged open reporting of adverse events and “near-misses” in a supportive, learning culture, vigilance in hospital transfusion practice, and evaluation of information technology to support this process. The importance of education and training has been emphasized. Detailed analysis of events has identified weaknesses in the transfusion chain. A collaborative initiative between SHOT, the Chief Medical Officer for England's National Blood Transfusion Committee, and the National Patient Safety Agency aims to reduce ABO-incompatible transfusions by improving bedside practice. Cumulative SHOT data have documented the decline in transfusion-related graft vs host disease after implementation of leucodepletion and have highlighted transfusion-related acute lung injury and bacterial contamination of platelets as important causes of death and morbidity. The UK blood services have developed strategies to reduce these risks. Future SHOT data will evaluate the success of these and other blood safety improvements


Abstract: Between 1996 and 2005 the Serious Hazards of Transfusion (SHOT) scheme analysed 3239 reports of adverse reactions and events associated with transfusion of labile blood components in the UK. 321 reports (10%) related to transfusion of children under 18 years and 147/3239 (4.5%) to infants less than 12 months of age. There were 264 cases in children of 'incorrect blood component transfused', resulting from errors at all stages in the transfusion chain; 26/264 suffered actual or potential morbidity. Thirty acute transfusion reactions, three delayed transfusion reactions, 20 cases (three fatal) of transfusion-related acute lung injury, two cases (both fatal) of transfusion-associated graft-versus-host disease and two transfusion transmitted infections were reported. A population-based epidemiological study of transfused patients in 2004 showed that 4.2% of red cells are transfused to patients less than 18 years and 1.7% to infants less than 12 months. Interpretation of SHOT data against this context enabled the estimation of the incidence of an adverse outcome to be 18:100,000 red cells issued for children less than 18 years and 37:100,000 for infants less than 12 months, compared to 13:100,000 for adults. Adherence to relevant guidelines, knowledge of specialist transfusion needs of children and good communication are essential if this risk is to be reduced


Abstract: Our objective was to quantify incremental risk associated with transfusion of packed red blood cells and other blood components on morbidity after coronary artery bypass grafting. DESIGN: The study design was an observational cohort study. SETTING: This investigation took place at a large tertiary care referral center. PATIENTS: A total of 11,963 patients who underwent isolated coronary artery bypass from January 1, 1995, through July 1, 2002. INTERVENTIONS AND MAIN RESULTS: Among the 11,963 patients who underwent isolated coronary artery bypass grafting, 5,814 (48.6%) were transfused. Risk-adjusted probability of developing in-hospital mortality and morbidity as a function of red blood cell and blood-component transfusion was modeled using logistic regression. Transfusion of red blood cells was associated with a risk-adjusted increased risk for every postoperative morbidity event: mortality (odds ratio [OR], 1.77; 95% confidence interval [CI], 1.67-1.87; p<.0001), renal failure (OR, 2.06; 95% CI, 1.87-2.27; p<.0001), prolonged ventilatory support (OR, 1.79; 95% CI, 1.72-1.86; p<.0001), serious infection (OR, 1.76; 95% CI, 1.68-1.84; p<.0001), cardiac complications (OR, 1.55; 95% CI, 1.47-1.63; p<.0001), and neurologic events (OR, 1.37; 95% CI, 1.30-1.44; p<.0001). CONCLUSIONS: Perioperative red blood cell transfusion is the single factor most reliably associated with increased risk of postoperative morbidity events after isolated coronary artery bypass grafting. Each unit of red blood cells transfused is associated with incrementally increased risk for adverse outcome.


Abstract: Background--Red blood cell transfusion can both benefit and harm. To inform decisions about transfusion, we aimed to quantify associations of transfusion with clinical outcomes and cost in patients having cardiac surgery. Methods and Results--Clinical, hematology, and blood transfusion databases were linked with the UK population register. Additional hematocrit information was obtained from intensive care unit charts. Composite infection (respiratory or wound infection or septicemia) and ischemic outcomes (myocardial infarction, stroke, renal impairment, or failure) were prespecified as coprimary end points. Secondary outcomes were resource use, cost, and survival. Associations were estimated by regression modeling with adjustment for potential confounding. All adult patients having cardiac surgery between April 1, 1996, and December 31, 2003, with key exposure and outcome data were included (98%). Adjusted odds ratios for composite infection (737 of 8516) and ischemic outcomes (832 of 8518) for transfused versus nontransfused patients were 3.38 (95% confidence interval [CI], 2.60 to 4.40) and 3.35 (95% CI, 2.68 to 4.35), respectively. Transfusion was associated with increased relative cost of admission (any transfusion, 1.42 times [95% CI, 1.37 to 1.46], varying from 1.11 for 1 U to 3.35 for >9 U). At any time after their operations, transfused patients were less likely to have been discharged from hospital (hazard ratio [HR], 0.63; 95% CI, 0.60 to 0.67) and were more likely to have died (0 to 30 days: HR, 6.69; 95% CI, 3.66 to 15.1; 31 days to 1 year: HR, 2.59; 95% CI, 1.68 to 4.17; >1 year: HR, 1.32; 95% CI, 1.08 to 1.64). Conclusions--Red blood cell transfusion in patients having cardiac surgery is strongly associated with both infection and ischemic postoperative morbidity, hospital stay, increased early and late mortality, and hospital costs.

Abstract: Studies have shown poor prognostic implications of anemia in patients with myocardial infarction (MI) and in patients undergoing percutaneous coronary intervention (PCI). The impact of blood transfusion in these populations remains controversial. The objective of this study was to examine the effect of transfusion on in-hospital mortality in anemic patients undergoing PCI for MI. Data from 67,051 PCIs (June 1, 1997 to January 31, 2004) were prospectively collected in a multicenter registry (Blue Cross Blue Shield of Michigan Cardiovascular Consortium). Of these, 4,623 patients who were classified as anemic according to the World Health Organization criteria underwent PCI within 7 days of presentation with acute MI. A propensity score for being transfused was estimated for each patient, and propensity matching and a prediction model for in-hospital death were developed. The average age was 67.8 years, 57.7% of patients were men, and 22.3% of patients received a transfusion during hospitalization. Transfused patients, compared to nontransfused patients, were more likely to be older, female, have lower preprocedure hemoglobin levels, more comorbidities, and a higher unadjusted in-hospital mortality rate (14.52% vs. 3.01%, p < 0.0001). After adjustment for comorbidities and propensity for transfusion, blood transfusion was associated with a higher risk of in-hospital mortality (adjusted odds ratio = 2.02, 95% confidence interval 1.47-2.79, p < 0.0001). In anemic patients undergoing PCI for MI, transfusion was associated with an increased crude and adjusted rate of in-hospital mortality. A randomized controlled trial is needed to determine the value of transfusion and the ideal transfusion criteria.


Abstract: OBJECTIVE: In an observational cohort study (2006-2007) the Paul-Ehrlich-Institut collected epidemiological data to investigate the frequency and causes of TRALI. METHODS: Diagnosis of TRALI was confirmed according to criteria of the European Haemovigilance Network. Subsequent testing of white blood cell antibodies (WBC-Ab) against HLA or human neutrophil alloantigens was performed. RESULTS: Of a total of 187 reported TRALI cases, 44 could be confirmed consisting of 35 cases of antibody-mediated TRALI and nine cases of non-immune-mediated TRALI. Eight of 44 affected patients (18%) had a fatal outcome, seven cases with WBC-Ab positive plasma donors and one case with red blood cell donors. WBC antibodies were found in one male and 39 female donors. In 34 female donors, a history of pregnancy was confirmed. WBC-Ab positive donors presented four HLA class I antibodies, 15 HLA class II antibodies, 13 HLA class I and class II antibodies, one HNA-2a, and seven HNA-3a antibodies. WBC antibodies matching with recipient antigens were found exclusively in 28 female donors; 26 FFP donors, one platelet donor and one red blood cell donor. Reporting frequency of immune-mediated TRALI was 1:66,000 for fresh frozen plasma, 1:2.86 million for red blood cell concentrates and 1:420,000 for platelet concentrates. Reporting frequency of TRALI-related fatalities was 1:285,000 for FFP. SUMMARY: Haemovigilance data show the significance of female donors with a history of pregnancy for the development of antibody-mediated TRALI. Manufacturing of FFP from male plasma and female donor screening for WBC-Ab could represent preventive measures.


Abstract: Divergent views remain regarding the safety of treating anemia with red blood cell (RBC) transfusion in patients with acute coronary syndrome (ACS). We used a prospective database to study effect of RBC transfusion in patients with acute myocardial infarction (MI; n = 2,358). Cox regression models were used to determine the association between RBC transfusion and 6-month outcomes, incorporating transfusion as a time-dependent variable. The models adjusted for baseline variables, propensity for transfusion, and nadir hemoglobin previous to the transfusion. One hundred ninety-two patients (8.1%) received RBC transfusion. Six-month mortality rates were higher in patients receiving transfusion (28.1% vs 11.7%, p <0.0001). The adjusted hazard ratio (HR) for mortality was 1.9 in transfused patients (95% confidence interval [CI] 1.3 to 2.9). Interaction between RBC transfusion and nadir hemoglobin with respect to mortality (p = 0.004) was significant. Stratified analyses showed a protective effect of transfusion in patients with nadir hemoglobin < or =8 g/dL (adjusted HR 0.13, 95% CI 0.03 to 0.65, p = 0.013). By contrast, transfusion was associated with increased mortality in patients with nadir hemoglobin >8 g/dL (adjusted HR 2.2, 95% CI 1.5 to 3.3; p <0.0001). Similar results were obtained for the composite end point of death/MI/heart failure (p for interaction = 0.04). In conclusion, RBC transfusion in patients with acute MI and hemoglobin < or =8 g/dL may be appropriate. The increased mortality observed in transfused patients with nadir hemoglobin above 8
g/dL underscores the clinical difficulty of balancing risks and benefits of RBC transfusion in the setting of ACS


Abstract: The purpose of the present investigation was to examine the impact of blood transfusion on resource utilisation, morbidity and mortality in patients undergoing coronary artery bypass graft (CABG) surgery at a major university hospital. The resources we examined are time to extubation, intensive care unit length of stay (ICULOS) and postoperative length of stay (PLOS). We further examined the impact of number of units of packed red blood cells (PRBCs) transfused during PLOS. This is a retrospective observational study and includes 1746 consecutive male and female patients undergoing primary CABG (on- and off-pump) at our institution. Of these, 1067 patients received blood transfusions, while 677 did not. The data regarding the demography, blood transfusion, resource utilisation, morbidity and mortality were collected from the records of patients undergoing CABG over a period of three years. The mean time to extubation following surgery was 8.0 h for the transfused group and 4.3 h for the nontransfused group (P <or= 0.001). The mean ICULOS for the transfused group was 1.6 d and 1.2 d for the nontransfused group (P <or= 0.001). In all patients and in patients with no preoperative morbidity, partial correlation coefficients were used to examine the effects of transfusion on mortality, time to extubation, ICULOS and PLOS. Linear regression model was used to assess the effect of number of PRBC units transfused on PLOS. We noted that PLOS increased with the number of PRBC units transfused. Transfusion is significantly correlated with the increased time to extubation, ICULOS, PLOS and mortality. The transfused patients had significantly more postoperative complications than their nontransfused counterparts (P <or= 0.001). The 30-day hospital mortality was 3.1% for the transfused group with no deaths in the nontransfused group (P <or= 0.001). We conclude that the CABG patients receiving blood transfusion have significantly longer time for tracheal extubation, ICULOS, PLOS and higher morbidity and 30-day hospital mortality. Blood transfusion was an independent predictor of increased resource utilisation, postoperative morbidity and mortality

(15) Reeves BC, Murphy GJ. Increased mortality, morbidity, and cost associated with red blood cell transfusion after cardiac surgery. Curr Opin Cardiol 2008;23:607-12.


Abstract: OBJECTIVES: We sought to determine the relationship between red blood cell (RBC) transfusion and clinical outcomes in patients undergoing primary percutaneous coronary intervention (PCI) for acute myocardial infarction (AMI). BACKGROUND: The implications of RBC transfusion in patients undergoing primary PCI for AMI have not been evaluated. METHODS: Clinical outcomes of patients from the prospective, randomized CADILLAC (Controlled Abciximab and Device Investigation to Lower Late Angioplasty Complications) trial were analyzed by administration of in-hospital RBC transfusion not related to coronary artery bypass surgery. RESULTS: Of 2,060 randomized patients, 82 (3.98%) received RBC transfusion during the index hospitalization, including 33 (1.60%) with moderate/severe bleeding and 49 (2.38%) without overt major bleeding. Transfusion was independently associated with baseline anemia (odds ratio [95% confidence interval]: 4.44 [2.60 to 7.58], p < 0.0001), older age (1.03 [1.01 to 1.06], p = 0.002), triple-vessel disease (2.54 [1.47 to 4.38], p = 0.0008), and female sex (1.04 [1.02 to 1.06], p = 0.0008). Patients transfused versus not transfused had significantly higher rates of 1-year mortality (23.9% vs. 3.4%), disabling stroke (2.5% vs. 0.5%), reinfarction (7.0% vs. 2.2%), and composite major adverse cardiac events (41.0% vs. 16.6%) (all p values < 0.01). After multivariable
adjustment for potential confounders including transfusion propensity, RBC transfusion was independently associated with mortality at 30 days (hazards ratio: 4.71, \( p = 0.0005 \)) and 1 year (hazards ratio: 3.16, \( p = 0.0005 \)). CONCLUSIONS: An RBC transfusion after primary PCI in AMI may be harmful, which is consistent with the findings from other studies after PCI in the noninfarct setting. Alternatively, RBC transfusion may be a marker of markedly increased risk. Randomized studies are warranted to determine the optimal threshold for RBC transfusion in patients with AMI undergoing mechanical reperfusion therapy.


Abstract: BACKGROUND: Transfusion of packed red blood cells (PRBCs) increases morbidity and mortality in select surgical specialty patients. The impact of low-volume, leukoreduced RBC transfusion on general surgery patients is less well understood. STUDY DESIGN: The American College of Surgeons National Surgical Quality Improvement Program participant use file was queried for general surgery patients recorded in 2005 to 2006 (n = 125,223). Thirty-day morbidity (21 uniformly defined complications) and mortality, demographic, preoperative, and intraoperative risk variables were obtained. Infectious complications and composite morbidity and mortality were stratified across intraoperative PRBCs units received. Multivariable logistic regression was used to assess influence of transfusion on outcomes, while adjusting for transfusion propensity, procedure type, wound class, operative duration, and 30+ patient risk factors. RESULTS: After adjustment for transfusion propensity, procedure group, wound class, operative duration, and all other important risk variables, 1 U PRBCs significantly (\( p < 0.05 \)) increased risk of 30-day mortality (odds ratio [OR] = 1.32), composite morbidity (OR = 1.23), pneumonia (OR = 1.24), and sepsis/shock (OR = 1.29). Transfusion of 2 U additionally increased risk for these outcomes (OR = 1.38, 1.40, 1.25, 1.53, respectively; \( p < 0.05 \)) versus surgical-site infection (OR = 1.25; \( p < 0.05 \)). A risk index for calculating transfusion likelihood demonstrated very good discrimination (c-index = 0.844). CONCLUSIONS: Intraoperative transfusion of PRBCs increases risk for mortality and several morbidities in general surgery patients. These risks, substantial for even 1 U, remain after adjustment for transfusion propensity and numerous risk factors available in the American College of Surgeons National Surgical Quality Improvement Program. Transfusion for mildly hypovolemic or anemic patients should be discouraged in light of these risks.


Abstract: BACKGROUND: Transfusion rates remain high in cardiac and orthopedic surgery and differ widely across physician practices in spite of growing knowledge that allogeneic blood transfusion (ABT) is associated with a risk of postoperative infection. METHODS: This prospective observational study compared the timing and incidence of ABT-associated postoperative infections (PIs) in 1,489 orthopedic or cardiac surgery patients at nine hospitals. RESULTS: Of 455 cardiovascular and 1,034 orthopedic surgery patients, 415 (55.6% of the cardiovascular patients and 15.7% of the orthopedic patients) were given ABT. The overall rate of PI during hospitalization was 5.8%. The relative risk of PI was 3.6-fold greater after ABT (50 patients; 12.1%) than in patients not having ABT (36 patients; 3.4%; 95% confidence interval 2.4, 5.4; \( p = 0.001 \)). Postoperative infections appeared both during hospitalization (n = 86) and within four weeks after discharge (n = 81). CONCLUSIONS: Patients should be followed for as long as four weeks after discharge to determine the true incidence and risk of ABT-associated PI.


Abstract: OBJECTIVES: We sought to examine the short- and long-term outcomes of blood transfusion in patients presenting with ST-segment elevation myocardial infarction (STEMI). BACKGROUND: The short- and long-term consequences of blood transfusion in anemic patients with recent STEMI remain controversial. METHODS: We evaluated 30-day, 6-month, and 1-year all-cause mortality among 4,131 STEMI patients enrolled in the GUSTO (Global Use of Strategies to Open Occluded Coronary Arteries) IIb trial. Patients were categorized according to whether they received a blood transfusion during hospitalization. Cox proportional hazards survival models with transfusion as a time-dependent
Abstract: BACKGROUND: Blood transfusion has been associated with an increased mortality in patients undergoing percutaneous coronary intervention (PCI). Although the reasons for this remain unclear, it may be related to the structural and functional changes occurring within red blood cells (RBCs) during storage. We investigated whether RBC storage duration was associated with mortality in patients requiring transfusion after PCI. METHODS: We collected data on all RBC transfusions occurring within 10 days of PCI (excluding those related to cardiac surgery) using the British Columbia Cardiac Registry and Central Transfusion Registry. Transfusion details were analyzed according to 30-day survival. RESULTS: From a total of 32,580 patients undergoing PCI, 909 (2.8%) patients received RBCs with a mean storage duration of 25+/- 10 days. In these 909 patients, mean transfusion volumes were lower in survivors (2.8 +/- 2.1 vs 3.8 +/- 2.9 U, P = .002) than those who died within 30 days. In a multivariate analysis to adjust for baseline characteristics, mean RBC storage age (HR 1.02 [95% CI 1.01-1.04], P = .002) and transfusion volume (HR 1.26 [95% CI 1.18-1.34], P < .001) both predicted 30-day mortality. Transfused patients who received only older blood (RBC min age >28 days) appeared to be at greater risk of death (HR 2.49 [95% CI 1.45-4.25], P = .001). CONCLUSION: Red blood cell transfusion is associated with increased short- and long-term mortality in patients undergoing PCI. Although current transfusion practice permits storage of blood for up to 42 days, the use of older red cells may pose an additional hazard to this patient group.
Abstract: Background: Guidelines have been offered on haemoglobin thresholds for blood transfusion in surgical patients. However, good evidence is lacking on the haemoglobin concentrations at which the risk of death or serious morbidity begins to rise and at which transfusion is indicated. METHODS: A retrospective cohort study was performed in 1958 patients, 18 years and older, who underwent surgery and declined blood transfusion for religious reasons. The primary outcome was 30-day mortality and the secondary outcome was 30-day mortality or in-hospital 30-day morbidity. Cardiovascular disease was defined as a history of angina, myocardial infarction, congestive heart failure, or peripheral vascular disease. FINDINGS: The 30-day mortality was 3.2% (95% CI 2.4-4.0). The mortality was 1.3% (0.8-2.0) in patients with preoperative haemoglobin 12 g/dL or greater and 33.3% (18.6-51.0) in patients with preoperative haemoglobin less than 6 g/dL. The increase in risk of death associated with low preoperative haemoglobin was more pronounced in patients with cardiovascular disease than in patients without (interaction p < 0.03). The effect of blood loss on mortality was larger in patients with low preoperative haemoglobin than in those with a higher preoperative haemoglobin (interaction p < 0.001). The results were similar in analyses of postoperative haemoglobin and 30-day mortality or in-hospital morbidity. INTERPRETATION: A low preoperative haemoglobin or a substantial operative blood loss increases the risk of death or serious morbidity more in patients with cardiovascular disease than in those without. Decisions about transfusion should take account of cardiovascular status and operative blood loss as well as the haemoglobin concentration.


Abstract: Background: The risk of preoperative anemia in patients undergoing heart surgery has not been described precisely. Specifically, the impact of low hemoglobin per se or combined with other risk factors on postoperative outcome is unknown. Thus, we determined the effects of low preoperative hemoglobin and comorbidities on postoperative adverse outcomes in patients with coronary artery bypass graft in a large comprehensive multicenter study. Methods and Results: The Multicenter Study of Perioperative Ischemia investigated 5065 patients with coronary artery bypass graft at 70 institutions worldwide, collecting [approx]7500 data points per patient. In 4804 patients who received no preoperative transfusions, we determined the association between lowest preoperative hemoglobin levels and in-hospital cardiac and noncardiac morbidity and mortality and the impact of concomitant risk factors, assessed by EuroSCORE, on this effect. In patients with EuroSCORE <4 (n=2054), only noncardiac outcomes were increased, whereas patients with EuroSCORE ≥4 (n=2750) showed an increased incidence of all postoperative events, starting at hemoglobin <11 g/dL. Low preoperative hemoglobin was an independent predictor for noncardiac (renal>cerebral; P<0.001) outcomes, whereas the increase in cardiac events was due to other factors associated with preoperative anemia. Conclusions: Anemic patients undergoing cardiac surgery have an increased risk of postoperative adverse events. Importantly, the extent of preexisting comorbidities substantially affects perioperative anemia tolerance. Therefore, preoperative risk assessment and subsequent therapeutic strategies, such as blood transfusion, should take into account both the individual level of preoperative hemoglobin and the extent of concomitant risk factors.


Abstract: Background: Preoperative anemia is an important risk factor for perioperative red blood cell transfusions, which are associated with postoperative morbidity and mortality. Whether preoperative anemia also is an independent risk factor for adverse outcomes after cardiac surgery, however, has not been fully elucidated. Methods and Results: In this multicenter cohort study, data were collected on 3500 consecutive patients who underwent cardiac surgery during 2004 at 7 academic hospitals. The prevalence of preoperative anemia, defined as hemoglobin <12.5 g/dL, and its unadjusted and adjusted relationships with the composite outcome of in-hospital death, stroke, or acute kidney injury were obtained. The overall prevalence of preoperative anemia was 26%, with values ranging from 22% to 30% at the participating hospitals. After the exclusion of patients who had severe preoperative
anemia (hemoglobin <9.5 g/dL) or preoperative kidney failure and those who underwent emergency surgery, the composite outcome was observed in 7.5% of patients (247 of 3286). The unadjusted odds ratio for the composite outcome in anemic versus nonanemic patients was 3.6 (95% confidence interval, 2.7 to 4.7). The risk-adjusted odds ratios, obtained by multivariable logistic regression and propensity-score matching to control for important confounders (including comorbidities, institution, surgical factors, and blood transfusion), were 2.0 (95% confidence interval, 1.4 to 2.8) and 1.8 (95% confidence interval, 1.2 to 2.7), respectively. Conclusions-- Preoperative anemia is independently associated with adverse outcomes after cardiac surgery. Future studies should determine whether therapies aimed at treating preoperative anemia would improve the outcomes of patients undergoing cardiac surgery


Abstract: OBJECTIVE: To collect population based information on transfusion of red blood cells. DESIGN: Prospective observational study over 28 days. SETTING: Hospital blood banks in the north of England (population 2.9 million). MAIN OUTCOME MEASURES: Indicators for transfusion, number of units given, and the age and sex of transfusion recipients. PARTICIPANTS: All patients who received a red cell transfusion during the study period. Data completed by hospital blood bank staff. RESULTS: The destination of 9848 units was recorded (97% of expected blood use). In total 9774 units were transfused: 5047 (51.6%) units were given to medical patients, 3982 (40.7%) to surgical patients, and 612 (6.3%) to obstetric and gynaecology patients. Nearly half (49.3%) of all blood is given to female recipients, and the mean age of recipients of individual units was 62.7 years. The most common surgical indications for transfusion were total hip replacement (4.6% of all blood transfused) and coronary artery bypass grafting (4.1%). Haematological disorders accounted for 15.5% of use. Overall use was 4274 units per 100 000 population per year. CONCLUSION: In the north east of England more than half of red cell units are transfused for medical indications. Demand for red cell transfusion increases with age. With anticipated changes in the age structure of the population the demand for blood will increase by 4.9% by 2008


Abstract: Background Transfusion recipient data are needed for correct estimation of cost-effectiveness in terms of recipient outcomes after transfusion. Also, such data are essential for monitoring blood use, estimation of future blood use and benchmarking. Study Design and Methods A sample of 20 of 93 Dutch hospitals was selected. Datasets containing all blood product transfusions between 1996 and 2006 were extracted from hospital blood bank computer systems, containing transfusion date, blood product type and recipient characteristics such as gender, address, date of birth. The datasets were appended and matched to national hospitalization datasets including primary discharge diagnoses (ICD-9). Using these data, we estimated distributions of blood recipient characteristics in the Netherlands. Results The dataset contains information on 290 043 patients who received 2 405 012 blood products (1 720 075 RBC, 443 697 FFP, 241 240 PLT) from 1996 to 2006. This is 28% of total blood use in the Netherlands during this period. Comparable diagnosis and age distributions of all hospitalizations indicate included hospitals to be representative, per hospital category, for the Netherlands. Of all red blood cells (RBC), fresh-frozen plasma (FFP) and platelets (PLT), respectively 1.7%, 2.5% and 4.5% were transfused to neonates. Recipients of 65 years or older received 57.6% of RBC, 41.4% of FFP and 29.0% of PLT. Most of the blood products were transfused to patients with diseases of the circulatory system (25.1%) or neoplasms (22.0%). Conclusion Transfusion data from a limited sample of hospitals can be used to estimate national distributions of blood recipient characteristics


Abstract: Bridging the gap between scientific evidence and its practical application is of the utmost importance in improving the quality of care and increasing patient safety. Guidelines based on evidenced-based medicine (EBM) have led to improved performances and better outcomes. However, even though
scientific data are available, resistance to adopting evidence-based guidelines is still enormous. Significant barriers hinder the introduction of best medical practice into the daily clinical routine. The barriers to implementing change are complex, multifunctional, and influenced on many levels by various interests both inside and outside the health-care system. Political, organizational, financial, cultural and scientific interests are regarded as being as important as the perception of patients and health workers. Strategies need to be planned which take account of the multidimensional character of quality of care and incorporate it at the various levels. The conclusion, therefore, is that we need to combine methods and tools to tailor our interventions to the patient’s needs.


Abstract: BACKGROUND: The purpose of this study was to assess current practices in blood management in elective orthopedic surgery in Europe. STUDY DESIGN AND METHODS: For this 225-center prospective survey, data were collected on 3996 patients. Actual perioperative blood loss was compared to preoperative estimates. Differences in Hb levels and other outcome variables for patients receiving allogeneic versus autologous transfusions were evaluated. The probability of allogeneic transfusion based on selected predictor variables was estimated. RESULTS: A total of 2640 (67%) hip and 1305 (33%) knee arthroplasty patients were evaluated. Estimated blood loss (median, 750 mL) was significantly lower than computed blood loss (median, 1944 mL). A total of 2762 (69%) patients received transfusions, including 1393 (35%) autologous-only and 1024 (25%) allogeneic-only. The probability of allogeneic transfusion decreased with increasing baseline Hb, but differentially so for men and women. Transfusion triggers were Hb levels of 8.93 +/- 1.83 g per dL for allogeneic transfusions, and 21 percent of these occurred when the Hb level was greater than 10 g per dL. Autologous blood transfusion was associated with a significantly lower rate (1%) of wound infections than allogeneic blood transfusion (4.2%). CONCLUSION: Accurate assessment of preoperative Hb levels, better estimation of perioperative blood loss, efficient use of autologous blood, adherence to transfusion guidelines, and pharmacologic alternatives contribute to effective and comprehensive blood and anemia management.


Abstract: BACKGROUND: Benchmarking transfusion activity may help to eliminate inappropriate use of blood products. The goal of this study was to measure and to compare the current transfusion practice and to identify predictors of transfusion in public hospitals to develop strategies to optimize transfusion practices. STUDY DESIGN AND METHODS: This was a prospective observational study in 18 randomly selected public hospitals from April 2004 to February 2005. Primary outcome measures were the amount of intra- and postoperative blood components transfused and intercenter variability of transfusion rate. Secondary outcome measures were prevalence of preoperative anemia, calculated perioperative blood loss, and lowest measured perioperative hemoglobin (Hb) level. RESULTS: Adult patients undergoing primary unilateral total hip replacement (THR, n = 1401), primary unilateral knee replacement (TKR, n = 1296), hemicolecotomy (HECOC, n = 148), and coronary artery bypass graft (CABG) surgery (n = 777) were enrolled. Due to the small number, data of HECOC patients were not fully analyzed. In the remaining procedures, there was a large intercenter variability in the percentage of patients who received transfusions: THR 16 to 85 percent, TKR 12 to 87 percent, and CABG 37 to 63 percent. In the patients who received transfusions, the number of red blood cells (RBC) units transfused varied significantly. There was also a considerable intercenter variability in RBC loss. The prevalence of preoperative anemia was 19 percent and identical in both sexes. The incidence of preoperative anemia was three times higher in patients who received transfusions compared to those who did not. CONCLUSION: This study demonstrates a high intercenter variability in RBC transfusions and RBC loss in standard surgical procedures. Whereas the variability in blood loss remains largely unexplained, the main predictors for allogeneic RBC transfusions are preoperative and nadir Hb and surgical RBC loss.

Abstract: Transfusion rates in coronary artery bypass grafting (CABG) continue to vary substantially, although guidelines for allogeneic transfusion have been developed. In order to evaluate ongoing transfusion practices, we performed a multicenter audit in four Danish hospitals regarding the use of allogeneic blood products among patients undergoing first-time CABG. Data on patient characteristics, peri- and postoperative factors were retrieved from 600 patient records (150 records per hospital). Substantial differences were seen regarding preoperative intake of antithrombotic drugs, perioperative use of antifibrinolytic drugs, use of cardiopulmonary bypass (CPB), cross-clamp time, time on CPB, lowest hemoglobin during CPB, and number of distal anastomoses. The percentage of patients transfused with allogeneic red blood cells ranged from 30.0% to 64.2%. Several patients (12.1-42.7%) transfused with red blood cells were discharged with a hemoglobin concentration >7 mmol/l, indicating inappropriate transfusions. The relative risk of receiving an allogeneic blood transfusion was 2.1 (95% CI: 1.6-2.7) in the hospital with the highest transfusion rate, after adjustment for patient-, drug-, and procedure-related factors. Interesting differences in transfusion rates exists in Danish hospitals and these differences may reflect true variations in transfusion practices. Audits create a basis for educational efforts among surgeons and anesthesiologists to standardize transfusion practices.


Abstract: The purpose of the present investigation was to examine the impact of blood transfusion on resource utilisation, morbidity and mortality in patients undergoing coronary artery bypass graft (CABG) surgery at a major university hospital. The resources we examined are time to extubation, intensive care unit length of stay (ICULOS) and postoperative length of stay (PLOS). We further examined the impact of number of units of packed red blood cells (PRBCs) transfused during PLOS. This is a retrospective observational study and includes 1746 consecutive male and female patients undergoing primary CABG (on- and off-pump) at our institution. Of these, 1067 patients received blood transfusions, while 677 did not. The data regarding the demography, blood transfusion, resource utilisation, morbidity and mortality were collected from the records of patients undergoing CABG over a period of three years. The mean time to extubation following surgery was 8.0 h for the transfused group and 4.3 h for the nontransfused group (P <or= 0.001). The mean ICULOS for the transfused group was 1.6 d and 1.2 d for the nontransfused group (P <or= 0.001). In all patients and in patients with no preoperative morbidity, partial correlation coefficients were used to examine the effects of transfusion on mortality, time to extubation, ICULOS and PLOS. Linear regression model was used to assess the effect of number of PRBC units transfused on PLOS. We noted that PLOS increased with the number of PRBCs units transfused. Transfusion is significantly correlated with the increased time to extubation, ICULOS, PLOS and mortality. The transfused patients had significantly more postoperative complications than their nontransfused counterparts (P <or= 0.001). The 30-day hospital mortality was 3.1% for the transfused group with no deaths in the nontransfused group (P <or= 0.001). We conclude that the CABG patients receiving blood transfusion have significantly longer time for tracheal extubation, ICULOS, PLOS and higher morbidity and 30-day hospital mortality. Blood transfusion was an independent predictor of increased resource utilisation, postoperative morbidity and mortality.


Abstract: The indications for red blood cell (RBC) transfusions remain unclear despite published guidelines. Our hypothesis was that the transfusion practice varies inside the Centre hospitalier de l'Universite de Montreal (CHUM). STUDY DESIGN AND METHODS: A total of 701 charts of patients who underwent a knee or hip arthroplasty or prosthesis revision in three hospitals of the CHUM were reviewed. Demography, hemoglobin (Hb) concentrations, details on transfusions, and postoperative adverse events (AEs) were collected up until discharge. The primary outcome was the presence or absence of RBC transfusion. Secondary outcomes were the nadir Hb, number of units transfused, discharge Hb, blood losses, and postoperative AEs. RESULTS: The rate of postoperative transfusion was 29%. We found no significant difference between odds ratios of each site for sex, coronary artery disease, chronic heart failure, type of procedure, American Society of Anesthesiologists physical status, weight, height, body mass index, body surface area, and estimated blood volume. Overall, patients were transfused at a Hb between 75 and 80 g/L. Eighty-five percent of postoperative...
transfusions could be predicted using only nadir Hb and adding patient characteristics did not substantially improve the model (86.1%). Discharge Hb was below 100 g/L in 66% of patients.

CONCLUSIONS: There was no difference among hospitals regarding the way RBC transfusions are used. Our data suggest that physicians mainly based their decision to transfuse on a single variable, the Hb concentration, with the use of a restrictive strategy. Future trials should focus on the optimal transfusion trigger to adopt in major orthopedic surgery.


Abstract: BACKGROUND: The 2007 Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists Clinical Practice Guideline for Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery was recently promulgated and has received much attention. Using a survey of cardiac anesthesiologists and perfusionists’ clinical practice, we aimed to assess the current practices of perfusion, anesthesia, and surgery, as recommended by the Guidelines, and to also determine the role the Guidelines had in changing these practices. METHODS: Nontrainee members of the Society of Cardiovascular Anesthesiologists, the American Academy of Cardiovascular Perfusion, the Canadian Society of Clinical Perfusion, and the American Society of Extracorporeal Technology were surveyed using a standardized survey instrument that examined clinical practices and responses to the Guidelines. RESULTS: A total of 1402 surveys from 1061 institutions principally in the United States (677 institutions) and Canada (34 institutions) were returned, a 32% response rate. There was wide distribution of the Guidelines with 78% of anesthesiologists and 67% of perfusionists reporting having read all, part, or a summary of the Guidelines. However, only 20% of respondents reported that an institutional discussion had taken place as a result of the Guidelines, and only 14% of respondents reported that an institutional monitoring group had been formed. There was wide variability in current preoperative testing, perfusion, surgical, and pharmacological practices reported by respondents. Twenty-six percent of respondents reported 1 or more practice changes in response to the Guidelines. The changes made were reported to be highly (9%) or somewhat (31%) effective in reducing overall transfusion rates. Only 4 of 38 Guideline recommendations were reported by >5% of respondents to have been changed in response to the Guidelines. CONCLUSIONS: Wide variation in clinical practices of cardiac surgery was reported. Little change in clinical practices was attributed to the Society of Thoracic Surgeons/Society of Cardiovascular Anesthesiologists Guidelines.


Abstract: BACKGROUND: There is a dearth of information about the cost of allogenic red blood cells (RBCs) and RBC transfusion in Canada in the aftermath of the Canadian blood system reorganization and the introduction of various safety measures. The unit cost of allogenic RBCs and RBC transfusion in Canada in 1994 was estimated at 152.17 US dollars. The objective of this study was to determine the unit cost of allogenic RBC transfusion in Canada from a societal perspective. STUDY DESIGN AND METHODS: A cost-structure analysis using the cost information from 2001 through 2002 was used. Costs of blood collection, production, distribution, delivery (hospital transfusion service processing and patient administration), transfusion reaction management, and opportunity cost of donor’s time were included in the analysis. Canadian Blood Services and Hema-Quebec supplied the data for collection, production, and distribution stages. Delivery and transfusion reaction costs were collected from eight hospitals across six Canadian provinces. In-patient costs were assessed for the intensive care unit, emergency, general medicine ward, and operating room. RESULTS: The aggregate mean societal unit cost of RBCs transfused on an inpatient basis in 2002 was 264.81 US dollars (95% confidence interval [CI], 256.29 dollars-275.65 dollars). The mean cost of blood collection, production, and distribution was 202.74 US dollars (95% CI, 199.63 dollars-204.31 dollars), the mean opportunity cost of donor time was 18.21 US dollars (95% CI, 17.11 dollars-21.63 dollars), the mean cost of hospital transfusion service processing was 16.65 US dollars (95% CI, 13.50 dollars-19.79 dollars), of RBC transfusion was 26.92 US dollars (95% CI, 25.33 dollars-28.52 dollars), and of transfusion reaction management was 0.29 US dollars (95% CI, 0.22 dollars-0.36 dollars). There were substantial variations in hospital transfusion service processing and RBC transfusion costs across hospitals. CONCLUSION: The societal unit cost of RBC transfusion has doubled since 1994 to 1995. Further increases in unit costs would be
expected as additional safety measures are introduced. This will have important financial implications for treating patient populations that require a high level of RBC transfusions

Abstract: BACKGROUND: Blood utilization has long been suspected to consume more health care resources than previously reported. Incomplete accounting for blood costs has the potential to misdirect programmatic decision making by health care systems. Determining the cost of supplying patients with blood transfusions requires an in-depth examination of the complex array of activities surrounding the decision to transfuse. STUDY DESIGN AND METHODS: To accurately determine the cost of blood in a surgical population from a health system perspective, an activity-based costing (ABC) model was constructed. Tasks and resource consumption (materials, labor, third-party services, capital) related to blood administration were identified prospectively at two US and two European hospitals. Process frequency (i.e., usage) data were captured retrospectively from each hospital and used to populate the ABC model. RESULTS: All major process steps, staff, and consumables to provide red blood cell (RBC) transfusions to surgical patients, including usage frequencies, and direct and indirect overhead costs contributed to per-RBC-unit costs between $522 and $1183 (mean, $761 +/- $294). These exceed previously reported estimates and were 3.2- to 4.8-fold higher than blood product acquisition costs. Annual expenditures on blood and transfusion-related activities, limited to surgical patients, ranged from $1.62 to $6.03 million per hospital and were largely related to the transfusion rate. CONCLUSION: Applicable to various hospital practices, the ABC model confirms that blood costs have been underestimated and that they are geographically variable and identifies opportunities for cost containment. Studies to determine whether more stringent control of blood utilization improves health care utilization and quality, and further reduces costs, are warranted

Abstract: Falling donor numbers and the threat of transfusion-transmitted variant Creutzfeldt-Jakob disease may lead to shortages in the national blood supply. Knowledge of current patterns of transfusion and trends in usage will help predict future change in blood use. Our previous survey identified medical indications as the major reason for transfusion, but detailed information within this category was limited. We performed prospective surveys of indications for red cell transfusion for two 14-day periods in 2004 in the North of England, concentrating on medical reasons for transfusion. Data were obtained for transfusion indications of 9003 units, which accounted for over 99% of red cell issues from the regional blood centre during the study. In 2004, medical patients received 62% (5558 units) of all transfused units, surgical patients 33% (3001 units) and Obstetric & Gynaecology patients 5% (444 units). These figures compare with 52, 41 and 6% for Medicine, Surgery, and Obstetrics & Gynaecology in 1999/2000. The three largest uses of blood within the medical category were for patients with primary haematological disorders (18.2% of all transfused blood), management of gastrointestinal haemorrhage (13.8%) and for patients with nonhaematological malignancies (8.8%). There has been a significant reduction in use of blood for surgical indications over the last 5 years, but an absolute increase in use of blood for medical indications. Lower transfusion triggers, education, use of cell salvage, the increasing price of a unit of red cells and changing population demographics may all have contributed to the reduction in surgical blood use. Promotion of good transfusion practice and alternatives to allogeneic transfusion should now focus on medical and surgical use of blood transfusion


Ref Type: Journal (Full)


Abstract: Epidemiological information was obtained by a series of questions to experts in the field of epidemiology of transfusion from the United States, England, Australia and Denmark. Although it
became clear that the methods for collecting the data had differed between the countries, useful information was obtained for all questions. The data highlighted some major differences between the countries: the incident rate for red cell transfusion varied from 44.7 to 54.1 units, for platelets from 2.0 to 6.0 units and for plasma from 4.8 to 13.8 units transfused per 1000 population per year. Age and sex distribution of transfused patients was similar in all countries. Most of the red cell products are transfused to older recipients, and the distribution between men and women is approximately equal. The distribution for platelets is over a wider age range, and the difference between men and women is marked, with men predominating in all countries. The distribution for plasma is also directed to the elderly, and there is a predominance of men. The relationship between the disease or surgical procedure and the use of blood products was similar between countries. The use of red cells in cardiovascular surgery predominated. Neoplasms and digestive disorders were also prevalent. Neoplasms, including those relating to haematology, were the main use for platelets, but cardiovascular surgery was also important. In all countries, plasma is largely used in cardiovascular surgery. Two countries provided data relating to the number of units per transfusion episode including information relating to massive transfusion. In Australia, red cell use of >or=50 units per episode was largely associated with multiple traumas. In Denmark, it was associated with gastrointestinal bleeding and various medical requests.


Abstract: Background. Despite the recent introduction of a number of technical and pharmacologic blood conservation measures, bleeding and allogeneic transfusion remain persistent problems in open heart surgical procedures. We hypothesized that a comprehensive multimodality blood conservation program applied algorithmically on the basis of bleeding and transfusion risk would provide a maximum, cost-effective, and safe reduction in postoperative bleeding and allogeneic blood transfusion. Methods. One hundred consecutive patients undergoing coronary artery bypass grafting were prospectively enrolled in a risk factor-based multimodality blood conservation program (MMD group). To evaluate the relative efficacy and safety of this comprehensive approach, comparison was made with a similar group of 90 patients undergoing coronary artery bypass grafting to whom the multimodality blood conservation program was not applied but in whom an identical set of transfusion guidelines was enforced (control group). To evaluate the cost effectiveness of the multimodality program, comparison was also made between patients in the MMD group and a consecutive series of contemporaneous, diagnostic-related group-matched patients. Results. One hundred consecutive patients in the MMD group underwent coronary artery bypass grafting without allogeneic transfusion. This compared favorably with the control population in whom a mean of 2.2 (+/-) 6.7 units of allogeneic blood was transfused per patient (34 patients [38%] received transfusion). In addition, the volume of postoperative blood loss at 12 hours in the control group was almost double that of the MMD group (660 (+/-) 270 mL versus 370 (+/-) 180 mL [p < 0.001]). Total costs for the MMD group in each of the three major diagnostic-related groups were equivalent to or significantly less than those in the consecutive series of diagnostic-related group-matched patients. Conclusions. Comprehensive risk factor-based application of multiple blood conservation measures in an optimized, integrated, and algorithmic manner can significantly decrease bleeding and need of allogeneic transfusion in coronary artery bypass grafting in a safe and cost-effective manner.


Abstract: BACKGROUND: Strategies to restrict transfusions are gaining acceptance in critical care. We implemented an anemia management program (AMP) for trauma patients in the Surgical Intensive Care Unit. AMP was based on a transfusion trigger of 7 g/dL hemoglobin once hemodynamic sufficiency was achieved. We hypothesized that AMP would decrease the transfusion of packed red blood cells (PRBCs) and cost without detriment in clinical outcomes. METHODS: Transfusion data were retrospectively collected for all trauma patients treated in our Surgical Intensive Care Unit between July 2002 and December 2003. AMP was implemented in a step-wise fashion during a 6-month period (January to June 2003). Data were compared for the 6-month period before (Group I, July to December 2002) and after (Group II, July to December 2003) complete AMP implementation. Blood transfusion volumes were compared using negative binomial regression. Clinical outcomes (length of...
stay [LOS], death, myocardial infarction [MI], and ventilator-associated pneumonia [VAP]) were compared using risk ratios. Age, sex, and injury severity score (ISS) were examined as potential confounders. RESULTS: In all, 514 trauma patients were treated during the study period (n = 270 in Group I and n = 244 in Group II). Group I and Group II were similar in age (mean: 43.6 versus 42.9) and ISS (mean: 18.3 versus 17.0). Mean PRBCs per patient transfused decreased from 23.1 units to 17.1 units (p = 0.057), reflecting a 22.5% reduction adjusted for confounders (p = 0.097). Outcome data revealed no differences in LOS (mean: 6.4 versus 5.9, p = 0.920), risk of death (4.1% versus 6.1%, p = 0.158), or MI (0.7% versus 0.8%, p = 0.974), but a significant reduction in the incidence of VAP (8.1% versus 0.8%, p = 0.002). Total PRBC cost decreased during the study period from 503,000 dollars to 397,000 dollars. CONCLUSIONS: An anemia management program appears to be safe when applied in the acute ICU phase of trauma care. Implementation of AMP in the ICU reduced the volume of PRBCs transfused with significant cost savings. No significant differences in length of stay, mortality rate, or MI rate were seen. The significant decrease in the rate of VAP requires further elucidation. Further long-term and larger studies are indicated

Abstract: BACKGROUND: Mounting evidence exists for more restrictive blood transfusion practices in patients undergoing cardiac surgery. Few studies, however, have recognized or agree upon a method by which this decrease in allogeneic red blood cell transfusion can be achieved. We will review our methods and experience in a blood conservation initiative from 2003 to 2007. METHODS: A data driven, multidisciplinary effort to decrease allogeneic red blood cell transfusion was instituted in a community hospital. Numerous innovations in treatment protocols were implemented and evaluated. Clinical data from 2003 to 2007 will be presented. Yearly review of outcomes led to an evolving clinical practice and lowered transfusion rates. RESULTS: A total of 2,531 consecutive cardiac surgical procedures were performed during a five-year period. Using a multidisciplinary approach to quality improvement, and with the goal of using fewer blood products, our incidence of allogeneic red blood cell transfusion was decreased, from 43% in 2003 to 18% in 2007. Patient outcomes were not significantly changed. CONCLUSIONS: Cardiac surgery in a community hospital can be performed safely with low utilization of allogeneic red blood cell transfusions. A multidisciplinary approach to blood conservation can result in lower transfusion rates and equivalent patient outcomes


Abstract: BACKGROUND: Preoperative autologous blood donation is a standard of care for elective surgical procedures requiring transfusion. The authors evaluated the efficacy of alternative blood-conservation strategies including preoperative recombinant human erythropoietin (rHuEPO) therapy and acute normovolemic hemodilution (ANH) in radical retropubic prostatectomy patients. METHODS: Seventy-nine patients were prospectively randomized to preoperative autologous donation (3 U autologous blood); rHuEPO plus ANH (preoperative subcutaneous administration of 600 U/kg rHuEPO at 21 and 14 days before surgery and 300 U/kg on day of surgery followed by ANH in the operating room); or ANH (blinded, placebo injections per the rHuEPO regimen listed previously). Transfusion outcomes, perioperative hematocrit levels, postoperative outcomes, and blood-conservation costs were
Abstract: We have reviewed prospective data on 1016 patients who underwent unilateral total hip replacement. Most patients who required transfusion were older and were of lower weight, height, pre-


Abstract: Anemia commonly affects critically ill patients. The causes are multifactorial and include acute blood loss, blood loss from diagnostic testing and blunted red blood cell production. Blood transfusions are frequently given to patients in intensive care units to treat low hemoglobin levels due to either acute blood loss or subacute anemia associated with critical illness. Although blood transfusion is a life-saving therapy, evidence suggests that it may be associated with an increased risk of morbidity and mortality. A number of blood conservation strategies exist that may mitigate anemia in hospital patients and limit the need for transfusion. These strategies include the use of hemostatic agents, hemoglobin substitutes and blood salvage techniques, the reduction of blood loss associated with diagnostic testing, the use of erythropoietin and the use of restrictive blood transfusion triggers. Strategies to reduce blood loss associated with diagnostic testing and the use of hemostatic agents and erythropoietin result in higher hemoglobin levels, but they have not been shown to reduce the need for blood transfusions or to improve clinical outcomes. Lowering the hemoglobin threshold at which blood is transfused will reduce the need for transfusions and is not associated with increased morbidity or mortality among most critically ill patients without active cardiac disease. Further research is needed to determine the potential roles for other blood conservation strategies.


Abstract: OBJECTIVE: To determine whether phlebotomy contributes to changes in hemoglobin and hematocrit levels in hospitalized general internal medicine patients. DESIGN: Retrospective cohort study. SETTING: General internal medicine inpatient service at a tertiary care hospital. PARTICIPANTS: All adult patients discharged from the Toronto General Hospital’s internal medicine service between January 1 and June 30, 2001. A total of 989 hospitalizations were reviewed and 404 hospitalizations were included in our analysis. MEASUREMENTS AND MAIN RESULTS: Mean (SD) hemoglobin and hematocrit changes during hospitalization were 7.9 (12.6) g/L (P<.0001) and 2.1% (3.8%) (P<.0001), respectively. The mean (SD) volume of phlebotomy during hospital stay was 74.6 (52.1) mL. On univariate analysis, changes in hemoglobin and hematocrit were predicted by the volume of phlebotomy, length of hospital stay, admission hemoglobin/hematocrit value, age, Charlson comorbidity index, and admission intravascular volume status. The volume of phlebotomy remained a strong predictor of drop in hemoglobin and hematocrit after adjusting for other predictors using multivariate analysis (P<.0001). On average, every 100 mL of phlebotomy was associated with a decrease in hemoglobin and hematocrit of 7.0 g/L and 1.9%, respectively. CONCLUSIONS: Phlebotomy is highly associated with changes in hemoglobin and hematocrit levels for patients admitted to an internal medicine service and can contribute to anemia. This anemia, in turn, may have significant consequences, especially for patients with cardiorespiratory diseases. Knowing the expected changes in hemoglobin and hematocrit due to diagnostic phlebotomy will help guide when to investigate anemia in hospitalized patients.


Abstract: We have reviewed prospective data on 1016 patients who underwent unilateral total hip replacement to establish the pre-operative risk factors associated with peri-operative blood transfusion. Most patients who required transfusion were older and were of lower weight, height, pre-
operative haemoglobin level and body mass index than patients who were not transfused. Multivariate analysis revealed that only the pre-operative haemoglobin level and the patients' weight were identified as significant independent factors increasing the need for transfusion (p < 0.001). A haemoglobin level below 12 g/dl was associated with a threefold increase in transfusion requirement.


Abstract: BACKGROUND: Current red blood cell (RBC) transfusion guidelines assume that most acutely anemic patients can tolerate hemoglobin (Hb) concentrations as low as 6.0 to 7.0 g per dL and recommend that range as the transfusion threshold in patients who have no overt signs of organ dysfunction. Nonetheless, "normal" Hb concentrations vary widely in the population, and this variability may influence patients' tolerance of acute anemia. This retrospective cohort study was carried out to test this hypothesis. STUDY DESIGN AND METHODS: Data were analyzed on 10,179 consecutive patients who had normal Hb concentrations (12.0-16.0 g/dl in women and 13.0-18.0 g/dl in men) and underwent on-pump cardiac surgery from 1999 to 2006 at an academic hospital. The relationships of lowest intraoperative Hb concentration and maximum decrease in Hb concentration (from baseline) with the composite outcome of in-hospital death, stroke, or kidney failure were determined in various patient subgroups. RESULTS: The relationship between lowest Hb concentration and adverse outcomes was not independently associated with increased risk. In contrast, the relationship between maximum decrease in Hb concentration and adverse outcomes was independently associated with increased risk, with a 50 percent decrease being the threshold beyond which risk was increased (adjusted odds ratio, 1.53; 95% confidence interval, 1.12-2.08; p = 0.007). CONCLUSION: The degree of acute anemia that patients can safely tolerate during cardiac surgery is inversely related to their baseline Hb concentration. Current transfusion guidelines do not account for this relationship.


Abstract: BACKGROUND: Preoperative anemia is an important risk factor for perioperative red blood cell transfusions and has been shown to be independently associated with adverse outcomes after noncardiac surgery. The objective of this observational study was to measure the prevalence of preoperative anemia and assess the relationship between preoperative anemia and postoperative mortality. METHODS: Data were retrospectively collected on 7,759 consecutive noncardiac surgical patients at the University Health Network between 2003 and 2006. Preoperative anemia was defined as a hemoglobin concentration less than 12.0 g/dl for women and less than 13.0 g/dl for men. The unadjusted and adjusted relationship between preoperative anemia and mortality was assessed using logistic regression and propensity analyses. RESULTS: Preoperative anemia was common and equal between genders (39.5% for men and 39.9% for women) and was associated with a nearly five-fold increase in the odds of postoperative mortality. After adjustment for major confounders using logistic regression, anemia was still associated with increased mortality (odds ratio, 2.36; 95% confidence interval, 1.57-3.41). This relationship was unchanged after elimination of patients with severe anemia and patients who received transfusions. In a propensity-matched cohort of patients, anemia was associated with increased mortality (odds ratio, 2.29; 95% confidence interval, 1.45-3.63). CONCLUSIONS: Anemia is a common condition in surgical patients and is independently associated with increased mortality. Although anemia increases mortality independent of transfusion, it is associated with increased requirement for transfusion, which is also associated with increased mortality. Treatment of preoperative anemia should be the focus of investigations for the reduction of perioperative risk.

Abstract: INTRODUCTION: N-terminal pro-B-type natriuretic peptide (NT-proBNP) predicts adverse cardiac outcome in patients undergoing vascular surgery. However, several conditions might influence this prognostic value, including anemia. In this study, we evaluated whether anemia confounds the prognostic value of NT-proBNP for predicting cardiac events in patients undergoing vascular surgery. METHODS: A detailed cardiac history, resting echocardiography, and hemoglobin and NT-proBNP levels were obtained in 666 patients before vascular surgery. Anemia was defined as serum hemoglobin <13 g/dL for men and <12 g/dL for women. Troponin T measurements and 12-lead electrocardiograms were performed on postoperative days 1, 3, 7, and 30 and whenever clinically indicated. The primary endpoint of the study was the composite of 30-day postoperative cardiovascular death, nonfatal myocardial infarction, and troponin T release. Receiver operating characteristic curve analysis was used to assess the optimal cutoff value of NT-proBNP for the prediction of the composite endpoint. Multivariable regression analysis was used to assess the additional value of NT-proBNP for the prediction of postoperative cardiac events in nonanemic and anemic patients. RESULTS: Anemia was present in 206 patients (31%) before surgery. Hemoglobin level was inversely related with the NT-proBNP levels (beta coefficient = -2.242; \( P = 0.025 \)). The optimal predictive cutoff value of NT-proBNP for predicting the composite cardiovascular outcome was 350 pg/mL. After adjustment for clinical cardiac risk factors, both anemia (odds ratio [OR] 1.53; 95% confidence interval [CI]: 1.07-2.99) and increased levels of NT-proBNP (OR 4.09; 95% CI: 2.19-7.64) remained independent predictors for postoperative cardiac events. However, increased levels of NT-proBNP were not predictive for the risk of adverse cardiac events in the subgroup of anemic patients (OR 2.16; 95% CI: 0.90-5.21). CONCLUSIONS: Both anemia and NT-proBNP are independently associated with an increased risk for postoperative cardiac events in patients undergoing vascular surgery. NT-proBNP has less predictive value in anemic patients.


Abstract: BACKGROUND: The purpose of the study was to investigate allogeneic blood transfusion (ABT) and preoperative anemia as risk factors for surgical site infection (SSI). STUDY DESIGN AND METHODS: A prospective, observational cohort of 5873 consecutive general surgical procedures at Basle University Hospital was analyzed to determine the relationship between perioperative ABT and preoperative anemia and the incidence of SSI. ABT was defined as transfusion of leukoreduced red blood cells during surgery and anemia as hemoglobin concentration of less than 120 g/L before surgery. Surgical wounds and resulting infections were assessed to Centers for Disease Control standards. RESULTS: The overall SSI rate was 4.8% (284 of 5873). In univariable logistic regression analyses, perioperative ABT (crude odds ratio [OR], 2.99; 95% confidence interval [CI], 2.1 to 4.0; \( p < 0.001 \)) and preoperative anemia (crude OR, 1.32; 95% CI, 1.0 to 1.7; \( p = 0.037 \)) were significantly associated with an increased odds of SSI. After adjusting for 13 characteristics of the patient and the procedure in multivariable analyses, associations were substantially reduced for ABT (OR, 1.25; 95% CI, 0.8 to 1.9; \( p = 0.310 \)) and preoperative anemia (OR, 1.07; 95% CI, 0.6 to 2.0; \( p = 0.817 \) for 1-2 blood units and \( \geq 3 \) blood units, respectively) and anemia (OR, 0.91; 95% CI, 0.7 to 1.2; \( p = 0.530 \)). Duration of surgery was the main confounding variable. CONCLUSION: Our findings point to important confounding factors and strengthen existing doubts on leukoreduced ABT during general surgery and preoperative anemia as risk factors for SSIs.


Abstract: STUDY OBJECTIVE: To determine factors that account for gender difference in the need for blood transfusion in coronary artery bypass graft (CABG) patients. DESIGN: Retrospective study of consecutive patients. SETTING: Anesthesiology department of a teaching hospital. PATIENTS: 253 CABG patients (163 males and 90 females). INTERVENTIONS: Packed red blood cells (PRBCs), platelets, and fresh frozen plasma (FFP) were transfused depending on the need of each patient. MEASUREMENTS AND MAIN RESULTS: For each patient, we recorded the gender, age, weight, height, body surface area (BSA), and duration of surgery. Hematocrit (Hct) levels prior to surgery, end of surgery, and at discharge from the hospital were recorded. PRBC administration and use of FFP and
platelets were noted. Differences between the data for female and male patients were evaluated using Student's t-test, Chi-square test, and regression analysis. Approximately 60% female and only 20% male patients received PRBCs intraoperatively, whereas 78% females and only 43% males received PRBCs during their entire hospital stay. On average, females received 1.20 units of PRBCs intraoperatively and 2.38 units during the entire hospital stay, while the males received 0.31 units and 1.36 units for similar periods. Gender differences in PRBC transfusion persisted even when females and males were compared within the same subgroups for age, weight, duration of surgery, and preoperative Hct. PRBC units given intraoperatively had a significant correlation with age and preoperative Hct in females, but they had a significant correlation with age, preoperative Hct, and duration of surgery in males. PRBCs given during the entire hospital stay, however, had significant correlation with age, preoperative Hct, and duration of surgery in both females and males. Multiple logistic regression analysis showed that the probability of a patient receiving or not receiving PRBC transfusion is significantly influenced by age, preoperative PRBC mass, duration of surgery, and gender. CONCLUSION: Gender is an independent essential determinant of blood transfusion in CABG patients, and it may interact with age, weight, preoperative Hct, duration of surgery, and other factors in determining the probability of transfusion.


Abstract: STUDY OBJECTIVE: To evaluate whether preoperative blood volume and postoperative blood loss influence blood transfusion in females and males undergoing coronary artery bypass graft (CABG) surgery. DESIGN: Prospective study. SETTING: Anesthesiology department of a teaching hospital. PATIENTS: 57 CABG patients (21 females and 36 males). MEASUREMENTS: Blood volume was determined using the radioactivity dilution method. Preoperatively, each patient received intravenous (IV) injection of 1 mL Albumin I(131) tracer having 25 microcuries of radioactivity. Five-milliliter blood samples were collected at different intervals. From these samples, hematocrit (Hct) value, preoperative total blood volume, red blood cell (RBC) volume, and plasma volume were determined. Postoperatively, some consenting patients received another 1 mL dose of the tracer, and the postoperative blood volumes were determined. If a patient received a blood transfusion, the units of packed red blood cells (PRBCs), platelets, or fresh frozen plasma (FFP) transfused were recorded. For each patient we recorded the gender, age, weight, height, body surface area (BSA), preoperative Hct, duration of surgery, and discharge Hct. RESULTS: Preoperatively, the mean total blood volume, RBC volume, and plasma volume, respectively, were 2095 mL/m(2), 631 mL/m(2), and 1,465 mL/m(2) in females; and 2,580 mL/m(2), 878 mL/m(2), and 1,702 mL/m(2) in males. The preoperative blood volumes were significantly lower (p < 0.01) in females than in males. There was no significant difference between males and females in the extent of blood loss during CABG. Intraoperatively, females received PRBC transfusion of 1.38 units, significantly more (p < 0.01) than the 0.39 units received by males. During the entire hospital stay, females received 4.33 units of PRBC, significantly more (p < 0.02) than the 1.33 units received by males. Significantly more (p < 0.01) females (12 of 21) received intraoperative PRBC transfusion than did males (6 of 36). Multiple logistic regression analysis of the data showed that PRBC transfusion was significantly correlated with the preoperative total blood volume and RBC volume. CONCLUSION: The greater need for blood transfusion in females than in males during CABG is primarily attributable to significantly lower preoperative total blood volume and RBC volume in females.


Abstract: The expected cost explosion in transfusion medicine (increasing imbalance between donors and potential recipients, treatment of transfusion-associated complications) increases the socio-economic significance of specific institutional transfusion programs. In this context the estimated use of the patient's physiologic tolerance to anemia enables 1) the tolerance of larger blood losses (loss of "diluted blood"), 2) the onset of transfusion to the time after surgical control of bleeding to be delayed and 3) the perioperative collection of autologous red blood cells. The present review article summarizes the mechanisms, influencing factors and limits of this natural tolerance to anemia and deduces the indication for perioperative red blood cell transfusion. Under strictly controlled conditions (anesthesia, normovolemia, complete muscular relaxation, hyperoxemia, mild hypothermia) extremely low hemoglobin concentrations [Hb <3 g/dl (<1.86 mmol/l)] are tolerated...
without transfusion by individuals with no cardiopulmonary disease. In the clinical routine these situations are limited to borderline situations e.g., unexpected massive blood losses in Jehovah’s Witnesses or unexpected shortcomings in blood supply. The current recommendations coincide to the effect that perioperative red blood cell transfusion 1) is unnecessary up to a Hb concentration of 10 g/dl (6.21 mmol/l) even in older patients with cardiopulmonary comorbidity and 2) is only recommended in cases of Hb <6 g/dl (<3.72 mmol/l) in otherwise healthy subjects including pregnant women and children. Critically ill patients with multiple trauma and sepsis do not seem to benefit from transfusions up to Hb concentrations >9 g/dl (>5.59 mmol/l). In cases of massive hemorrhaging and diffuse bleeding disorders the maintenance of a Hb concentration of 10 g/dl (6.21 mmol/l) seems to contribute to stabilization of coagulation.


Ref Type: Journal (Full)


Abstract: BACKGROUND: A high proportion of patients having cardiac bypass surgery receive erythrocyte transfusions. Decisions about when to transfuse patients having surgery for coronary artery disease may impact on erythrocyte utilization and patient morbidity and mortality. There are no published data about the factors that influence physicians’ decisions to transfuse erythrocytes to these patients. The objectives of this study were to determine the hemoglobin concentration for transfusion and the factors that influence physicians’ perioperative transfusion decisions for coronary artery bypass patients. METHODS: The authors conducted a cross-sectional study using pretested, self-administered, mailed questionnaires sent in 2004 to all cardiac surgeons and anesthesiologists in Canada who participate in coronary artery bypass surgery. The questionnaire included four intraoperative and four postoperative vignettes. Factors assessed included patient age, sex, cardiac index, and myocardial ischemia. RESULTS: The response rates were 70% (345 of 489) for the intraoperative and 61% (297 of 489) for the postoperative case scenarios. The mean hemoglobin concentrations for transfusion were 7.0 g/dl for the intraoperative case scenarios and 7.2 g/dl for the postoperative case scenarios. Older age, the presence of myocardial ischemia, and a low cardiac index were factors that increased the hemoglobin concentration for transfusion (P < 0.0001). Physicians ranked myocardial ischemia as the most significant factor affecting their transfusion decisions. CONCLUSIONS: Factors such as the presence of a low cardiac index, myocardial ischemia, and older age increase the hemoglobin concentrations at which physicians transfuse coronary bypass surgery patients. Future studies are required to elucidate whether transfusions based on these variables affect patient morbidity and mortality.


Abstract: The aim of this study was to identify the clinical factors associated with the need for peri-operative blood transfusion in non-anaemic patients undergoing hip or knee arthroplasty. We prospectively evaluated 162 consecutive patients who underwent total hip or knee arthroplasty. Analysis was performed to establish the relationship between all independent variables and the need for postoperative transfusion. Univariate analysis revealed a significant relationship between the need for postoperative blood transfusion and the pre-operative haemoglobin levels (P= 0.001), weight (P= 0.019) and age (P= 0.018). Multivariate analysis identified a significant relationship only between the need for transfusion and the pre-operative haemoglobin level (P= 0.0001). The pre-operative haemoglobin level of the patient was the only variable to independently predict the need for blood transfusion after primary hip or knee arthroplasty.
OBJECTIVES: Orthotopic liver transplantation (OLT) may be associated with major blood loss and equally considerable transfusion requirements. We had developed previously a model capable of predicting the probability of packed red blood cell (PRBC) transfusion. We tested the ability of that model in predicting the need for PRBC transfusion after its conversion into the nomogram format, which represents a friendly tool to be used. Moreover, the nomogram was validated in an independent cohort of 109 prospectively gathered OLTs. MATERIALS AND METHODS: A total of 515 OLTs were performed by a group of 17 anesthesiologists and 7 hepatobiliary surgeons. The initial series of 406 OLTs were used for model development. The remaining 109 OLTs were used as an independent validation cohort. Logistic regression analyses addressed the relationship between the three previously identified predictors of the likelihood of PRBC transfusion and the actual rate of PRBC transfusion. The predictors consisted of plasma transfusion status, phlebotomy, and immediate preoperative hemoglobin value. The regression coefficients from the multivariable logistic regression model that included all three predictors were used to develop a nomogram predicting the individual probability of PRBC transfusion. RESULTS: In univariable models, transfusion of plasma (odds ratio [OR] 15.0, P<0.001) increased the rate of PRBC transfusion. Conversely, phlebotomy (OR 0.06, P<0.001) and a high starting hemoglobin level (OR 0.95, P<0.001) had a protective effect. In the multivariable model, all three variables reached independent predictor status (P<0.001). The bootstrap-adjusted area under curve (AUC) of the model was 89.8%. CONCLUSION: Our nomogram represents the first model capable of predicting the individual risk of PRBC transfusion at OLT.


Abstract: BACKGROUND: The purpose of this study was to validate a previously published point score system for predicting the likelihood of a postoperative blood transfusion following hip or knee replacement. STUDY DESIGN AND METHODS: Data were collected prospectively on 460 sequential patients undergoing elective hip and knee replacement at two academic hospitals. Blood transfusion frequency was determined for patients in each of the four risk strata, as defined by the point score system. The accuracy of the system was validated by calculating the area under the receiver operating characteristic (ROC) curve for each site. Data were then combined and inappropriate blood transfusions were eliminated, by using the American College of Physicians guidelines. The frequencies of blood transfusion within each strata were recalculated along with an ROC curve. RESULTS: The point score system accurately predicted the likelihood of blood transfusion at both hospitals, despite marked differences in overall transfusion frequencies. The calculated areas under the ROC curves were 0.78 and 0.79 for the two sites. The point score system also proved valid when only appropriate blood transfusions were considered, with a calculated area under the ROC curve of 0.74. CONCLUSION: The point score system can accurately predict the likelihood of postoperative blood transfusion following hip or knee replacement. Such a system can be used to target high-risk patients for preoperative autologous blood donation.


Abstract: BACKGROUND: We have developed a prediction rule for the occurrence of perioperative red blood cell transfusion to help to reduce the number of unnecessary preoperative type and screen procedures. We evaluated the robustness of this prediction rule in patients from another hospital. METHODS: The rule was retrospectively applied to 1282 consecutive patients ('validation set') who underwent similar surgical procedures to the patients in the derivation study. The outcome was similarly defined as any allogeneic transfusion on the day of surgery or during the first postoperative day. The predictive value of the rule was assessed using a Receiver Operating Characteristic curve (ROC) and compared with the results of the derivation study. Subsequently, the number of correctly predicted transfusions was compared. RESULTS: The patient characteristics did not differ between the two sets, except for the incidence of transfusion (derivation study: 18%; present study: 8%). In the validation set, the ROC area of the prediction rule was 0.78 (95% confidence intervals [CI]: 0.73-0.82), which was within the CI of the ROC area found in the derivation study (0.75; 95% CI: 0.72-0.79). In total, 35% of the type and screen procedures could be omitted (derivation study: 50%), with 13%...
Abstract: OBJECTIVE: To develop 2 instruments that predict the probability of perioperative transfusion in patients undergoing elective liver resection for primary and secondary tumors. SUMMARY BACKGROUND DATA: Hepatic resection is the most effective treatment for several benign and malignant conditions, but may be accompanied by substantial blood loss and the need for perioperative transfusions. While blood conservation strategies such as autologous blood donation,
acute normovolemic hemodilution, or cell saver systems are available, they are economically efficient only if directed toward patients with a high risk of transfusion. METHODS: Using preoperative data from 1204 consecutive patients who underwent liver resection between 1995 and 2000 at Memorial Sloan-Kettering Cancer Center, we modeled the probability of perioperative red blood cell transfusion. We used the resulting model, validated on an independent dataset (n = 555 patients), to develop 2 prediction instruments, a nomogram and a transfusion score, which can be easily implemented into clinical practice. RESULTS: The planned number of liver segments resected, concomitant extrahepatic organ resection, a diagnosis of primary liver malignancy, as well as preoperative hemoglobin and platelets levels predicted the probability of perioperative red blood cell transfusion. The predictions of the model appeared accurate and with good discriminatory abilities, generating an area under the receiver operating characteristic curve of 0.71. CONCLUSIONS: Preoperative factors can be combined into risk profiles to predict the likelihood of transfusion during or after elective liver resection. These predictions, easy to calculate in the frame of a nomogram or of a transfusion score, can be used to identify patients who are at high risk for red cell transfusions and therefore most likely to benefit from blood conservation techniques.


Abstract: OBJECTIVES: Perioperative transfusion of red blood cells is associated with increased morbidity and mortality. The authors investigated the correlation between preoperative risk factors and the number of red blood cell units received in patients undergoing coronary artery bypass graft surgery. DESIGN: A retrospective analysis of prospectively collected data. SETTING: A single-center study performed in an educational hospital. PARTICIPANTS: All patients who underwent isolated coronary artery bypass graft surgery between 1998 and 2007 (N = 10,626) were included. INTERVENTIONS: Isolated coronary artery bypass graft surgery. MEASUREMENTS AND MAIN RESULTS: Univariate and multivariate logistic regression analyses were performed to investigate the impact of preoperative and perioperative factors on transfusion of 1 or more units of red blood cells. The following independent risk factors for receiving red blood cell units were identified: age, female sex, low body surface area, low left ventricular ejection fraction (<35%), emergency operation, previous cardiac surgery, low preoperative hemoglobin, and low preoperative creatinine clearance. Perioperative risk factors were the use of extracorporeal circulation, longer bypass time, use of crystalloid cardioplegia, the need for intra-aortic balloon pump, perioperative myocardial infarction, and re-exploration for any cause. CONCLUSIONS: In this study, the authors identified risk factors for receiving red blood cells in patients undergoing coronary artery bypass graft surgery. The authors were able to implement these factors in their daily practice by sharpening the criteria for the direct availability of red blood cells in the operating room.


Abstract: The following recommendations, which aim at standardising and rationalising clinical indications for the transfusion of red cells in Belgium, were drawn up by a working group of the Superior Health Council. To this end, the Superior Health Council organised an expert meeting devoted to “Guidelines for the transfusion of red cells” in collaboration with the Belgian Hematological Society. The experts discussed the indications for red cell transfusions, the ideal red cell concentrate, the practical issues of administering red cells, and red cell transfusions in patients in a critical condition. The
recommendations formulated by the experts were validated by the working group with the purpose of harmonising red cell transfusion in Belgian hospitals


Abstract: BACKGROUND: A minority of patients having cardiac procedures (15% to 20%) consume more than 80% of the blood products transfused at operation. Blood must be viewed as a scarce resource that carries risks and benefits. A careful review of available evidence can provide guidelines to allocate this valuable resource and improve patient outcomes. METHODS: We reviewed all available published evidence related to blood conservation during cardiac operations, including randomized controlled trials, published observational information, and case reports. Conventional methods identified the level of evidence available for each of the blood conservation interventions. After considering the level of evidence, recommendations were made regarding each intervention using the American Heart Association/American College of Cardiology classification scheme. RESULTS: Review of published reports identified a high-risk profile associated with increased postoperative blood transfusion. Six variables stand out as important indicators of risk: (1) advanced age, (2) low preoperative red blood cell volume (preoperative anemia or small body size), (3) preoperative antiplatelet or antithrombotic drugs, (4) reoperative or complex procedures, (5) emergency operations, and (6) noncardiac patient comorbidities. Careful review revealed perioperative interventions that are likely to reduce bleeding and postoperative blood transfusion. Perioperative interventions that are likely to reduce blood transfusion include identification of high-risk patients who should receive all available preoperative and perioperative blood conservation interventions and limitation of antithrombotic drugs. Perioperative blood conservation interventions include use of antifibrinolytic drugs, selective use of off-pump coronary artery bypass graft surgery, routine use of a cell-saving device, and implementation of appropriate transfusion indications. An important intervention is application of a multimodality blood conservation program that is institution based, accepted by all health care providers, and that involves well thought out transfusion algorithms to guide transfusion decisions. CONCLUSIONS: Based on available evidence, institution-specific protocols should screen for high-risk patients, as blood conservation interventions are likely to be most productive for this high-risk subset. Available evidence-based blood conservation techniques include (1) drugs that increase preoperative blood volume (eg, erythropoietin) or decrease postoperative bleeding (eg, antifibrinolytics), (2) devices that conserve blood (eg, intraoperative blood salvage and blood sparing interventions), (3) interventions that protect the patient’s own blood from the stress of operation (eg, autologous predonation and normovolemic hemodilution), (4) consensus, institution-specific blood transfusion algorithms supplemented with point-of-care testing, and most importantly, (5) a multimodality approach to blood conservation combining all of the above.


Abstract: OBJECTIVES: To determine the normative distribution of time elapsed for blood bank personnel to fill nonscheduled operating room (OR) blood component orders in hospital communities throughout the United States, and to examine hospital blood bank practices associated with faster blood component delivery times. DESIGN: Participants in the College of American Pathologists Q-Probes laboratory quality improvement program collected data prospectively on the times elapsed for blood bank personnel to fill nonscheduled emergent orders from hospital ORs for red blood cell (RBC) products, fresh frozen plasma (FFP), and platelets (PLTs). Participants also completed questionnaires describing their hospitals' and blood banks' laboratory and transfusion practices. SETTING AND PARTICIPANTS: Four hundred sixty-six public and private institutions located in 48 states in the United States (n = 444), Canada (n = 9), Australia (n = 8), the United Kingdom (n = 4), and Spain (n = 1). MAIN OUTCOME MEASURES: The median time elapsed between requests for blood components by OR personnel and the retrieval of those components by blood component transport personnel, and the median time elapsed between requests for blood components by OR personnel and the arrival of those components in ORs. RESULTS: Participants submitted data on 12 647 units of RBCs, FFP, and PLTs. The median aggregate request-to-retrieval turnaround times (TATs) for RBCs, FFP, and PLTs ranged from 30 to 35 minutes, and the median aggregate request-to-arrival TATs for RBCs, FFP, and PLTs ranged
from 33 to 39 minutes. Most of the TAT was consumed by events occurring prior to, rather than after release of components from blood banks. Shorter prererelease TATs were associated with having surgical schedules that listed patients’ names and procedures available to blood bank personnel prior to surgeries, and having adequate clotted specimens in the blood bank and completed type-and-screen procedures performed before requests for blood components were submitted to blood banks. Among the fastest-performing 10% of participants (90th percentile and above), request-to-retrieval TATs ranged from 12 to 24 minutes for the 3 blood components, whereas among the slowest-performing 10% of participants (10th percentile and below), request-to-retrieval TATs ranged from 63 to 115 minutes for the 3 components. Median TATs ranged from 33 to 37 minutes for the 3 components. Institutions with TATs in the fastest-performing 25th percentile more frequently stored cross-matched RBCs in the OR daily, stocked PLTs for unexpected surgical use, stored PLTs in or near the OR, and had laboratory rather than nonlaboratory personnel deliver components to the OR than did those institutions with TATs in the slowest-performing 25th percentile. CONCLUSIONS: Hospital blood bank personnel can deliver blood components to the OR in slightly longer than 30 minutes, measured from the time that those units are requested by OR personnel. Practices aimed at saving time before components are released from blood banks will be more efficient in reducing overall TAT than those practices aimed at saving time after components are released from blood banks. Specific practices associated with shorter blood delivery TATs included providing blood bank personnel with access to the names of surgical patients potentially requiring blood components, having pretransfusion testing completed on those patients prior to surgery, having ample blood products on hand, and having laboratory personnel control blood product delivery.


Abstract: CONTEXT: Market-driven changes in the timing of elective surgeries and admissions have introduced barriers to completing pretransfusion testing in a timely manner. Consequently, blood bank personnel may not have adequate time to identify appropriate blood products for scheduled surgeries. Incomplete pretransfusion testing can delay surgery and significantly compromise patient safety. OBJECTIVES: To identify the incidence of avoidable problems associated with obtaining timely samples for adequate pretransfusion type and screen (T&S) testing, to identify the practices and characteristics associated with improved rates of pretransfusion testing completed prior to surgery, and to determine the likelihood of antibody identification problems that affect the availability of blood. DESIGN: Participants in the College of American Pathologists (CAP) Q-Probes laboratory quality improvement program were asked to collect data on when a T&S was collected in anticipation of elective scheduled surgery, when the T&S was completed, when the surgery started, and the results of those T&S tests. Participants also completed questionnaires describing their facilities, procedures, and practices.

SETTING AND PARTICIPANTS: One hundred eight public and private institutions participated in this Q-Probes Study, 97% of which were located in the United States. MAIN OUTCOMES MEASURES: Type and screen collection and completion relative to the start of surgery, and the results of those tests.

RESULTS: Of the 8941 T&Ss, 64.6% were collected prior to the day of surgery. The median laboratory completed the T&S at least 1 day prior to surgery 74% of the time. When the institution coupled the T&S collection protocol with T&S collection earlier than 3 days prior to surgery, the median laboratory completed the T&S at least 1 day prior to surgery almost 87% of the time. Type and screen collection less than 3 days prior to surgery resulted in special efforts needed to obtain blood more than 1% of the time. Type and screen collected on the same day as surgery directly resulted in a surgery delay 0.8% of the time. CONCLUSIONS: Patients are unnecessarily being placed at risk by inadequate mechanisms to ensure available blood for surgery. All T&Ss were collected for scheduled surgeries with adequate opportunity for a T&S to be completed in advance of the surgery. Specific protocols helped improve the performance in terms of completing the T&S prior to surgery, as did mechanisms that permitted T&S collections in advance of
the admission. Type and screen collection time relative to surgery was significantly associated with the incidence of surgery delay due to unavailable blood; the less time between collection and surgery, the less likely blood was available.


Abstract: BACKGROUND: A maximum surgical blood ordering schedule may lead to wastage of valuable resources due to over-ordering of blood and/or under-utilisation. We audited the results of a group-and-save (GS) policy for primary hip (THR) and knee (TKR) arthroplasty to evaluate its safety and practicality. PATIENTS AND METHODS: We conducted a retrospective review of consecutive patients attending for THR (177) or TKR (137) over a period of 8 months (phase 1). Following introduction of a limited GS policy, 205 THR and 147 TKR were reviewed prospectively over a corresponding period of 8 months (phase 2). Corresponding THR and TKR groups in each phase were comparable with respect to age, gender, length of stay, operating surgeon, pre- and lowest postoperative hemoglobin, reason for and timing of transfusion. Quantities (units) of blood requested pre- and postoperatively, transfused and returned to the blood bank, were recorded. RESULTS: 77 and 62% of all blood requested for THR and TKR, respectively, in phase 1 was not used. 58 and 21% of patients undergoing THR and TKR, respectively, in phase 2 underwent preoperative GS, with 92% and 100% of all blood requested being used for transfusion. Overall, the quantity of blood returned was reduced by 25% for the THR group. Transfusion rates fell by 9% and 5% for the TKR and THR groups, respectively. We found no adverse events associated with blood from a GS sample. Cost savings of 37 800 euro were calculated estimated for the study period (phase 2). INTERPRETATION: For routine primary THR/TKR, GS policy is a safe procedure. Reduction in non-utilisation of blood has economic and cost-saving implications for limited healthcare resources. Having subsequently introduced a group-and-save policy for all patients undergoing routine THR/TKR, considerable savings have been identified after only 2 months.


Abstract: Most blood transfusions are given in the operating room. Adoption of the Maximum Surgical Blood Ordering Schedule in the 1970s reduced the amount of blood unnecessarily cross-matched, but the national cross-match-to-transfusion ratio remains at approximately two-to-one. We tested the ability of a patient-specific blood ordering system (PSBOS) to more accurately predict potential operative transfusion. All adult patients who had blood cross-matched before surgery (February through June 1999) for elective operative procedures at the University of Michigan Hospital were identified. Complex surgeries were excluded. Surgeons estimated the expected blood loss for their surgeries, and the expected postoperative hematocrit was calculated using the patient's blood volume, the surgeon-defined expected blood loss, and preoperative hematocrit. Lowest tolerated hematocrit was set at 21% except in patients with coronary artery disease or who were ASA physical status III or more (28%). Sensitivity, specificity, positive predictive value, and negative predictive value of the PSBOS were calculated. Our analysis included 178 cases in which blood was cross-matched before surgery, representing 69 different surgeries and 42 surgeons. Only 16% of patients received an intraoperative transfusion. Of the 156 patients that PSBOS predicted would not require an operating room transfusion, 139 were not transfused. Of the 21 patients PSBOS predicted would be transfused, 11 were. The sensitivity of the algorithm as tested was 41%, the specificity 93%, the positive predictive value was 55%, and the negative predictive value was 89%. We conclude that PSBOS, which includes patient and surgeon variables in transfusion prediction, is more accurate than the Maximum Surgical Blood Ordering Schedule, which uses only surgical procedure. IMPLICATIONS: Currently, many units of blood set aside for surgery are never required, resulting in extra work and expense for blood banks. A formula that included patient weight and hematocrit and typical surgery blood loss was used to predict who would require transfusions. We reduced the predicted number of patients who had blood set aside from 178 to 21.

(85) Richardson NG, Bradley WN, Donaldson DR, O'Shaughnessy DF. Maximum surgical blood ordering schedule in a district general hospital. Over that period, 2720 units of red cells were electively cross-matched, 957 being transfused.
The overall cross-match-to-transfusion ratio (CTR) was 2.8, but this varied from over 40 for some gynaecological procedures to 1.5 for major surgical procedures. The average CTR for general surgery was 2.2, orthopaedics 2.3, and obstetrics and gynaecology 5.7. A maximum surgical blood ordering system (MSBOS) was introduced and a second 6-month audit carried out. The number of units cross-matched had fallen by 36% to 1746, with a CTR of 1.8. The change in activity had led to a saving conservatively estimated at 11,616.00 Pounds per annum. Local audit and the introduction of a MSBOS in a district general hospital is an exercise which can demonstrate inefficiencies in blood ordering practices and can lead to large financial savings without detracting from standards of patient care.

Abstract: OBJECTIVES: To determine the normative rates of blood unit crossmatched to transfused (C:T) ratios, and implemented. A prospective audit of preoperative blood cross matching and subse...


Abstract: The objective of this study was to design and implement a maximum surgical blood order schedule (MSBOS) within a specialist gynaecological oncology department in a tertiary referral center and evaluate its impact on the cross-match to transfusion ratio (CTR). A retrospective case note audit was undertaken to identify common operations performed within the unit and their transfusion requirements. The efficiency of blood usage was assessed using the CTR, and an MSBOS was devised and implemented. A prospective audit of preoperative blood cross-matching and subsequent blood usage was then performed for consecutive elective operations in the unit, to assess the effect of the MSBOS. The retrospective study of 222 cases demonstrated a CTR of 2.25 equivalent to 44% usage of...
cross-matched blood. Ninety two percent of operations performed within the unit could be incorporated into an MSBOS. The prospective study of 207 cases demonstrated a significantly reduced CTR of 1.71 or 59% blood usage (chi2 = 12.4, P < 0.001). This equates to a saving of 102 units of blood over the 15 months prospective audit. Protocol adherence was 77%. No patient was adversely affected by the adoption of the MSBOS. We conclude that an MSBOS can be safely introduced into a gynaecological oncology department resulting in significant financial savings

Abstract: INTRODUCTION: This prospective audit studies the use of cross-matched blood in 301 patients over a 1-year period undergoing total knee (TKR) and total hip replacement (THR) surgery in an orthopaedic unit. PATIENTS AND METHODS: Analysis over the first 6 months revealed a high level of unnecessary cross-matched blood. The following interventions were introduced: (i) to cease routine cross-matching for THR; (ii) all patients to have a check full blood count on day 2 after surgery; and (iii) Hb < 8 g/dl to be considered as the trigger for transfusion in patients over 65 years and free from significant comorbidity. These changes are in accordance with published national guidelines [Anon. Guidelines for the clinical use of red cell transfusions. Br J Haematol 2001; 113: 24-31]. RESULTS: In the next 6 months, the number of units cross-matched but not transfused fell by 96% for THR, and the cross-match transfusion (C:T) ratio reduced from 3.21 to 1.62. Reductions were also observed for the TKR cohort. These results provide evidence of a substantial risk and cost benefit in the use of this limited resource. A telephone survey of 44 hospitals revealed that 20 hospitals routinely cross-matched blood for THR and 11 do so for TKR. CONCLUSIONS: Changes can be made to the Maximum Surgical Blood Ordering Schedules (MSBOS) in other orthopaedic units according to national guidelines

Abstract: We have prospectively evaluated the efficacy of an individualized pre-operative blood saving protocol in elective total hip arthroplasty (THA) or total knee arthroplasty (TKA). The primary aim was to obtain a pre-operative haemoglobin (Hb) level of > or =14 g dL(-1). A reduction in requirements for allogeneic transfusion was considered the second aim. Several strategies are available for increasing pre-operative Hb levels and reducing red blood cell (RBC) transfusions following THA or TKA, but the success of these programmes depends on selecting the most appropriate treatment for each patient. Three hundred and five patients with an indication of elective THA or TKA were individually assigned to the following strategies according to Hb and ferritin levels and medical conditions: (a) no pre-operative intervention, (b) oral iron therapy, (c) intravenous (i.v.) iron therapy, (d) recombinant human erythropoietin alpha with i.v. iron and (e) pre-operative autologous donation (PAD) plus oral iron. Eighty-two percent of the patients reached a pre-operative Hb level of > or =14 g dL(-1) compared with 62% of patients with Hb levels of > or =14 g dL(-1) at the baseline visit. Treatment with PAD showed a significant reduction in the pre-operative Hb levels. The rate of RBC transfusion was 18.8% compared with 31.5% of matched historic group (P < 0.001). In conclusion, all patients scheduled to undergo THA or TKA should be candidates for an individualized pre-operative blood salvage programme

Abstract: Objective.--To assess the efficacy of oral iron therapy in the recovery of patients' hemoglobin levels after major surgery. Design.--Randomized controlled trial. Setting.--Private orthopedic practice confined to one large community hospital. Patients.--One hundred seventy consecutive elderly patients undergoing hip surgery; 75 failed to meet entry hematologic or medical criteria; 95 were randomized, with 16 withdrawn because of complications. Intervention.--Thirty-seven patients received ferrous sulfate orally four times a day for the duration of their hospitalization. Forty-two patients who received no iron supplement served as the control group. Main Outcome Measures.--Changes in hemoglobin levels and reticulocyte counts over the 2- to 3-week follow-up period. Results.--There was no significant difference in mean hemoglobin levels between the treatment and control groups (95% confidence interval [CI] for difference of --6.6 to 5.4 g/L). Corrected reticulocyte fractions increased equally in both groups (95% CI for difference of --9 x 103 to 2 x 10-3. The study was designed to detect a difference in mean hemoglobin levels of 8.5 g/L or greater or a difference in mean
reticulocyte fraction of 10 × 10^-3 between the two groups with a power of 0.80 at the .05 (two-sided) level of significance. Conclusion.--The administration of oral iron supplements to elderly, healthy orthopedic patients postoperatively did not hasten the recovery of hemoglobin levels, provided adequate tissue iron stores were present. (JAMA. 1992;267:525-527)


Abstract: INTRODUCTION: There is increasing evidence that the anaemia of surgery is not iron deficient and is, therefore, unresponsive to iron supplementation. Oral iron is best avoided postoperatively, particularly in children, due to its dose-dependent side effects. We undertook a national survey of major paediatric orthopaedic surgical units in the UK to investigate the current management of postoperative anaemia with particular reference to iron supplementation. MATERIALS AND METHODS: Middle-grade doctors and charge nurses at 23 major paediatric orthopaedic units in the UK were contacted by telephone and a structured questionnaire was used to determine the management of postoperative anaemia in major hip, pelvic and spinal surgery. RESULTS: Only one (4.3%) of the units surveyed had a formally established protocol for the management of postoperative anaemia. Only 10 out of 23 units (43.5%) did not routinely prescribe iron postoperatively. Of the remaining units, 11 commenced iron based on the postoperative haemoglobin level while only 2 used iron supplementation after investigation of serum haematinics for iron deficiency. One unit used erythropoietin in the treatment of postoperative anaemia. CONCLUSIONS: Iron supplementation continues to be used in major paediatric orthopaedic surgery in the treatment of postoperative anaemia in the absence of iron deficiency. Given the current available evidence, we call for an end to the practice of routine iron supplementation for postoperative anaemia following major paediatric orthopaedic surgery in the UK


Abstract: Previously undiagnosed anaemia is common in elective orthopaedic surgical patients and is associated with increased likelihood of blood transfusion and increased perioperative morbidity and mortality. A standardized approach for the detection, evaluation, and management of anaemia in this setting has been identified as an unmet medical need. A multidisciplinary panel of physicians was convened by the Network for Advancement of Transfusion Alternatives (NATA) with the aim of developing practice guidelines for the detection, evaluation, and management of preoperative anaemia in elective orthopaedic surgery. A systematic literature review and critical evaluation of the evidence was performed, and recommendations were formulated according to the method proposed by the Grades of Recommendation Assessment, Development and Evaluation (GRADE) Working Group. We recommend that elective orthopaedic surgical patients have a haemoglobin (Hb) level determination 28 days before the scheduled surgical procedure if possible (Grade 1C). We suggest that the patient's target Hb before elective surgery be within the normal range, according to the World Health Organization criteria (Grade 2C). We recommend further laboratory testing to evaluate anaemia for nutritional deficiencies, chronic renal insufficiency, and/or chronic inflammatory disease (Grade 1C). We recommend that nutritional deficiencies be treated (Grade 1C). We suggest that erythropoiesis-stimulating agents be used for anaemic patients in whom nutritional deficiencies have been ruled out, corrected, or both (Grade 2A). Anaemia should be viewed as a serious and treatable medical condition, rather than simply an abnormal laboratory value. Implementation of anaemia management in the elective orthopaedic surgery setting will improve patient outcomes

Abstract: The prevalence of anemia in elective surgical patients may be as frequent as 75% in certain populations. A national audit demonstrated that 35% of patients scheduled for joint replacement therapy have a hemoglobin <13 g/dL on preadmission testing. Standard practice currently consists of preadmission testing 3 to 7 days before an elective operative procedure, precluding the opportunity to effectively evaluate and manage a patient with unexpected anemia. Therefore, a standardized approach for the detection, evaluation, and management of anemia in the preoperative surgical setting was identified as an unmet medical need. To address this knowledge gap, we convened a panel of physicians to develop a clinical care pathway for anemia management in this setting. Elective surgery patients should receive a hemoglobin (Hgb) determination a minimum of 30 days before the scheduled surgical procedure. Because the identification and evaluation of anemia in this setting will assist in expedited diagnosis and treatment of underlying comorbidities and will improve patient outcomes, unexplained anemia (Hgb <12g/dL for females and <13g/dL for males) should cause elective surgery to be deferred until an evaluation can be performed.


Abstract: Background: The hypochromic red cell is a direct indicator of functional iron deficiency (ID) in contrast to the majority of biochemical markers, which measure functional ID indirectly via iron-deficient erythropoiesis. The aim of this study was to evaluate the extent to which these biochemical markers can distinguish ID from anemia of chronic disease (ACD) as well as from the combined state of functional ID/ACD, using red cell hemoglobinization as the gold standard. Methods: We studied 442 patients with various disease-specific anemias and 154 nonanemic patients. As indicators of red cell hemoglobinization, we measured the reticulocyte hemoglobin content (CHR) and the proportion of hypochromic red cells (HYPO), using an Advia 120 hematology analyzer. Ferritin, transferrin, transferrin saturation, and the concentration of the soluble transferrin receptor (sTfR) were determined by ELISA and immunoturbidimetric assay. The sTFR/log ferritin ratio (sTFR-F index) was used as an additional marker for biochemical identification of iron-deficient erythropoiesis. Results: In a control group (n = 71), the 2.5 percentile values were 28 pg for CHR and 5% for HYPO. These values were used to indicate unimpaired red cell hemoglobinization and absence of functional ID. In patients with deficient red cell hemoglobinization but no acute-phase response (APR), iron-deficient erythropoiesis was indicated by serum ferritin and sTFR-F index values [\(\leq\)20.8 {micro}g/L and >1.5, respectively. Corresponding values in patients with APR were [\(\leq\)61.7 {micro}g/L and >0.8, respectively. The positive likelihood ratios for the biochemical markers and the sTFR-F index for identifying iron-restricted erythropoiesis in patients with and without APR were 2.6-6.9 and 4.3-16.5, respectively. Conclusion: In APR patients, biochemical markers demonstrate weaknesses in the diagnosis of functional ID as defined by hematologic indices. Use of diagnostic plots to illustrate the relationship between the sTFR-F index and CHR allows the progression of ID to be identified, regardless of whether an APR is present.


Abstract: Iron deficiency anemia is one of the most common diseases worldwide. In the majority of cases, the presence of hypochromic microcytic anemia and biochemical evidence for depletion of body iron stores makes the diagnosis relatively straightforward. However, in several clinical conditions, classic biochemical indices such as serum iron, transferrin saturation, and ferritin may not be informative or may not change rapidly enough to reflect transient iron-deficient states (functional iron deficiency), such as the ones that develop during recombinant human erythropoietin (r-HuEPO) therapy. The identification and treatment of iron deficiency in settings such as r-HuEPO therapy, anemia of chronic disease, and iron deficiency of early childhood may be improved by the use of red cell and reticulocyte cellular indices, which reflect in almost real time the development of iron deficiency and the response to iron therapy. In the anemia of chronic disease, measurements of plasma cytokines and iron metabolism regulators such as hepcidin (when available) may be helpful in the characterization of the pathophysiologic basis of this condition. The ratio of serum transferrin receptor (sTFR) to serum ferritin (R/F ratio) has been shown to have excellent performance in estimating body iron stores, but it cannot be used widely because of the lack of standardization for sTFR assays. The combination of hematologic markers such as reticulocyte hemoglobin content, which decreases with iron deficiency, and R/F ratio may allow for a more precise classification of anemias.
Abstract: A multidisciplinary panel of physicians was convened by Network for Advancement of Transfusion Alternatives to review the evidence on the efficacy and safety of i.v. iron administration to increase...
haemoglobin levels and reduce blood transfusion in patients undergoing surgery, and to develop a consensus statement on perioperative use of i.v. iron as a transfusion alternative. After conducting a systematic literature search to identify the relevant studies, critical evaluation of the evidence was performed and recommendations formulated using the Grades of Recommendation Assessment, Development and Evaluation Working Group methodology. Two randomized controlled trials (RCTs) and six observational studies in orthopaedic and cardiac surgery were evaluated. Overall, there was little benefit found for the use of i.v. iron. At best, i.v. iron supplementation was found to reduce the proportion of patients requiring transfusions and the number of transfused units in observational studies in orthopaedic surgery but not in cardiac surgery. The two RCTs had serious limitations and the six observational limited by the selection of the control groups. Thus, the quality of the available evidence is considered moderate to very low. For patients undergoing orthopaedic surgery and expected to develop severe postoperative anaemia, the panel suggests i.v. iron administration during the perioperative period (weak recommendation based on moderate/low-quality evidence). For all other types of surgery, no evidence-based recommendation can be made. The panel recommends that large, prospective, RCTs be undertaken to evaluate the efficacy and safety of i.v. iron administration in surgical patients. The implementation of some general good practice points is suggested


Abstract: BACKGROUND AND OBJECTIVES: Intravenous (i.v.) Recombinant erythropoietin (Epoetin alfa) is effective in allowing autologous blood donation in patients unable to donate because of anemia. We undertook this open pilot study in order to assess whether a low subcutaneous (s.c.) dose of Epoetin alfa would prove as effective and well tolerated as the higher i.v. dose. Such a move would also decrease costs. MATERIALS AND METHODS: A total Epoetin alfa s.c. dose of 800 IU/kg was compared with a total i.v. dose of 1,800 IU/kg. Twenty-two rheumatoid arthritis patients, unable to donate because of hemoglobin (Hb) < 11 g/dl, received 300 IU/kg of IV Epoetin alfa twice weekly for 3 weeks (11 patients), or 100 IU/kg of s.c. Epoetin alfa twice weekly for 3 weeks plus an i.v. bolus of 200 IU/kg of Epoetin alfa at the first visit (11 patients). At each visit, all patients received 100 mg of i.v. iron saccharate and when the hematocrit (hct) > or = 34%, 350 ml of autologous blood (AB) were collected.

RESULTS: No significant differences were observed between the 2 groups of treated patients in terms of units of AB collected (2.6 +/- 0.6 vs. 2.5 +/- 0.5 units for i.v. and s.c. groups, respectively), ml of RBC produced during the study period (291 +/- 99 vs. 337 +/- 65 ml for the i.v. and s.c. groups, respectively), or in the degree of reduced exposure to allogeneic blood in comparison with the control group. CONCLUSIONS: Lower dose of Epoetin alfa (reduced by 56%), supplemented by i.v. iron, is as effective and well tolerated as higher doses administered i.v., supplemented by i.v. iron.


Abstract: In unilateral total knee replacement (TKR), perioperative blood loss, low transfusion thresholds and short hospital stay result in patients being discharged with low haemoglobin (Hb). We assessed the effects of perioperative administration of intravenous iron, with or without erythropoietin, plus a restrictive transfusion threshold (Hb < 80 g L(-1)) both on transfusion rate and recovery from post-operative anaemia. TKR patients received iron sucrose (2 x 200 mg per 48 h, iv) (Group IVI, n = 129). Patients with admission Hb < 130 g L(-1), also received erythropoietin (1 x 40 000 IU, sc) (Group EPO, n = 19). Perioperative clinical and laboratory data were obtained. Mean Hb loss was 36 g L(-1), but only seven patients were transfused (5%). Pre-operatively, 66 (45%) patients did not have enough stored iron to compensate Hb loss. At post-operative day 30, only 15% were anaemic, 70% of Hb loss and 92% of pre-operative Hb were recovered and ferritin increased by 73 microg L(-1) (P < 0.01), although erythropoietic response was higher in patients receiving erythropoietin (P < 0.05). No adverse effects of iron sucrose or erythropoietin were witnessed. This protocol seems to reduce allogeneic blood transfusion rate and may hasten the recovery from post-operative anaemia in TKR patients, without depleting iron stores. Further studies are needed to ascertain which patients may benefit of extended intravenous iron and/or erythropoietin administration.
Abstract: In 2008, after reports of an association between erythropoietic stimulating agent (ESA) therapy and
treatment with either oral iron supplementation or blood transfusion. Hence, the aim of our study was to
come to exist. Hence, the aim of our study was to compare the effect of treatment with either oral ferrous sulphate or intravenous ferrous sucrose on postpartum IDA. DESIGN: A single centre, prospective randomised controlled trial. SETTING: Women's Centre, John Radcliffe Hospital, Oxford, UK. POPULATION: Forty-four women with haemoglobin (Hb) of <9 g/dl and ferritin of <15 microgram/l at 24-48 hours postdelivery. METHODS: Women were randomised to receive either oral ferrous sulphate 200 mg twice daily for 6 weeks (group O) or intravenous ferrous sucrose 200 mg (Venoferr; Vifor International Ltd, St Gallen, Switzerland), two doses given on days 2 and 4 following recruitment (group I). RESULTS: were analysed by the Students t-test, chi-square test and analysis of variance. MAIN OUTCOME MEASURES: Hb, haematocrit, red cell indices, ferritin and serum iron levels were measured on days 0, 5, 14 and 40. Results: By day 5, the Hb level in women treated with intravenous iron had risen from 7.3 +/- 0.9 to 9.9 +/- 0.7 g/dl, while there was no change in those treated with oral iron. Women treated with intravenous iron had significantly higher Hb levels on days 5 and 14 (P < 0.01) than those treated with oral iron; although by day 40, there was no significant difference between the two groups. Throughout the study, ferritin levels rose rapidly in those treated with intravenous iron and remained significantly higher than in those treated with oral iron (P < 0.01). CONCLUSIONS: Intravenous iron sucrose increases the Hb level more rapidly than oral ferrous sulphate in women with postpartum IDA. It also appears to replenish iron stores more rapidly. However, this study was not large enough to address the safety of this strategy.

Abstract: OBJECTIVE: Postpartum iron deficiency anaemia (IDA) is common in women. Most women are treated

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Abstract: BACKGROUND: Preoperative anemia is frequent in patients undergoing orthopedic surgery. The purpose of this study was to assess the preoperative increase of hemoglobin in iron deficiency anemia patients treated with intravenous iron. METHODS: After obtaining written informed consent, 20 patients with iron deficiency anemia received 900 mg intravenous iron sucrose over 10 days starting 4 weeks before surgery. Changes of hemoglobin a

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Abstract: BACKGROUND: Preoperative anemia is frequent in patients undergoing orthopedic surgery. The purpose of this study was to assess the preoperative increase of hemoglobin in iron deficiency anemia patients treated with intravenous iron. METHODS: After obtaining written informed consent, 20 patients with iron deficiency anemia received 900 mg intravenous iron sucrose over 10 days starting 4 weeks before surgery. Changes of hemoglobin and iron status were measured over 4 weeks and at discharge. In the last 11 patients, endogenous erythropoietin was also measured. Data were analyzed using the Friedman test followed by pairwise Wilcoxon signed rank tests with Bonferroni correction. RESULTS: Hemoglobin increased significantly (P < 0.0001) after intravenous iron treatment. Overall, the mean maximum increase was 1.0 +/- 0.6 g/dl (range, 0.2-2.2 g/dl). Ferritin increased from 78 +/- 70 to 428 +/- 191 microg/l (P = 0.0001), ferritin index decreased from 2.7 +/- 2.4 to 1.5 +/- 1.0 (P = 0.0001), and soluble transferrin receptor decreased from 4.1 +/- 2.3 mg/l to 3.7 +/- 2.3 mg/l (P = 0.049), whereas transferrin saturation (20.5 +/- 9.0 to 22.9 +/- 9.0%) and serum iron (13.3 +/- 4.6 to 13.1 +/- 4.5 microg/microm) did not change significantly after intravenous iron treatment. Endogenous erythropoietin decreased from 261 +/- 130 pg/ml to 190 +/- 49 pg/ml 2 weeks after intravenous iron treatment (P = 0.050, not significantly after Bonferroni correction). No adverse events related to intravenous iron were observed. The maximum increase of hemoglobin was observed 2 weeks after the start of intravenous iron treatment, indicating that administration of intravenous iron 2-3 weeks before surgery may be optimal. CONCLUSION: Treatment with intravenous iron allows correcting iron deficiency anemia before elective surgery.

Shander A, Spence RK, Auerbach M. Can intravenous iron therapy meet the unmet needs created by the new restrictions on erythropoietic stimulating agents? Transfusion 2010 Mar;50(3):719-32.

Abstract: In 2008, after reports of an association between erythropoietic stimulating agent (ESA) therapy and the potential for either thrombotic cardiovascular events or more rapid tumor progression in some cancers, the Food and Drug Administration changed the product labeling for ESAs, adding a black box warning as well as more restrictive indications, especially in oncology patients. In addition the Centers for Medicare and Medicaid Services has placed significant restrictions on payments for ESA therapy. These new limitations on ESA have led to increased use of transfusions in anemic cancer patients. This increase in allogeneic transfusions potentially will place an additional burden on the US blood supply. Although allogeneic blood transfusion is one answer to ESA restrictions, the use of intravenous iron
therapy (IV iron) is another possible alternative. We will discuss the use of IV iron as primary therapy for anemia, the use of combination IV iron and ESA therapy to improve efficiency and decrease costs, and evidence that IV iron with and without ESA therapy can reduce allogeneic blood transfusions in surgical patients. We will also review the available IV iron agents and their comparative safety profiles.

Abstract: Macrophages and other host cells activated by interferon-gamma (IFN-gamma) can be induced to form a flavoprotein that converts L-arginine to nitric oxide+L-citrulline. Nitric oxide causes efflux of non-heme iron from neoplastic and infected host cells. In the absence of L-arginine, IFN-gamma-induced infected cells can lower their net uptake of iron. Cellular depletion of the metal via either mechanism suppresses DNA synthesis as well as the functioning of aerobic respiratory enzymes. Macrophage regulation of growth of other host cells during embryogenesis, immune responses, or immunosurveillance might involve iron depletion.

Abstract: Diabetic nephropathy has become the leading cause of uremia. Several lines of evidence suggest dietary factors other than protein intake have a substantial role in the progression of diabetic nephropathy to end-stage renal disease. The present investigation was initiated to evaluate whether a carbohydrate-restricted, low-iron-available, polyphenol-enriched (CR-LIPE) diet may delay and improve the outcome of diabetic nephropathy to a greater extent than standard protein restriction. To this aim, 191 diabetic patients, all with type 2 diabetes, were randomized to either CR-LIPE or standard protein restriction and the following outcomes monitored: doubling of serum creatinine, cumulative incidence of end-stage renal disease, and all cause mortality. Over a mean follow-up interval of 3.9 - 1.8 years, serum creatinine concentration doubled in 19 patients on CR-LIPE (21%) and in 31 control subjects (39%) (< 0.01). Renal replacement therapy or death occurred in 18 patients on CR-LIPE (20%) and in 31 control subjects (39%) (< 0.01). These differences were independent from follow-up interval, sex, mean arterial blood pressure, HbA1c, initial renal dysfunction, and angiotensin system inhibitor use. In conclusion, CR-LIPE was 40% ± 50% more effective than standard protein restriction in improving renal and overall survival rates.

Abstract: Context Accumulation of iron in excess of physiologic requirements has been implicated in risk of cardiovascular disease because of increased iron-catalyzed free radical-mediated oxidative stress. Objective To test the hypothesis that reducing body iron stores through phlebotomy will influence clinical outcomes in a cohort of patients with symptomatic peripheral arterial disease (PAD). Design, Setting, and Patients Multicenter, randomized, controlled, single-blinded clinical trial based on the Iron (Fe) and Atherosclerosis Study (FeAST) (VA Cooperative Study #410) and conducted between May 1, 1999, and April 30, 2005, within the Department of Veterans Affairs Cooperative Studies Program and enrolling 1277 patients with symptomatic but stable PAD. Those with conditions likely to cause acute-phase increase of the ferritin level or with a diagnosis of visceral malignancy within the preceding 5 years were excluded. Analysis was by intent-to-treat. Intervention Patients were assigned to a control group (n = 641) or to a group undergoing reduction of iron stores by phlebotomy with removal of defined volumes of blood at 6-month intervals (avoiding iron deficiency) (n = 636), stratified by hospital, age, and baseline smoking status, diagnosis of diabetes mellitus, ratio of high-density to low-density lipoprotein cholesterol level, and ferritin level. Main Outcome Measures The primary end point was all-cause mortality; the secondary end point was death plus nonfatal myocardial infarction and stroke. Results There were no significant differences between treatment groups for the primary or secondary study end points. All-cause deaths occurred in 148 patients (23%) in the control group and in 125 (20%) in the iron-reduction group (hazard ratio (HR), 0.85; 95% confidence interval (CI), 0.67-1.08; P = .17). Death plus nonfatal myocardial infarction and stroke occurred in 205 patients (32%) in the control group and in 180 (28%) in the iron-reduction group (HR, 0.88; 95% CI, 0.72-1.07; P = .20). Conclusion Reduction of body iron stores in patients with symptomatic PAD did not significantly decrease all-cause mortality or death plus nonfatal myocardial infarction and stroke. Trial Registration clinicaltrials.gov Identifier: NCT00032357

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Abstract: Background: Excess iron has been implicated in cancer risk through increased iron-catalyzed free radical-mediated oxidative stress. Methods: A multicenter randomized, controlled, single-blinded clinical trial (VA Cooperative Study #410) tested the hypothesis that reducing iron stores by phlebotomy would influence vascular outcomes in patients with peripheral arterial disease. Patients without a visceral malignancy in the last 5 years (n = 1277) were randomly assigned to control (n = 641) or iron reduction (n = 636). Occurrence of new visceral malignancy and cause-specific mortality data were collected prospectively. Cancer and mortality outcomes in the two arms were compared using intent-to-treat analysis with a Cox proportional hazards regression model. Statistical tests were two-sided. Results: Patients were followed up for an average of 4.5 years. Ferritin levels were similar in both groups at baseline but were lower in iron reduction patients than control patients across all 6-month visits (mean = 79.7 ng/mL, 95% confidence interval [CI] = 73.8 to 85.5 ng/mL vs 122.5 ng/mL, 95% CI = 115.5 to 129.5 ng/mL; P < .001). Risk of new visceral malignancy was lower in the iron reduction group than in the control group (38 vs 60, hazard ratio [HR] = 0.65, 95% CI = 0.43 to 0.97; P = .036), and, among patients with new cancers, those in the iron reduction group had lower cancer-specific and all-cause mortality (HR = 0.39, 95% CI = 0.21 to 0.72; P = .003; and HR = 0.49, 95% CI = 0.29 to 0.83; P = .009, respectively) than those in the control group. Mean ferritin levels across all 6-monthly visits were similar in patients in the iron reduction and control groups who developed cancer but were lower among all patients who did not develop cancer than among those who did (76.4 ng/mL, 95% CI = 71.4 to 81.4 ng/mL vs 127.1 ng/mL, 95% CI = 71.2 to 183.0 ng/mL; P = .017). Conclusions: Iron reduction was associated with lower cancer risk and mortality. Further studies are needed to define the role of body iron in cancer risk.


Abstract: BACKGROUND: The production of peroxide and superoxide is an inevitable consequence of aerobic metabolism, and while these particular ‘reactive oxygen species’ (ROSs) can exhibit a number of biological effects, they are not of themselves excessively reactive and thus they are not especially damaging at physiological concentrations. However, their reactions with poorly liganded iron species can lead to the catalytic production of the very reactive and dangerous hydroxyl radical, which is exceptionally damaging, and a major cause of chronic inflammation. REVIEW: We review the considerable and wide-ranging evidence for the involvement of this combination of (su)peroxide and poorly liganded iron in a large number of physiological and indeed pathological processes and inflammatory disorders, especially those involving the progressive degradation of cellular and organismal performance. These diseases share a great many similarities and thus might be considered to have a common cause (i.e. iron-catalysed free radical and especially hydroxyl radical generation). The studies reviewed include those focused on a series of cardiovascular, metabolic and neurological diseases, where iron can be found at the sites of plaques and lesions, as well as studies showing the significance of iron to aging and longevity. The effective chelation of iron by natural or synthetic ligands is thus of major physiological (and potentially therapeutic) importance. As systems properties, we need to recognise that physiological observables have multiple molecular causes, and studying them in isolation leads to inconsistent patterns of apparent causality when it is the simultaneous combination of multiple factors that is responsible. This explains, for instance, the decidedly mixed effects of antioxidants that have been observed, since in some circumstances (especially the presence of poorly liganded iron) molecules that are nominally antioxidants can actually act as pro-oxidants. The reduction of redox stress thus requires suitable levels of both antioxidants and effective iron chelators. Some polyphenolic antioxidants may serve both roles. Understanding the exact speciation and liganding of iron in all its states is thus crucial to separating its various pro- and anti-inflammatory activities. Redox stress, innate immunity and pro- (and some anti-inflammatory cytokines are linked in particular via signalling pathways involving NF-kappaB and p38, with the oxidative roles of iron here seemingly involved upstream of the IkappaB kinase (IKK) reaction. In a number of cases it is possible to identify mechanisms by which ROSs and poorly liganded iron act synergistically and autocatalytically, leading to ‘runaway’ reactions that are hard to control unless one tackles multiple sites of action simultaneously. Some molecules such as statins and erythropoietin, not traditionally associated with anti-inflammatory activity, do indeed have
Abstract: Conventional therapies with recombinant human erythropoietin (rHuEPO) to sustain preoperative autologous red cells were obtained from this group (776 +/- 49 mL vs 682 +/- 91 mL; P < 0.05). One consequence of this is that in combination with peroxide and superoxide its activity underpins the behaviour of a great many physiological processes that degrade over time.

Understanding these requires an integrative, systems-level approach that may lead to novel therapeutic targets.


Abstract: BACKGROUND: Recombinant human erythropoietin (EPO) therapy has been known to enhance erythropoiesis and facilitate autologous blood donation before elective orthopedic operations. However, the optimal EPO dose in this setting remains undefined. To help determine this, we have examined the effect of patient weight and EPO dose on red blood cell (RBC) volume expansion. STUDY DESIGN: Forty-six nonanemic autologous blood donors enrolled at our institution in two previously reported multicenter clinical trials were analyzed. Patients received either placebo or EPO (150, 300, or 600 units [U] per kg) given intravenously at each of six AB blood type donation visits. RESULTS: Total preoperative RBC volume expansion over a 22 day period was 465 +/- 135 mL (mean +/- SD) in patients receiving a placebo and 588 +/- 201 mL, 735 +/- 144 mL, and 881 +/- 292 mL in patients receiving graded concentrations of EPO. When RBC volume increase was corrected for patient weight and EPO dose, patients receiving placebo or EPO (150, 300, and 600 U per kg) expanded RBC volume by 5.9 mL per kg in patients receiving placebo and 7.9, 9.1, and 10.9 mL per kg in patients receiving EPO, respectively (p < 0.02 for each EPO group compared with placebo group). A direct relationship between EPO dose and RBC volume increase (response) over 22 days was determined by the linear regression equation: RBC volume (mL per kg) = 6.34 + 0.0013X, r = 0.98, where X equals total units EPO administered (per kg body weight). CONCLUSIONS: We conclude that EPO dose can be based on anticipated blood losses and transfusion needs in autologous blood donors before orthopedic operation.


Abstract: To study whether the administration of recombinant human erythropoietin increases the amount of autologous blood that can be collected before surgery, we conducted a randomized, controlled trial of erythropoietin in 47 adults scheduled for elective orthopedic procedures. The patients received either erythropoietin (600 units per kilogram of body weight) or placebo intravenously twice a week for 21 days, during which time up to 6 units of blood was collected. Patients were excluded from donation when their hematocrit values were less than 34 percent. All patients received iron sulfate (325 mg orally three times daily). The mean number of units collected per patient (+/- SE) was 5.4 +/- 0.2 for the erythropoietin group and 4.1 +/- 0.2 for the placebo group. The mean red-cell volume donated by the patients who received erythropoietin was 41 percent greater than that donated by the patients who received placebo (961 vs. 683 mL, P less than 0.05). Only 1 of the 23 patients treated with erythropoietin was unable to donate greater than or equal to 4 units (4 percent) as compared with 7 of the 24 patients who received placebo (29 percent). No adverse effects were attributed to erythropoietin. We conclude that recombinant human erythropoietin increases the ability of patients about to undergo elective surgery to donate autologous blood.


Abstract: Conventional therapies with recombinant human erythropoietin (rHuEPO) to sustain preoperative autologous blood collection entail high doses of the drug at short intervals. To evaluate the efficacy of a single weekly dose of rHuEPO for autologous blood collection, we randomly assigned 24 male patients scheduled for coronary artery bypass surgery to receive 400 IU/kg rHuEPO subcutaneously once a week or iron only. Patients were examined weekly and a total of up to 4 units of autologous blood were obtained if the hemoglobin level exceeded 12 g/dL. Patients receiving rHuEPO had consistently higher hemoglobin values than those receiving iron only (P < 0.001). Consequently, more autologous red cells were obtained from this group (776 +/- 49 mL vs 682 +/- 91 mL; P < 0.05). One
patient receiving rHuEPO and eight in the control group required homologous blood at surgery (P < 0.01). These results suggest that 400 IU/kg rHuEPO administered subcutaneously once a week efficiently stimulates erythropoiesis and compensates the hemoglobin decrease after autologous blood donation.


Abstract: OBJECTIVES: In an effort to avoid allogeneic transfusions, many patients scheduled for radical retropubic prostatectomy (RRP) participate in preoperative autologous donation (PAD) programs. Yet, PAD programs are costly, time-consuming, and not without risks. Perioperative administration of recombinant human erythropoietin (Epoetin alfa) also has been shown to reduce patients exposure to allogeneic transfusion. This study sought to compare the costs and transfusion rates associated with either PAD or perioperative Epoetin alfa in patients undergoing RRP. METHODS: The study population consisted of 120 men randomized to one of two treatment groups. Patients in group 1 donated up to 3 U of autologous blood preoperatively, provided that their hematocrit (HCT) was 33% or higher. Patients in group 2 received 600 IU/kg of Epoetin alfa on days -14 and -7 preoperatively, provided that their HCT was 46% or lower. RESULTS: Overall, 107 (89%) of 120 patients underwent RRP. In group 1, 5 (9.6%) of 52 patients received a total of 12 U of allogeneic blood (0.23 U/patient). In group 2, 5 (9.6%) of 52 patients received a total of 10 U of allogeneic blood (0.19 U/patient). Three patients in group 1 but no patients in group 2 experienced an adverse event. The average costs related to PAD and pharmacologic administration per patient were $540 in group 1 and $657 in group 2. Participation in PAD required an average of 5 hours more per patient compared with Epoetin alfa administration. CONCLUSIONS: Preoperative Epoetin alfa therapy is safe, well tolerated, and equally effective as PAD in reducing allogeneic blood transfusion requirements. Epoetin alfa therapy also is comparable in cost to PAD and offers patients greater convenience and less of a time commitment.


Abstract: BACKGROUND: Controversy exists about the advantages of predeposit of autologous blood (PDAB), and whether more comfortable blood conservation regimens may yield comparable results. To test the hypothesis that preoperative treatment with recombinant human erythropoietin (rHuEPO) with or without acute concomitant normovolaemic haemodilution (ANHD) is as effective as PDAB in reducing allogeneic blood transfusions, we conducted a prospective randomised study in women undergoing primary hip replacement. METHODS: Sixty consecutive female patients scheduled for primary hip replacement and suitable for PDAB were randomly assigned to one of 3 groups. Group I (EPO) and II (ANHD) received 600 U/kg rHuEPO s.c. and 100 mg iron saccharate i.v. on day 14 and, if needed, on day 7 before surgery. Additionally, in group II acute normovolaemic haemodilution (ANHD) was implemented after induction of anaesthesia. In group III (PDAB) conventional PDAB up to 3 U, without volume replacement but with concomitant oral iron therapy, was performed starting 4 weeks before surgery. RESULTS: The blood conservation methods resulted in a comparable net gain of red cells in all 3 groups until the day of surgery. Because of the withdrawal of autologous blood, haemoglobin values before surgery were lower in the PDAB group than in the EPO and ANHD groups, and during surgery were lower in the PDAB and ANHD groups than in the rHuEPO-only group. Applying moderate ANHD in conjunction with preoperative rHuEPO treatment did not yield an incremental decrease in allogeneic transfusions. There was no difference between the groups in the number of patients who received allogeneic transfusions or in the total number of allogeneic units transfused. CONCLUSIONS: Withdrawal of autologous blood is associated with lower pre- and intraoperative haemoglobin levels when compared to preoperative augmentation of red cell mass using rHu-EPO. As a measure to reduce allogeneic transfusion requirements, preoperative treatment with rHuEPO may be as effective as standard predeposit of autologous blood in women undergoing primary hip replacement, but requires less preoperative time.

Abstract: STUDY DESIGN: Prospective, open-label, randomized, parallel-group study at 80 centers. OBJECTIVE: To demonstrate there is no clinically important additional risk for deep vein thrombosis with perioperative use of epoetin alfa versus standard of care in spine surgery without prophylactic anticoagulation. SUMMARY OF BACKGROUND DATA: Trials of epoetin alfa in orthopedic surgery that demonstrated no additional risk of thrombovascular events included perioperative pharmacologic anticoagulation. METHODS: Subjects received epoetin alfa 600 U/kg subcutaneously once weekly starting 3 weeks before spinal surgery plus standard of care for blood conservation, or standard of care alone. Perioperative anticoagulation therapy was not permitted; mechanical deep vein thrombosis prophylaxis was allowed. Doppler imaging for deep vein thrombosis was done on postoperative day 4 (or day of discharge), or for suspected deep vein thrombosis. Deep vein thrombosis was diagnosed by Doppler result or adverse event report. The criterion for no additional risk of deep vein thrombosis was a 1-sided 97.5% upper confidence limit <or =4% between groups. RESULTS: Of the 680 subjects analyzed (340 in each treatment group), 16 (4.7%) in the epoetin alfa group and 7 (2.1%) in the standard of care group had a diagnosis of deep vein thrombosis either by Doppler or by adverse event report with normal Doppler. The between-group difference was 2.6% (97.5% upper confidence limit, 5.4%). Deep vein thrombosis confirmed by Doppler (4.1% vs. 2.1%), other clinically relevant thrombovascular events (1.5% vs. 0.9%), and all adverse events combined (76.5% vs. 73.2%) occurred with similar frequency in the 2 treatment groups. CONCLUSION: This study documented a higher incidence of deep vein thrombosis and similar rates of other clinically relevant thrombovascular events with epoetin alfa versus standard of care for blood conservation in subjects who did not receive prophylactic anticoagulation before spinal surgery. Antithrombotic prophylaxis should be considered when erythropoietin is used in the surgical setting.


Abstract: Context The erythropoiesis-stimulating agents (ESAs) erythropoietin and darbepoetin are licensed to treat chemotherapy-associated anemia in patients with nonmyeloid malignancies. Although systematic overviews of trials have identified venous thromboembolism (VTE) risks, none have identified mortality risks with ESAs. Objective To evaluate VTE and mortality rates associated with ESA administration for the treatment of anemia among patients with cancer. Data Sources A published overview from the Cochrane Collaboration (search dates: January 1, 1985-April 1, 2005) and MEDLINE and EMBASE databases (key words: clinical trial, erythropoietin, darbepoetin, and oncology), the public Web site of the US Food and Drug Administration and ESA manufacturers, and safety advisories (search dates: April 1, 2005-January 17, 2008). Study Selection Phase 3 trials comparing ESAs with placebo or standard of care for the treatment of anemia among patients with cancer. Data Extraction Mortality rates, VTE rates, and 95% confidence intervals (CIs) were extracted by 3 reviewers from 51 clinical trials with 13 611 patients that included survival information and 38 clinical trials with 8172 patients that included information on VTE. Data Synthesis Patients with cancer who received ESAs had increased VTE risks (334 VTE events among 4610 patients treated with ESA vs 173 VTE events among 3562 control patients; 7.5% vs 4.9%; relative risk, 1.57; 95% CI, 1.31-1.87) and increased mortality risks (hazard ratio, 1.10; 95% CI, 1.01-1.20). Conclusions Erythropoiesis-stimulating agent administration to patients with cancer is associated with increased risks of VTE and mortality. Our findings, in conjunction with basic science studies on erythropoietin and erythropoietin receptors in solid cancers, raise concern about the safety of ESA administration to patients with cancer.

(120) Dicato M. Venous Thromboembolic Events and Erythropoiesis-Stimulating Agents: An Update. Oncologist 2008 May 1;13(suppl_3):11-S.

Abstract: Venous thromboembolic events (VTEs) are frequent in cancer patients because of the effects of malignant disease, its treatment, and comorbidities. The higher risk for VTEs associated with the use of erythropoiesis-stimulating agents (ESAs) appears to be a class effect but may be particularly pronounced when these agents are used in patients who are not anemic at baseline and/or to achieve hemoglobin targets higher than those recommended in current labeling. Particular attention should be taken to assess the balance of risks and benefits in patients with a history of thromboembolism. If the goal of treatment of patients with chemotherapy-associated anemia is aimed to raise the hemoglobin level to 12 g/dl, and is confined to that, ESA-induced VTEs should rarely be a problem.
Abstract: The variations in plasma erythropoietin (EPO) concentration during preoperative deposit of autologous blood were studied in 12 patients (8 men, 4 women). Four donations were scheduled at weekly intervals. A predonation hemoglobin concentration of 11 g per dL (110 g/L) was required. Hemoglobin concentration decreased from 14.3 +/- 1.1 g per dL (143 +/- 11 g/L) (mean +/- SD) before the first donation to 11.7 +/- 0.7 g per dL (117 +/- 7 g/L) on Day 22 (p less than or equal to 0.0001). Reticulocyte counts increased from a median of 31,800 [range, 4900-95,000] per microl [median, 32 x 10(9)/L [range, 5-95 x 10(9)/L] to 93,800 (16,800-194,900) per microl [median, 94 x 10(9)/L [range, 17-195 x 10(9)/L]) on Day 28 (p less than or equal to 0.01). Plasma EPO concentration was 17.8 +/- 5.1 mU per mL prior to the first donation and displayed a small and transient peak after each donation. A sustained elevation followed each peak. Although plasma EPO concentration differed significantly from the baseline value after the first donation, only the peak concentrations after the second (35.5 +/- 15.5 mU/mL), third (38.0 +/- 14.5 mU/mL), and fourth (36.1 +/- 11.0 mU/mL) donations exceeded the normal range. The moderate, biphasic increase in plasma EPO concentration and the moderate increase in erythropoiesis suggest two strategies in autologous blood donation that should be...
investigated with respect to efficiency and safety: 1) more aggressive donation schemes, which reduce donation intervals and/or the minimum hemoglobin concentration and 2) the administration of recombinant human EPO


Abstract: Background Concern about risks associated with allogeneic red blood cell transfusion has led to interest in methods of decreasing patient exposure to perioperative transfusion. Objective To perform a meta-analysis to determine the degree to which predonation of autologous blood reduces patients' exposure to allogeneic blood and all transfusions of red blood cells (allogeneic or autologous). Methods We searched MEDLINE, EMBASE, bibliographies, annual reports, press releases, newsletters from organizations with interests in the blood system, and personal files for randomized studies and concurrent control cohort studies in which the control groups were patients excluded for nonmedical reasons. Results Patients who predonated autologous blood were less likely to receive allogeneic blood in the 6 randomized studies (n=933) (odds ratio [OR], 0.17; 95% confidence interval [CI], 0.08-0.32) and in the 9 cohort studies (n=2351) (OR, 0.19; 95% CI, 0.14-0.26). However, autologous donors were more likely to undergo transfusion with allogeneic and/or autologous blood (for randomized studies: OR, 3.03; 95% CI, 1.70-5.39 and for cohort studies: OR, 12.32; 95% CI, 5.90-25.40). Studies that reported use of transfusion protocols found less benefit with preoperative autologous donation, although the difference was not statistically significant. Conclusions Preoperative autologous donation of blood decreases exposure to allogeneic blood but increases exposure to any transfusion (allogeneic and/or autologous). There is a direct relationship between the transfusion rate in the control group and the benefit derived from preoperative autologous donation. This suggests that other methods of decreasing blood transfusion, such as surgical technique and transfusion protocols, may be as important as preoperative autologous donation of blood


Abstract: The purpose of this study was to evaluate the blood levels of patients preparing for total knee arthroplasty (TKA) who were enrolled in a preoperative autologous donation program. The charts and hospital records of 70 consecutive patients who underwent primary unilateral TKA between 2000 and 2002 were retrospectively reviewed. Study participants were instructed to donate one unit of blood approximately 4 weeks prior to surgery. Predonation and preoperative hemoglobin levels were assessed throughout the study and transfusion requirements were recorded. Transfusions were administered only when warranted by clinical symptoms. The mean initial (predonation) hemoglobin concentration was 14.1 g/dL. The mean number of days donations were made prior to surgery was 13 +/- 3.3 days. Prior to surgery, the average hemoglobin concentration dropped to 12.8 g/dL. Fifty (71%) patients had a hemoglobin value > 13.0 g/dL prior to their autologous donation, but only 30 (43%) patients had blood levels > or = 13.0 g/dL following blood donation. Postoperatively, the mean hemoglobin concentration in the recovery room was 11.6 g/dL and dropped to a nadir of 10.8 g/dL on postoperative day 3. Overall, 91% of patients required autologous blood transfusion following TKA but no patients required allogeneic blood transfusions. Preoperative autologous donation was associated with a decrease in preoperative hemoglobin levels and with a high rate of autologous transfusion based on clinical symptoms of postoperative anemia


Abstract: BACKGROUND: Preoperative autologous blood donation (PABD) and intraoperative blood salvage (IBS) represent established blood conservation measures. However, data comparing PABD to IBS are very sparse. STUDY DESIGN AND METHODS: We analyzed data from 1103 patients undergoing PABD and subsequent major orthopedic surgery in one center. We then used a validated model to compare PABD to IBS. We calculated maximal allowable blood losses (MABLs) for both IBS and PABD. We also identified criteria for efficacious use of either PABD or IBS. Our calculations were based on exclusive application of either technique, complete exhaustion of predeposited or salvaged blood, and one round of IBS. RESULTS: The vast majority of patients would have tolerated greater MABLs if subjected
to IBS rather than PABD (425 of 432 with 1 PABD unit, 580 of 664 patients with 2 PABD units, 3 of 7 patients with 3 PABD units). For a few patients, however, our model demonstrated greater MABL with PABD than with IBS. These patients were characterized by 1) lower initial hematocrit (Hct), 2) recovery from PABD with return to baseline Hct or above by the time of surgery, and 3) longer time between first PABD and surgery. CONCLUSION: IBS appears to be the superior blood conservation technique if PABD cannot be performed under optimal conditions. Tolerable predonation anemia and sufficient time for regeneration appear to be crucial for post-PABD erythropoiesis. If these goals cannot be accomplished, PABD should be abandoned and be replaced by IBS.

Abstract: To avoid the potential risks of allogeneic transfusion during total hip arthroplasty (THA), the use of preoperative autologous blood donation (PABD) has been utilized. We performed a retrospective chart review of 283 patients undergoing THA that either donated 1 U of autologous blood (188 patients) or did not donate autologous blood before surgery (95 patients) in order to investigate the difference in postoperative transfusion rate (autologous and allogeneic), the incidence of allogeneic transfusion, and the difference in cost of each protocol. In addition, the study compared transfusion rates in patients with and without preoperative anemia (hemoglobin (Hb) <≤ 12.5 g/dL). At 0.75 transfusions per patient versus 0.22 transfusions per patient, the PABD patients had a significantly higher overall transfusion rate. PABD significantly reduced the need for allogeneic blood in anemic patients (Hb <≤ 12.5 g/dL) from 52.6% to 11.8%. PABD did not have the same affect in nonanemic patients (allogeneic transfusion rate 5.7% versus 4.0%). The study demonstrated that nonanemic patients undergoing THA do not benefit from PABD, but it is effective for anemic patients.

Abstract: For patients who donate blood for autologous use and undergo major orthopedic surgery, low basal hematocrit (Hct) is the major cause of allogeneic blood exposure. To determine whether recombinant human erythropoietin (rHuEPO) could increase autologous blood procurement and reduce allogeneic blood exposure, a prospective randomized study was conducted in 50 women undergoing total hip replacement who had basal Hct < 40 percent (0.40). Patients were randomly placed in three groups: those receiving placebo, those receiving 300 U of rHuEPO per kg, and those receiving 600 U of rHuEPO per kg every 3 to 4 days for 21 days. Oral iron (125-270 mg/day) was given; in the last 24 patients, 100 mg of iron saccharate was administered intravenously at each donation. At each visit, 350 mL of blood was collected if Hct was > or = 34 percent (0.34). Patients receiving rHuEPO donated a greater amount of blood for autologous use than did patients in the placebo group (4.5 +/- 1.1 vs. 2.8 +/- 0.6 units; p < 0.05) and received a significantly lower amount of allogeneic blood (1.2 +/- 1.4 vs. 0.4 +/- 0.8 units; p < 0.05). No difference between the effects of the two doses of rHuEPO was observed. Iron support was a critical factor in the efficacy of treatment. No untoward effects were observed. The rHuEPO emerged as a safe and effective treatment, with adequate iron support, by which to increase preoperative deposit of autologous blood and to reduce exposure to allogeneic blood for patients with low basal Hct.

Abstract: INTRODUCTION: Cardiac surgery using cardiopulmonary bypass in newborns, infants and small children often requires intraoperative red blood cell transfusions to prime the circuit and oxygenator and to replace blood lost during surgery. The purpose of this study was to investigate the influence of red blood cell storage time prior to transfusion on postoperative morbidity in pediatric cardiac operations. Methods: One hundred ninety-two consecutive children aged 5 years or less who underwent cardiac operations using cardiopulmonary bypass and who received red blood cells for priming the cardiopulmonary bypass circuit comprised the blood-prime group. Forty-seven patients receiving red blood cells transfusions after cardiopulmonary bypass were separately analyzed. Patients in the blood-prime group were divided into two groups based on the duration of storage of the red blood cells they received. The newer blood group included patients who received only red blood cells stored for <4 days and the older blood group included patients who received red blood cells stored for >4 days. RESULTS: Patients in the newer blood group had a significantly lower rate of pulmonary
complications (3.5% versus 14.4%; P = 0.011) as well as a lower rate of acute renal failure (0.8% versus 5.2%; P = 0.154) than patients in the older blood group. Major complications (calculated as a composite score based on pulmonary, neurological, and gastroenterological complications, sepsis and acute renal failure) were found in 6.9% of the patients receiving newer blood and 17.1% of the patients receiving older blood (P = 0.027). After adjusting for other possible confounding variables, red blood cell storage time remained an independent predictor of major morbidity. The same association was not found for patients receiving red blood cells transfusions after cardiopulmonary bypass.

CONCLUSIONS: The storage time of the red blood cells used for priming the cardiopulmonary bypass circuit in cardiac operations on newborns and young infants is an independent risk factor for major postoperative morbidity. Pulmonary complications, acute renal failure, and infections are the main complications associated with increased red blood cell storage time.

(130) Vamvakas EC. Meta-analysis of clinical studies of the purported deleterious effects of "old" (versus "fresh") red blood cells: are we at equipoise? Transfusion 2009 Nov;50(11):2307-14.

Abstract: BACKGROUND: A meta-analysis examined whether the available data support an adequate suspicion that transfusion of red blood cells (RBCs) is associated with increased mortality, organ failure, infection, prolonged mechanical ventilation, and prolonged stay in the hospital or the intensive care unit. Such suspicion is required for intentionally exposing patients enrolled in randomized controlled trials (RCTs) to the known or probable-but rare-risks of old RBCs, to document (and prevent) purported common adverse effects of old RBCs. STUDY DESIGN AND METHODS: Observational studies presenting adjusted results were eligible for analysis if the adequacy of the adjustment for confounding factors could be assessed. Three RCTs and 24 observational studies were retrieved. Medically and statistically homogeneous studies were integrated by fixed-effects methods. Otherwise homogeneous studies conducted in different clinical settings were integrated by random-effects methods. RESULTS: Based on "as-treated" analysis, transfusion of old RBCs was associated with a significant reduction in mortality (summary odds ratio, 0.38; 95% confidence interval, 0.14-0.99; p < 0.05) across two small RCTs. Integration of adjusted findings on the same outcome, from observational studies conducted in the same setting, produced summary results that were either negative (in six analyses) or impossible to evaluate owing to uncontrolled confounding by the number of transfused RBCs (in two analyses). CONCLUSION: The available data do not support an adequate suspicion that old RBCs may be associated with common adverse morbidity and/or mortality outcomes, so as to justify exposing experimental subjects to the other known or probable-but rare-risks of old RBCs.


Abstract: Objective: The storage time of allogeneic red blood cells (RBCs) has been linked with the risk of severe postoperative infections following cardiac surgery. However, existing data are sparse and inconsistent. We therefore examined the association between the age of transfused RBCs and development of severe postoperative infection following coronary artery bypass grafting (CABG) in a large population-based cohort study. Methods: The study included patients undergoing CABG with or without concomitant cardiac surgery between June 2003 and July 2008 in the North and Central Denmark regions. Data on demography, perioperative variables, allogeneic blood transfusion and severe postoperative infections (deep sternal wound infection, bacteremia or septicemia) were retrieved from medical databases and medical records. We used logistic regression analyses to compute the crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for the association between storage time of transfused RBCs and the risk of severe infection. Results: A total of 4240 patients were included in the final analyses, and 1748 of these patients (41%) were transfused with RBCs. Among transfused patients, 953 were exclusively transfused with RBC stored for <14 days and 548 were exclusively transfused with RBC stored for >/=14 days. Severe infection was identified in 165 patients (3.9%). The adjusted ORs for severe infection among all transfused patients and patients transfused with RBCs stored exclusively for either <14 days or >/=14 days were 1.6 (95% CI: 0.9-2.8), 1.1 (95% CI: 0.6-2.1), and 2.3 (95% CI: 1.2-4.2), respectively, when compared with non-transfused patients. There was a dose-response relationship between the number of transfused RBC units and the risk of severe infection among patients exclusively transfused with RBCs stored for >/=14 days. Conclusion: Although the risk of possible confounding could not be eliminated entirely in this observational study, the
findings add further support for the hypothesis that storage time of RBCs is positively associated with the risk of transfusion-related severe postoperative infection in patients undergoing CABG.


Abstract: Although red blood cell (RBC) transfusions can be lifesaving, they are not without risk. In critically ill patients, RBC transfusions are associated with increased morbidity and mortality, which may increase with prolonged RBC storage before transfusion. The mechanisms responsible remain unknown. We hypothesized that acute clearance of a subset of damaged, stored RBCs delivers large amounts of iron to the monocyte/macrophage system, inducing inflammation. To test this in a well-controlled setting, we used a murine RBC storage and transfusion model to show that the transfusion of stored RBCs, or washed stored RBCs, increases plasma nontransferrin bound iron (NTBI), produces acute tissue iron deposition, and initiates inflammation. In contrast, the transfusion of fresh RBCs, or the infusion of stored RBC-derived supernatant, ghosts, or stroma-free lysate, does not produce these effects. Furthermore, the insult induced by transfusion of stored RBC synergizes with subclinical endotoxinemia producing clinically overt signs and symptoms. The increased plasma NTBI also enhances bacterial growth in vitro. Taken together, these results suggest that, in a mouse model, the cellular component of leukoreduced, stored RBC units contributes to the harmful effects of RBC transfusion that occur after prolonged storage. Nonetheless, these findings must be confirmed by prospective human studies.


Abstract: In a double-blind, randomized, placebo-controlled trial, we evaluated the ability of epoetin beta (recombinant human erythropoietin) to avoid allogeneic blood transfusions (ABT) and the associated risks in patients undergoing primary elective open-heart surgery and in whom autologous blood donation (ABD) was contraindicated. Seventy-six patients overall were enrolled onto the trial and were randomly assigned to the two treatment groups, 5 x 500 U/kg body weight (BW) epoetin beta or placebo intravenously over 14 days preoperatively. All patients received 300 mg Fe2+ orally per day during the treatment period. Preoperatively, the mean hemoglobin increase was 1.50 g/dL greater in epoetin beta patients than in placebo patients (95% confidence interval, 1.10 to 1.90 g/dL), allowing a rapid return to the baseline value by the seventh postoperative day in most epoetin beta patients. The mean volume of blood collected by intraoperative isovolemic hemodilution was 562 mL (red blood cell mass, 274 mL) in the epoetin beta group and 218 mL (red blood cell mass, 94 mL) in the placebo group, respectively. Only four patients (11%) in the epoetin beta group received an ABT, compared with 19 (53%) in the placebo group (P = .0003). Epoetin beta was most useful in patients with a perioperative blood loss greater than 750 mL, in those with a baseline hematocrit value less than 0.42, and in those aged > or = 60 years. The iron supplementation proved adequate despite the fact that a significant decrease in ferritin (median, 48.1%) and transferrin saturation (median, 40.5%) was observed in epoetin beta patients preoperatively. No influence of epoetin beta therapy on blood pressure, laboratory safety variables, or the frequency of specific adverse events was observed. Intravenous epoetin beta treatment of 5 x 500 U/kg BW in combination with 300 mg Fe2+ orally per day administered over 14 days preoperatively is an adequate therapy for increasing mean hemoglobin levels by approximately 1.50 g/dL and reducing the allogeneic blood requirement in patients undergoing elective open-heart surgery and in whom ABD is contraindicated.


Abstract: The purpose of this study was to evaluate the blood levels of patients preparing for total knee arthroplasty (TKA) who were enrolled in a preoperative autologous donation program. The charts and hospital records of 70 consecutive patients who underwent primary unilateral TKA between 2000 and 2002 were retrospectively reviewed. Study participants were instructed to donate one unit of blood
approximately 4 weeks prior to surgery. Predonation and preoperative hemoglobin levels were assessed throughout the study and transfusion requirements were recorded. Transfusions were administered only when warranted by clinical symptoms. The mean initial (predonation) hemoglobin concentration was 14.1 g/dL. The mean number of days donations were made prior to surgery was 13 +/- 3.3 days. Prior to surgery, the average hemoglobin concentration dropped to 12.8 g/dL. Fifty (71%) patients had a hemoglobin value > 13.0 g/dL prior to their autologous donation, but only 30 (43%) patients had blood levels > or = 13.0 g/dL following blood donation. Postoperatively, the mean hemoglobin concentration in the recovery room was 11.6 g/dL and dropped to a nadir of 10.8 g/dL on postoperative day 3. Overall, 91% of patients required autologous blood transfusion following TKA but no patients required allogeneic blood transfusions. Preoperative autologous donation was associated with a decrease in preoperative hemoglobin levels and with a high rate of autologous transfusion based on clinical symptoms of postoperative anemia.


Abstract: A randomized, prospective study of the use of allogeneic blood was performed in a consecutive series of patients who underwent primary total knee arthroplasty (TKA) and had autologous transfusion either from one unit of predonated autologous blood or from postoperative unwashed blood salvage. In this study, 83 patients (88 knees) were included, with 47 knees in the salvage group and 41 in the predonation group. There were no differences between groups in average age, height, and weight, or gender, diagnoses, or anesthesia type. No significant difference was seen between the groups in the prevalence of allogeneic blood transfusion (5% for the predonation group and 0% for salvage group). Postoperative blood salvage was as effective as predonated autologous blood in preventing the risk associated with allogeneic blood after TKA.


Abstract: Many researchers have reported lower hemoglobin concentrations in blacks than in whites, but the reason for this difference is unknown. Data for 2515 persons (in 3-12 y and 18-45 y age groups) from the Second National Health and Nutrition Examination Survey (NHANES II) were evaluated to investigate the roles of iron intake and biochemical iron status indicators in explaining black and white differences in hemoglobin concentration. Dietary iron intake was estimated from one 24-h food recall, and hemoglobin, serum ferritin, transferrin saturation and erythrocyte protoporphyrin were measured by standard laboratory methods. Hemoglobin levels were substantially lower in black children (120.3 g/L) than in white children (126.8 g/L). Hemoglobin concentrations were also lower in black women (128.4 g/L) than in white women (133.9 g/L), and in black men (144.8 g/L) than in white men (153.2 g/L). Blacks had lower hemoglobin concentration than whites at most levels of dietary iron intake, serum ferritin, transferrin saturation and erythrocyte protoporphyrin. Despite their lower hemoglobin levels, blacks had higher serum ferritin levels than whites. These results suggest that the difference in hemoglobin concentrations between blacks and whites in the United States is the result of factors other than iron intake and iron status. More specific investigations of both the genetic and environmental determinants of iron utilization in blacks are needed.


Abstract: The diagnosis of anemia is an important aspect of the practice of hematology. The first step is to decide whether the patient is, in fact, anemic. Unless earlier blood counts are available, and they often are not, the physician must make his or her decision on the basis of the population distribution of hemoglobin values. How likely is it that the patient's hemoglobin value lies below the normal distribution; that is, "the lower limit"?


Abstract: Background Anemia is viewed as a negative prognostic factor in the elderly population; its independent impact on survival is unclear. Methods Baseline hemoglobin quintiles and anemia, as defined by the World Health Organization criteria, were assessed in relation to mortality in the Cardiovascular Health Study, a prospective cohort study with 11.2 years of follow-up of 5888 community-dwelling men and women 65 years or older, enrolled in 1989-1990 or 1992-1993 in 4 US communities. Results A total of 1205 participants were in the lowest hemoglobin quintile (<13.7 g/dL for men; <12.6 g/dL for women), and 498 (8.5%) were anemic (<13 g/dL for men; <12 g/dL for women). A reverse J-shaped relationship with mortality was observed; age-, sex-, and race-adjusted hazard ratios (95% confidence interval [CI]) in the first and fifth quintiles, compared with the fourth quintile, were 1.42 (95% CI, 1.25-1.62) and 1.24 (95% CI, 1.09-1.42). After multivariate adjustment, these hazard ratios were 1.33 (95% CI, 1.15-1.54) and 1.17 (95% CI, 1.01-1.36). The demographic-and fully-adjusted hazard ratios of anemia for mortality were 1.57 (95% CI, 1.38-1.78) and 1.38 (95% CI, 1.19-1.54). Adjustment for causes and consequences of anemia (renal function, inflammation, or frailty) did not reduce associations. Conclusions Lower and higher hemoglobin concentrations and anemia by World Health Organization criteria were independently associated with increased mortality. The World Health Organization criteria did not identify risk as well as a lower hemoglobin value. Additional study is needed on the clinically valid definition for and causes of anemia in the elderly and on the increased mortality at the extremes of hemoglobin concentrations.


Abstract: BACKGROUND: Ageing populations will impact on healthcare provision, especially since extra years are not necessarily spent in good health. It is important to identify and understand the significance of common medical problems in older people. Anaemia may be one such problem. We report on the prevalence of anaemia in cohorts of elderly people in the general population. The presence of
Abstract: Anemia is associated with a worse prognosis for both morbidity and mortality. METHODS: Electronic searching and reference lists of published reports were used to identify studies that reported on prevalence of anemia in cohorts of at least 100 individuals predominantly aged 65 years and over living in developed countries, together with criteria used to define anemia. Studies of anemia prevalence in specific disease groups or published before 1980 were excluded. Prevalence data for the entire cohort, for men and women separately and for different age bands were extracted. RESULTS: Forty-five studies contributed data. Thirty-four studies (n = 85,409) used WHO criteria to define anemia. The weighted mean prevalence was 17% (3-50%) overall, and 12% (3-25%) in studies based in the community (27, n = 69,975), 47% (31-50%) in nursing homes (3, n = 1481), and 40% (40-72%) in hospital admissions (4, n = 13,953). Anemia prevalence increased with age, was slightly higher in men than women, and was higher in black people than white. Most individuals classified as anemic using WHO criteria were only mildly anemic. CONCLUSION: Anemia, as defined by WHO criteria, is common in older people living in the community and particularly common in nursing home residents and hospital admissions. Predicted demographic changes underline the need to understand more about anemia in older people.


Abstract: AIMS: The prevalence, incidence, and prognostic value of anemia in patients with an acute myocardial infarction (AMI) complicated by heart failure is unclear. METHODS AND RESULTS: We analysed the relationship between haemoglobin (Hb) and outcome in 5010 patients with AMI complicated by heart failure in the OPTIMAAL study. In 3921 patients, follow-up Hb levels were available at 365 (+/-90) days. In a subgroup of 224 patients, iron-related haematinsics were assessed at baseline and during follow-up. At baseline, mean Hb was 12.6 +/- 1.3 g/dL in women and 13.7 +/- 1.4 g/dL in men. Hb < 11.5 g/dL was found in 9.3% of patients (women: 18.2%, men: 5.8%). Lower haemoglobin at baseline was clearly associated with female gender and the presence of diabetes, higher age and Killip class, lower body mass index, systolic blood pressure, total cholesterol, and the absence of current smoking (all P < 0.05). Higher Hb [per one standard deviation (SD)] related to lower mortality [adjusted hazard ratios (HR) 0.88; 95% confidence interval (CI) 0.83-0.93], CHF hospitalizations [HR 0.85 (0.77-0.93)], and all-cause hospitalizations [HR 0.96 (0.92-0.99), all P < 0.05]. In patients without anemia at baseline, the anemia incidence after 1 year of follow-up was 10.1% in women and 10.0% in men. Of patients with anemia at baseline, 65% did not have anemia at 12 months and 46% did not have anemia at any time during follow-up (median 3.0 years, inter-quartile range, Q1-Q3 = 2.7-3.3 years). At 12 months, an increase in Hb (per SD) was related to lower mortality [HR 0.73 (0.63-0.85; P < 0.0001)] independent of baseline Hb and other clinical characteristics. CONCLUSION: In patients with complicated AMIs, anemia on admission and/or reductions in haemoglobin during follow-up are independent risk factors for mortality and hospitalization. Studies are warranted to determine whether correcting anemia after a complicated AMI improves outcome.


Abstract: Anemia is more common in patients with diabetes than without diabetes, and the problem is magnified in patients with renal impairment. Diabetic patients with anemia may be at increased risk of adverse outcomes from diabetic retinopathy, nephropathy, neuropathy, and cardiovascular disease. The etiology of anemia in diabetes is multifactorial and includes inflammation, nutritional deficiencies, concomitant autoimmune diseases, drugs, and hormonal changes in addition to kidney disease. Anemia that is associated with erythropoietin deficiency may have prognostic significance for persons with nephropathy or heart failure. In early diabetic nephropathy, damage to the peritubular fibroblasts can occur and lead to erythropoietin deficiency and anemia prior to the loss of filtration.
Correction of the anemia not only leads to less fatigue, greater exercise tolerance, and an improved quality of life but also to a reduction in mortality and hospital admissions for congestive heart failure (CHF). Data are accumulating that suggest that treatment of anemia will slow the progression of microvascular and macrovascular complications, including postural hypotension from autonomic neuropathy, retinopathy, and loss of renal function from diabetic nephropathy. Promptly diagnosing and treating anemia in patients with diabetes may result in an improved quality of life and decreased morbidity and mortality


Abstract: OBJECTIVES: To find the prevalence of anemia in patients hospitalized with the primary diagnosis of congestive heart failure (CHF). BACKGROUND: There is growing evidence that anemia is common in CHF and may contribute to the high morbidity and mortality associated with this condition. However, there is considerable disagreement about the prevalence of anemia in this condition. METHODS: In 338 consecutive patients who were admitted to the medical wards with a primary diagnosis of CHF we extracted from the charts the hemoglobin (Hb), serum creatinine, age, sex, New York Heart Association (NYHA) functional class, presence of smoking, diabetes, hypertension, hyperlipidemia and the primary cardiac etiology of the CHF. Anemia was considered to be present when the Hb on admission was <12 g/dl. RESULTS: All the patients were NYHA functional class III-IV. One hundred seventy seven (52.4%) of the 338 patients had a Hb on admission that was <12 g/dl. The mean Hb for the entire group was 12.0+/-1.8 g/dl. One hundred three (51.0%) of the 202 males were anemic compared to 74 (54.4%) of the 136 women. The mean serum creatinine was 1.7+/-1.1 mg/dl. The prevalence of renal insufficiency (serum creatinine >1.5 mg%) was 47.6%. There was a negative correlation between the level of serum creatinine and Hb (r=-0.294) P<0.00001. Of the 177 patients who were anemic, most of 114 (64.4%) had a serum creatinine >1.5 mg/dl. CONCLUSIONS: Anemia is a common finding in patients hospitalized with CHF and most anemic CHF patients have some degree of renal insufficiency. In view of the negative effect of anemia on cardiac function, it may be a common and important contributor to the mortality and morbidity of CHF in these patients


Abstract: Anemia is a common comorbidity in patients with heart failure and is associated with worse long-term outcomes. Although the cause of anemia in heart failure is unclear, the weight of evidence suggests that renal dysfunction, along with neurohormonal and proinflammatory cytokine activation in heart failure, favors the development of anemia of chronic disease, with defective iron utilization, inappropriate erythropoietin production, and depressed bone marrow function. Similarly, the mechanisms by which anemia worsens heart failure outcomes are unknown but may be related to increased myocardial workload. If anemia is a mediator and not just a marker of poor outcomes, correcting anemia could become an important and novel therapeutic target to improve long-term outcomes in such patients. Indeed, several small-sized studies have shown the beneficial effects of empirically treating anemia in heart failure patients with recombinant erythropoietin and intravenous iron. However, the ideal threshold at which therapy should be initiated and the extent of correction considered safe and desirable in the individual patient with heart failure need to be known. These issues become more important because of increasing safety concerns that recombinant erythropoietin therapy for treating anemia may be associated with adverse cardiovascular outcomes in patients with chronic kidney disease and may worsen cancer in patients receiving chemotherapy to treat various types of cancer. Therefore, further prospectively designed studies are required to address some of these questions. Fortunately, 2 large mortality morbidity trials, TREAT (Trial to Reduce Cardiovascular Events with Aranesp Therapy) in patients with chronic kidney disease and RED-HF (Reduction of Events with Darbepoetin alfa in Heart Failure) in heart failure patients, are in progress and are likely to provide definitive answers


Abstract: Background-- Anemia is often observed in patients with chronic heart failure (CHF), but its implications for patient outcomes are not well understood. The goal of this study was to investigate the relationship between anemia, severity of CHF, and clinical outcomes. Methods and Results--
Hemoglobin concentration (Hb) was measured in 912 subjects with CHF enrolled in the Randomized Etanercept North American Strategy to Study Antagonism of Cytokines (RENAISSANCE) trial. In a subgroup of 69 subjects, cardiac MRI was performed at randomization and 24 weeks later. Anemia (Hb ≤ 12.0 g/dL) was present in 12% of subjects. Cox regression analysis indicated that for every 1-g/dL-higher baseline Hb, the risk of mortality was 15.8% lower (P=0.0009) and the risk of mortality or hospitalization for heart failure was 14.2% lower (P<0.0001). Greater CHF severity was associated with significantly lower Hb concentrations. An increase in Hb over time was associated with a decrease in left ventricular mass and lower mortality, whereas a decrease in Hb over time was associated with an increase in left ventricular mass and higher mortality. In multivariate analysis, anemia remained a significant, independent predictor of death or hospitalization for heart failure, with both outcomes being significantly higher in all NYHA classes. Conclusions—Anemia is frequently present in patients with CHF. Lower Hb is associated with greater disease severity, a greater left ventricular mass index, and higher hospitalization and mortality rates.


Abstract: BACKGROUND: Anemia is an important determinant of heart failure and death after ST elevation myocardial infarction (STEMI). The frequency of anemia and its impact on these outcomes across the range of acute coronary syndromes (ACS), however, have not been defined. METHODS: This is a cohort study of 2310 patients with ACS stratified by quartiles of admission hemoglobin concentration (Hb): Q1, <12.5 g/dL; Q2, 12.5-13.6 g/dL; Q3, 13.7-14.7 g/dL; Q4, >14.7 g/dL. RESULTS: There were 29.7% of women and 23.2% of men who were anemic. Rates of STEMI increased across [Hb] quartile groups from 25.0% (Q1) to 35.5% (Q4) as rates of unstable angina decreased from 52.0% (Q1) to 40.7% (Q4) (P < .0005). Despite this, rates of left ventricular failure (LVF) were inversely related to [Hb] in all diagnostic groups, patients with unstable angina (Q1, 14.2%; Q4, 4.4%; P < .0005) showing a similar trend to patients with non-STEMI (Q1, 26.8%; Q4, 10.4%; P < .0005) and STEMI (Q1, 33.8%; Q4, 20.6%; P < .0005). The age-adjusted odds of LVF in Q4 compared with Q1 were 0.64 (95% confidence interval, 0.45-0.90). Inhospital cardiac mortality was 3.0% and was not influenced by [Hb]. CONCLUSIONS: Anemia is a common comorbidity in patients presenting with ACS, and it is a powerful independent determinant of LVF. The association with LVF occurs not only in STEMI but also in less severe diagnostic groups.


Abstract: BACKGROUND: Anemia is common in cancer patients, although the prevalence is influenced both by the type of malignancy and the choice of treatment. Individual studies have compared the survival of patients with and without anemia and have shown reduced survival times in patients with various malignancies, including carcinoma of the lung, cervix, head and neck, prostate, lymphoma, and multiple myeloma. The objective of this study was to systematically review, to summarize, and to obtain an overall estimate of the effect of anemia on survival in patients with malignant disease. METHODS: A comprehensive literature review was carried out using the MEDLINE data base and reviewing the reference lists from published studies. Two hundred papers were identified. Of these, 60 papers that reported the survival of cancer patients according to either hemoglobin levels or the presence of anemia were included. Among these papers, 25% related to patients with lung carcinoma, 17% related to patients with head and neck carcinoma, 12% related to patients with multiple myeloma, 10% related to patients with prostate carcinoma, 8% related to patients with cervicouterine carcinoma, 7% related to patients with leukemia, 5% related to patients with lymphoma, and 16% related to patients with other types of malignancies. RESULTS: The relative risk of death increased by 19% (95% confidence interval, 10-29%) in anemic patients with lung carcinoma, by 75% (37-123%) in anemic patients with head and neck carcinoma, by 47% (21-78%) in anemic patients with prostate carcinoma, and by 67% (30-113%) in anemic patients with lymphoma. The overall estimate increase in risk was 65% (54-77%). CONCLUSIONS: Anemia is associated with shorter survival times for patients with lung carcinoma, cervicouterine carcinoma, head and neck carcinoma, prostate carcinoma, lymphoma, and multiple myeloma.

Abstract: OBJECTIVE: To identify associations among haemoglobin (Hb) concentrations, blood transfusions, and clinical outcomes in patients after cardiac surgery, especially in those who undergo valve replacement or bypass surgery. DESIGN: Prospective observational trial. SETTING: Surgical intensive care unit in a tertiary-level university hospital. PATIENTS: 1216 Consecutive patients. MEASUREMENTS: Haemoglobin at admission and 6, 12, 24, and 48 h later, and then, every 24 h while patients remained in the intensive care unit (ICU); number of transfusions and clinical events. RESULTS: Patients were divided into quartiles according to minimal haemoglobin, the first and second of which (Hb <8.10 and <8.91 g/dL, respectively) differed significantly (P < 0.001) from the other two quartiles in terms of more organ failure, longer ICU stay, and higher mortality. We found associations between being transfused >or=4 packed red cells (PRCs) and a worse clinical outcome and higher mortality. The associated mortality rate was higher for patients who underwent bypass surgery when they had Hb <or=8.9 g/dL and for those who underwent valve replacement when they had Hb >8.9 g/dL and were transfused >or=4 PRCs. CONCLUSIONS: Low haemoglobin concentrations and transfusions in patients undergoing cardiac surgery are associated with increased morbidity and mortality. Also, anaemia and transfusions are associated with poor outcome. Therefore, intra- and postoperative bleeding seem to be a risk factor in patients undergoing cardiac surgery.


Abstract: OBJECTIVES: This study sought to determine the characteristics and long-term prognosis of anemia in ambulatory patients with chronic heart failure. BACKGROUND: Anemia is prevalent in heart failure, and may portend poor outcomes. METHODS: We reviewed 6,159 consecutive outpatients with chronic stable heart failure at baseline, short-term (3-month) follow-up, and long-term (6-month) follow-up between 2001 and 2006. Clinical, demographic, laboratory, and echocardiographic data were reviewed from electronic medical records. Mortality rates were determined from 6-month follow-up to end of study period. RESULTS: Prevalence of anemia (hemoglobin [Hb] <12 g/dl for men, <11 g/dl for women) was 17.2% in our cohort. Diabetes, B-natriuretic peptide, left ventricular ejection fraction, and estimated glomerular filtration rate were independent predictors of baseline anemia. Documented evaluation of anemia was found in only 3% of all anemic patients, and better in internal medicine than in cardiology clinics. At 6-month follow-up, new-onset anemia developed in 16% of patients without prior anemia, whereas 43% patients with anemia at baseline had resolution of their hemoglobin levels. Higher total mortality rates were evident in patients with persistent anemia (58% vs. 31%, p < 0.0001) or with incident anemia (45% vs. 31%, p < 0.0001) compared with those with without anemia at 6 months. CONCLUSIONS: These observations in a broad unselected outpatient cohort suggest that anemia in patients with heart failure is under-recognized and underevaluated. However, resolution of anemia was evident in up to 43% of patients who presented initially with anemia, and did not pose greater long-term risk for all-cause mortality. However, the presence of persistent anemia conferred poorest survival in patients with heart failure when compared with that of incident, resolved, or no anemia.


Abstract: Background: Despite decreasing cardiac events, perioperative [beta]-blockade also increases perioperative stroke and mortality. Major bleeding and/or hypotension are independently associated with these outcomes. To investigate the hypothesis that [beta]-blockade limits the cardiac reserve to compensate for acute surgical anemia, the authors examined the relationship between cardiac events and acute surgical anemia in patients with and without [beta]-blockade. Methods: The records of all noncardiac, nontransplant surgical patients between March 2005 and June 2006 were retrospectively retrieved. The primary outcome was a composite that comprised myocardial infarction, nonfatal cardiac arrest, and in-hospital mortality (major adverse cardiac event). The lowest recorded hemoglobin in the first 3 days defined nadir hemoglobin. Propensity scores estimating the probability of receiving a perioperative [beta]-blocker were used to match (1:1) patients who did or did not receive [beta]-blockers postoperatively. The relationship between nadir hemoglobin and major
adverse cardiac event was then assessed. Results: This analysis identified 4,387 patients in whom nadir hemoglobin could be calculated; 1,153 (26%) patients were administered [beta]-blockers within the first 24 h of surgery. Propensity scores created 827 matched pairs that were well balanced for all measured confounders. Major adverse cardiac event occurred in 54 (6.5%) [beta]-blocked patients and in 25 (3.0%) [beta]-blocker naive patients (relative risk 2.38; 95% CI 1.43-3.96; P = 0.0009). The restricted cubic spline relationship demonstrated that this difference was restricted to those patients in whom the hemoglobin decrease exceeded 35% of the baseline value. Conclusions: [beta]-Blocked patients do not seem to tolerate surgical anemia when compared with patients who are naive to [beta]-blockers. Prospective studies are required to validate these findings. (C) 2010 American Society of Anesthesiologists, Inc


Abstract: OBJECTIVES: Recent authoritative studies suggested that low preoperative hemoglobin concentration may affect cardiac surgery outcomes. This study aimed, primarily, to investigate whether preoperative anemia is an independent determinant of adverse events after coronary artery bypass grafting and, secondarily, to evaluate the potential dose responsiveness between anemia severity and primary end points. METHODS: This single-center prospective study investigated 1214 consecutive patients undergoing coronary artery bypass grafting between January 2004 and June 2007, collecting 100 variables per patient. In 1047 patients (median age 64 years, 18.8% female, 38.9% diabetic, 31.9% urgent/emergency, 15.3% with low preoperative left ventricular ejection fraction) who underwent on-pump procedures and received no preoperative transfusion, the prevalence of preoperative anemia (according to World Health Organization definition) and its unadjusted and adjusted relationships with in-hospital death, cardiac morbidity, and acute kidney injury (AKI-RIFLE [Risk, Injury, Failure, Loss, End-stage kidney disease] criteria) were obtained. RESULTS: The prevalence of preoperative anemia was 28%. In-hospital death averaged 3.9%, cardiac morbidity 7.3%, and acute kidney injury 4%. Unadjusted odds ratios (Ors) for in-hospital death, cardiac morbidity, and acute kidney injury were 3.8 (95% confidence interval [CI] 2.0-7.3), 1.7 (95% CI 1.1-2.8), and 4.0 (95% CI 2.1-7.6), respectively. Adjusting for anemia in confounders proved an independent predictor of acute kidney injury (OR 2.06; 95% CI 1.14-3.70), whereas the cardiac morbidity and in-hospital mortality were independently predicted by kidney function. No dose-response relationship emerged between anemia severity and acute kidney injury. CONCLUSIONS: Preoperative anemia is independently associated with acute kidney injury after coronary artery bypass grafting. Further studies are warranted to determine whether preoperative low hemoglobin concentration is a marker of severity of illness or a modifiable risk factor


Abstract: BACKGROUND: The anemia associated with perioperative blood conservation has raised concerns regarding the safety of these strategies in patients with ischemic cardiovascular disease. Therefore the relationship between hematocrit level and myocardial ischemic episodes in a group of elderly patients undergoing elective noncardiac surgery was studied. STUDY DESIGN AND METHODS: One hundred ninety patients undergoing radical prostatectomy were randomly assigned to one of three blood conservation groups: preoperative autologous blood donation, acute normovolemic hemodilution, and preoperative erythropoietin therapy with acute normovolemic hemodilution. Patients underwent ambulatory electrophysiography monitoring to evaluate for myocardial ischemia at randomization (baseline), 7 days preoperatively, throughout surgery, and for 24 hours after surgery. RESULTS: Myocardial ischemic episodes occurred in 61 (34%) of 181 eligible patients. Patients with hematocrit levels < 28 percent immediately after surgery were significantly (p = 0.05) more likely to have intraoperative and postoperative ECG ischemic episodes. Intraoperative ischemia and tachycardia correlated (r = 0.21, p = 0.008) with hematocrit levels. Hematocrit levels after surgery were associated with postoperative ischemia (r = 0.14, p = 0.03) and duration of myocardial ischemic episodes (r = 0.14, p = 0.04). After adjusting for other risk factors, intraoperative tachycardia episodes, hematocrit level < 28 percent immediately after surgery, and risk factors for coronary artery disease were independently associated with the likelihood of intraoperative ischemia (r = 0.36, p = 0.002, area under receiver operating characteristic curve = 0.73). Similarly, tachycardia episodes and hematocrit levels < 28 percent immediately after surgery were independently associated with ischemic episodes during the first postoperative day (r = 0.30, p = 0.004, area under receiver operating characteristic
Abstract: OBJECTIVE: To determine if postoperative anemia is a frequent finding, particularly in the elderly population, and usually indicative of a serious disease. The main causes of preoperative anemia are acute or chronic hemorrhage, iron deficiency, renal insufficiency, inflammatory and neoplastic diseases. A preexisting mild anemia may be enhanced or unmasked by surgically induced bleeding or repeated diagnostic phlebotomies, and by a postoperative erythropoietic dysfunction caused by the surgical trauma, irrespective of any hemorrhage. Low hemoglobin values are associated with a distinct increase of mortality and morbidity, both in the normal population and perioperatively and in the critically ill patients. The anemia-associated risk is exacerbated by preexisting cardiovascular disease, important intraoperative blood loss and advanced age. In contradiction to established therapeutical concepts, the administration of allogenic blood beyond hemoglobin levels of 8-10 g/dl has not been found to decrease perioperative or intensive care morbidity or mortality. Rather, in addition to the inherent long-term risks of transfusions, a liberal transfusion strategy seems to increase the incidence of postoperative complications. Thus, current transfusion guidelines tend to be interpreted in an increasingly restrictive manner. Depending on the urgency of the clinical situation, the primary goal should be to diagnose and treat the underlying disease, rather than to focus on the symptom anemia. Time permitting, the patient's cardiovascular and pulmonary status should be optimized preoperatively. Furthermore, iron should be substituted to treat and prevent deficiency. Recombinant human erythropoietin has successfully been used to treat anemia of chronic renal failure and chronic disease, as well as in the perioperative and intensive care setting, and to support the efficiency of autologous programs.

Abstract: BACKGROUND: The relationship between degree of hemodilution during cardiopulmonary bypass (CPB) and perioperative stroke has not been fully elucidated. The objective of this observational study was to evaluate the relationship between nadir hematocrit during CPB and perioperative stroke while adjusting for variables known to have an association with stroke and anemia. METHODS: Perioperative data were prospectively collected on 10,949 consecutive patients who underwent cardiac surgery with CPB from 1999 to 2004 at a quaternary care hospital. Stroke was defined as a persistent neurologic deficit, consistent with a central nervous system lesion, occurring within 30 days of operation. Stroke was classified as perioperative if patients awoke from anesthesia with neurologic symptoms and postoperative if patients awoke without symptoms. Multivariable logistic regression analysis was used to control for confounding variables to obtain the independent relationship between nadir hematocrit during CPB and perioperative stroke. RESULTS: The prevalence of perioperative stroke was 1.0% (n = 110). An additional 50 patients had postoperative stroke. Nadir hematocrit during CPB was an independent predictor of perioperative stroke. After controlling for confounding variables, each percent decrease in hematocrit was associated with a 10% increase in the odds of suffering perioperative stroke (95% confidence interval, 4% to 18%; p = 0.002). The model was accurate (c-index = 0.85) and reliable (Hosmer-Lemeshow test p = 0.4). CONCLUSIONS: There is an independent, direct association between degree of hemodilution during CPB and risk of perioperative stroke. Prospective randomized clinical trials comparing different degrees of hemodilution during CPB are required to determine whether this is a cause-effect relationship or a simple association.

Abstract: Anemia is a frequent finding, particularly in the elderly population, and usually indicative of a serious disease. The main causes of preoperative anemia are acute or chronic hemorrhage, iron deficiency, renal insufficiency, inflammatory and neoplastic diseases. A preexisting mild anemia may be enhanced or unmasked by surgically induced bleeding or repeated diagnostic phlebotomies, and by a postoperative erythropoietic dysfunction caused by the surgical trauma, irrespective of any hemorrhage. Low hemoglobin values are associated with a distinct increase of mortality and morbidity, both in the normal population and perioperatively and in the critically ill patients. The anemia-associated risk is exacerbated by preexisting cardiovascular disease, important intraoperative blood loss and advanced age. In contradiction to established therapeutical concepts, the administration of allogenic blood beyond hemoglobin levels of 8-10 g/dl has not been found to decrease perioperative or intensive care morbidity or mortality. Rather, in addition to the inherent long-term risks of transfusions, a liberal transfusion strategy seems to increase the incidence of postoperative complications. Thus, current transfusion guidelines tend to be interpreted in an increasingly restrictive manner. Depending on the urgency of the clinical situation, the primary goal should be to diagnose and treat the underlying disease, rather than to focus on the symptom anemia. Time permitting, the patient’s cardiovascular and pulmonary status should be optimized preoperatively. Furthermore, iron should be substituted to treat and prevent deficiency. Recombinant human erythropoietin has successfully been used to treat anemia of chronic renal failure and chronic disease, as well as in the perioperative and intensive care setting, and to support the efficiency of autologous programs.

Abstract: OBJECTIVE: To determine if postoperative anemia is associated with postoperative myocardial ischemia and morbidity in high-risk vascular patients in the intensive care unit. Crit Care Med 1993 Jun;21(6):860-6. METHODS: To determine if postoperative anemia is associated with postoperative myocardial ischemia and morbidity in high-risk vascular patients in the intensive care unit. PATIENTS: A total of 27 high-risk patients undergoing infra-inguinal arterial bypass procedures. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: After informed consent, patients were continuously monitored by ambulatory electrocardiographic recorders from the evening before surgery up to 80 hrs during the postoperative period. Myocardial ischemia and shock were determined by obstructive ECG changes and/or a positive delta aortic pressure response to a dobutamine challenge. Postoperative anemia was defined as an hemoglobin less than 10 g/dl. The mean operating time was 130 ± 20 min, the number of bypasses, 1 ± 0.5, the mean aortic cross clamp time, 48 ± 22 min, and the mean total blood loss, 749 ± 242 ml. The mean postoperative hemoglobin was 10.2 ± 1.5 g/dl. There was no statistically significant difference in the incidence of ischemia and shock in patients with or without postoperative anemia. The study was designed to have 80% power to detect a 10% difference in the incidence of ischemia and shock between patients with and without postoperative anemia. CONCLUSIONS: Perioperative anemia was not associated with an increased incidence of ischemia or shock in high-risk vascular patients in the intensive care unit.
ischemia was defined as > or = 1 mm of horizontal or downsloping ST depression or > or = 2 mm ST segment elevation persisting for at least 60 secs on the ambulatory electrocardiogram. Morbid cardiac events were defined as: cardiac death, myocardial infarction, unstable angina, and ischemic pulmonary edema. Using a receiver operating characteristic curve, a hematocrit of 28% was determined to be the best threshold hematocrit value below which morbid cardiac events were most likely to occur. Statistical significance between hematocrit and cardiac outcome was determined by Fisher’s exact test where appropriate. Thirteen of 27 patients had a hematocrit < 28%. Of these 13 patients, ten demonstrated postoperative myocardial ischemia and six sustained a morbid cardiac event. Of 14 patients with a hematocrit > or = 28%, two displayed myocardial ischemia and none sustained a morbid cardiac event. A hematocrit of < 28% was significantly associated with myocardial ischemia (p = .001) and morbid cardiac events (p = .0058). No significant differences in baseline heart rate and heart rate at the onset of myocardial ischemia were noted between the anemic and nonanemic patients. CONCLUSIONS: This study suggests that postoperative anemia may play a role in postoperative myocardial ischemia and cardiac morbidity.
late mortality. Compared with the general population, anemic patients had worse survival than expected, whereas nonanemic patients had better survival than expected.


Abstract: Context Elderly patients are at high risk of both abnormal hematocrit values and cardiovascular complications of noncardiac surgery. Despite nearly universal screening of patients for abnormal preoperative hematocrit levels, limited evidence demonstrates the adverse effects of preoperative anemia or polycythemia. Objective To evaluate the prevalence of preoperative anemia and polycythemia and their effects on 30-day postoperative outcomes in elderly veterans undergoing major noncardiac surgery. Design Retrospective cohort study using the VA National Surgical Quality Improvement Program database. Based on preoperative hematocrit levels, we stratified patients into standard categories of anemia (hematocrit <39.0%), normal hematocrit (39.0%-53.9%), and polycythemia (hematocrit [≥]54%). We then estimated increases in 30-day postoperative cardiac event and mortality risks in relation to each hematocrit point deviation from the normal category. Setting and Patients A total of 310 311 veterans aged 65 years or older who underwent major noncardiac surgery between 1997 and 2004 in 132 Veterans’ Affairs medical centers across the United States. Main Outcome Measures The primary outcome measure was 30-day postoperative mortality; a secondary outcome measure was composite 30-day postoperative mortality or cardiac events (cardiac arrest or Q-wave myocardial infarction). Results Thirty-day mortality and cardiac event rates increased monotonically, with either positive or negative deviations from normal hematocrit levels. We found a 1.6% (95% confidence interval, 1.1%-2.2%) increase in 30-day postoperative mortality associated with every percentage-point increase or decrease in the hematocrit value from the normal range. Additional analyses suggest that the adjusted risk of 30-day postoperative mortality and cardiac morbidity begins to rise when hematocrit levels decrease to less than 39% or exceed 51%. Conclusions Even mild degrees of preoperative anemia or polycythemia were associated with an increased risk of 30-day postoperative mortality and cardiac events in older, mostly male veterans undergoing major noncardiac surgery. Future studies should determine whether these findings are reproducible in other populations and if preoperative management of anemia or polycythemia decreases the risk of postoperative mortality.


Abstract: null


Abstract: BACKGROUND AND OBJECTIVES: From 1954 to 1987, flour in Denmark was fortified with 30 mg carbonyl iron per kg. This mandatory fortification was abolished in 1987. The aim of this study was to compare iron status in Danish men before and after abolition of iron fortification. METHODS: Iron status (serum ferritin, haemoglobin), was assessed in population surveys in Copenhagen County during 1983-84 comprising 1324 Caucasian men (1024 non-blood-donors, 300 blood donors) and in 1993-94 comprising 1288 Caucasian men (1103 non-blood-donors, 185 donors), equally distributed in age cohorts of 40, 50, 60 and 70 yr. RESULTS: In the 1984 survey median serum ferritin values in the four age cohorts in non-blood-donors were 136, 141, 133 and 111 microg/L, and in the 1994 survey 177, 173, 186 and 148 microg L(-1), respectively. The difference was significant in all age groups (P<0.001). There was no significant difference between the two surveys concerning the prevalence of small iron stores (ferritin 16-32 micro g L(-1)), depleted iron stores (ferritin <16 micro g L(-1)) or iron-deficiency anaemia (ferritin <13 micro g L(-1) and Hb <5th percentile for iron-replete men). However, from 1984 to 1994, the prevalence of iron overload (ferritin >300 micro g L(-1)) increased from 11.3% to 18.9% (P<0.0001). During the study period there was an increase in body mass index (P<0.0001), alcohol consumption (P<0.03) and use of non-steroid anti-inflammatory drugs (NSAID) (P<0.0001), and a decrease in the use of vitamin-mineral supplements (P<0.04) and in the prevalence of tobacco smoking (P<0.0001). In contrast, median ferritin in blood donors showed a significant fall from 1984 to
Abstract: In Denmark, the intake of dietary iron has decreased since 1987, when the mandatory iron fortification of flour (30 mg carbonyl iron/kg) was stopped. Since there have been no studies of iron status in elderly Danes after the abolishment of iron fortification, there is a need to assess actual iron status in the elderly population. The objective was to evaluate iron status and the relationship with food composition and dietary and supplemental iron intake in an elderly population in Copenhagen County. Participants in this health examination survey were 358 subjects (171 men, 187 women) 80 years of age from a 1914 cohort study. Blood samples included serum ferritin and hemoglobin (Hb). A dietary survey was performed in 232 subjects (120 men, 112 women) using a dietary history method. Median serum ferritin was 100 microg/l in men and 78 microg/l in women (p<0.001). Ferritin concentrations <16 microg/l (i.e., depleted iron stores) were found in three men (2%) and in ten women (5%). Median Hb was 140 g/l in men and 131 g/l in women (p<0.001). Three subjects (0.84%) had iron deficiency anemia (i.e., ferritin <13 microg/l and Hb <5th percentile for iron-replete subjects (121 g/l in men, 114 g/l in women)). Ferritin concentrations >300 microg/l (i.e., iron overload) were found in 15 (9%) men and in 5 (3%) women. Median dietary iron intake was higher in men (8.7 mg/day) than in women (7.3 mg/day) (p<0.001). Serum ferritin was positively correlated to dietary intake of iron, meat, and alcohol and to body mass index in men. Serum ferritin displayed a negative correlation to the consumption of tea. The use of vitamin-mineral supplements containing iron had no influence on iron status. Dietary intake of iron and/or the bioavailability of dietary iron were adequate to maintain a favorable iron status in 80-year-old subjects displaying a low prevalence of iron deficiency and a moderate prevalence of iron overload.

CONCLUSION: Abolition of iron fortification reduced the iron content of the Danish diet by an average of 0.24 mg MJ(-1), and the median dietary iron intake in men from 17 to 12 mg d(-1). From 1984 to 1994, body iron stores and the prevalence of iron overload in Danish men increased significantly, despite the abolition of food iron fortification. The reason appears to be changes in dietary habits, with a lower consumption of dairy products and eggs, which inhibit iron absorption, and a higher consumption of alcohol, meat, and poultry, containing haem iron and enhancing iron absorption. The high prevalence of iron overload in men may constitute a health risk for the population.


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Abstract: Background: Iron deficiency is the most prevalent micronutrient deficiency disease in the world and occurs in young women in the United States. Female military personnel represent a unique population faced with intense physical and cognitive demands. Objective: The objective of this study was to determine the prevalence of iron deficiency and iron deficiency anemia among three populations of female military personnel in the US Army. Methods: Iron status was assessed in 1216 volunteers. Volunteers were recruited from three groups: immediately following initial entry to the Army (IET), immediately following basic combat training (AIT), or following at least six months of permanent assignment (PP). Iron deficiency was determined using a three variable model, including cut-off values for serum ferritin, transferrin saturation, and red cell distribution width (RDW). Iron deficiency anemia was categorized by iron deficiency and a hemoglobin (Hgb) value of <12 g/dL. Results: The prevalence of iron deficiency was greater in women in the AIT group (32.8%) than in the IET and PP groups (13.4 and 9.6%, respectively). The prevalence of iron deficiency anemia was greater in the AIT group (20.9%) than in the IET and PP groups (5.8 and 4.8%, respectively). Furthermore, the prevalence of iron deficiency anemia was greater in Hispanic (21.9%) and African-American military personnel (22.9%) than in Caucasian military personnel (10.5%). Conclusions: These data indicate that female military personnel experience diminished iron status following training, and that iron nutriure is an important issue facing females in the military.
Abstract: Background and Objectives The impact of a poor iron status on the difficulties to keep recruitment of new donors at pace with the ongoing increased demand for blood transfusions was studied by comparing the iron status of new donors recruited in 1993-1997 and in 2005-2006. Materials and Methods Iron status was defined by haemoglobin and serum ferritin. Inclusion criteria for approving new donors were haemoglobin ≥12.5 g/dl for women and ≥13.5 g/dl for men, and serum ferritin >15 microg/l for both genders. Data were gathered retrospectively from 943 subjects (55% women) in the 1990 ties and prospectively from 1013 subjects (63% women) 10 years later. Results In women, there was a significant fall in haemoglobin and serum ferritin mean values from 13.2 to 13.1 g/dl and from 30.9 to 26.9 microg/l, respectively. Conclusion Iron status of women who want to serve as blood donors has deteriorated in the last 10 years, leading to an increased rejection due to haemoglobin below the inclusion criterion for blood donors.


Abstract: OBJECTIVES: The study was undertaken to assess the hematologic, clinical, and biochemical response to intravenous iron in patients with chronic heart failure (CHF) and anemia. BACKGROUND: Anemia is common in patients with CHF and is associated with higher morbidity and mortality. The combination of erythropoietin (EPO) and iron increases hemoglobin (Hb) and improves symptoms and exercise capacity in anemic CHF patients. It is not known whether intravenous iron alone is an effective treatment for anemia associated with CHF. METHODS: Sixteen anemic patients (Hb < or =12 g/dl) with stable CHF (age 68.3 +/- 11.5 years, 12 men, 9 participants New York Heart Association [NYHA] functional class II and the remainder class III, left ventricular ejection fraction 26 +/- 13%) received a maximum of 1 g of iron sucrose by bolus intravenous injections over a 12-day treatment phase in an outpatient setting. Mean follow-up was 92 +/- 6 days. RESULTS: Hemoglobin rose from 11.2 +/- 0.7 to 12.6 +/- 1.2 g/dl (p = 0.0007), Minnesota Living with Heart Failure (MLHF) score fell (denoting improvement) from 33 +/- 19 to 19 +/- 14 (p = 0.02), 6-min walk distance increased from 242 +/- 78 m to 286 +/- 72 m (p = 0.01), and all patients recorded NYHA class II at study end (p < 0.02). Changes in MLHF score and 6-min walk distance related closely to changes in Hb (r = 0.76, p = 0.002; r = 0.56, p = 0.03, respectively). Of all baseline measurements, only iron and transferrin saturation correlated with increases in Hb (r = 0.60, p = 0.02; r = 0.60, p = 0.01, respectively). There were no adverse events relating to drug administration or during follow-up. CONCLUSIONS: Intravenous iron sucrose, when used without concomitant EPO, is a simple and safe therapy that increases Hb, reduces symptoms, and improves exercise capacity in anemic patients with CHF. Further assessment of its efficacy should be made in a multicenter, randomized, placebo-controlled trial.


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Abstract: OBJECTIVES: Our objective was to evaluate in a double-blind, randomized, placebo-controlled study possible modifications in NT-pro-brain natriuretic peptide (NT-proBNP) and C-reactive protein (CRP) levels together with clinical and functional parameters, in a group of anemic patients with chronic heart failure (CHF) and chronic renal failure (CRF) receiving intravenous iron therapy, without recombinant human erythropoietin (rhEPO), versus placebo. BACKGROUND: Chronic heart failure and CRF associated with absolute or relative iron deficiency anemia is a common problem. This situation is linked with a variable inflammatory status. Both NT-proBNP and CRP are recognized markers for left ventricular dysfunction and inflammatory status, respectively. In this double-blind, randomized, placebo-controlled study, modifications in NT-proBNP and CRP level and clinical and functional parameters, in anemic patients with CHF and CRF receiving intravenous iron therapy, without rhEPO, versus placebo were evaluated. METHODS: Forty patients with hemoglobin (Hb) <12.5 g/dl, transferrin saturation <20%, ferritin <100 ng/ml, creatinine clearance (CrCl) <90 ml/min, and left ventricular...
ejection fraction (LVEF) < or =35% were randomized into 2 groups (n = 20 for each). For 5 weeks, group A received isotonic saline solution and group B received iron sucrose complex, 200 mg weekly. Minnesota Living with Heart Failure Questionnaire (MLHFQ) and 6-min walk (6MW) test were performed. NT-pro brain natriuretic peptide and CRP were evaluated throughout the study. No patients received erythropoietin any time. RESULTS: After 6 months follow-up, group B showed better hematology values and CrCl (p < 0.01) and lower NT-proBNP (117.5 +/- 87.4 pg/ml vs. 450.9 +/- 248.8 pg/ml, p < 0.01) and CRP (2.3 +/- 0.8 mg/l vs. 6.5 +/- 3.7 mg/l, p < 0.01). There was a correlation initially (p < 0.01) between Hb and NT-proBNP (group A: r = -0.94 and group B: r = -0.81) and after 6 months only in group A: r = -0.80. Similar correlations were observed with Hb and CRP. Left ventricular ejection fraction percentage (35.7 +/- 4.7 vs. 28.8 +/- 2.4), MLHFQ score, and 6MW test were all improved in group B (p < 0.01). Additionally, group B had fewer hospitalizations: 0 of 20 versus group A, 5 of 20 (p < 0.01; relative risk = 2.33). CONCLUSIONS: Intravenous iron therapy without rhEPO substantially reduced NT-proBNP and inflammatory status in anemic patients with CHF and moderate CRF. This situation was associated with an improvement in LVEF, NYHA functional class, exercise capacity, renal function, and better quality of life.


Abstract: BACKGROUND: Iron deficiency may impair aerobic performance. This study aimed to determine whether treatment with intravenous iron (ferric carboxymaltose) would improve symptoms in patients who had heart failure, reduced left ventricular ejection fraction, and iron deficiency, either with or without anemia. METHODS: We enrolled 459 patients with chronic heart failure of New York Heart Association (NYHA) functional class II or III, a left ventricular ejection fraction of 40% or less (for patients with NYHA class II) or 45% or less (for NYHA class III), iron deficiency (ferritin level <100 microg per liter or between 100 and 299 microg per liter, if the transferrin saturation was <20%), and a hemoglobin level of 95 to 135 g per liter. Patients were randomly assigned, in a 2:1 ratio, to receive 200 mg of intravenous iron (ferric carboxymaltose) or saline (placebo). The primary end points were the self-reported Patient Global Assessment and NYHA functional class, both at week 24. Secondary end points included the distance walked in 6 minutes and the health-related quality of life. RESULTS: Among the patients receiving ferric carboxymaltose, 50% reported being much or moderately improved, as compared with 28% of patients receiving placebo, according to the Patient Global Assessment (odds ratio for improvement, 2.51; 95% confidence interval [CI], 1.75 to 3.61). Among the patients assigned to ferric carboxymaltose, 47% had an NYHA functional class I or II at week 24, as compared with 30% of patients assigned to placebo (odds ratio for improvement by one class, 2.40; 95% CI, 1.55 to 3.71). Results were similar in patients with anemia and those without anemia. Significant improvements were seen with ferric carboxymaltose in the distance on the 6-minute walk test and quality-of-life assessments. The rates of death, adverse events, and serious adverse events were similar in the two study groups. CONCLUSIONS: Treatment with intravenous ferric carboxymaltose in patients with chronic heart failure and iron deficiency, with or without anemia, improves symptoms, functional capacity, and quality of life; the side-effect profile is acceptable. (ClinicalTrials.gov number, NCT00520780)


Abstract: In a double-blind placebo-controlled study we investigated the effect of recombinant human erythropoietin (r-HuEPO), on the perioperative hemoglobin concentration and the use of blood transfusions in patients undergoing elective colorectal surgery with a preoperative hemoglobin level <8.5 mmol/L. Altogether 100 were included, and 81 patients could be evaluated. A total of 38 patients received r-HuEPO in a dose of 300 IU/kg body weight on day 4 before surgery and 150 IU/kg daily for the following 7 days; 43 patients received placebo. In addition, all patients received daily doses of 200 mg iron orally for 4 days before surgery. There were no differences between the two groups with regard to sex, height, weight, serum electrolytes, and liver function tests at study entry. The preentry hemoglobin concentration was similar in the two groups, with a median value of 7.9 (range 5.3-8.5) mmol/L in the erythropoietin group and 7.6 (5.1-8.5) mmol/L in the placebo group. On
the day of surgery the median hemoglobin concentration was 7.8 (5.3-9.2) mmol/L in the erythropoietin group and 7.2 (4.6-8.5) mmol/L in the placebo group (p < 0.05). On postoperative days 3 and 7 the values were 7.2 (5.3-8.2) and 7.5 (5.4-9.4) mmol/L, respectively, in the erythropoietin group compared to 6.7 (5.2-7.8) and 6.9 (5.1-8.6) mmol/L in the placebo group (p < 0.01). At discharge the hemoglobin concentration was 7.8 (5.9-8.8) mmol/L in the erythropoietin group and 7.2 (5.4-8.6) mmol/L in the placebo group (p < 0.002). The blood loss during operation was similar in the two groups. In the erythropoietin group the median value was 280 ml (range 25-2000 ml), with the lower and upper quartiles 150 and 500 ml, respectively. In the placebo group the blood loss was median 300 ml (range 50-1800 ml), with the lower and upper quartiles 200 and 750 ml, respectively. The number of blood transfusions given was significantly lower in the erythropoietin group, with a mean of 0.3 (range 0-6) units compared to 1.6 (0-9) units in the control group (p < 0.05). In conclusion, the hemoglobin concentration at the time of surgery and during the week following surgery was significantly higher in the group of patients receiving r-HuEPO perioperatively compared to the placebo group together with a significant lower use of blood transfusions in the r-HuEPO group. However, the clinical implications of these findings has yet to be proven.


Abstract: BACKGROUND: The optimum regimen of epoetin alfa for prevention of allogeneic blood transfusion is unknown. OBJECTIVE: To determine whether a modified regimen of epoetin alfa reduces allogeneic blood transfusion in patients undergoing hip arthroplasty. DESIGN: Randomized, double-blind, multicenter trial comparing two modified dose regimens of epoetin alfa with placebo. SETTING: 13 teaching hospitals and 4 community hospitals in Canada. PATIENTS: 201 patients undergoing primary hip arthroplasty who had a hemoglobin concentration of 98 to 137 g/L and did not predonate blood. INTERVENTION: Patients were assigned in a 3:5:5 ratio to receive four weekly doses of epoetin alfa, 40 000 U (high-dose; n = 44) or 20 000 U (low-dose; n = 79), or placebo (n = 78), starting 4 weeks before surgery. All patients received oral iron supplementation, 450 mg/d, for 42 or more days before surgery. MEASUREMENTS: The primary end point was allogeneic transfusion. Secondary end points were thromboembolic events and change in reticulocyte count and hemoglobin concentration. RESULTS: Both modified epoetin alfa regimens significantly reduced the need for allogeneic transfusion: Five (11.4%) patients in the high-dose group (P = 0.001) and 18 (22.8%) patients in the low-dose group (P = 0.003) had transfusion, compared with 35 (44.9%) patients in the placebo group. The hematologic response was substantial in patients who received epoetin alfa. In the high-dose group, low-dose group, and placebo group, the preoperative increase in reticulocyte count was 58.8, 37.0 and 1.8 x 10(9) cells/L (P < 0.001), respectively, and the increase in hemoglobin concentration was 19.5, 17.2, and 1.2 g/L (P < 0.001). The incidence of thromboembolic events did not differ among groups. CONCLUSIONS: Both modified epoetin alfa regimens were effective compared with placebo in reducing allogeneic transfusion in patients undergoing hip arthroplasty. Patients who received high-dose epoetin alfa had the lowest transfusion rate.


Abstract: Background--Patients with chronic heart failure (CHF) are frequently anemic. An increase in hemoglobin could enhance exercise performance by increasing oxygen delivery. We investigated the effect of erythropoietin (EPO) on exercise performance in anemic patients with CHF. Methods and Results--Twenty-six anemic patients aged 57+/-11 years were randomized to receive EPO (15 000 to 30 000 IU per week) or placebo for 3 months. Parameters measured at baseline and end therapy included blood parameters (hemoglobin, hematocrit, plasma volume), exercise parameters (peak oxygen consumption [(image)O2], exercise duration, 6-minute walk), muscle aerobic metabolism (half-time of (image)O2 and near infrared recovery), and forearm vasodilatory function. EPO was well tolerated by all patients. Twelve patients in the EPO group felt improvement versus 1 in the placebo group (P<0.05). There were significant increases in hemoglobin (11.0+/-0.5 to 14.3+/-1.0 g/dL, P<0.05), peak (image)O2 (11.0+/-1.8 to 12.7+/-2.8 mL [middle dot] min{middle dot}1 [middle dot] kg{middle dot}1, P<0.05)
and exercise duration (590{+/-}107 vs 657{+/-}119 s, P<0.004) in the EPO group but no significant changes in the control group. Resting and hyperemic forearm vascular resistance and indices of the rate of muscle oxidative capacity were unchanged in both groups. Conclusion—EPO significantly enhances exercise capacity in patients with CHF. One mechanism of improvement in [image]O2 is increased oxygen delivery from increased hemoglobin concentration


Abstract: Background: Erythropoiesis-stimulating agents are used to treat anemia in patients with cancer. However, their safety and effectiveness is controversial. We did a systematic review of the clinical efficacy and harms of these agents in adults with anemia related to cancer or chemotherapy.

Methods: We conducted a systematic review of published and unpublished randomized controlled trials (RCTs) using accepted methods for literature search, article selection, data extraction and quality assessment. We included RCTs involving anemic adults with cancer. We compared the use of erythropoiesis-stimulating agents with nonuse and assessed clinical outcomes (all-cause mortality, cardiovascular events and hypertension, health-related quality of life, blood transfusions and tumor response) and harms (serious adverse events) between groups. Results: We identified 52 trials (n = 12 006) that met our selection criteria. The pooled all-cause mortality during treatment was significantly higher in the group receiving erythropoiesis-stimulating therapy than in the control group (relative risk [RR] 1.15, 95% confidence interval [CI] 1.03 to 1.29). Compared with no treatment, use of erythropoiesis-stimulating agents led to clinically detectable improvements in disease-specific measures of quality of life. It also reduced the use of blood transfusions (RR 0.64, 95% CI 0.56 to 0.73). However, it led to an increased risk of thrombotic events (RR 1.69, 95% CI 1.27 to 2.24) and serious adverse events (RR 1.16, 95% CI 1.08 to 1.25). Interpretation: Use of erythropoiesis-stimulating agents in patients with cancer-related anemia improved some disease-specific measures of quality of life and decreased the use of blood transfusions. However, it increased the risk of death and serious adverse events. Our findings suggest that such therapy not be used routinely as an alternative to blood transfusion in patients with anemia related to cancer


Abstract: Anaemia is a frequent comorbidity in patients with chronic heart failure (CHF) and is associated with worse outcomes. It is logical to consider whether correcting anaemia is a novel therapeutic target in such patients. We performed a meta-analysis to explore whether treatment of anaemia with erythropoietin-stimulating agents (ESA) can improve symptoms and progression in patients with CHF.

Studies were identified in English-language articles by searching PUBMED (inception to May 2009). A standardized protocol with predefined criteria was used to extract details on study design, Jadad score, demographic data, interventions, and outcomes. The main outcome measures were cardiac function, exercise capacity, quality of life, and all-cause mortality. Seven randomized controlled trials involving 678 patients were identified and included in the analysis. Cardiac function as well as exercise capacity were improved post-treatment in the ESA group; however, the overall deaths analysis demonstrated a lower trend but no significant protective effect in the ESA treatment group (RR, 0.71; 95% confidence interval, 0.41{ΓÇô}0.71; = 0.23). This meta-analysis suggests a symptomatic improvement in anaemic patients with CHF receiving ESA. However, a non-significant reduction in all-cause mortality in the ESA treatment group compared with the control group was observed


Abstract: BACKGROUND: Anemia, which is common in the critically ill, is often treated with red-cell transfusions, which are associated with poor clinical outcomes. We hypothesized that therapy with recombinant human erythropoietin (epoetin alfa) might reduce the need for red-cell transfusions.

METHODS: In this prospective, randomized, placebo-controlled trial, we enrolled 1460 medical, surgical, or trauma patients between 48 and 96 hours after admission to the intensive care unit. Epoetin alfa (40,000 U) or placebo was administered weekly, for a maximum of 3 weeks; patients were followed for 140 days. The primary end point was the percentage of patients who received a red-cell transfusion. Secondary end points were the number of red-cell units transfused, mortality, and the change in hemoglobin concentration from baseline.

RESULTS: As compared with the use of placebo,
Abstract: BACKGROUND: The introduction of recombinant human erythropoietin for the treatment of anemia of chronic renal failure provided the opportunity to correct anemia in this patient population. The optimal target hemoglobin for patients with end-stage renal disease (ESRD) remains controversial. A large database of hemodialysis patients was analyzed to determine whether increasing hemoglobin level above the current Kidney Dialysis Outcomes Quality Initiative (K/DOQI) recommendations was associated with increased risk of mortality and hospitalization. METHODS: A longitudinal study of hemodialysis patients in Fresenius Medical Care-North America facilities was performed. Selection was restricted to patients in the census for 6 consecutive months from July 1, 1998 through June 30, 2000. Patient mean hemoglobin and other covariates measured during the initial 6 months were related to survival, number of hospitalizations, and length of stay over the subsequent 6 months of follow-up. RESULTS: Patients with hemoglobin <9 g/dL had an adjusted relative risk of death of 2.11 compared to...
those patients with 11 ≤ hemoglobin < 12 g/dL (P < 0.0001). The adjusted relative risk of death was 0.84 for 12 ≤ hemoglobin < 13 g/dL (P = 0.007). These data suggest there is no increased risk of mortality associated with hemoglobin above the current recommended values. Both number of hospitalizations and length of stay decreased as hematocrit increased. Patients with hemoglobin >13 g/dL had an adjusted length of stay of 9.6 days compared to 10.9 days for those with 11 ≤ hemoglobin < 12 g/dL (P < 0.0001). CONCLUSION: These data indicate the relative risk of death and hospitalization are inversely associated with hemoglobin levels, with no apparent additional risk associated with hemoglobin levels> 12 g/dL.


Abstract: Recombinant erythropoietin, first approved for Medicare reimbursement in June 1989, was prescribed at initial doses for dialysis patients of 2,500 to 2,700 U per administration independent of hematocrit level. By 1997, however, patients with hematocrits less than 30% were administered 6,000 U/dose, compared with 4,500 U administered to patients with hematocrits of 33% to 36%. Since 1990, the percentage of patients with hematocrits less than 30% decreased from 60% to 22% in 1997, whereas the percentage of patients with hematocrits of 33% to 36% increased from 10% to 30%. In 1997, Medicare initiated the Hematocrit Measurement Audit (HMA) policy, which was directed at reducing the percentage of claims for hematocrits greater than 36% and increasing the stability of the hematocrit levels. The policy change achieved the initial effect but resulted in a reduction of the mean hematocrit as well. The policy was changed in 1998 in response to patient and provider concerns. Mortality studies show that hematocrits less than 30% (or hemoglobin levels < 110 g/L) are associated with an 18% to 40% increased associated risk for death. Higher hematocrits of 33% to 36% appear to be associated with a 7% reduced risk for death. The risk for hospitalization parallels that of mortality. Patients with sustained hematocrits of 33% to 36% over 1 year appear to have the best outcome compared with patients with hematocrits that decrease. The latter are at greater risk than those patients in whom the hematocrits increase. In conclusion, dramatic improvements in hemodialysis patient hematocrits have occurred since 1989. Mortality and hospitalization studies support the National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF DOQI) target hematocrit range of 33% to 36% as providing the best associated outcomes.


Abstract: BACKGROUND: In patients with end-stage renal disease, anemia develops as a result of erythropoietin deficiency, and recombinant human erythropoietin (epoetin) is prescribed to correct the anemia partially. We examined the risks and benefits of normalizing the hematocrit in patients with cardiac disease who were undergoing hemodialysis. METHODS: We studied 1233 patients with clinical evidence of congestive heart failure or ischemic heart disease who were undergoing hemodialysis: 618 patients were assigned to receive increasing doses of epoetin to achieve and maintain a hematocrit of 42 percent, and 615 were assigned to receive doses of epoetin sufficient to maintain a hematocrit of 30 percent throughout the study. The median duration of treatment was 14 months. The primary end point was the length of time to death or a first nonfatal myocardial infarction. RESULTS: After 29 months, there were 183 deaths and 19 first nonfatal myocardial infarctions among the patients in the normal-hematocrit group and 150 deaths and 14 nonfatal myocardial infarctions among those in the low-hematocrit group (risk ratio for the normal-hematocrit group as compared with the low-hematocrit group, 1.3; 95 percent confidence interval, 0.9 to 1.9). Although the difference in event-free survival between the two groups did not reach the prespecified statistical stopping boundary, the study was halted. The causes of death in the two groups were similar. The mortality rates decreased with increasing hematocrit values in both groups. The patients in the normal-hematocrit group had a decline in the adequacy of dialysis and received intravenous iron dextran more often than those in the low-hematocrit group. CONCLUSIONS: In patients with clinically evident congestive heart failure or ischemic heart disease who are receiving hemodialysis, administration of epoetin to raise their hematocrit to 42 percent is not recommended.

Abstract: BACKGROUND: Anaemia is associated with poor cancer control, particularly in patients undergoing radiotherapy. We investigated whether anaemia correction with epoetin beta could improve outcome of curative radiotherapy among patients with head and neck cancer. METHODS: We did a multicentre, double-blind, randomised, placebo-controlled trial in 351 patients (haemoglobin <120 g/L in women or <130 g/L in men) with carcinoma of the oral cavity, oropharynx, hypopharynx, or larynx. Patients received curative radiotherapy at 60 Gy for completely (R0) and histologically incomplete (R1) resected disease, or 70 Gy for macroscopically incompletely resected (R2) advanced disease (T3, T4, or nodal involvement) or for primary definitive treatment. All patients were assigned to subcutaneous placebo (n=171) or epoetin beta 300 IU/kg (n=180) three times weekly, from 10-14 days before and continuing throughout radiotherapy. The primary endpoint was locoregional progression-free survival. We assessed also time to locoregional progression and survival. Analysis was by intention to treat. FINDINGS: 148 (82%) patients given epoetin beta achieved haemoglobin concentrations higher than 140 g/L (women) or 150 g/L (men) compared with 26 (15%) given placebo. However, locoregional progression-free survival was poorer with epoetin beta than with placebo (adjusted relative risk 1.62 [95% CI 1.22-2.14]; p=0.0008). For locoregional progression the relative risk was 1.69 (1.16-2.47, p=0.007) and for survival it was 1.39 (1.05-1.84, p=0.02). INTERPRETATION: Epoetin beta corrects anaemia but does not improve cancer control or survival. Disease control might even be impaired. Patients receiving curative cancer treatment and given erythropoietin should be studied in carefully controlled trials.


Abstract: PURPOSE: To evaluate the effect on survival and quality of life of maintaining hemoglobin (Hb) in the range of 12 to 14 g/dL with epoetin alfa versus placebo in women with metastatic breast cancer (MBC) receiving first-line chemotherapy. PATIENTS AND METHODS: Eligible patients were randomly assigned to receive epoetin alfa 40,000 U once weekly or placebo for 12 months. Study drug was initiated if baseline Hb was < or = 13 g/dL or when Hb decreased to < or = 13g/dL during the study. The primary end point was 12-month overall survival (OS). RESULTS: The study drug administration was stopped early in accordance with a recommendation from the Independent Data Monitoring Committee because of higher mortality in the group treated with epoetin alfa. Enrollment had been completed,
with 939 patients enrolled (epoetin alfa, n = 469; placebo, n = 470). Most patients had Hb more than 12 g/dL at baseline (median Hb, 12.8 g/dL) or during the study. From the final analysis, 12-month OS was 70% for epoetin alfa recipients and 76% for placebo recipients (P = .01). Optimal tumor response and time to disease progression were similar between groups. The reason for the difference in mortality between groups could not be determined from additional subsequent analyses involving both study data and chart review. CONCLUSION: In this trial, the use of epoetin alfa to maintain high Hb targets in women with MBC, most of whom did not have anemia at the start of treatment, was associated with decreased survival. Additional research is required to clarify the potential impact of erythropoietic agents on survival when the Hb target range is 10 to 12 g/dL


Abstract: PURPOSE: Previous trials have suggested a quality-of-life (QOL) improvement for anemic cancer patients treated with erythropoietin, but few used QOL as the primary outcome. We designed a trial to investigate the effects of epoetin alfa therapy on the QOL of anemic patients with advanced non-small-cell carcinoma of the lung (NSCLC). PATIENTS AND METHODS: A multicenter, randomized, double-blind, placebo-controlled trial was conducted. The proposed sample size was 300 patients. Eligible patients were required to have NSCLC unsuitable for curative therapy and baseline hemoglobin (Hgb) levels less than 121 g/L. Patients were assigned to 12 weekly injections of subcutaneous epoetin alpha or placebo, targeting Hgb levels between 120 and 140 g/L. The primary outcome was the difference in the change in Functional Assessment of Cancer Therapy-Anemia scores between baseline and 12 weeks. RESULTS: Reports of thrombotic events in other epoetin trials prompted an unplanned safety analysis after 70 patients had been randomly assigned (33 to the active arm and 37 to the placebo arm). This revealed a significant difference in the median survival in favor of the patients on the placebo arm of the trial (63 v 129 days; hazard ratio, 1.84; P = .04). The Steering Committee closed the trial. Patient numbers compromised the interpretation of the QOL analysis, but a positive Hgb response was noted with epoetin alfa treatment. CONCLUSION: An unplanned safety analysis suggested decreased overall survival in patients with advanced NSCLC treated with epoetin alfa. Although infrequent, other similar reports highlight the need for ongoing trials evaluating erythropoietin receptor agonists to ensure that overall survival is monitored closely.


Abstract: AIMs: To study the prevalence and long-term prognostic significance of changes in haemoglobin levels during hospital course in survivors of acute myocardial infarction (AMI). METHODS AND RESULTS: A prospective study involving 1390 patients who were admitted with AMI. Median follow-up was 24 months. Multivariable Cox models were used to evaluate the relationship between nadir and discharge haemoglobin and mortality after hospital discharge. Anaemia was present in 248 patients on admission (17.8%) and in 502 patients at discharge (36.1%). Nadir haemoglobin during hospital course was 1.3 g/dL lower (IQR 0.6-2.2) when compared with baseline haemoglobin (P < 0.0001). Low nadir haemoglobin and discharge haemoglobin were strongly associated with increased mortality. After adjusting for clinical variables and ejection fraction, the hazard ratios for a 1 g/dL decrease in nadir haemoglobin and discharge haemoglobin were 1.36 (95% CI 1.19-1.55; P < 0.0001) and 1.27 (95% CI 1.16-1.40; P < 0.0001), respectively. CONCLUSION: The development of anaemia during hospitalization for AMI is frequent and is associated with an increased long-term mortality.


Abstract: BACKGROUND: Using algorithms based on point of care coagulation tests can decrease blood loss and blood component transfusion after cardiac surgery. We wished to test the hypothesis that a management algorithm based on near-patient tests would reduce blood loss and blood component use after routine coronary artery surgery with cardiopulmonary bypass when compared with an algorithm based on routine laboratory assays or with clinical judgement. METHODS: Patients (n=102) undergoing elective coronary artery surgery with cardiac bypass were randomized into two groups. In the point of care group, the management algorithm was based on information provided by three devices, the Hepcon, thromboelastography and the PFA-100 platelet function analyser. Management in the laboratory test group depended on rapidly available laboratory clotting tests and transfusion of haemostatic blood components only if specific criteria were met. Blood loss and transfusion was compared between these two groups and with a retrospective case-control group (n=108), in which management of bleeding had been according to the clinician's discretion. RESULTS: All three groups had similar median blood losses. The transfusion of packed red blood cells (PRBCs) and blood components was greater in the clinician discretion group (P<0.05) but there was no difference in the transfusion of PRBCs and blood components between the two algorithm-guided groups. CONCLUSION: Following algorithms based on point of care tests or on structured clinical practice with standard laboratory tests does not decrease blood loss, but reduces the transfusion of PRBCs and blood components after routine cardiac surgery, when compared with clinician discretion. Cardiac surgery services should use transfusion guidelines based on laboratory-guided algorithms, and the possible benefits of point of care testing should be tested against this standard.


Abstract: INTRODUCTION: Anemia among the critically ill has been described in patients with short to medium length of stay (LOS) in the intensive care unit (ICU), but it has not been described in long-stay ICU patients. This study was performed to characterize anemia, transfusion, and phlebotomy practices in patients with prolonged ICU LOS. METHODS: We conducted a retrospective chart review of consecutive patients admitted to a medical-surgical ICU in a tertiary care university hospital over three years; patients included had a continuous LOS in the ICU of 30 days or longer. Information on transfusion, phlebotomy, and outcomes were collected daily from days 22 to 112 of the ICU stay. RESULTS: A total of 155 patients were enrolled. The mean age, admission Acute Physiology and Chronic Health Evaluation II score, and median ICU LOS were 62.3 +/- 16.3 years, 23 +/- 8, and 49 days (interquartile range 36-70 days), respectively. Mean hemoglobin remained stable at 9.4 +/- 1.4 g/dl from day 7 onward. Mean daily phlebotomy volume was 13.3 +/- 7.3 ml, and 62% of patients received a mean of 3.4 +/- 3.5 units of packed red blood cells at a mean hemoglobin trigger of 7.7 +/- 0.9 g/dl after day 21. Transfused patients had significantly greater acuity of illness, phlebotomy volumes, ICU LOS and mortality, and had a lower hemoglobin than did those who were not transfused. Multivariable logistic regression analysis identified the following as independently associated with the likelihood of requiring transfusion in nonbleeding patients: baseline hemoglobin, daily phlebotomy volume, ICU LOS, and erythropoietin therapy (used almost exclusively in dialysis dependent renal failure in this cohort of patients). Small increases in average phlebotomy (3.5 ml/day; 95% confidence interval 2.4-6.8 ml/day) were associated with a doubling in the odds of being transfused after day 21. CONCLUSION: Anemia, phlebotomy, and transfusions, despite low hemoglobin triggers, are common in ICU patients long after admission. Small decreases in phlebotomy volume are associated with significantly reduced transfusion requirements in patients with prolonged ICU LOS.


Abstract: Sixty very low birth weight infants (birth weight 560-1450 g) were studied during the first 28 days of life. The infants were classified as group A (n = 19 infants who never required ventilator support), group B (n = 20 infants mechanically ventilated for minor respiratory problems), and group C (n = 21 infants ventilated for respiratory distress syndrome). Diagnostic blood sampling was measured, infants were checked for clinical symptoms and laboratory signs of anaemia 24 h before and after the transfusion of packed red cells. A total of 7998 punctures (average: 4.8 per infant per day) were performed, the mean blood loss due to diagnostic sampling was 50.3 ml/kg per 28 days (range 7-142)
for all infants. A high correlation (rs = +0.91) was found between the blood volumes sampled and transfused. In group A, the mean blood loss was 24 ml/kg, and a total of 29 blood transfusions were administered. The most frequent symptoms of anaemia were poor weight gain and apnoeic spells. In group B, the mean blood loss was 60 ml/kg and a total of 97 blood transfusions were administered. In group C, the mean blood loss was 67 ml/kg and a total of 116 blood transfusions were administered. In both groups B and C, poor weight gain, pallor and distended abdomen were the most frequent symptoms of anaemia. Following the blood transfusion, haematocrit rose and blood pressure remained unchanged. The symptoms that responded most favourably to the blood transfusion were: poor weight gain, oxygen requirement, and distended abdomen. The results emphasize the need for miniaturizing laboratory techniques and monitoring blood sampling.


Abstract: In a prospective investigation, 99 very preterm infants (gestational age (GA) 24-32 weeks, birthweight 560-2,255 g) were studied during the first 4 weeks of life. The infants were divided into two groups: infants born extremely early (GA <28 weeks, n = 20) and infants of GA 28-32 weeks; the groups were then subdivided into critically ill or not. Diagnostic blood sampling and blood transfusion events were recorded. In total, 1905 blood samples (5,253 analysis) were performed, corresponding to 0.7 samples (1.9 analysis) per day per infant. The highest frequencies were found during the first week, in infants with extremely low GA and in critically ill infants. The mean blood loss and transfusion volume values were 13.6 ml/kg and 6.3 ml/kg, respectively. In total, 19 infants (19%) received 34 transfusions corresponding to 0.3 transfusions per infant. Thirteen out of 20 infants of extremely low GA received 28 blood transfusions, corresponding to 27.0 ml/kg of blood on average during the study period. Four developed late anaemia; thus, in total, 14 (70%) of the infants born extremely early received 35 transfusions during the first 3 months of life, corresponding to a total mean of 34.8 ml/kg. For the extremely preterm infants a significant correlation between sampled and transfused blood volume was found (mean 37.1 and 33.3 ml/kg, respectively, r = +0.71, p = 0.0003). The most frequently requested analyses were glucose, sodium and potassium. Few blood gas analyses were requested (1.9/infant). No blood losses attributable to excessive generous sampling were detected. The results show an acceptable low frequency of sampling and transfusion events for infants of GA 28-32 weeks. The study emphasizes the necessity of thorough reflection and monitoring of blood losses when ordering blood sampling in extremely preterm, critically ill infants.


Abstract: BACKGROUND: Preterm infants typically experience heavy phlebotomy losses from frequent laboratory testing in the first few weeks of life. This results in anemia, requiring red blood cell (RBC) transfusions. We recently introduced a bedside point-of-care (POC) blood gas analyzer (iSTAT, Princeton, NJ) that requires a smaller volume of blood to replace conventional Radiometer blood gas and electrolyte analysis used by our neonatal intensive care unit (NICU). The smaller volume of blood required for sampling (100 vs 300-500 microl), provided an opportunity to assess if a decrease in phlebotomy loss occurred and, if so, to determine if this resulted in decreased transfusions administered to extremely low birth weight (ELBW) infants. OBJECTIVE: We hypothesized that the use of the POC iSTAT analyzer that measures pH, PCO(2), PO(2), hemoglobin, hematocrit, serum sodium, serum potassium and ionized calcium would result in a significant decrease in the number and volume of RBC transfusions in the first 2 weeks of life. DESIGN/METHODS: A retrospective chart review was conducted of all inborn premature infants with birth weights less than 1000 g admitted to the NICU that survived for 2 weeks of age during two separate 1-year periods. Blood gas analysis was performed by conventional laboratory methods during the first period (designated Pre-POC testing) and by the iSTAT POC device during the second period (designated post-POC testing). Data collected for individual infants included the number of RBC transfusions, volume of RBCs transfused, and the number and kind of blood testing done. There was no effort to change either the RBC transfusion criteria applied or blood testing practices. RESULTS: The mean (+/-SD) number of RBC transfusions administered in the first 2 weeks after birth was 5.7 +/- 3.74 (n=46) in the pre-POC testing period to 3.1 +/- 2.07 (n=34) in the
Abstract: PURPOSE: Most cases of endoscopic sinus surgery are amenable to techniques using local anesthesia with monitored sedation. However, it is frequently the preference of the patient to have surgery under general anesthesia. One major drawback of general anesthesia is the increased bleeding encountered which can interfere with optimal visualization of the intranasal anatomy. In this study, an analysis was made to see if technique of general anesthesia has an impact on estimated blood loss in patients undergoing endoscopic sinus surgery. METHODS: Twenty-five patients undergoing outpatient endoscopic sinus surgery under general anesthesia over a 1-year period were reviewed retrospectively to determine if anesthetic technique had an impact on estimated blood loss. Twelve patients were


Abstract: BACKGROUND: A recent meta-analysis showed that compared with general anesthesia (GA), neuraxial block reduced many serious complications in patients undergoing various types of surgeries. It is not known whether this finding from studying heterogeneous patient groups is applicable to a particular surgical patient population. We performed the present meta-analysis to determine whether anesthesia choice affected the outcome after elective total hip replacement (THR). METHODS: Medline (1966 to August 2005), MD Consult (1966 to August 2005), BIOSIS (1969 to August 2005), and EMBASE (1969 to August 2005) databases were searched. Randomized and quasi randomized studies comparing GA and neuraxial (spinal or epidural) block for elective THR were included in this analysis.

RESULTS: Ten independent trials, involving 330 patients under GA and 348 patients under neuraxial block, were identified and analyzed. Pooled results from five trials showed that neuraxial block significantly decreased the incidence of radiographically diagnosed deep venous thrombosis or pulmonary embolism. The odds ratio (OR) for deep venous thrombosis was 0.27 with 95% confidence interval (CI) 0.17-0.42. The OR for pulmonary embolism was 0.26 with 95% CI 0.12-0.56. Neuraxial block also decreased the operative time by 7.1 min/case (95% CI 2.3-11.9 min) and intraoperative blood loss by 275 mL/case (95% CI 180-371 mL). Data from three trials showed that patients under neuraxial block for THR were less likely to require blood transfusion than were patients under GA (21/177 = 12% vs 62/188 = 33% of patients transfused, P < 0.001 by z-test). The OR for this comparison was 0.26. However, the CIs were wide and compatible with both no effect and a nine-tenths reduction (95% CI 0.06-1.05). CONCLUSIONS: Patients undergoing elective THR under neuraxial anesthesia seem to have better outcomes than those under GA


Abstract: We performed a meta-analysis to evaluate the relative efficacy of regional and general anaesthesia in patients undergoing total hip or knee replacement. A comprehensive search for relevant studies was performed in PubMed (1966 to April 2008), EMBASE (1969 to April 2008) and the Cochrane Library. Only randomised studies comparing regional and general anaesthesia for total hip or knee replacement were included. We identified 21 independent, randomised clinical trials. A random-effects model was used to calculate all effect sizes. Pooled results from these trials showed that regional anaesthesia reduces the operating time (odds ratio (OR) -0.19; 95% confidence interval (CI) -0.33 to -0.05), the need for transfusion (OR 0.45; 95% CI 0.22 to 0.94) and the incidence of thromboembolic disease (deep-vein thrombosis OR 0.45, 95% CI 0.24 to 0.84; pulmonary embolism OR 0.46, 95% CI 0.29 to 0.80). Regional anaesthesia therefore seems to improve the outcome of patients undergoing total hip or knee replacement


Abstract: PURPOSE: Most cases of endoscopic sinus surgery are amenable to techniques using local anesthesia with monitored sedation. However, it is frequently the preference of the patient to have surgery under general anesthesia. One major drawback of general anesthesia is the increased bleeding encountered which can interfere with optimal visualization of the intranasal anatomy. In this study, an analysis was made to see if technique of general anesthesia has an impact on estimated blood loss in patients undergoing endoscopic sinus surgery. METHODS: Twenty-five patients undergoing outpatient endoscopic sinus surgery under general anesthesia over a 1-year period were reviewed retrospectively to determine if anesthetic technique had an impact on estimated blood loss. Twelve patients were
identified who received a continuous intravenous infusion of the nonbarbiturate hypnotic agent propofol as the primary anesthetic agent, and 13 patients were identified who received anesthesia based on inhalational isoflurane. RESULTS: There was no difference between the duration of surgery or the intraoperative mean arterial blood pressure when comparing the two groups. The average estimated blood loss in the propofol group was 101 mL compared with an average estimated blood loss of 251 mL in the isoflurane group (P < .01). CONCLUSIONS: General anesthesia based on propofol infusion may have the advantage of decreased bleeding compared with conventional inhalation agents, making endoscopic sinus surgery technically easier and safer by improving endoscopic visualization of the surgical field. This anesthetic technique may have other applications in otolaryngology, where bleeding within a confined space frequently can interfere with visibility.

Abstract: This systematic review was performed to investigate and review the evidence on the risks and benefits of hypotensive anaesthesia in order to answer the following question: ‘Should deliberate hypotension be used routinely during orthognathic surgery?’ An electronic search on MEDLINE and the Cochrane Library database was carried out for all relevant articles using specific search keywords. All articles were classified by their levels of evidence. Studies with highest level of evidence and rated to have the lowest risk of bias were reviewed. Regarding the benefits of hypotensive anaesthesia, three studies reported significant decrease of blood loss in patients receiving hypotensive anaesthesia. Two studies reported a significant decrease in transfusion rate. Two studies demonstrated improved surgical field and significant reduction in operation time. In terms of risk, no significant changes in cerebral, cardiovascular, renal and hepatic functions in patients receiving hypotensive anaesthesia compared to control were reported. In conclusion, hypotensive anaesthesia appears to be effective in reducing blood loss. Serious consequences due to organ hypoperfusion are uncommon. Hypotensive anaesthesia can be justified as a routine procedure for orthognathic surgery especially bimaxillary osteotomy. Patient selection and appropriate monitoring are mandatory for this technique to be carried out safely.


Abstract: Visual loss is a traumatic occurrence that has been reported after prone spine surgical procedures performed under general anesthesia. The most common cause of postoperative visual loss is ischemic optic neuropathy. Although the incidence of postoperative visual loss is rare, this devastating injury has been reported more frequently. Several factors increase the risk for the development of ischemic optic neuropathy. Results from several case studies have attributed ischemic optic neuropathy with vision loss after general anesthesia to perioperative anemia, blood loss, hypotension, and prolonged operative times. Ischemic optic neuropathy usually presents with painless visual loss and visual field deficits during the immediate postoperative period. There is no definitive treatment. Prevention is the key.

Abstract: Trauma is a serious global health problem, accounting for approximately one in 10 deaths worldwide. Uncontrollable bleeding accounts for 39% of trauma-related deaths and is the leading cause of potentially preventable death in patients with major trauma. While bleeding from vascular injury can usually be repaired surgically, coagulopathy-related bleeding is often more difficult to manage and may also mask the site of vascular injury. The causes of coagulopathy in patients with severe trauma are multifactorial, including consumption and dilution of platelets and coagulation factors, as well as dysfunction of platelets and the coagulation system. The interplay between hypothermia, acidosis and progressive coagulopathy, referred to as the lethal triad', often results in exsanguination. Current management of coagulopathy-related bleeding is based on blood component replacement therapy. However, there is a limit on the level of haemostasis that can be restored by replacement therapy. In addition, there is evidence that transfusion of red blood cells immediately after injury increases the incidence of post-injury infection and multiple organ failure. Strategies to prevent significant coagulopathy and to control critical bleeding effectively in the presence of coagulopathy may decrease
the requirement for blood transfusion, thereby improving clinical outcome of patients with major trauma


Abstract: BACKGROUND: Bleeding is the most frequent cause of preventable death after severe injury. Coagulopathy associated with severe injury complicates the control of bleeding and is associated with increased morbidity and mortality in trauma patients. The causes and mechanisms are multiple and yet to be clearly defined. METHODS: Articles addressing the causes and consequences of trauma-associated coagulopathy were identified and reviewed. Clinical situations in which the various mechanistic causes are important were sought along with quantitative estimates of their importance. RESULTS: Coagulopathy associated with traumatic injury is the result of multiple independent but interacting mechanisms. Early coagulopathy is driven by shock and requires thrombin generation from tissue injury as an initiator. Initiation of coagulation occurs with activation of anticoagulant and fibrinolytic pathways. This Acute Coagulopathy of Trauma-Shock is altered by subsequent events and medical therapies, in particular acidemia, hypothermia, and dilution. There is significant interplay between all mechanisms. CONCLUSIONS: There is limited understanding of the mechanisms by which tissue trauma, shock, and inflammation initiate trauma coagulopathy. Acute Coagulopathy of Trauma-Shock should be considered distinct from disseminated intravascular coagulation as described in other conditions. Rapid diagnosis and directed interventions are important areas for future research


Abstract: BACKGROUND: Recent civilian studies have documented a relationship between increased mortality and the presence of an early coagulopathy of trauma diagnosed in the emergency department (ED). We hypothesized that acute coagulopathy (international normalized ratio >/=1.5) in combat casualties was associated with increased injury severity and mortality as is seen in civilian trauma patients. METHODS: A retrospective study of combat casualties who received a blood transfusion at a single combat support hospital between September 2003 and December 2004 was performed. Coagulation status, pH, base deficit, and temperature were recorded at arrival to the ED. These were analyzed by Injury Severity Score (ISS), associated injury patterns, and mortality. RESULTS: A total of 3,287 patients were treated at the combat support hospital during the study period. Of these, 391 patients were transfused and primarily admitted, thus meeting the study criteria, 347 had coagulation data, and 92% had a penetrating mechanism. The prevalence of acute coagulopathy in transfused casualties measured with point-of-care devices at arrival in the ED was 38%. Mortality in those who were coagulopathic at arrival to the ED was 24% (32/133) versus 4% (8/214) in those not presenting with coagulopathy (p < 0.001). The prevalence of mortality by coagulopathy increased as ISS increased. Coagulopathy and acidosis were associated with mortality, odds ratio (OR), 5.38 [95% confidence interval (CI), 1.55-11.37] and 6.9 [95% CI, 2.1-19.5], respectively. Temperature did not affect outcomes (OR, 1.1; 95% CI, 0.4-2.6). CONCLUSIONS: The early coagulopathy of trauma was rapidly diagnosed in the ED and present in more than one-third of combat casualties who received a transfusion, similar to the incidence found in civilian trauma patients. Coagulopathy, independent of hypothermia but strongly correlated with acidosis and ISS, was associated with mortality in combat casualties, similar to that found in civilian trauma patients. Early diagnosis and treatment of acute traumatic coagulopathy with new resuscitation paradigms may improve outcomes


Abstract: BACKGROUND: The Damage Control Surgery (DCS) approach to massive intraperitoneal hemorrhage has been shown to significantly reduce the morbidity and mortality in severely injured trauma patients. We applied the same principles to patients who developed a massive hemorrhage and the "lethal triad" (acidosis, hypothermia, coagulopathy) during a surgical procedure in order to assess feasibility and efficacy of DCS on nontraumatic grounds. METHODS: A retrospective analysis of eight consecutive cases was performed aimed at collecting information on laboratory parameters, fluids requirements, operative times, APACHE II score, damage control surgery procedure, angioembolization, morbidity, mortality, and need for repacking. RESULTS: Average APACHE II score was 25.5 (predicted mortality rate = 54%); overall and early mortality in the nontraumatic group was nil, while the intra-abdominal septic (packing-related) complication rate was 12.5%. CONCLUSIONS:
Intra-abdominal packing was shown to be feasible, safe, and effective for patients with intra-abdominal nontraumatic massive hemorrhage, and the application of the principles of DCS may improve survival in cases of surgical hemorrhage with development of the lethal triad


Abstract: OBJECTIVE: The purpose of this study was to assess the incidence, case fatality rates, and risk factors of peripartum hysterectomy and arterial embolization for major obstetric hemorrhage. STUDY DESIGN: This was a 2-year prospective nationwide population-based cohort study. All pregnant women in the Netherlands during the same period acted as reference cohort (n = 371,021). RESULTS: We included 205 women; the overall incidence was 5.7 per 10,000 deliveries. Arterial embolization was performed in 114 women (incidence, 3.2 per 10,000; case fatality rate, 2.0%). Peripartum hysterectomy was performed in 108 women (incidence, 3.0 per 10,000; case fatality rate, 1.9%). Seventeen women underwent hysterectomy after failure of embolization. Cesarean delivery (relative risk, 6.6; 95% confidence interval, 5.0-8.7) and multiple pregnancy (relative risk, 6.6; 95% confidence interval, 4.2-10.4) were the most important risk factors in univariable analysis. CONCLUSION: The rate of obstetric hemorrhage that necessitates hysterectomy or arterial embolization in the Netherlands is 5.7 per 10,000 deliveries; fertility is preserved in 46% of women by successful arterial embolization


Abstract: INTRODUCTION: Hemorrhage is the leading cause of death in patients with a pelvic fracture. The majority of blood loss derives from injured retroperitoneal veins and broad cancellous bone surfaces. The emergency management of multiply injured patients with pelvic ring disruption and severe hemorrhage remains controversial. Although it is well accepted that the displaced pelvic ring injury must be rapidly reduced and stabilized, the methods by which control of hemorrhagic shock is achieved remain under discussion. It has been proposed to exclusively use external pelvic ring stabilization for control of hemorrhage by producing a 'tamponade effect' of the pelvis. However, the frequency of clinically important arterial bleeding after external fixation of the pelvic ring remains unclear. We therefore undertook this retrospective review to attempt to answer this one important question: How frequently is arterial embolization necessary to control hemorrhage and restore hemodynamic stability after external pelvic ring fixation? MATERIALS AND METHODS: We performed a retrospective review of 55 consecutive patients who presented with unstable types B and C pelvic ring fractures. Those patients designated as being in hemorrhagic shock (defined as a systolic blood pressure less than 90 mmHg after receiving 2 L of intravenous crystalloid) were treated by application of the pelvic C-clamp. Patients who remained in hemorrhagic shock, or were determined to be in severe shock (defined as mandatory catecholamines or more than 12 blood transfusions over 2 h), underwent therapeutic angiography within 24 h in order to control bleeding. RESULTS: Fourteen patients were identified as being hemodynamically unstable (ISS 30.1 +/- 11.3 points) and were treated with a C-clamp. In those patients with persistent hemodynamic instability, arterial embolization was performed. After C-clamp application, 5 of 14 patients required therapeutic angiography to control bleeding. Two patients died, one from multiple sources of bleeding and the other from an open pelvic fracture (total mortality 2/14, 14%). CONCLUSIONS: Although the C-clamp is effective in controlling hemorrhage, one must be aware of the need for arterial embolization to restore hemodynamic stability in a select subgroup of patients


Abstract: OBJECTIVES: To compare intraoperative blood loss, perioperative hematocrit, and transfusion requirements in patients undergoing radical retropubic prostatectomy (RRP) versus robotic-assisted laparoscopic prostatectomy (RALP) by a single surgeon. METHODS: During a 14-month period, 279 patients with localized carcinoma of the prostate were prospectively enrolled in this comparative study. The decision of which surgical approach to use was by patient choice. Of the 279 patients, 176 underwent RALP and 103 underwent RRP. The serum hematocrit was obtained preoperatively and 24 hours postoperatively in all patients. The intraoperative blood loss was recorded, and transfusion
requirements were noted. RESULTS: Patients in the RALP group had significantly less intraoperative blood loss compared with the RRP group (mean 191 mL versus 664 mL, P < 0.001). Additionally, the difference in the discharge hematocrit (36.8% versus 32.8%, P < 0.001) and the mean perioperative change in hematocrit (8.0% decrease versus 10.7% decrease, P < 0.001) were significant between the RALP and RRP groups, respectively. Three patients in the RRP group (2.9%) and one in the RALP group (0.5%) required transfusion of blood products (P = 0.14). CONCLUSIONS: The results of this study have shown that RALP is associated with less intraoperative bleeding than RRP, and patients undergoing RALP have a greater serum hematocrit at hospital discharge. The lack of a statistically significant difference in blood transfusion was partially attributable to the low transfusion rate in both groups in this series.


Abstract: BACKGROUND: The objective is to provide surgical and pathological guidelines for radical prostatectomy (RP) with or without concurrent pelvic lymph node dissection (PLND) to achieve optimal benefit for patients, with minimal risk of harm. METHODS: For surgical questions, a literature search of MEDLINE, EMBASE and the Cochrane database was performed. A literature search for the pathological questions was not conducted since the protocol for invasive carcinomas of the prostate gland developed by the College of American Pathologists (CAP) was endorsed. Urologists and pathologists were consulted for their assessment of the surgical and pathological recommendations. RESULTS: Limited high-quality evidence from 95 primary studies was available and, therefore, the expert panel developed recommendations on the basis of a consensus of the expert opinion of the working group and through a consultation with urologists and pathologists. In addition to the CAP protocol, some technical recommendations related to the handling and processing of the specimen were made. CONCLUSION: Radical prostatectomy is recommended for the surgical treatment of prostate cancer, depending on a patient's preoperative risk profile. The panel unanimously determined that the goals for RP are to attain a positive margin rate of <25% for pT2 disease, a mortality rate of <1%, rates of rectal injury of <1% and blood transfusion rates of <10% in non-anemic patients. Standard PLND should be mandatory in high-risk patients, should be recommended for intermediate-risk patients and should be optional for low-risk patients. The quality and effectiveness of this treatment and of subsequent patient care depend on good management, effective communication and reporting between surgeons and pathologists working together as part of a multidisciplinary team. The complete guideline document is posted on the Cancer Care Ontario website (www.cancercare.on.ca); search in their Toolbox, Quality Guidelines & Standards, Clinical Program category under "surgery."


Abstract: OBJECTIVE: To review the success rate of embolization in stopping hemorrhage for unstable patients with severe pelvic fractures, to calculate the time to achieve embolization, and to determine the yield from angiography. DESIGN: Retrospective review of patients admitted to a Level I trauma center with pelvic fractures during a 5-year period. MATERIALS AND METHODS: Charts were reviewed for Injury Severity Score, age, blood pressure, prothrombin time/partial thromboplastin time, pelvic fracture type, mortality, time to reach the angiography suite, time to achieve embolization, and mechanism of injury. MEASUREMENTS AND MAIN RESULTS: Of 806 patients admitted with pelvic fractures, 35 underwent pelvic angiography, and 15 (1.9%) required embolization. Embolization was successful for all patients. No deaths resulted from ongoing hemorrhage. Angiography yield in initially unstable patients was 64%. The mean age and initial hemodynamic instability were significantly greater in nonsurvivors. The time from arrival in the trauma bay to arrival in the angiography suite ranged from 50 to 1,140 minutes, and the time spent in the angiography suite performing embolization ranged from 50 to 140 minutes, with an average time of 90 minutes. Patients who were embolized within 3 hours of arrival had a significantly greater survival rate. CONCLUSION: Only a small percentage of patients with pelvic fractures require embolization, but when it is used, embolization can be 100% effective. Age, time to achieve embolization, and initial hemodynamic instability appear to be important factors in survival.

Abstract: BACKGROUND: Cardiopulmonary bypass (CPB) in neonates and infants is associated with significant haemodilution when priming of the CPB circuit is accomplished without transfusion of homologous blood components. The degree of haemodilution and, thus, the requirements for blood transfusion may be reduced when the CPB circuit is miniaturized without compromising patient safety. METHOD: Between January 2002 and October 2003, selected neonates and small infants were operated on using a nonhaemic prime extracorporeal circuit. CPB priming volume could be reduced from 300 ml to 190 ml by using a dedicated neonatal CPB console with mast-mounted roller pump heads. Reduction of priming volume resulted from shortening of all CPB lines to the minimum, downsizing of all CPB lines, exclusion of unused CPB components, use of vacuum-assisted venous drainage and from close cooperation between the perfusionist, cardiac surgeon and anaesthesiologist. The reduction in priming volume was achieved without eliminating the arterial line filter as safety device. RESULTS: A total of nine patients weighing between 3.2 and 5.9 kg (mean 4.7 kg) and with a body surface area of 0.22-0.35 m² (mean 0.29 m²) were operated on with the use of the modified neonatal CPB circuit and a nonhaemic prime. Bypass time varied from 38 to 167 min (mean 96 min). The mean haematocrit on CPB was 22.5% with a range of 17-29%. The postoperative course of all patients was uneventful. CONCLUSION: A significant reduction in CPB priming volume makes nonhaemic prime CPB in neonates and small infants undergoing complex repair of congenital heart defects possible.


Abstract: We compared the inflammatory response and blood loss in patients who underwent mini-cardiopulmonary bypass (CPB) or conventional CPB during coronary artery bypass grafting (CABG). Ninety-eight consecutive patients with ischemic heart disease were randomly assigned to mini-CPB (n = 34) or conventional CPB (n = 64). Interleukin (IL) -8 and neutrophil elastase levels were measured before and after surgery. Hemodilution during CPB, blood loss during and after surgery were also evaluated. Compared with the conventional group, the mini-CPB group had lower levels of IL-8 on postoperative day 1 (8.3 +/- 6.4 vs. 19 +/- 11 pg/mL, p = 0.016) and of neutrophil elastase on postoperative days 1 (127 +/- 52 vs. 240 +/- 100 microg/L, p = 0.013) and 2 (107 +/- 17 vs. 170 +/- 45 micro/L, p = 0.0001). The mini-CPB group also has less blood loss during (620 +/- 595 vs. 978 +/- 658 ml, p = 0.012) and after the operation (578 +/- 651 mL, p = 0.0034) and a hemodilution ratio of 14 +/- 2 vs. 25% +/- 3%, p < 0.0001. Thus, mini-CPB attenuated the inflammatory response and hemodilution, resulting in blood conservation in patients undergoing CABG.


Abstract: This retrospective study analyzed the current practice of blood transfusion-free open-heart surgery in 536 children weighing 5-20 kg undergoing surgery between 2004 and 2007. A miniaturized cardiopulmonary bypass (CPB) circuit was used (priming volume; 300 ml for the flow rate <1,500 ml/min; 550 ml for the flow rate of 1500-2300 ml/min). Modified ultrafiltration was routinely performed. Criteria for blood transfusion during CPB included a hematocrit of <20% and/or mixed venous oxygen saturation of <65%. Transfusion during CPB was avoided in 264 (49.3%) of the 536 patients (5-10 kg group, 29.0%; 11-15 kg group, 67.4%; 16-20 kg group, 80.8%). There was no neurological complication related to hemodilution. Multiple logistic regression analysis revealed that body weight, preoperative hematocrit, priming volume of CPB circuit, CPB time, and lowest hematocrit during CPB predict requirement of blood transfusion (p < 0.01). Transfusion rate was lowest in the atrial septal defect group (5.6%) and highest in tetralogy of Fallot group (78.7%), being associated with complexity of diagnosis and procedure required. Blood transfusion-free open-heart surgery may be achieved in the half of the patients weighing 5-20 kg, and further miniaturization of CPB circuit and refinement of perfusion strategy might reduce transfusion rate in patients <10 kg and/or with complex congenital heart disease.

Abstract: Since 2005, we have used a novel technique based on the closed cardiopulmonary bypass system without cardiotomy suction (minimal cardiopulmonary bypass [mini-CPB]) for aortic valve replacement (AVR). In this study, we investigated the clinical advantages of this approach. We prospectively studied 32 patients who underwent isolated AVR using the mini-CPB (group M, n = 13) or conventional CPB (group C, n = 19). We compared the hemodilution ratio, serum interleukin (IL)-6 and IL-8 levels, and blood transfusion volume between the two groups. The characteristics, duration of CPB, and aortic cross-clamping time did not differ between the two groups. The hemodilution ratio was significantly lower in group M just after starting CPB (M vs. C: 14% +/- 2% vs. 25% +/- 3%, p = 0.0009). IL-6 levels increased significantly after surgery in both groups, but the postoperative levels were significantly lower in group M at 6 (84.9 +/- 24.9 pg/ml vs. 152 +/- 78 pg/ml, p = 0.042) and 12 (72.7 +/- 36.1 pg/ml vs. 123 +/- 49.6 pg/ml, p = 0.029) hours after CPB. There were no differences in IL-8 or blood transfusion volume after CPB. Mini-CPB offers an alternative to conventional CPB for AVR and has some advantages regarding hemodilution and serum IL-6 levels. However, it is unlikely to become the standard approach for AVR because there are no marked clinical advantages of mini-CPB.


Abstract: A literature review and meta-analysis were undertaken to assess the clinical effectiveness of retrograde autologous priming of the cardiopulmonary bypass circuit to reduce allogeneic packed red blood transfusions in adult cardiac surgery. Structured searches of Medline, Embase, Cochrane Collaboration Library, Scopus, Cumulative Index to Nursing and Allied Health Literature and Science Direct were performed to identify randomized trials comparing retrograde autologous priming to a prospective control group. A total of 21,643 studies were identified and eighteen trials were retrieved for full-text review. Six trials met eligibility criteria. Pooled estimates demonstrated that retrograde autologous priming significantly reduced the number of patients receiving intraoperative packed red cell transfusions (OR=0.36; 95% CI: 0.13, 0.94; P=0.04, I(2)=47.5%), total hospital stay packed red cell transfusions (OR=0.26; 95% CI: 0.13, 0.52; P=0.0001, I(2)=0%), and the number of units transfused of total hospital stay packed red blood cells (WMD=0.60; 95% CI: -0.90, -0.31; P=0.0001, I(2)=0%). Retrograde autologous priming, however, did not provide a clinical benefit in reducing the number of units transfused of intraoperative packed red blood cells (WMD=-0.29; 95% CI: -0.59, 0.01; P=0.05). The combined patient population studied in the six trials was mainly primary isolated coronary artery bypass surgery. Assessing the safety of retrograde autologous priming was not possible due to limited data.


Abstract: OBJECTIVE: Prolonged bleeding during cardiovascular surgery presents a risk for the patient and increases the time and cost of surgery. TachoSil is a ready-to-use haemostatic agent that consists of an equine collagen patch coated with human fibrinogen and thrombin. This trial evaluated the efficacy and safety (< or =30 days post-surgery) of TachoSil surgical patch compared with standard haemostatic fleece for the control of bleeding in patients undergoing cardiovascular surgery. Methods: Patients scheduled for elective surgery on the heart, ascending aorta or aortic arch requiring cardiopulmonary bypass were eligible for this open-label multicentre trial. After primary haemostatic measures, patients were randomised to TachoSil or conventional haemostatic fleece if an area of persisting haemorrhage was identified (target area). After the application of trial treatment, haemostasis was evaluated at 3 min (primary endpoint). If haemostasis was not achieved, trial treatment was re-applied and haemostasis assessed at 6 min (secondary endpoint). Results: A total of 120 patients were randomised and 119 received trial treatment (TachoSil, n=59; standard treatment, n=60). Twenty-six percent of patients were female and the mean age was 67 years (range: 23-86 years). Baseline characteristics were similar in both the groups. Bleeding occurred mainly from the aorta (56%), right ventricle (16%) or right atrium (13%), more often from a vessel (68%) than tissue (32%), and was assessed to be arterial in 74% of cases. TachoSil was significantly superior to standard haemostatic fleece in controlling bleeding after insufficient primary haemostasis, with 75% (95% confidence interval [CI]: 0.64-0.86) of the TachoSil group achieving haemostasis at 3 min compared with only 33% (95% CI: 0.21-0.45) of the standard treatment group (p=0.0001). This difference persisted at 6 min, with 95% of patients achieving haemostasis in the TachoSil group compared with 72% in the standard treatment group (p=0.0006). Three (5%) TachoSil patients compared with 17 (28%) standard

Abstract: BACKGROUND AND AIMS: A new carrier-bound fibrin sealant, TachoSil, is expected to be efficacious and safe as a haemostatic treatment in hepatic resection. DESIGN: A prospective, randomised, open and controlled multicentre trial with intraoperative as well as postoperative assessment of efficacy and a 1 month follow-up period. SETTING: Tertiary care centres. PATIENTS/METHODS: One hundred and twenty-one patients requiring secondary haemostasis during planned liver resection. Patients with coagulation disorders and patients with persistent major bleeding after primary haemostatic measures were excluded. INTERVENTION: Application of either carrier-bound fibrin sealant (n=59) or
argen beamer (argon beam coagulator) (n=62) as secondary haemostatic treatment. MAIN OUTCOME MEASURE: Time to intraoperative haemostasis. RESULTS: There was a significant superiority of TachoSil over argon beamer with regard to time to haemostasis (3.9 min, median 3.0, range 3-20 min vs 6.3 min, median 4.0, range 3-39 min) (P=0.0007). Haemoglobin concentration of drainage fluid was significantly lower on day 2 after surgery in TachoSil patients (1.1 mmol/l) than in argon beamer patients (2.3 mmol/l) (P=0.012). Overall, the frequency and causality of adverse events did not differ between the two treatment groups. CONCLUSION: TachoSil is superior to argon beamer in obtaining effective and fast intraoperative haemostasis. The safety data show TachoSil to be tolerable and safe for haemostatic treatment in liver resection


Abstract: OBJECTIVE: To describe the method of extraperitoneal pelvic packing (EPP), and to assess the impact of EPP on outcome in severely hemodynamically unstable patients after blunt pelvic trauma. METHODS: Of 661 patients treated for pelvic trauma, 18 underwent EPP as part of our protocol with the intent to control massive pelvic bleeding and constituted the study population. Data retrospectively collected from the medical records and from the Ulleval Trauma Registry included demographics, fracture classification, additional injuries, blood transfusions, surgical interventions, angiographic procedure, physiologic parameters, and survival. RESULTS: Survival rate within 30 days was 72% (13/18), and correlated inversely to the age of the patient (p = 0.038). Only one of the nonsurvivors died of exsanguination. A significant increase in systolic blood pressure (BP) (p = 0.002) was observed immediately after EPP. Angiography performed after EPP was positive for arterial injury in 80% of patients. All types of pelvic ring fractures were represented. CONCLUSIONS: EPP as part of a multi-interventional resuscitation protocol might be life saving in patients with life-threatening pelvic injury who are exsanguinating. However, the high rate of arterial injuries seen after EPP indicates that the procedure should be supplemented with angiography once the patient is sufficiently stabilized to tolerate transportation to the angiography suite


Abstract: BACKGROUND: Despite different forms of treatment, few studies have been performed on the outcome and prognosis of patients admitted to the hospital because of gastric vascular ectasia (GVE) and upper-GI bleeding (UGIB). There is also little knowledge on the efficacy of argon plasma coagulation (APC) in different subgroups of GVE lesions. OBJECTIVE: This study was designed to evaluate the efficacy of APC in patients admitted to the hospital with UGIB because of GVE. DESIGN: Prospective evaluation of consecutive cases of UGIB because of GVE. SETTING: Tertiary and university-affiliated hospital. PATIENTS AND INTERVENTIONS: Twenty-nine patients were included and divided into 3 subgroups: focal vascular ectasia lesions (FVE) (n = 10), portal hypertensive gastropathy (PHG) (n = 11), and gastric antral vascular ectasia (GAVE) (n = 8). Patients were followed at 3 months and every 6 months thereafter during a mean of 23.1 months (range 18-37 months). All patients received intensive APC treatment that was repeated, depending on the endoscopic appearance or clinical evaluation. RESULTS: The overall success of APC treatment was 86%, with only one recurrence of UGIB during the follow-up period. The number of APC sessions was 1.2, 2.2, and 2.3, in each subgroup (not significant), with a total number of sessions of 1.9 +/- 1.3. Treatment success was 90% in the FVE group, 81% in the PHG group, and 87.5% in the GAVE group (NS). The rise in hematocrit from baseline values in the overall group and in each subgroup was significant (P > .01). LIMITATIONS: A single-center study and small sample. CONCLUSIONS: Endoscopic thermal ablation with APC is effective in managing UGIB and in reducing transfusion requirements in patients admitted for GI hemorrhage because of different endoscopic types of GVE


Abstract: OBJECTIVE: To compare the effectiveness of preliminary uterine artery ligation versus pericervical mechanical tourniquet in reducing hemorrhage during myomectomy. METHODS: A total of 103 patients undergoing myomectomy were randomly allocated to undergo preliminary uterine artery ligation (52 patients) or pericervical tourniquet (51 patients). The primary outcome measure was
Abstract: After rapid changes in transfusion practices over the past few years, blood conservation techniques have become standard in modern perioperative management. As a result, the amount of homologous blood products transfused has been markedly reduced in some types of surgical procedures. Provided that skilful surgical technique is applied and the use of blood products is restricted, autologous transfusion techniques (predonation of autologous blood, preoperative plasmapheresis, acute normovolaemic haemodilution, and intra- and postoperative blood salvage) can be performed with an acceptable risk for patients. In addition, stimulation of erythropoiesis with recombinant human
Abstract: Acute normovolemic hemodilution (ANH) may help to reduce demand for homologous blood but requires extra time and apparatus. A more simple procedure is acute hypervolemic hemodilution (HHD), where hydroxyethylstarch is administered preoperatively without removal of blood. In a prospectively randomized study we compared ANH (preoperatively 15 mL/kg autologous blood removal and replacement with 15 mL/kg of hydroxyethylstarch with HHD (15 mL/kg of hydroxyethylstarch administered preoperatively) in 49 patients undergoing hip arthroplasty. To avoid excessive intravascular volume, we used the vasodilating effect of isoflurane. No significant differences were found between groups (ANH, n = 23; HHD, n = 26) for intraoperative blood loss (ANH versus HHD, median [minimum-maximum]); 545 [295-785] mL versus 520 [315-825] mL) and postoperative blood loss (730 [525-945] mL versus 780 [495-895] mL), postoperative hemoglobin, hematocrit, platelet count or coagulation variables, and transfusion requirements (ANH 43% versus HHD 35% of patients received homologous blood) (P > 0.05). Heart rate did not change significantly in either group. In the ANH group mean arterial blood pressure (MAP) decreased after hemodilution (P < 0.05) while in the HHD group MAP did not change over time. Mean time required to perform ANH was 58 (46-62) min versus HHD 16 (12-19) min (P < 0.05). Costs for ANH were $63.60 USD and for HHD $32.75 USD (labor costs not included). In orthopedic patients undergoing hip replacement with a predicted blood loss of about 1000 mL, HHD seems to be a simple as well as time- and cost-saving alternative for ANH.


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collection techniques decrease the need for blood bank transfusions, but acute normovolemic hemodilution is less expensive and more convenient for patients

Abstract: Between April, 1988, and February, 1989, 22 consecutive patients underwent liver resection (17 hepatectomy, 5 segmentectomy) with intraoperative haemodilution to avoid blood transfusion. The results were compared with those of 22 patients who underwent liver resection without haemodilution between February, 1987, and April, 1988, and who were matched for the nature of the tumour and the type of liver resection. Age, preoperative haematocrit and haemoglobin concentration, and intraoperative blood loss did not differ between the groups who did and did not undergo haemodilution. There was no abnormal bleeding during liver transection in haemodiluted patients. No allogeneic blood products at all were needed in a significantly greater proportion of the group with haemodilution than of the group without (19 [86%] vs 6 [27%]). The two groups also showed significant differences in the total requirements of allogeneic packed red cells (haemodilution 9 units, no haemodilution 84 units) and fresh frozen plasma (9 vs 119 units). Although the haematocrit was slightly but significantly lower in the group who underwent haemodilution than in those who did not on postoperative days 1 and 8, the differences had disappeared by the second postoperative month. Postoperative complication rates, abnormal results in liver biochemical tests, and lengths of hospital stay were the same in patients with and without haemodilution. Intraoperative haemodilution in patients undergoing liver resection reduced requirements for all blood products, further lowering the risks associated with liver resection

Abstract: Blood loss in patients undergoing radical prostatectomy may be substantial. In a randomized, prospective study, we assessed two methods of reducing the need for allogeneic blood transfusion with regard to efficacy and costs. Sixty patients undergoing retropubic radical prostatectomy were allocated randomly to one of three groups. In group 1 (n = 20), acute normovolaemic haemodilution (ANH) was initiated after induction of anaesthesia; autologous blood 15 ml kg⁻¹ was withdrawn and replaced by colloidal solutions (gelatin) to maintain haemodynamic stability. In group 2 (n = 20), controlled hypotension was established using sodium nitroprusside (target mean arterial pressure (MAP) approximately 50 mm Hg). Group 3 (n = 20), without manipulations, served as a control group. Troponin T (TnT), a sensitive marker for myocardial ischaemia, and various coagulation variables were measured in the perioperative period. Packed red blood cells (PRBC) were given when haemoglobin concentration was less than 7 g dl⁻¹. Cost calculations did not include hospital overhead costs or staff costs. In the ANH group, mean 1278 (SD 150) ml of autologous blood were withdrawn. Significantly more volume was infused in the ANH patients (gelatin 2450 (550) ml) than in the two other groups. Coagulation data (platelet count, activated partial thromboplastin time (aPTT), fibrinogen, antithrombin III (AT III), D-dimers) did not differ significantly between the three groups. The hypotension group had significantly lower blood loss (1260 (570) ml), whereas the ANH (1820 (680) ml) and control group (1920 (590) ml) did not differ significantly. Patients in the hypotension group needed significantly less PRBC (total 14 units; 75% of patients did not need PRBC) than the ANH (total 21 units; 55% of patients did not need PRBC) or control patients (total 28 units; 40% of patients did not need PRBC). Total costs were lowest in the hypotension group (41% less than in the control patients) (P < 0.05). We conclude that the use of hypotension during radical prostatectomy resulted in approximately 40% reduction in total transfusion costs. ANH was less effective and more costly than controlled hypotension

Abstract: The aim of the present study was to demonstrate the practicality and efficacy of acute normovolemic hemodilution (ANH) to reduce allogeneic red blood cell (RBC) transfusion in patients undergoing elective surgery with anticipated high intraoperative blood loss (BL). 124 patients (age 48 +/- 18 years, ASA classes I-III) underwent major maxillofacial surgery in a university hospital (68% tumor surgery, 32% dysgnathia correction). After induction of general anesthesia, ANH was performed by
standardized withdrawal of 900 ml (2 units) of whole blood and simultaneous infusion of 500 ml of hydroxyethyl starch solution (6% HES 130,000/0.4) and 1500 ml of crystalloidal solution. Intraoperative BL was fluid-compensated until physiologic parameters indicated the need for RBC transfusion. First, autologous ANH-blood was retransfused followed by, if necessary, allogeneic RBC. Total BL was referred to the patient's calculated blood volume (BV): fractional blood volume loss, BL(frac) = BL/BV. ANH took 16 +/- 2 min and was void of any adverse event. The costs for ANH was 24 per patient. 55 patients had a mean BL(frac) of 44 +/- 28% and required an intraoperative transfusion; 49/55 patients with an average BL(frac) of 37 +/- 14% were transfused with only autologous ANH-blood; 6/55 patients with a mean BL(frac) of 100 +/- 47% underwent additional transfusion with allogeneic RBC. Standardized, 2 unit, ANH is a practicable, safe and economic blood conservation technique that allowed for the complete avoidance of allogeneic RBC transfusion in 89% of patients undergoing maxillofacial surgery that required an intraoperative RBC transfusion.


Abstract: BACKGROUND: The efficacy of acute normovolaemic haemodilution (ANH) remains uncertain because of a lack of well-designed prospective randomized controlled trials. The aim of this study was to assess the effects of ANH on allogeneic transfusion, postoperative complications, and duration of stay. METHODS: Consecutive patients undergoing major gastrointestinal surgery were randomized to a planned 3-unit ANH, or no ANH. Both groups underwent identical management including adherence to a transfusion protocol after surgery. Outcome measures included the number of patients receiving allogeneic blood, complications, and duration of stay. RESULTS: 380 patients were screened of which 160 were included in the study, median age was 62 yr (range 23-90), 'ANH' n=78, 'no ANH' n=82. There was no significant difference between groups in the number of patients receiving allogeneic blood 22/78 (28%) vs 25/82 (30%), the total number of allogeneic units transfused (90 vs 93), complication rate, or duration of stay. Haemodilution significantly increased anaesthetic time, median 55 (range 15-90) vs 40 min (range 17-80) (P<0.001). Significantly fewer patients in the ANH group experienced oliguria in the immediate postoperative period 37/78 (47%) vs 55/82 (67%) (P=0.012). The most significant factors affecting transfusion were blood loss, starting haemoglobin, and age. When compared with ASA-matched historical controls, the introduction of a transfusion protocol reduced the transfusion rate in colorectal patients from 136/333 (41%) to 37/138 (27%), P=0.004. CONCLUSIONS: In this large pragmatic study, ANH did not affect allogeneic transfusion rate in major gastrointestinal surgery. Preoperative haemoglobin, blood loss, and transfusion protocol are the key factors influencing allogeneic transfusion.


Abstract: We evaluated the blood-sparing effects of intraoperative moderate acute normovolemic hemodilution (ANH) combined with intraoperative tranexamic acid treatment and shed blood reinfusion in patients undergoing off-pump coronary artery bypass (OPCAB). One-hundred consecutive OPCAB patients (baseline hematocrit >34%) were prospectively randomized to tranexamic acid treatment (control group; 50 patients) or to tranexamic acid treatment plus normovolemic (1:1 replacement with colloids) withdrawal of 17% +/- 2% of the circulating blood volume (ANH group; 50 patients). All patients had shed blood reinfused with intraoperative bleeding in excess of 250 ml. The requirement for allogeneic transfusions, based on strict a priori defined criteria, was the primary end point of the study. Hematochemical evaluations, bleeding, major complications, and other outcomes were also recorded. Demographics, baseline hematochemical data, and operative characteristics were similar in the two groups. Patients in the ANH group had a median of 850 ml of blood withdrawn and showed a lower intraoperative minimum hematocrit (31% vs 37%; P < 0.0001). Two patients in the ANH group versus 10 patients in the control group (odds ratio, 0.17; 95% confidence interval, 0.03-0.89; P = 0.028) required transfusion of a significantly smaller number of packed red blood cell units (5 vs 24; P < 0.001). Postoperative hematochemical variables, bleeding, and outcomes were similar in the two groups of patients. Moderate ANH, combined with tranexamic acid administration and on-demand shed blood reinfusion, may reduce allogeneic transfusion requirements in OPCAB patients.

IMPLICATIONS: We studied the blood-sparing effects of moderate acute normovolemic hemodilution (ANH) in 100 patients undergoing off-pump coronary surgery (OPCAB). Combined with tranexamic acid

OBJECTIVES: To evaluate the efficacy and safety of acute normovolemic hemodilution (ANH) in patients undergoing radical prostatectomy. Preoperative autologous blood donation (PAD) is widely accepted as a means of reducing the need for allogeneic blood transfusion in radical prostatectomy. ANH is an alternative method for obtaining autologous blood. METHODS: On the basis of our previous report that showed the equivalence of PAD and ANH, we prospectively replaced PAD with ANH as a standard practice for radical prostatectomy after September 1999. Of 174 radical prostatectomy patients between September 1999 and June 2004, 153 underwent ANH alone, 15 chose to receive both PAD and ANH, and ANH was contraindicated in 15 because of comorbidities. RESULTS: For the 153 patients undergoing ANH alone, 1032 +/- 201 mL of autologous blood was collected. With an intraoperative blood loss of 1602 +/- 926 mL, 14 patients (9.2%) received allogeneic blood transfusion. The preoperative, intraoperative nadir, and postoperative hematocrit value was 43.6% +/- 3.4%, 25.8% +/- 3.8%, and 31.9% +/- 4.3%, respectively. No patient experienced a perioperative adverse event related to hemodilution or blood transfusion. CONCLUSIONS: Our continued experience has shown that ANH is a safe and effective means of autologous blood procurement. Given its advantages, including lower cost, lower risk, and simplicity, we conclude that ANH can replace conventional PAD for use in radical prostatectomy, although the true value of ANH should be determined by future randomized studies including a no-treatment control group.


METHODS: Two hundred four consecutive adult patients undergoing elective hip surgery were randomly assigned to either “ANH” (n = 78) or “standard transfusion” (n = 77). ANH on induction of anesthesia was to a target hemoglobin (Hb) level of 110 g per L with return of autologous blood on wound closure. Allogeneic blood was prescribed by an objective transfusion trigger based on an Hb level of less than 80 g per L. Transfusion requirements and postoperative complications were recorded. RESULTS: Allogeneic transfusion was necessary in 22 (29%) standard transfusion patients and 15 (19%) ANH (odds ratio [OR], 0.65; 95% CI, 0.41-0.99; p = 0.053) with 63 and 33 units transfused, respectively (p = 0.1). Significant postoperative complications occurred in 30 (38%) standard transfusion patients compared with 14 (18%) of those randomly assigned to ANH (OR, 0.3; 95% CI, 0.14-0.65; p = 0.009). The major difference between the groups was the frequency of infective complications. CONCLUSION: Despite modest allogeneic blood transfusion requirements in hip surgery, ANH reduced postoperative complications.


METHODS: Two hundred four consecutive adult patients undergoing elective hip surgery were randomly assigned to either “ANH” (n = 78) or “standard transfusion” (n = 77). ANH on induction of anesthesia was to a target hemoglobin (Hb) level of 110 g per L with return of autologous blood on wound closure. Allogeneic blood was prescribed by an objective transfusion trigger based on an Hb level of less than 80 g per L. Transfusion requirements and postoperative complications were recorded. RESULTS: Allogeneic transfusion was necessary in 22 (29%) standard transfusion patients and 15 (19%) ANH (odds ratio [OR], 0.65; 95% CI, 0.41-0.99; p = 0.053) with 63 and 33 units transfused, respectively (p = 0.1). Significant postoperative complications occurred in 30 (38%) standard transfusion patients compared with 14 (18%) of those randomly assigned to ANH (OR, 0.3; 95% CI, 0.14-0.65; p = 0.009). The major difference between the groups was the frequency of infective complications. CONCLUSION: Despite modest allogeneic blood transfusion requirements in hip surgery, ANH reduced postoperative complications.


BACKGROUND: Recently, various studies have questioned the efficacy of intraoperative acute normovolemic hemodilution (ANH) in reducing bleeding and the need for allogeneic transfusions in cardiac surgery. The aim of the present study was to reevaluate the effects of a low-volume ANH in elective, adult open-heart surgery. METHODS: Two hundred four consecutive adult patients undergoing cardiac surgery were prospectively randomized in a nonblinded manner into two groups: ANH group (103 patients), where 5-8 mL/kg of blood was withdrawn before systemic heparinization and replaced with colloid solutions, and a control group, where no hemodilution was performed (101 patients). Procedures included single and multiple valve surgery, aortic root surgery, coronary surgery combined with valve surgery, or partial left ventriculectomy. The purpose of the study was to evaluate the efficacy of ANH in reducing the need for allogeneic blood components. Routine hematocrit evaluations, perioperative blood loss, major complications, and outcomes were also recorded. RESULTS: No differences were found between the groups regarding demographics, baseline hematocrit evaluations, and operative characteristics. There was no difference in the amount of
Abstract: Acute normovolemic hemodilution (ANH), in which blood for autologous use is collected immediately before the onset of surgical blood loss, is a recommended autologous blood procurement technique for blood conservation. Both crystalloid and colloid replacement fluids have been used to maintain normovolemia during ANH, but few data are available to justify the use of a particular replacement fluid. Therefore, we designed a prospective, randomized study to determine if the replacement fluid choice affects various coagulation variables and perioperative blood loss. Forty adult patients, ASA status 1-3, scheduled for ANH during radical prostatectomy were randomly assigned to one of four replacement fluid groups: (a) Ringer’s lactate, (b) 5% albumin, (c) 6% dextran 70 (DEX), or (d) 6% hetastarch (HES). After the induction of a standardized general anesthetic, all patients underwent ANH to a final hemoglobin level of 9 g/dL. Complete blood count, prothrombin time, partial thromboplastin time, fibrinogen, factors V and VIII levels, bleeding time, and thromboelastography (TEG) measurements were obtained at similar time points in the procedure. When compared with baseline, activated partial thromboplastin time decreased and factor VIII levels increased in the postanesthesia care unit in both the Ringer’s lactate and 5% albumin groups. The DEX and HES groups demonstrated a decrease in TEG maximum amplitude between preoperative and postanesthesia care unit measurements and TEG alpha (angle) was decreased from baseline in the DEX group. The changes in factor VIII, activated partial thromboplastin time, and TEG measurements indicate that HES and DEX may attenuate the hypercoagulability related to surgery.
Abstract: Quantitative changes of hemostasis during hemodilution remain unclear. With the increasing popularity of artificial blood substitutes (ABS), which solely provide oxygen-transport capacity, this issue becomes even more complex. We developed a mathematical model to quantitatively analyze hemostasis during hemodilution and validated it by recalculating patient data. We calculated and compared maximal allowable blood losses (MABL) related to minimal acceptable hematocrit, platelet concentration, and plasma fibrinogen concentration. MABL is the maximal blood loss that can be tolerated without any additional blood products. The variable with the smallest MABL thus limits hemodilution foremost. Hemodilution included isovolemic replacement of blood loss with colloid or acute normovolemic hemodilution (ANH) followed by isovolemic replacement of blood loss with colloid and ABS. We also related our findings to preoperative patient data (n = 204). The decline in platelet concentrations rarely (<2% of all patients) limits hemodilution. By contrast, critical plasma fibrinogen (< or =100 mg/dL) concentrations can often (< or =20% of all patients) limit hemodilution if their initial concentrations are within the lower normal range (<300 mg/dL). These findings become more frequent if ANH is combined with ABS. Under those circumstances ANH blood products are solely required for stabilization of hemostasis, thereby defeating the original purpose of combining ANH with ABS. IMPLICATIONS: The causes of quantitative changes of hemostasis during hemodilution, as well as their clinical effect and relevance, remain unclear. Using a validated, realistic mathematical model, we demonstrate that hemostasis, especially plasma fibrinogen, can limit the extent of hemodilution. This phenomenon is particularly prominent when acute normovolemic hemodilution is combined with artificial blood substitutes


Abstract: The use of intraoperative cell salvage and autologous blood transfusion has become an important method of blood conservation. The main aim of autologous transfusion is to reduce the need for allogeneic blood transfusion and its associated complications. Allogeneic blood transfusion has been associated with increased risk of tumour recurrence, postoperative infection, acute lung injury, perioperative myocardial infarction, postoperative low-output cardiac failure, and increased mortality. We have reviewed the current evidence for cell salvage in modern surgical practice and examined the controversial issues, such as the use of cell salvage in obstetrics, and in patients with malignancy, or intra-abdominal or systemic sepsis. Cell salvage has been demonstrated to be safe and effective at reducing allogeneic blood transfusion requirements in adult elective surgery, with stronger evidence in cardiac and orthopaedic surgery. Prolonged use of cell salvage with large-volume autotransfusion may be associated with dilution of clotting factors and thrombocytopenia, and regular laboratory or near-patient monitoring is required, along with appropriate blood product use. Cell salvage should be considered in all cases where significant blood loss (>1000 ml) is expected or possible, where patients refuse allogeneic blood products or they are anaemic. The use of cell salvage in combination with a leucocyte depletion filter appears to be safe in obstetrics and cases of malignancy; however, further trials are required before definitive guidance may be provided. The only absolute contraindication to the use of cell salvage and autologous blood transfusion is patient refusal


Abstract: OBJECTIVES: To compare patient outcomes, resource use and costs to the NHS and NHS Blood Transfusion Authority (BTA) associated with cell salvage and alternative methods of minimising perioperative allogeneic blood transfusion. DATA SOURCES: Electronic databases covering the period 1996-2004 for systematic reviews and 1994-2004 for economic evidence. REVIEW METHODS: Existing systematic reviews were updated with data from selected randomised controlled trials (RCTs) that involved adults scheduled for elective non-urgent surgery. Any resource use or cost data were extracted for potential use in populating an economic model. Relative risks or weighted mean difference of each outcome for each intervention were assessed, taking into account the number of RCTs included in each outcome and intervention and the presence of any heterogeneity. This allowed indirect comparison of the relative effectiveness of each intervention when the intervention is compared with allogeneic blood transfusion. A decision analytic model synthesised clinical and economic data from several sources, to estimate the relative cost-effectiveness of cell salvage for people undergoing elective surgery with moderate to major expected blood loss. The perspective of the NHS and patients and a time horizon of 1 month were used. The economic model was developed
from reviews of effectiveness and cost-effectiveness and clinical experts. Secondary analysis explored
the robustness of the results to changes in the timing and costs of cell salvage equipment, surgical
procedure, use of transfusion protocols and time horizon of analysis. RESULTS: Overall, 668 studies
were identified electronically for the update of the two systematic reviews. This included five RCTs, of
which two were cell salvage and three preoperative autologous donation (PAD). Five published
systematic reviews were identified for antifibrinolytics, fibrin sealants and restrictive transfusion
triggers, PAD plus erythropoietin, erythropoietin alone and acute normovolaemic haemodilution
(ANH). Twelve published studies reported full economic evaluations. All but two of the transfusion
strategies significantly reduced exposure to allogeneic blood. The relative risk of exposure to
allogeneic blood was 0.59 for the pooled trials of cell salvage (95% confidence interval: 0.48 to 0.73).
This varied by the type and timing of cell salvage and type of surgical procedure. For cell salvage, the
relative risk of allogeneic blood transfusion was higher in cardiac surgery than in orthopaedic surgery.
Cell salvage had lower costs and slightly higher quality-adjusted life years compared with all of the
alternative transfusion strategies except ANH. The likelihood that cell salvage is cost-effective
compared with strategies other than ANH is over 50%. Most of the secondary analyses indicated
similar results to the primary analysis. However, the primary and secondary analyses indicated that
ANH may be more cost-effective than cell salvage. CONCLUSIONS: The available evidence indicates
that cell salvage may be a cost-effective method to reduce exposure to allogeneic blood transfusion.
However, ANH may be more cost-effective than cell salvage. The results of this analysis are subject to
the low quality and reliability of the data used and the use of indirect comparisons. This may affect the
reliability and robustness of the clinical and economic results. There is a need for further research that
includes adequately powered high-quality RCTs to compare directly various blood transfusion
strategies. These should include measures of health status, health-related quality of life and patient
preferences for alternative transfusion strategies. Observational and tracking studies are needed to
estimate reliably the incidence of adverse events and infections transmitted during blood transfusion
and to identify the lifetime consequences of the serious hazards of transfusion on mortality, health
status and health-related quality of life

Abstract: BACKGROUND: Concerns regarding the safety of transfused blood, have prompted reconsideration
of the use of allogeneic (blood from an unrelated donor) red blood cell (RBC) transfusion, and a range of
techniques to minimise transfusion requirements. OBJECTIVES: To examine the evidence for the
efficacy of cell salvage in reducing allogeneic blood transfusion and the evidence for any effect on
clinical outcomes. SEARCH STRATEGY: We searched the Cochrane Central Register of Controlled Trials,
MEDLINE, EMBASE, Current Contents and the websites of international health technology assessment
agencies. The reference lists in identified trials and review articles were also searched, and study
authors were contacted to identify additional studies. The searches were updated in January 2004.
SELECTION CRITERIA: Controlled parallel group trials in which adult patients, scheduled for non-urgent
surgery, were randomised to cell salvage, or to a control group, who did not receive the intervention.
DATA COLLECTION AND ANALYSIS: Two authors independently screened search results, extracted data
and assessed methodological quality. The main outcomes measures were the number of patients
exposed to allogeneic red cell transfusion, and the amount of blood transfused. Other outcomes
measured were re-operation for bleeding, blood loss, post-operative complications (thrombosis,
infection, non-fatal myocardial infarction, renal failure), mortality, and length of hospital stay (LOS).
MAIN RESULTS: Overall, the use of cell salvage reduced the rate of exposure to allogeneic RBC
transfusion by a relative 39% (relative risk [RR] = 0.61: 95% confidence interval [CI] 0.52 to 0.71). The
absolute reduction in risk (ARR) of receiving an allogeneic RBC transfusion was 23% (95% CI 16% to
30%). In orthopaedic procedures the RR of exposure to RBC transfusion was 0.42 (95% CI 0.32 to 0.54)
compared to 0.77 (95% CI 0.68 to 0.87) for cardiac procedures. The use of cell salvage resulted in an
average saving of 0.67 units of allogeneic RBC per patient (weighted mean difference was -0.64; 95% CI
-0.89 to -0.45). Cell salvage did not appear to impact adversely on clinical outcomes. AUTHORS’
CONCLUSIONS: The results suggest cell salvage is efficacious in reducing the need for allogeneic red
cell transfusion in adult elective surgery. However, the methodological quality of trials was poor. As
the trials were unblinded and lacked adequate concealment of treatment allocation, transfusion
practices may have been influenced by knowledge of the patients' treatment status biasing the results
in favour of cell salvage
Abstract: Concern about risks of allogeneic transfusion has led to an interest in methods for decreasing perioperative allogeneic blood transfusions administered to patients treated with a retransfusion system was similar to the results found in a preceding prospective study. A total of 438 patients treated with the Bellovac ABT retransfusion system were analysed in which the majority was operated on a total hip arthroplasty (THA) and total knee arthroplasty (TKA). The amount of retransfused shed blood, the perioperative haemoglobin levels and the number of allogeneic blood transfusions were registered. The average amount of retransfusion was 152 mL in THA and 410 mL in TKA, whereas the allogeneic blood transfusion rate was 8.4 and 5.1% in both groups, respectively. The average percentage of allogeneic blood transfusions administered in this study (i.e. 7%) proved to be marginally higher than the percentage found in a preceding prospective study (i.e. 6%) because of slackening of attention for transfusion policy in everyday practice. Limited bone resection procedures such as resurfacing THA or unicompartmental knee arthroplasty were associated with very limited shed blood and low risk of allogeneic blood transfusion, indicating the doubtful cost efficiency of using a retransfusion system in these patients. It can be concluded that the efficiency of the retransfusion system in everyday practice was similar to the efficiency shown in a preceding prospective study focusing on blood management. However, continual training of the clinical team is crucial.


Abstract: Concern about risks of allogeneic transfusion has led to an interest in methods for decreasing perioperative transfusion. To determine whether cell salvage reduces patient exposure to allogeneic blood, we performed meta-analyses of randomized trials, evaluating the effectiveness and safety of cell salvage in cardiac or orthopaedic elective surgery. The primary outcome was the proportion of patients who received at least one perioperative allogeneic red cell transfusion. Twenty-seven studies were included in the meta-analyses. Cell salvage devices that do not wash salvaged blood were marginally effective in cardiac surgery patients when used postoperatively (relative risk [RR] = 0.85, 95% confidence interval [CI] = 0.79-0.92). Devices that wash or do not wash salvaged blood considerably decreased the proportion of orthopaedic surgery patients who received allogeneic transfusion (RR = 0.39, 95% CI = 0.30-0.51 and RR = 0.35, 95% CI 0.26-0.46, respectively). No studies of cell savers that wash salvaged blood during cardiac surgery were included. Cell salvage did not appear to increase the frequency of adverse events. We conclude that cell salvage in orthopaedic surgery decreases the risk of patients’ exposure to allogeneic blood transfusion perioperatively. Postoperative cell salvage in cardiac surgery, with devices that do not wash the salvaged blood, is only marginally effective. IMPLICATIONS: This meta-analysis of all published randomized trials provides the best current estimate of the effectiveness of cell salvage and is useful in guiding clinical practice. We conclude that cell salvage in orthopaedic surgery decreases the proportion of patients requiring allogeneic blood transfusion perioperatively, but postoperative cell salvage is only marginally effective in cardiac surgery.


Abstract: BACKGROUND: Concerns regarding the safety of transfused blood, have prompted reconsideration of the use of allogeneic (blood from an unrelated donor) red blood cell (RBC) transfusion, and a range of techniques to minimise transfusion requirements. OBJECTIVES: To examine the evidence for the efficacy of cell salvage in reducing allogeneic blood transfusion and the evidence for any effect on clinical outcomes. SEARCH STRATEGY: We identified studies by searching CENTRAL (The Cochrane Library 2009, Issue 2), MEDLINE (1950 to June 2009), EMBASE (1980 to June 2009), the Internet (to August 2009) and bibliographies of published articles. SELECTION CRITERIA: Randomised controlled trials with a concurrent control group in which adult patients, scheduled for non-urgent surgery, were randomised to cell salvage (autotransfusion), or to a control group, who did not receive the
intervention. DATA COLLECTION AND ANALYSIS: Data were independently extracted and the risk of bias assessed. Relative risks (RR) and weighted mean differences (WMD) with 95% confidence intervals (CIs) were calculated. Data were pooled using a random effects model. The primary outcomes were the number of patients exposed to allogeneic red cell transfusion, and the amount of blood transfused. Other clinical outcomes are detailed in the review. MAIN RESULTS: A total of 75 trials were included. Overall, the use of cell salvage reduced the rate of exposure to allogeneic RBC transfusion by a relative 38% (RR=0.62; 95% CI 0.55 to 0.70). The absolute reduction in risk (ARR) of receiving an allogeneic RBC transfusion was 21% (95% CI 15% to 26%). In orthopaedic procedures the RR of exposure to RBC transfusion was 0.46 (95% CI 0.37 to 0.57) compared to 0.77 (95% CI 0.69 to 0.86) for cardiac procedures. The use of cell salvage resulted in an average saving of 0.68 units of allogeneic RBC per patient (WMD=-0.68; 95% CI -0.88 to -0.49). Cell salvage did not appear to impact adversely on clinical outcomes. AUTHORS' CONCLUSIONS: The results suggest cell salvage is efficacious in reducing the need for allogeneic red cell transfusion in adult elective cardiac and orthopaedic surgery. The use of cell salvage did not appear to impact adversely on clinical outcomes. However, the methodological quality of trials was poor. As the trials were unblinded and lacked adequate concealment of treatment allocation, transfusion practices may have been influenced by knowledge of the patients' treatment status potentially biasing the results in favour of cell salvage.


Abstract: Hemodilution during cardiopulmonary bypass (CPB) continues to be a cause of morbidity associated with coagulation dysfunction, bleeding, and allogeneic blood transfusion. Clot formation and strength have been shown to impact bleeding and transfusions. Strategies to reduce hemodilution may be negated based on the course of the cardiac procedure itself. Modified ultrafiltration (MUF) is commonly used in pediatric cardiac surgery; however, it is not well accepted in adult surgery. This study aimed to evaluate clot formation and strength, bleeding, and transfusions in adult subjects undergoing MUF. Nineteen subjects having primary coronary artery bypass, aortic, or mitral valve surgeries were recruited and randomized to having MUF (n = 10) or no-MUF (n = 9) performed after the termination of CPB. Five time points for data collection were designated: T1, baseline/induction; T2, termination CPB; T3, post-MUF; T4, post-protamine; T5, 24 hours postoperative. Subjects randomized to MUF had 1505 +/- 15.8 mL of effluent removed, and no-MUF subjects had the CPB remnants processed with a cell salvage device. There was no statistical difference seen in 24-hour chest tube output, thromboelastograph values, or allogeneic transfusions at any time point between MUF and no-MUF subjects. There was a significant difference between MUF and no-MUF in the number of autologous cell salvage units processed (1.3 +/- .48 vs. 2.9 +/- .78, p = .0013) and end of procedure net fluid balance (+2003 +/- 1211 vs. +4194 +/- 1276 mL, p = .001), respectively. Estimated plasma loss from the cell salvage device was 477.6 mL greater in the no-MUF group. In primary adult cardiac procedures, MUF did not change coagulation measures as measured by thromboelastography, number of allogeneic unit transfusions, or chest tube output at 24 hours postoperatively. There was a significant difference in autologous cell salvage units processed and end of procedure net fluid balance that benefited MUF subjects.


Abstract: BACKGROUND: Previous data show improved clot formation after retransfusion of salvaged red blood cells (RBCs). This study was conducted to explore whether such RBCs contain clinically relevant numbers of active residual platelets (PLTs) or exhibit formation of microparticles (MPs). STUDY DESIGN AND METHODS: Thirteen patients undergoing major orthopedic surgery were included in the study, and arterial blood samples from patients and samples from the retransfusion bag were analyzed with various PLT function tests and flow cytometry. RESULTS: With commercial blood cell counters, the numbers of PLTs in the RBC unit were reduced to approximately 25% compared to patients' blood. In contrast, results from flow cytometry showed an 11- to 945-fold reduction in median counts referring to total PLTs and free PLTs. Interestingly, smaller quantities of PLT-derived MPs were found in samples from the retransfusion bag than in patients' arterial blood. Conversely, RBC- and white blood cell-derived MP counts were increased in the retransfusion bag compared to the patient. Rotational thrombelastometry and the Impact-R system (DiaMed) showed a pronounced impairment of PLT ability with regard to adhesion, aggregation, and clot formation. With the use of confocal microscopy,
only a few free thrombocytes were detectable among the huge numbers of RBCs. CONCLUSION: Only few free and thus active PLTs are detectable in processed RBCs. It seems very unlikely that these few PLTs can improve clot strength. Nevertheless, the impact of the detected MPs on thrombin generation needs to be clarified in further studies.


Abstract: To support blood supply in the growing field of cancer surgery and to avoid transfusion induced immunomodulation caused by the allogeneic barrier and by blood storage lesions we use intraoperative blood salvage with blood irradiation. This method is safe as it provides efficient elimination of contaminating cancer cells, and as it does not compromise the quality of RBC. According to our experience with more than 700 procedures the combination of blood salvage with blood irradiation also is very effective in saving blood resources. With this autologous, fresh, washed RBC a blood product of excellent quality is available for optimal hemotherapy in cancer patients.


Abstract: BACKGROUND: Blood conservation techniques are being increasingly used because of the increased cost and lack of availability of allogeneic blood. Cell salvage offers great blood savings opportunities but is thought to be contraindicated in a number of areas (e.g., blood contaminated with bacteria). Several outcome studies have suggested the safety of this technique in trauma and colorectal surgery, but many practitioners are still hesitant to apply cell salvage in the face of frank bacterial contamination. This study was undertaken to assess the efficacy of bacterial removal when cell salvage was combined with leukocyte depletion filtration. METHODS: Expired packed erythrocytes were obtained and inoculated with a fixed amount of a stock bacteria (Escherichia coli American Type Culture Collections [ATCC] 25922, Pseudomonas aeruginosa ATCC 27853, Staphylococcus aureus ATCC 29213, or Bacteroides fragilis ATCC 25285) in amounts ranging from 2,000 to 4,000 colony forming units/ml. The blood was processed via a cell salvage machine. The washed blood was then filtered using a leukocyte reduction filter. The results for blood taken during each step of processing were compared using a repeated-measures design. RESULTS: Fifteen units of blood were contaminated with each of the stock bacteria. From the prewash sample to the postfiltration sample, 99.0%, 99.6%, 100%, and 97.6% of E. coli, S. aureus, P. aeruginosa, and B. fragilis were removed, respectively. DISCUSSION: Significant but not complete removal of contaminating bacteria was seen. An increased level of patient safety may be added to cell salvage by including a leukocyte depletion filter when salvaging blood that might be grossly contaminated with bacteria.


Abstract: BACKGROUND: Cell salvage in obstetrics is still a controversial subject and has yet to be fully embraced. The aim of this exploratory study was to measure amniotic fluid (AF), heparin, and fetal red cell contamination of washed filtered salvaged maternal blood and to investigate differences based on the number of suction devices used. METHODS: Patients undergoing elective Caesarean section were assigned alternately to one of two groups. In Group 1, all blood and AF was collected with one suction. In Group 2, AF was aspirated to waste with a second separate suction device before collection of any blood. RESULTS: In both groups, alpha-fetoprotein (AFP), squames cells, and heparin were significantly reduced (P<0.001) by the washing and filtering process. Mean AFP levels post-filtration were 2.58 IU ml(-1) in Group 1 and 3.53 IU ml(-1) in Group 2. Squames cells were completely removed in all but two cases. Fetal red blood cells were still present in the final product, range 0.13-4.35%. In Group 1, haemoglobin and haematocrit were higher than in Group 2, with lower white blood cell, AFP, and fetal red cell counts. CONCLUSIONS: This study adds to the growing body of evidence that there is little or no possibility for AF contamination to enter the re-infusion system when used in conjunction with a leukodepletion filter.

Abstract: BACKGROUND: Cell salvage has been used in obstetrics to a limited degree because of a fear of amniotic fluid embolism. In this study, cell salvage was combined with blood filtration using a leukocyte depletion filter. A comparison of this washed, filtered product was then made with maternal central venous blood. METHODS: The squamous cell concentration, lamellar body count, quantitative bacterial colonization, potassium level, and fetal hemoglobin concentration were measured in four sequential blood samples collected from 15 women undergoing elective cesarean section. The blood samples collected included (1) unwashed blood from the surgical field (prewash), (2) washed blood (postwash), (3) washed and filtered blood (postfiltration), and (4) maternal central venous blood drawn from a femoral catheter at the time of placental separation. RESULTS: Significant reductions in the following parameters were seen when the postfiltration samples were compared to the prewash samples (median [25th-75th percentile]): squamous cell concentration [0.0 [0.0-0.1 counts/high-powered field (HPF)] vs. 8.3 counts/HPF [4.0-10.5 counts/HPF], P < 0.05); bacterial contamination [0.1 [0.0-0.2] vs. 3.0 [0.6-7.7] colony-forming units (CFU)/ml, P < 0.01]; and lamellar body concentration [0.0 [0.0-1.0] vs. 22.0 [18.5-29.5] thousands/microl, P < 0.01]. No significant differences existed between the postfiltration and maternal samples for each of these parameters. Fetal hemoglobin was in higher concentrations in the postfiltration sample when compared with maternal blood (1.9 [1.1-2.5] vs. 0.5% [0.3-0.7]). Potassium levels were significantly less in the postfiltration sample when compared with maternal [1.4 [1.0-1.5] vs. 3.8 mEq/l [3.7-4.0]]. CONCLUSIONS: Leukocyte depletion filtering of cell-salvaged blood obtained from cesarean section significantly reduces particulate contaminants to a concentration equivalent to maternal venous blood


Abstract: There continues to be evidence regarding the negative impact of blood transfusion on morbidity and mortality in the adult literature, including infection risk, increased hospital and intensive care length of stay, and costs. More effort has been put into reducing the use of blood components in adult surgical centers but blood transfusions continue to be used frequently in pediatric centers. From 2002 through 2005, we embarked on a mission of reduced prime volume in an effort toward bloodless cardiac surgery to meet the needs of the Jehovah’s Witness patient. The same bloodless surgical and perfusion techniques were applied to all patients undergoing cardiopulmonary bypass beginning in 2006. Circuit size was minimized and acute normovolemic hemodilution (ANH) was considered and attempted more often, especially if a re-operation. Retrograde arterial prime (RAP) and venous antegrade prime (VAP), dilutional or balanced ultrafiltration during cardiopulmonary bypass, modified arteriovenous ultrafiltration post bypass, and cell salvage of remaining circuit contents after flushing with crystalloid were recorded. ANH, RAP, and VAP, separately or in combination, were used less than 1% of the time prior to 2006. From 2006-2008 ANH was performed on 42% of the patients and RAP/VAP was performed on 70% of the patients. From 2006-2008, 43% (287 of 662) of the open heart surgeries were performed bloodless in the operating room versus 30% (193 of 633) from 2003-2005. Bloodless surgery more than doubled for the 0-6, 6-15, and 15-20 kg groups from 3.5%, 23%, and 23% respectively in 2003-2005 to 9%, 44%, and 58%, respectively in 2006-2008. With the cooperation of the entire cardiac surgical team, bloodless open heart surgery is achievable in a pediatric cardiac surgical center, including neonates


Abstract: BACKGROUND: Pulmonary dysfunction is one of the most common manifestations of inflammatory response after cardiopulmonary bypass (CPB). OBJECTIVE: This prospective randomized study was conducted to evaluate the effect of a modified ultrafiltration (MUF) technique on pulmonary function after CPB in children. METHODS: Forty patients weighing from 5 to 10 kg with congenital heart disease who required CPB for primary biventricular operative repair were prospectively randomized into two groups. The control group received conventional ultrafiltration (CUF) during CPB, and the study group received CUF and MUF. Pulmonary compliance (static and dynamic) and gas exchange capacity of the lung expressed as oxygen index, respiratory index, ventilation index, and alveolar-arterial oxygen pressure difference were measured after intubation (baseline), at the termination of CPB, at the end of MUF, on admission to the ICU, and 6 h postoperatively. RESULTS: There was no significant difference in lung compliance and gas exchange between the two groups before CPB. CPB produced a significant decrease in static and dynamic lung compliance in both groups. In the control group, static and dynamic lung compliance decreased from 1.0 +/- 0.3 to 0.90 +/- 0.3 mL/cm/kg and 0.87 +/- 0.2 to...
Abstract: BACKGROUND: Preoperative bleeding time (BT) does not correlate with postoperative bleeding in patients subjected to surgical procedures. A significant positive correlation has been reported between the BT 2 hours after cardiopulmonary bypass surgery and the nonsurgical blood loss during the first 4 hours after bypass surgery. This study was done to investigate the effect of Hct and platelet count on the BT measurement in normal, healthy men and women. STUDY DESIGN AND METHODS: To assess the relative effect of RBCs and platelets on the BT, 22 healthy male and 7 healthy female volunteers were subjected to the removal of 2 units of RBCs (360 mL), followed by the return of the platelet-rich plasma (PRP) from both units and the infusion of 1000 mL of 0.9-percent NaCl. Four of the men and all seven women received their RBCs 1 hour after their removal. Shed blood levels of thromboxane B(2) (TXB(2)), 6-keto prostaglandin F(1 alpha), and peripheral venous Hct were measured. BTs were measured in 15 men and 13 women before and after a platelethresis procedure to collect 3.6 x 10(11) platelets per unit. RESULTS: The 2-unit RBC apheresis procedure produced a 60-percent increase in the BT associated with a 15-percent reduction in the peripheral venous Hct and a 9-percent reduction in the platelet count. The platelethresis procedure produced a 32-percent decrease in the platelet count, no change in peripheral venous Hct, and no change in the BT. After the removal of 2 units of RBCs, the shed blood TXB(2) level decreased significantly. Reinfusion of 2 units of RBCs restored the BT and restored the TXB(2) level to the baseline levels. CONCLUSION: The acute reduction in Hct produced a reversible platelet dysfunction manifested by an increase in BT and a decrease in the shed blood TXB(2) level at the template BT site. Return of the RBCs restored both the BT and the shed blood TXB(2) level to normal. The platelet dysfunction


Abstract: The purpose of this study was: 1) to define coagulation abnormalities in patients who receive red cell concentrates rather than whole blood for large volume blood loss (greater than 0.5 blood volume); and 2) to determine when coagulation abnormalities lead to increased bleeding in the massively transfused surgical patient. We studied 32 ASA physical status I or II patients (mean age 15.6 +/- 2.3 yr) who lost more than 50% of their blood volume during elective posterior spinal stabilization. Crystalloid solutions and packed red cell concentrates were used to replace blood and fluid losses. Invasive hemodynamic measures, urinary output, and serial hematocrit determinations were used to help maintain a constant intravascular volume and confirm the estimates of blood loss. The quality of hemostasis was assessed during operation. In 15 of the 32 patients, surgical hemostasis remained effective throughout posterior spinal fusion. A coagulation profile (prothrombin time [PT] and activated partial thromboplastin time [aPTT], platelet count, and fibrinogen) was measured at the conclusion of operation in these patients. In 17 patients, increased surgical bleeding as a result of decreased clot formation and increased bleeding from the wound was present. In these 17 patients at the time increased bleeding was diagnosed, hemostatic tests (PT, aPTT, fibrinogen, platelet count, and coagulation factor assays V, VIII, and IX) were obtained. (ABSTRACT TRUNCATED AT 250 WORDS)


Abstract: BACKGROUND: Preoperative bleeding time (BT) does not correlate with postoperative bleeding in patients subjected to surgical procedures. A significant positive correlation has been reported between the BT 2 hours after cardiopulmonary bypass surgery and the nonsurgical blood loss during the first 4 hours after bypass surgery. This study was done to investigate the effect of Hct and platelet count on the BT measurement in normal, healthy men and women. STUDY DESIGN AND METHODS: To assess the relative effect of RBCs and platelets on the BT, 22 healthy male and 7 healthy female volunteers were subjected to the removal of 2 units of RBCs (360 mL), followed by the return of the platelet-rich plasma (PRP) from both units and the infusion of 1000 mL of 0.9-percent NaCl. Four of the men and all seven women received their RBCs 1 hour after their removal. Shed blood levels of thromboxane B(2) (TXB(2)), 6-keto prostaglandin F(1 alpha), and peripheral venous Hct were measured. BTs were measured in 15 men and 13 women before and after a platelethresis procedure to collect 3.6 x 10(11) platelets per unit. RESULTS: The 2-unit RBC apheresis procedure produced a 60-percent increase in the BT associated with a 15-percent reduction in the peripheral venous Hct and a 9-percent reduction in the platelet count. The platelethresis procedure produced a 32-percent decrease in the platelet count, no change in peripheral venous Hct, and no change in the BT. After the removal of 2 units of RBCs, the shed blood TXB(2) level decreased significantly. Reinfusion of 2 units of RBCs restored the BT and restored the TXB(2) level to the baseline levels. CONCLUSION: The acute reduction in Hct produced a reversible platelet dysfunction manifested by an increase in BT and a decrease in the shed blood TXB(2) level at the template BT site. Return of the RBCs restored both the BT and the shed blood TXB(2) level to normal. The platelet dysfunction
observed with the reduction in Hct was due in part to a reduction in shed blood TXB(2) and other, unknown mechanisms

(271) Segal JB, Dzik WH. Paucity of studies to support that abnormal coagulation test results predict bleeding in the setting of invasive procedures: an evidence-based review. Transfusion 2005 Sep;45(9):1413-25.
Abstract: BACKGROUND: The literature was systematically reviewed to determine whether a prolonged prothrombin time or elevated international normalized ratio predicts bleeding during invasive diagnostic procedures. STUDY DESIGN AND METHODS: MEDLINE and CENTRAL were searched through August 2004, with no language restriction, and reference lists were reviewed. For inclusion, articles must have reported on bleeding in more than five patients with abnormal test results undergoing diagnostic procedures. RESULTS: One trial and 24 observational studies were included. In 2 studies of bronchoscopy, the bleeding rates were similar among those with normal and abnormal tests, with wide confidence intervals (CIs) around the risk differences. During central vein cannulation (3 studies), bleeding rates among those with abnormal tests was unlikely to exceed 2.3 percent. The largest of 3 studies of arteriography found equivalent bleeding rates in patients with and without abnormal tests (risk difference, 0%; 95% CI, -3% to 2%). In the 3 studies of liver biopsy with plugging, bleeding rates were 0, 4, and 5 percent with the upper bounds of the CI as high as 17 percent. In the largest study of transjugular biopsy, the bleeding rate was 1.5 percent (95% CI, 0.3%-4%) in patients with abnormal tests. The highest bleeding rate in the 3 studies of percutaneous liver biopsy was 5.3 percent (95% CI, 1%-13%), similar to the rate in patients with normal test results. CONCLUSION: There is insufficient evidence to conclude that abnormal test results predict bleeding. Randomized controlled trials should be performed to provide stronger evidence for clinical decision making regarding preprocedure transfusion

Abstract: Unselected coagulation testing is widely practiced in the process of assessing bleeding risk prior to surgery. This may delay surgery inappropriately and cause unnecessary concern in patients who are found to have 'abnormal' tests. In addition it is associated with a significant cost. This systematic review was performed to determine whether patient bleeding history and unselected coagulation testing predict abnormal perioperative bleeding. A literature search of Medline between 1966 and 2005 was performed to identify appropriate studies. Studies that contained enough data to allow the calculation of the predictive value and likelihood ratios of tests for perioperative bleeding were included. Nine observational studies (three prospective) were identified. The positive predictive value (0.03-0.22) and likelihood ratio (0.94-5.1) for coagulation tests indicate that they are poor predictors of bleeding. Patients undergoing surgery should have a bleeding history taken. This should include detail of previous surgery and trauma, a family history, and detail of anti-thrombotic medication. Patients with a negative bleeding history do not require routine coagulation screening prior to surgery

Abstract: Patients with cardiovascular disease have an array of haemostasis disorders that predispose to the development of thrombotic and embolic disease states. These patients are often maintained on anti-thrombotic medication to prevent adverse cardiovascular events. Patients undergoing cardiac surgery also have haemostatic disorders that include their intrinsic disease state, adjunctive medication, and the coagulation disturbances induced by cardiopulmonary bypass. The following review introduces the monitors that are available for monitoring perioperative coagulation, with an emphasis on cardiovascular surgery. Heparin monitors, platelet function monitors for use in transfusion algorithms, and monitoring anti-platelet drugs will be discussed

Abstract: OBJECTIVE: Bleeding and allogeneic transfusion remain constant problems in cardiac surgical procedures. In this study, we aimed to test the role of a routine thromboelastography (TEG)-based algorithm on bleeding and transfusions in patients undergoing elective coronary artery bypass grafting
(CABG). METHODS: Patients (n = 224) undergoing elective CABG with cardiopulmonary bypass were prospectively randomized into two groups according to transfusion strategy: in group 1 (clinician-directed transfusion, n = 110) need for blood transfusion was based on clinician’s discretion and standard coagulation tests and in group 2 (TEG algorithm group, n = 114) kaolin-activated (k) TEG-based algorithm-guided perioperative transfusion management. Transfusion, blood loss, and outcome data were recorded. RESULTS: There were no differences in consumption of packed cell units, blood loss, re-exploration for bleeding, and early clinical outcome between the groups. Patients in the TEG group had significantly lower median units of fresh frozen plasma and platelets compared with the other group (p = 0.001). The median number of total allogeneic units transfused (packed cells and blood products) was significantly reduced in the TEG group compared with the other group (median 2, range 1-3 units vs. median 3, range 2-4 units, respectively, p = 0.001). The need for tranexamic acid was significantly diminished in the TEG group compared with the other group (10.3% vs. 19%, respectively, p = 0.007). CONCLUSION: Our results show that routine use of a kTEG-guided algorithm reduces the consumption of blood products in patients undergoing elective CABG. Adopting such an algorithm into routine management of these patients may help to improve clinical outcome and reduce the potential risks of transfusion-related complications and total costs after CABG

Abstract: BACKGROUND: The hemostatic effect of platelets has been well established, but the possible role of red cells in hemostasis has not yet been well studied. An evaluation of the hemostatic effect of packed red cell transfusion in patients with chronic anemia was the purpose of this study. STUDY DESIGN AND METHODS: In a prospective study, bleeding time (BT), activated partial thromboplastin time (APTT), and prothrombin time (PT) were measured before and after the transfusion of allogeneic packed red cells in 42 patients with chronic anemia. The results were compared and analyzed. RESULTS: APTT and BT decreased significantly after transfusion, by a mean of 1.3 seconds (p = 0.01) and 2.6 minutes (p < 0.01), respectively. PT did not change significantly after transfusion (p = 0.65). Factors studied (patient’s age, sex, and renal function measurements; pretransfusion and posttransfusion hemoglobin levels, platelet counts, and PTs; change in platelet count [delta platelet count] and PT [delta PT] after transfusion) did not independently affect the change in BT (delta BT) or in APTT (delta APTT). The delta BT was not affected by the pretransfusion or posttransfusion levels of APTT or by the delta APTT. The delta APTT was not affected by the pretransfusion or posttransfusion levels of BT or by the delta BT. Diagnosis of malignant or benign diseases was found to affect delta APTT, but not delta BT. Patients with pretransfusion hemoglobin < or = 60 g per L had a 4.07 times greater chance of postransfusion increase in BT than the patients with hemoglobin > 60 g per L (p = 0.04). CONCLUSION: Red cell transfusion might decrease the APTT and BT in some anemic patients, though the actual cause of the decrease was not determined in the present study

Abstract: Low haematocrit values are generally well tolerated in terms of oxygen transport but a low haematocrit might interfere with blood coagulation. We thus sampled 60 ml of blood in 30 healthy volunteers. The blood was centrifuged for 30 min at 2000 g and separated into plasma, which contained the platelet fraction, and packed red blood cells. The blood was subsequently reconstituted by combining the entire plasma fraction with a mixture of packed red cells, 0.9% saline, so that the final haematocrit was either 40, 30, 20, or 10%. Blood coagulation was assessed by computerized Thrombelastograph(R) analysis. Data were compared using repeated measures analysis of variance and post-hoc paired t-tests with Bonferroni correction. Decreasing the haematocrit from 40 to 10% resulted in a shortening of reaction time (r) and coagulation time (k), and an increase in angle (alpha), maximum amplitude (MA) and clot strength (G) (all P<0.02). This pattern represents acceleration of blood coagulation with low haematocrit values. The isolated reduction in haematocrit, therefore, does not compromise in vitro blood coagulation. Br J Anaesth 2001; 87: 246-9

Abstract: BACKGROUND: Currently there is no sensitive laboratory test to establish the influence of red blood cells (RBCs) on hemostasis. As thromboelastography (TEG) measures hemostasis in whole blood, taking into account the interactions of all cellular elements, we used this instrument to investigate the
role that RBCs play in hemostasis. STUDY DESIGN AND METHODS: In 29 patients with chemotherapy-induced anemia we studied the effect of progressive anemia on the coagulation profile. In 24 patients with chronic anemia we studied the effect of transfusion of RBCs on coagulation. Finally, in 18 patients we evaluated whether storage time of RBCs has additional effects on hemostasis. RESULTS: We observed a significant negative correlation between hemoglobin and TEG variables related to both clot strength and elasticity (p < 0.05). Moreover, anemia was associated with a delay in the initiation of the coagulation cascade. Correction of anemia by RBC transfusion resulted in significant shortening of this initiation phase with now the opposite effect on clot strength and elasticity. The negative effects on clot quality were significantly worse when fresh RBCs were transfused compared to longer-stored RBCs. Furthermore, in contrast to the longer-stored RBCs, fresh RBCs did not enhance initial fibrin formation. CONCLUSIONS: In this study we found that anemia was associated with a delay in the initiation of the coagulation cascade with a finally formed clot with superior strength and viscoelastic properties. Transfusion of RBCs was associated with impaired clot quality, with even worse effects on the initial fibrin build-up and clot quality by fresh RBCs

Abstract: OBJECTIVE: The detrimental effects of coagulopathy, hypothermia, and acidosis are well described as markers for mortality after traumatic hemorrhage. Recent military experience suggests that a high fresh frozen plasma (FFP):packed red blood cell (PRBC) transfusion ratio improves outcome; however, the appropriate ratio these transfusion products should be given remains to be established in a civilian trauma population. METHODS: Data were obtained from a multicenter prospective cohort study evaluating clinical outcomes in blunt injured adults with hemorrhagic shock. Those patients who required >/=8 units PRBCs within the first 12 hours postinjury were analyzed (n = 415). RESULTS: Patients who received transfusion products in >/=1:1.50 FFP:PRBC ratio (high F:P ratio, n = 102) versus <1:1.50 FFP:PRBC ratio (low F:P, n = 313) required significantly less blood transfusion at 24 hours (16 +/- 9 units vs. 22 +/- 17 units, p = 0.001). Crude mortality differences between the groups did not reach statistical significance (high F:P 28% vs. low F:P 35%, p = 0.202); however, there was a significant difference in early (24 hour) mortality (high F:P 3.9% vs. low F:P 12.8%, p = 0.012). Cox proportional hazard regression revealed that receiving a high F:P ratio was independently associated with 52% lower risk of mortality after adjusting for important confounders (HR 0.48, p = 0.002, 95% CI 0.3-0.8). A high F:P ratio was not associated with a higher risk of organ failure or nosocomial infection, however, was associated with almost a twofold higher risk of acute respiratory distress syndrome, after controlling for important confounders. CONCLUSIONS: In patients requiring >/=8 units of blood after serious blunt injury, an FFP:PRBC transfusion ratio >/=1:1.5 was associated with a significant lower risk of mortality but a higher risk of acute respiratory distress syndrome. The mortality risk reduction was most relevant to mortality within the first 48 hours from the time of injury. These results suggest that the mortality risk associated with an FFP:PRBC ratio <1:1.5 may occur early, possibly secondary to ongoing coagulopathy and hemorrhage. This analysis provides further justification for the prospective trial investigation into the optimal FFP:PRBC ratio required in massive transfusion practice

Abstract: BACKGROUND: In trauma, most hemorrhagic deaths occur within the first 6 hours. This study examined the effect on survival of high ratios of fresh frozen plasma (FFP) and platelets (PLTs) to packed red blood cells (PRBCs) in the first 6 hours. METHODS: Records of 466 massive transfusion trauma patients (>or=10 U of PRBCs in 24 hours) at 16 level 1 trauma centers were reviewed. Transfusion ratios in the first 6 hours were correlated with outcome. RESULTS: All groups had similar baseline characteristics. Higher 6-hour ratios of FFP:PRBCs and PLTs:PRBCs lead to improved 6-hour mortality (from 37.3 [in the lowest ratio group] to 15.7 [in the middle ratio group] to 2.0% [in the highest ratio group] and 22.8% to 19.0% to 3.2%, respectively) and in-hospital mortality (from 54.9 to 41.1 to 25.5% and 43.7% to 46.8% to 27.4%, respectively). Initial higher ratios of FFP:PRBCs and PLTs:PRBCs decreased overall PRBC transfusion. CONCLUSIONS: The early administration of high ratios of FFP and platelets improves survival and decreases overall PRBC need in massively transfused
patients. The largest difference in mortality occurs during the first 6 hours after admission, suggesting that the early administration of FFP and platelets is critical.


Abstract: BACKGROUND: Although hemostatic resuscitation with a 1:1 ratio of fresh-frozen plasma (FFP) to packed red blood cells (PRBC) after severe hemorrhage has been shown to improve survival, its benefit in patients with traumatic-induced coagulopathy (TIC) after >10 units of PRBC during operation has not been elucidated. We hypothesized that a survival benefit would occur when early hemostatic resuscitation was used intraoperatively after injury in patients with TIC. METHODS: A 7-year retrospective study of patients with emergency department diagnosis of TIC after transfusion of >10 units of PRBC in the operating room. TIC was defined as initial emergency department international normalized ratio > 1.2, prothrombin time > 16 seconds, and partial thromboplastin time > 50 seconds. Patients were divided into FFP:PRBC ratios of 1:1, 1:2, 1:3, and 1:4. Patients with diagnosis of TIC who received transfusion of both FFP and PRBC during surgery were included. Other variables evaluated included age, gender, mechanism of injury, initial base deficit, mean operative time, trauma intensive care unit length of stay (TICU LOS) and Injury Severity Score. The primary outcome measure evaluated was the impact of the early FFP:PRBC ratio on mortality. RESULTS: Four hundred thirty-five patients underwent emergency operations postinjury and received FFP with >10 units of PRBC in the operating room; 135 (31.0%) of these patients had TIC and 53 died (39.5% mortality). Mean operative time was 137 minutes (SD +/- 49). There were no differences with regard to age, gender, mechanism of injury, initial base deficit, or Injury Severity Score among all groups. A significant difference in mortality was found in patients who received >10 units of PRBC when FFP:PRBC ratio was 1:1 versus 1:4 (28.2% vs. 51.1%, p = 0.03). Intermediate mortality rates were noted in patients with 1:2 and 1:3 ratios (38% and 40%, respectively). From a linear regression model, 13 days of increased TICU LOS was observed among 1:4 group compared with 1:1 group (p < 0.01). CONCLUSION: TIC is common after severe injury and is associated with a high mortality in patients transfused with >10 units of PRBC during surgery. Early hemostatic resuscitation during first hours after injury improves survival with shorter TICU LOS in patients with TIC.


Abstract: BACKGROUND AND OBJECTIVE: Patients with critical limb ischemia have a perioperative cardiovascular morbidity comparable to patients with acute coronary syndromes. We hypothesized that perioperative dual antiplatelet therapy would improve biomarkers of atherothrombosis without causing unacceptable bleeding in patients undergoing surgery for critical limb ischemia. METHODS: In a double-blind randomized controlled trial, 108 patients undergoing infrainguinal revascularization or amputation for critical limb ischemia were maintained on aspirin (75 mg daily) and randomized to clopidogrel (600 mg prior to surgery, and 75 mg daily for 3 days; n = 50) or matched placebo (n = 58). Platelet activation and myocardial injury were assessed by flow cytometry and plasma troponin concentrations, respectively. RESULTS: Clopidogrel reduced platelet-monocyte aggregation before surgery (38%-30%; P = 0.007). This was sustained in the postoperative period (P = 0.0019). There were 18 troponin-positive events (8 [16.0%] clopidogrel vs. 10 [17.2%] placebo; relative risk [RR]: 0.93, 95% confidence interval [CI]: 0.39-2.17; P = 0.86). Half of troponin-positive events occurred preoperatively with clopidogrel causing a greater decline in troponin concentrations (P < 0.001). There was no increase in major life-threatening bleeding (7 [14%] vs. 6 [10%]; RR: 1.4, 95% CI: 0.49-3.76; P = 0.56) or minor bleeding (17 [34%] vs. 12 [21%]; RR 1.64, 95% CI: 0.87-3.1; P = 0.12), although blood transfusions were increased (28% vs. 12.6%; RR: 2.3, 95% CI: 1.0-5.29; P = 0.037). CONCLUSIONS: In patients with critical limb ischemia, perioperative dual antiplatelet therapy reduces biomarkers of atherothrombosis without causing unacceptable bleeding. Large-scale randomized controlled trials are needed to establish whether dual antiplatelet therapy improves clinical outcome in high-risk patients undergoing vascular surgery.

Abstract: New trends in interventional cardiology, e.g. the increasing practice of coronary intervention with stent implantation and the prolonged use of dual antiplatelet therapy–usually a combination of clopidogrel and aspirin–has also increased the number of patients presenting for non-cardiac surgery. The two most commonly used stent types, bare-metal stents (BMSs) and drug-eluting stents (DESs), mandate different lengths of dual antiplatelet drug therapy to avoid stent thrombosis. Perioperative caregivers face a knife-edge dilemma between perioperative stent thrombosis, due to preoperative discontinuation of antiplatelet drugs, or surgical bleeding, by continuation of therapy. Pre- and intraoperatively, the risk factors for thrombosis have to be balanced against the risk factors for surgical bleeding. As long as prospective trials are not available, the recommendations and guidelines of task forces and experts are based on retrospective studies and case reports. The perioperative management, decision trees and the importance of close interdisciplinary collaboration between cardiologists, surgeons and anaesthetists will be described.


Abstract: PURPOSE: Tranexamic acid has been used to reduce blood loss and the subsequent need for transfusion in orthopedic, spinal, and cardiac surgery. Orthognathic surgery can be associated with significant bleeding yet its efficacy in this setting is not clear. The purpose of this study was to investigate the effect of tranexamic acid on blood loss during bimaxillary osteotomy. PATIENTS AND METHODS: Seventy-three consecutive patients, scheduled for elective bimaxillary osteotomy, were included in this double blind, randomized, controlled trial. They received either a bolus of tranexamic acid (20 mg/kg) or placebo (normal saline) intravenously just before surgery. All patients received induced mild hypotension and had surgery according to a standard protocol. Intraoperative blood loss, operation time, transfusion of blood products, periparative hemoglobin, and hematocrit were recorded. RESULTS: The total blood loss and blood loss during maxillary surgery was reduced significantly in the tranexamic acid group compared with the control group (878.6 +/- 577.7 mL vs 1,257.2 +/- 817.8 mL and 428.0 +/- 233.3 mL vs 643.8 +/- 430.0 mL, respectively; P < .05). Considering the duration of operation and the treatment groups only, the mean total blood loss in the control group was 422 mL more than that in the tranexamic acid group (P < .001). There was no significant difference in blood transfusion or the length of hospital stay between the 2 groups. CONCLUSION: Preoperative intravenous bolus administration of tranexamic acid at 20 mg/kg reduces blood loss compared with placebo during bimaxillary osteotomy.


Abstract: BACKGROUND: Multiple studies suggest tranexamic acid reduces blood loss and red cell transfusions in patients undergoing THA or TKA. However, many of the dosing schedules in these studies are not ideally suited for routine application. QUESTIONS/PURPOSES: We asked whether one 20-mg per kg intraoperative dose of tranexamic acid in patients having primary THA or TKA would (1) decrease perioperative blood loss and red cell transfusion rates and (2) be a cost-effective protocol. PATIENTS AND METHODS: We retrospectively reviewed the records of 234 patients operated on from April 1 to June 30, 2007 (before our study protocol) and 259 patients from April 1 to June 30, 2008 with the single-dose protocol. We then compared change in hemoglobin, transfusion rates, hemoglobin at discharge, hospital length of stay, and complications between the two groups. No other routine patient care practices or blood conservation program strategies were altered during this time. RESULTS: We found a reduction in the decrease in hemoglobin in 2007 compared with 2008 for THA and TKA (46 to 39 g/L and 45 to 36 g/L, respectively), which led to a reduction in transfusion rates (13.5% to 3.6% and 13.1% to 2.0%, respectively) and higher hemoglobin levels at discharge. There were no recorded major adverse events associated with the introduction of this protocol. CONCLUSIONS: One 20-mg per kg intraoperative dose of tranexamic acid reduced the perioperative decrease in hemoglobin and red blood cell transfusion rates in patients having TKA and THA compared with those of a similar cohort of patients in whom the protocol was not used. This weight increment dosing facilitated pharmacy drug preparation, led to minimal dose variability and wastage, and resulted in a substantial estimated cost savings. LEVEL OF EVIDENCE: Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Abstract: BACKGROUND: Because of recent concerns about the safety of aprotinin, we updated our 2007 Cochrane review that compared the relative benefits and risks of aprotinin and the lysine analogues tranexamic acid and epsilon aminocaproic acid. METHODS: We searched electronic databases, including CENTRAL, MEDLINE, EMBASE, Google and Google Scholar for trials of antifibrinolytic drugs used in adults scheduled for cardiac surgery. Searches were updated to January 2008. By comparing aprotinin and the 2 lysine analogues to control, we derived indirect head-to-head comparisons of aprotinin to the other drugs. We derived direct estimates of risks and benefits by pooling estimates from head-to-head trials of aprotinin and tranexamic acid or epsilon aminocaproic acid. RESULTS: For indirect estimates, we identified 49 trials involving 182 deaths among 7439 participants. The summary relative risk (RR) for death with aprotinin versus placebo was 0.93 (95% confidence interval [CI] 0.69-1.25). In the 19 trials that included tranexamic acid, there were 24 deaths among 1802 participants. The summary RR was 0.55 (95% CI 0.24-1.25). From the risk estimates derived for individual drugs, we calculated an indirect summary RR of death with use of aprotinin versus tranexamic acid of 1.69 (95% CI 0.70-4.10). To calculate direct estimates of death for aprotinin versus tranexamic acid, we identified 13 trials with 107 deaths among 3537 participants. The summary RR was 1.43 (95% CI 0.98-2.08). Among the 1840 participants, the calculated estimates of death for aprotinin compared directly to epsilon aminocaproic acid was 1.49 (95% CI 0.98-2.28). We found no evidence of an increased risk of myocardial infarction with use of aprotinin compared with the lysine analogues in either direct or indirect analyses. Compared with placebo or no treatment, all 3 drugs were effective in reducing the need for red blood cell transfusion. The RR of transfusion with use of aprotinin was 0.66 (95% CI 0.61-0.72). The RR of transfusion was 0.70 (95% CI 0.61-0.80) for tranexamic acid, and it was 0.75 (95% CI 0.58-0.96) for use of epsilon aminocaproic acid. Aprotinin was also effective in reducing the need for re-operation because of bleeding (RR 0.48, 95% CI 0.34-0.67). INTERPRETATION: The risk of death tended to be consistently higher with use of aprotinin than with use of lysine analogues. Aprotinin had no clear advantages to offset these harms. Either tranexamic acid or epsilon aminocaproic acid should be recommended to prevent bleeding after cardiac surgery.


Abstract: In 2 separate centers, we observed a notable increase in the incidence of postoperative convulsive seizures from 1.3% to 3.8% in patients having undergone major cardiac surgical procedures. These events were temporally coincident with the initial use of high-dose tranexamic acid (TXA) therapy after withdrawal of aprotinin from general clinical usage. The purpose of this review was to perform a retrospective analysis to examine whether there was a relation between TXA usage and seizures after cardiac surgery. An in-depth chart review was undertaken in all 24 patients who developed perioperative seizures. Electroencephalographic activity was recorded in 11 of these patients, and all patients had a formal neurological evaluation and brain imaging studies. Twenty-one of the 24 patients did not have evidence of new cerebral ischemic injury, but seizures were likely due to ischemic brain injury in 3 patients. All patients with seizures did not have permanent neurological abnormalities. All 24 patients with seizures received high doses of TXA intraoperatively ranging from 61 to 259 mg/kg, had a mean age of 69.9 years, and 21 of 24 had undergone open chamber rather than coronary bypass procedures. All but one patient were managed using cardiopulmonary bypass. No evidence of brain ischemic, metabolic, or hyperthermia-induced causes for their seizures was apparent. Our results suggest that use of high-dose TXA in older patients in conjunction with cardiopulmonary bypass and open-chamber cardiac surgery is associated with clinical seizures in susceptible patients.


Abstract: As a result of their interpretation of the Bible, members of Jehovah's Witnesses do not accept blood transfusions under any circumstances. Consequently, they present moral and ethical problems to surgeons and anesthetists, especially in cardiac surgery. PATIENTS and METHODS. From November 1978 to November 1988, 66 members Jehovah's Witnesses were scheduled for cardiac surgery; 57 patients were operated upon (mean age 33.3 years, 14 days to 70.4 years; mean body weight 51 kg, 0.7 to 95.5 kg); 21 were younger than 14 years. Patients with hematocrit (Hct) less than 35%, expected high intra- and postoperative blood loss, compromised left ventricular function, ST-segment alterations, critical aortic stenosis, severe unstable angina pectoris, complex heart defects, especially
Abstract: Jehovah's Witnesses is a Christian faith whose members will not accept blood or blood products. In children, extreme body weight, severe diabetes, renal insufficiency, coagulopathies, severe pulmonary disease, and heavy smokers were excluded from operation. Whereas in nonbypass patients no special blood-saving techniques were used, in bypass patients a modified version of isovolemic hemodilution, with a hypothermic, bloodless priming technique of extracorporeal circulation (ECC) was performed after induction of anesthesia. At the end of the ECC all blood collected in the pericardial and pleural cavities was returned to the oxygenator and the entire content of the extracorporeal circuit was infused into the patient through the aortic cannula. All patients receiving ECC were ventilated for 24 h postoperatively and received dopamine (2-5 micrograms/kg) and antibiotics routinely. RESULTS: Due to the above mentioned contraindications, 9 patients were not accepted for surgery, 10 were operated upon without cardiopulmonary bypass or blood-saving techniques. In 47 patients open heart surgery with ECC and moderate or deep hypothermia was performed. In the adult patients (n = 36) Hct values decreased from 44.4% (35-70%) preoperatively to 32.1% (21-46%) after hemodilution, reached their lowest levels during cardiopulmonary bypass at 17.9% (9.9-43%), and increased to 33.7% (22%-43%) at the end of the operation. Hct averaged 28.2% (20%-39%) on the 3rd and 33.2% (23%-46%) on the 12th postoperative day. In children (n = 11) Hct decreased from 47.2% (36.9%-70%) to 33.6% (27.2%-49.1%) after hemodilution, during bypass to 16.1% (10.5%-25.5%) and increased to 32.1% (24.4%-37.4%) at the end of the operation. On the 3rd postoperative day Hct was 25% (21.4%-39%) and increased to 29.4% (25.1%-40%) on the 12th postoperative day. No statistical differences in Hct values were found between both groups. (ABSTRACT TRUNCATED AT 400 WORDS)


Abstract: Between January 1979 and July 1989, 15 children of Jehovah’s Witnesses underwent corrective open surgery for congenital heart disease (CHD) on cardiopulmonary bypass (CPB). Ages ranged from 1.5-17 years and body weight from 9.1-63 kg, with five patients weighing less than 15 kg. Eight children were cyanotic, and two of them had had previous thoracic operations. All operations were performed in moderate to deep hypothermia using a modified version of isovolemic hemodilution with bloodless priming technique of extracorporeal circulation. Mean hematocrit levels decreased from 47.3% (36.9-70%) to 34.6% (27.2-49.1%) after hemodilution, and then to 17.9% (10.5-25.6%) during bypass. They increased again to 34.1% (24.4-50%) at the end of the operation and to 33.4% (25.1-40%) on day 12. All intra- and postoperative hematocrit levels were significantly lower (p less than 0.001). There was one postoperative death, not related to the technique. Our results demonstrate that bloodless cardiac surgery on bypass is feasible in children as shown in this special group of children of Jehovah’s Witnesses. Knowing the risks of homologous blood transfusion this technique should be used more extensively in the future.


Abstract: Jehovah’s Witnesses is a Christian faith whose members will not accept blood or blood products under any circumstances on the basis of religious grounds. To date, no comparative studies have evaluated the outcome of open heart surgery in Jehovah’s Witnesses compared with patients who accept the transfusion of blood products. The present study was conducted to systematically compare the operative mortality and early clinical outcome after open cardiac surgery in Jehovah’s Witnesses versus non-Jehovah’s Witnesses. From January 1990 to July 2004, 49 Jehovah’s Witness patients underwent cardiac surgery, and their data were compared with those of a contemporaneous control group of 196 non-Jehovah’s Witnesses. Logistic regression analysis was used to compare operative mortality, postoperative intensive care unit care, and hospital length of stay between the 2 groups, controlling for preoperative risk factors. The Jehovah’s Witnesses were matched in a 1:4 ratio to the non-Jehovah’s Witnesses using propensity scores. No significant differences were identified in unadjusted stroke (p = 0.5), acute myocardial infarction (p = 0.6), new-onset atrial fibrillation (p = 0.106), prolonged ventilation (p = 0.82), acute renal failure (p = 0.70), and hemorrhage-related reexploration (p = 0.59) rates between the 2 groups. On multivariate analysis, Jehovah’s Witnesses had operative mortality (odds ratio 0.66, 95% confidence interval 0.12 to 3.59, p = 0.63), intensive care unit stay (odds ratio 1.36, 95% confidence interval 0.46 to 3.97, p = 0.58), and postoperative length of stay (odds ratio 1.43, 95% confidence interval 0.92 to 2.20, p = 0.16) comparable to those of the non-Jehovah’s Witnesses, after controlling for preoperative risk factors through matching. In conclusion,
cardiac surgery in Jehovah's Witnesses is associated with clinical outcomes comparable to those of non-Jehovah's Witnesses by adhering to blood conservation protocols


Abstract: The religious organization of Jehovah's Witnesses numbers more than 7 million members worldwide, including 165,000 members in Germany. Although Jehovah's Witnesses strictly refuse the transfusion of allogeneic red blood cells, platelets and plasma, Jehovah's Witness patients may nevertheless benefit from modern therapeutic concepts including major surgical procedures without facing an excessive risk of death. The present review describes the perioperative management of surgical Jehovah's Witness patients aiming to prevent fatal anemia and coagulopathy. The cornerstones of this concept are 1) education of the patient about blood conservation techniques generally accepted by Jehovah's Witnesses, 2) preoperative optimization of the cardiopulmonary status and correction of preoperative anemia and coagulopathy, 3) perioperative collection of autologous blood, 4) minimization of perioperative blood loss and 5) utilization of the organism's natural anemia tolerance and its acute accentuation in the case of life-threatening anemia


Abstract: Hemodilution tolerance is not well defined in elderly patients. In 20 patients older than 65 yr and free from known cardiovascular disease, hemodynamic variables, ST segment deviation, and O2 consumption were determined prior to and after 6 and after 12 mL/kg isovolemic exchange of blood for 6% hydroxyethyl starch. The mean age of the patients was 76 +/- 2 yr (mean +/- SEM, range 66-88 yr). During hemodilution, hemoglobin decreased from 11.6 +/- 0.4 to 8.8 +/- 0.3 g/dL (P < 0.05). With stable filling pressures, cardiac index increased from 2.02 +/- 0.11 to 2.19 +/- 0.10 L.min-1.m-2 (P < 0.05) while systemic vascular resistance decreased from 1796 +/- 136 to 1568 +/- 126 dynes.s.cm-5 (P < 0.05) and O2 extraction increased from 28.0% +/- 0.9% to 33.0% +/- 0.8% (P < 0.05) resulting in a stable O2 consumption during hemodilution. No alterations in ST segments were observed in lead II during hemodilution. In lead V5, ST segment deviation became slightly less negative during hemodilution from -0.03 +/- 0.01 to -0.02 +/- 0.01 mV (P < 0.05). The moderate decrease in hemoglobin was fully compensated by both an increase in cardiac index and in O2 extraction. Electrocardiographic signs of myocardial ischemia were not observed in this population. In conclusion, isovolemic hemodilution to a hemoglobin value of 8.8 +/- 0.3 g/dL is well tolerated in elderly patients free from known cardiac disease at the ages of 65-88 yr


Abstract: BACKGROUND AND OBJECTIVES: Red cell transfusion is commonly used in orthopaedic surgery. Evidence suggests that a restrictive transfusion strategy may be safe for most patients. However, concern has been raised over the risks of anaemia in those with ischaemic cardiac disease. Perioperative silent myocardial ischaemia (SMI) has a relatively high incidence in the elderly population undergoing elective surgery. This study used Holter monitoring to compare the effect of a restrictive and a liberal red cell transfusion strategy on the incidence of SMI in patients without signs or symptoms of ischaemic heart disease who were undergoing lower limb arthroplasty. MATERIALS AND METHODS: We performed a multicentre, controlled trial in which 260 patients undergoing elective hip and knee replacement surgery were enrolled and randomized to transfusion triggers that were either restrictive (8 g/dl) or liberal (10 g/dl). Participants were monitored with continuous ambulatory electrocardiogram (ECG) (Holter monitoring), preoperatively for 12 h and postoperatively for 72 h. The tapes were analysed for new ischaemia by technicians blinded to treatment. The total ischaemia time in minutes was divided by the recording time in hours and an ischaemic load in min/h was calculated. Haemoglobin levels were measured preoperatively, postoperatively in the recovery room, and on days one, three and five after surgery. RESULTS: The mean postoperative haemoglobin concentration was 9.87 g/dL in the restrictive group and 11.09 g/dL in the liberal group. In the restrictive group, 34% were transfused a total of 89 red cell units, and in the liberal group 43% were given a total of 119 red cell units. A postoperative episode of silent ischaemia was experienced by 21/109 (19%) patients in the restrictive group and by 26/109 (24%) patients in the liberal group [mean difference -4.6%; 95% confidence interval (CI): -15.5% to 6%, P = 0.41]. There was no significant
difference (P = 0.53) between the overall ischaemic load in the restrictive group (median 0 min/h, range 0-4.18) and the liberal group (median 0 min/h, range 0-19.48). In those patients who did experience postoperative SMI, the mean ischaemic load was 0.48 min/h in the restrictive group and 1.51 min/h in the liberal group (ratio 0.32, 95% CI: 0.14-0.76, P = 0.011). The median postoperative length of hospital stay in the restrictive group was 7.3 days (range 5-11; interquartile range [IQR] 6-8) compared with 7.5 days (range 5-13; IQR 7-8) in the liberal group. The numbers were not large enough to conclude equivalence. CONCLUSIONS: In patients without preoperative evidence of myocardial ischaemia undergoing elective hip and knee replacement surgery, a restrictive transfusion strategy seems unlikely to be associated with an increased incidence of SMI. A proportion of these patients experience moderate SMI, regardless of the transfusion trigger. Use of a restrictive transfusion strategy did not increase length of hospital stay, and use of this strategy would lead to a significant reduction in red cell transfusion in orthopaedic surgery. Our data did not indicate any potential for harm in employing such a strategy in patients with no prior evidence of cardiac ischaemia who were undergoing elective orthopaedic surgery.


Abstract: We have compared compensatory mechanisms during acute isovolaemic haemodilution of 12 ml/kg body weight of blood with hydroxyethyl starch (450,000/0.7) exchange, in non-beta-blocked and beta-blocked patients with coronary artery disease. During haemodilution, mean concentrations of haemoglobin decreased from 12.8 (SEM 0.2) to 10.1 (0.1) g dl-1 (P < 0.01). Only beta-blocked patients had an increase in cardiac index (P < 0.01); in non-beta-blocked patients, cardiac index remained constant. In both groups oxygen extraction increased (P < 0.01), but the increase tended to be greater in non-beta-blocked patients (P = 0.06). Oxygen consumption was maintained in both groups. There were no ECG signs of myocardial ischaemia. We conclude that beta-blocked and non-beta-blocked patients with coronary artery disease tolerated well moderate haemodilution to a haemoglobin value of approximately 10 g dl-1, however, compensatory haemodynamic mechanisms differed fundamentally between the two groups.


Abstract: Hemodilution tolerance is not well defined in patients with coronary artery disease receiving beta-adrenergic blockers chronically. Ninety patients scheduled for coronary artery bypass graft (CABG) surgery were randomized to a hemodilution (n = 60) and a control group (n = 30). During midazolam-fentanyl anesthesia, hemodynamic variables, ST segment deviation, and O2 consumption were determined prior to and after 6 and 12 ml/kg isovolemic exchange of blood for 6% hydroxyethyl starch. Hemoglobin decreased from 12.6 +/- 0.2 to 9.9 +/- 0.2 g/dL (mean +/- SEM, P < 0.05). With stable filling pressures, cardiac index increased from 2.05 +/- 0.05 to 2.27 +/- 0.05 L.min-1.m-2(P < 0.05) and O2 extraction from 27.4% +/- 0.6% to 31.2% +/- 0.7% (P < 0.05), resulting in stable O2 consumption. No alterations in ST segments were observed in leads II and V5 during hemodilution. Individual increases in cardiac index and O2 extraction were not linearly related to age and left ventricular (LV) ejection fraction (P = 0.841, P = 0.799). We conclude that isovolemic hemodilution to a hemoglobin value of 9.9 +/- 0.2 g/dL is well tolerated and fully compensated in patients with coronary artery disease receiving beta-adrenergic blockers chronically. Within the investigated ranges, the compensatory mechanisms during hemodilution are largely independent of age (35-81 yr) and LV ejection fraction (26%-83%)


Abstract: Haemodynamic parameters and oxygen consumption were determined in 20 patients with mitral regurgitation before and after a 12 ml.kg-1 isovolaemic exchange of blood for 6% hydroxyethyl starch. During haemodilution, mean (SEM) haemoglobin concentration decreased from 13.0 (0.4) to 10.3 (0.4) g.dl-1 (p = 0.001). With cardiac filling pressures maintained at predilution levels, cardiac index increased from 1.84 (0.08) to 1.94 (0.08) L.min-1.m-2 (p = 0.025) while systemic vascular resistance decreased from 1556 (86) to 1425 (83) dyne.s.cm-5 (p = 0.002) and oxygen extraction increased from 31.7 (1.1) to 37.3 (1.4%) (p = 0.001) resulting in an unchanged oxygen consumption. The
haemodynamic response to haemodilution was not affected by the patients' cardiac rhythm, i.e. whether it was sinus rhythm or atrial fibrillation. In conclusion, isovolaemic haemodilution to a haemoglobin of 10.3 g.dl⁻¹ is well tolerated in patients with mitral regurgitation. Compensatory mechanisms include both an increase in cardiac index and an increase in oxygen extraction.


Abstract: BACKGROUND: Although moderate hemodilution is usually well tolerated in coronary artery surgery patients, this may not be the case when myocardial oxygen demand is increased. We hypothesized that, in these patients, hemodilution in the presence of an increased heart rate could be associated with an impairment of myocardial function. METHODS: Forty coronary surgery patients were randomly assigned to two groups (n = 20), according to the rate of atrioventricular pacing [70 bpm (Group 70) or 90 bpm (Group 90)]. While paced at the fixed heart rate, hemodilution was performed before the start of cardiopulmonary bypass. Data were obtained from a pulmonary artery, a PICCO catheter and a left ventricular pressure catheter. Measurements were obtained in steady-state conditions before and after isovolemic hemodilution. RESULTS: Hemodilution from 40% (+/-) 2% to 30% (+/-) 1% in Group 70, and from 39% (+/-) 4% to 30% (+/-) 2% in Group 90 resulted in a decrease in systemic vascular resistance and an increase in end-diastolic volume in both groups. This was associated with an increase in stroke volume in Group 70 but not in Group 90. In this latter group, the maximal rate of pressure development decreased significantly after hemodilution [from 856 (+/-) 93 to 716 (+/-) 80 mm Hg/s (P < 0.01)], whereas it remained unchanged in Group 70 (843 (+/-) 86 mm Hg/s before and 832 (+/-) 79 mm Hg/s after hemodilution). CONCLUSIONS: In the conditions of the present study, increased heart rate during moderate hemodilution was associated with a depression of myocardial function.


Abstract: OBJECTIVE: Human recombinant erythropoietin has been used to obtain a rapid increase in red blood cells before surgery. Previously, the shortest preparatory interval has been 4 days, but at the European Hospital only 2.4 days on average separate hospitalization and surgery. We therefore proposed a randomized blind trial to test the efficacy of high-dose erythropoietin for very short-term administration. METHODS: All patients presenting with a diagnosis of isolated coronary vessel disease were randomized to either erythropoietin therapy or a control group. Patients with a creatinine level greater than 2 mg/dL or hemoglobin level greater than 14.5 g/dL were excluded. Hemoglobin values were collected preoperatively and on postoperative days 1 and 4. Blood loss and blood transfusion rate were recorded at the time of discharge. RESULTS: We enrolled 320 consecutive patients in the study. No significant difference was found in preoperative parameters, postoperative blood loss, or mean preoperative hemoglobin levels. On postoperative day 4, mean hemoglobin was 15.5% higher in the erythropoietin group (10.70 +/- 0.72 g/dL vs 9.26 +/- 0.71 g/dL; P < .05). This group required 0.33 units of blood per patient, whereas the controls required 0.76 units per patient (risk ratio 0.43, P = .008). CONCLUSION: A significant reduction in transfusion rate and a significant increase in hemoglobin values were observed in the erythropoietin group. No adverse events related to erythropoietin administration were recorded. A very short preoperative erythropoietin administration seems to be a safe and easy method to reduce the need for blood transfusions.


Abstract: In this study we investigated the effects of allogeneic red blood cell (RBC) transfusion on tissue oxygenation compared with those of 100% oxygen ventilation by using systemic oxygen transport variables and skeletal muscle oxygen tension (Ptio2). Fifty-one volume-resuscitated, mechanically ventilated patients with a nadir hemoglobin concentration in the range from 7.5 to 8.5 g/dL after elective coronary artery bypass grafting were allocated randomly to receive 1 unit (transfusion 1; n = 17) or 2 units (transfusion 2; n = 17) of allogeneic RBCs and ventilation with 40% oxygen or pure oxygen ventilation (100% oxygen; n = 17) and no allogeneic blood for 3 hours. Invasive arterial and pulmonary artery pressures and calculations of oxygen delivery (oxygen delivery index) and
consumption indices (oxygen consumption index) were documented at 30-min intervals. PtiO2 was measured continuously by using implantable polarographic microprobes. Systemic oxygen transport variables and PtiO2 were similar between groups at baseline. The oxygen delivery index increased significantly with transfusion of allogeneic RBCs and 100% oxygen ventilation, whereas the oxygen consumption index remained unchanged. Oxygen 100% ventilation increased PtiO2 significantly (from 24.0 \(\pm\) 1.5 mm Hg to 34.2 \(\pm\) 6.2 mm Hg), whereas no change was found after transfusion of allogeneic RBCs. Peak PtiO2 values were 25.2 \(\pm\) 5.2 mm Hg and 26.3 \(\pm\) 6.5 mm Hg in the transfusion 1 and 2 groups, respectively. Transfusion of stored allogeneic RBCs was effective only in improving systemic oxygen delivery index, whereas 100% oxygen ventilation improved systemic oxygen transport and PtiO2. This improved oxygenation status was most likely due to an increase in convective oxygen transport with a large driving gradient for diffusion of plasma-dissolved oxygen into the tissue. IMPLICATIONS: We used systemic oxygen transport variables and skeletal muscle oxygen tension to assess the oxygenation status of moderately anemic, mechanically ventilated cardiac surgery patients in response to either allogeneic red blood cell transfusion or 100% oxygen ventilation. Transfusion of stored allogeneic blood was effective only in improving systemic oxygen delivery, whereas 100% oxygen ventilation improved systemic oxygenation and skeletal muscle oxygen tension.


Abstract: BACKGROUND: When initiated in anemic hypoxia, hyperoxic ventilation (ventilation with pure O2, FiO2 1.0, HV) reverses hypoxia-induced ECG-changes and enables survival for several hours. The quantification of the HV-induced gain in anaemia tolerance and particularly the Hb-equivalent of HV in this situation are unknown. METHODS: Nine anaesthetized pigs were hemodiluted under normoxia (FiO2 0.21) by exchange of whole blood for hydroxyethyl starch (HES) until predefined, ischemia associated ECG-changes occurred (timepoint Hb(crit)). From that time on all animals were ventilated with 100% O2 (FiO2 1.0). In the case of disappearance of the ECG changes with onset of HV, the animals were further hemodiluted until ECG changes reoccurred. RESULTS: HV initiated in anemic hypoxia (Hb 2.3 +/- 0.2 g/dl) improved ECG-readings of all animals, and allowed for a further exchange of 14 +/- 11 ml/kg blood until ECG-changes reoccurred at Hb 1.2 +/- 0.4 g/dl. CONCLUSION: HV initiated in anemic hypoxia creates a margin of safety for myocardial tissue oxygenation and thus further increases anaemia tolerance. The Hb equivalent of HV in this situation amounts to approximately 1g/dl.


Abstract: OBJECTIVE: Extreme anemia threatens myocardial oxygen supply by 1) a decline of arterial oxygen content and 2) by a decline of mean aortic pressure (MAP) and thus coronary perfusion pressure. Standard treatment of low arterial oxygen content includes ventilation with pure oxygen and the transfusion of red blood cells. However, it is unknown whether the stabilization of MAP and coronary perfusion pressure with norepinephrine as the sole therapeutic modality may also increase tolerance to extreme anemia and thus improve outcome. DESIGN: Prospective, randomized, controlled study. SETTING: Experimental animal laboratory of a university hospital. SUBJECTS: A total of 28 anesthetized, mechanically ventilated pigs. INTERVENTIONS AND MEASUREMENTS: In the first protocol, 14 anesthetized pigs were hemodiluted by exchange of whole blood for 6% hydroxyethyl starch (200,000:0.5) until the individual critical hemoglobin concentration was reached. For the next 6 hrs, animals were either observed without any further intervention (control group) or their MAP was maintained by adapted infusion of norepinephrine (norepinephrine group). The main outcome variable of this protocol was the 6-hr mortality in both groups. In the second protocol, 14 anesthetized pigs received hemodilution until death. In seven animals, no intervention was performed during the hemodilution procedure, whereas in the other seven animals, MAP was maintained at >60 mm Hg by adapted infusion of norepinephrine. The main outcome variable of this protocol was the maximum exchangeable blood volume until death. MAIN RESULTS: MAP stabilization with norepinephrine reduced the 6-hr mortality at the critical hemoglobin concentration from 100% to 14%. Maintaining MAP by adapted norepinephrine infusion during the hemodilution procedure allowed for the exchange of 125 (110/126) (median [quartile 1/quartile 3]) mL/kg blood (163% of blood volume) in the norepinephrine group, whereas only 76 (73/91) mL/kg blood (104% of blood volume) could be exchanged in the control group. CONCLUSIONS: Application of norepinephrine can be judged a first-line intervention to bridge acute anemia via a stabilization of MAP and coronary perfusion pressure.
However, due to the relevant side effects of norepinephrine, its sole long-term use during extreme anemia without concomitant transfusion of erythrocytes is not advised.


Abstract: BACKGROUND: Blood is a sparse commodity. Transfusion needs increase while the number of donors decreases. These constraints incite Belgian authorities to pay more attention to transfusion financing. This implies pathologic knowledge of the epidemiology of in-hospital transfusion and the consumption of blood products. STUDY DESIGN AND METHODS: This study is a retrospective analysis of in-hospital stays from the year 2000 and includes data from all 124 Belgian hospitals. The database contains information on diagnoses, procedures, and all patients refined diagnosis-related groups (APRDRGs) but also on expenses linked to blood products transfused and to transfusion-related pharmaceutical products. RESULTS: Three percent of surgical patients used 55.7 percent of transfusion resources and 75.4 percent of transfusion costs were associated with 24 APRDRGs. In the medical group, 3 percent of the patients accounted for 80.2 percent of transfusion costs and 20 APRDRGs consumed 71.9 percent of transfusion resources. The variables with the highest impact on the proportion of patients transfused were severity, pathology, and age. The effect of hospitals remained significant but had less impact. No substitution of blood products by transfusion-related pharmaceutical products was observed in our analysis. CONCLUSION: Our study confirms that transfusion now centers on a limited number of pathologic entities and, within those, in small subsets of patients. This implies that the costs linked to setting up and running the transfusion system can no longer be shared by a large number of patients who receive transfusions but rely increasingly on patients at higher risks of more unpredictable needs. The system must nevertheless be able to cope with them at any time.


Abstract: BACKGROUND: Multiprobe near infrared spectroscopy (NIRS) has been used to study regional cerebral (rSO(2)C), splanchnic (rSO(2)S), and renal (rSO(2)R) tissue oxygenation in newborns. We used this method to study the effects of red blood cell (RBC) transfusions in anemic preterm infants to assess if thresholds for transfusions were appropriate for recognizing a clinical condition permitting tissue oxygenation improvement. STUDY DESIGN AND METHODS: Multiprobe NIRS (INVOS 5100, Somanetics) was applied during transfusion to 15 preterm infants with symptomatic anemia of prematurity (hematocrit level of <25%). rSO(2)C, rSO(2)S, and rSO(2)R were recorded at selected times, and then fractional oxygen cerebral extraction ratio [FOEC: (SaO(2)-rSO(2)C)/SaO(2)], fractional oxygen splanchnic extraction ratio [FOES: (SaO(2)-rSO(2)S)/SaO(2)], fractional oxygen renal extraction ratio [FOER: (SaO(2)-rSO(2)R)/SaO(2)], cerebrospinal fluid oxygenation ratio [CSOR: (rSO(2)S/rSO(2)C)], and cerebrorenal oxygenation ratio [CROR: (rSO(2)R/rSO(2)C)] were calculated. In addition, we used Doppler ultrasonography for evaluating cerebral blood flow (CBF), splanchnic blood flow (SBF), and renal blood flow (RBF) velocity. RESULTS: rSO(2)C, rSO(2)S, and rSO(2)R significantly increased during transfusions, while FOEC, FOES, and FOER decreased. CSOR and CROR increased during transfusions. CBF velocity decreased during the study period, while SBF and RBF velocities did not vary. CONCLUSION: RBC transfusions performed at used thresholds permitted an increase in cerebral, splanchnic, and renal oxygenation. The associated decreases in oxygen tissue extraction might suggest that transfusions were well timed for preventing tissue hypoxia or too early and theoretically prooxidant. Further studies could help to clarify this issue.


Abstract: OBJECTIVE: To compare oxygen consumption (VO(2)) measured by indirect calorimetry before and after a packed red blood cell (PRBC) transfusion in patients with isovolemic anemia. DESIGN: Prospective, repeated-measures clinical study. SETTING: Outpatient pediatric hematology-oncology clinic. PATIENTS: A total of 17 pediatric hematology-oncology outpatients undergoing a PRBC transfusion for a hematocrit of <26%. INTERVENTIONS: VO(2) was measured by indirect calorimetry before and after a PRBC transfusion. MEASUREMENTS AND MAIN RESULTS: Baseline hematocrit averaged 23% (15.5-25.7%), hemoglobin averaged 8.24 g/dL (5.2 g/dL-9.3 g/dL). Patients received an average of 10.3 mL/kg (2.8-17.5 mL/kg) of PRBC. After PRBC transfusion, all patients had an increase in VO(2), with a mean increase of 35.09 mL x min(-1) x m(-2) (5-75 mL x min(-1) x m(-2)) or 19% (3.1-52%;
Abstract: Systemic and microvascular hemodynamic responses to transfusion of oxygen using functional and non-functional packed fresh red blood cells (RBCs) from hemorrhagic shock were studied in the hamster window chamber model to determine the significance of RBCs on rheological and oxygen transport properties. Moderate hemorrhagic shock was induced by arterial controlled bleeding of 50% of the blood volume, and a hypovolemic state was maintained for 1 h. Volume restitution was performed by infusion of the equivalent of 2.5 units of packed cells, and the animals were followed for 90 min. Resuscitation study groups were non-oxygen functional fresh RBCs where the hemoglobin (Hb) was converted to methemoglobin (MetHb) [MetRBC], fully oxygen functional fresh RBCs [OxyRBC] and 10% hydroxyethyl starch [HES] as a volume control solution. Measurement of systemic variables, microvascular hemodynamics and capillary perfusion were performed during the hemorrhage, hypovolemic shock and resuscitation. Final blood viscosities after the entire protocol were 3.8 cP for transfusion of RBCs and 2.9 cP for resuscitation with HES (baseline: 4.2 cP). Volume restitution with RBCs with or without oxygen carrying capacity recovered higher mean arterial pressure (MAP) than HES. Functional capillary density (FCD) was substantially higher for transfusion versus HES, and the presence of MetHb in the fresh RBC did not change FCD or microvascular hemodynamics. Oxygen delivery and extraction were significantly lower for resuscitation with HES and MetRBC compared to OxyRBC. Incomplete re-establishment of perfusion after resuscitation with HES could also be a consequence of the inappropriate restoration of blood rheological properties which unbalance compensatory mechanisms, and appear to be independent of the reduction in oxygen carrying capacity.


Abstract: Systemic and microvascular hemodynamic responses to transfusion of oxygen using functional and non-functional packed fresh red blood cells (RBCs) from hemorrhagic shock were studied in the hamster window chamber model to determine the significance of RBCs on rheological and oxygen transport properties. Moderate hemorrhagic shock was induced by arterial controlled bleeding of 50% of the blood volume, and a hypovolemic state was maintained for 1 h. Volume restitution was performed by infusion of the equivalent of 2.5 units of packed cells, and the animals were followed for 90 min. Resuscitation study groups were non-oxygen functional fresh RBCs where the hemoglobin (Hb) was converted to methemoglobin (MetHb) [MetRBC], fully oxygen functional fresh RBCs [OxyRBC] and 10% hydroxyethyl starch [HES] as a volume control solution. Measurement of systemic variables, microvascular hemodynamics and capillary perfusion were performed during the hemorrhage, hypovolemic shock and resuscitation. Final blood viscosities after the entire protocol were 3.8 cP for transfusion of RBCs and 2.9 cP for resuscitation with HES (baseline: 4.2 cP). Volume restitution with RBCs with or without oxygen carrying capacity recovered higher mean arterial pressure (MAP) than HES. Functional capillary density (FCD) was substantially higher for transfusion versus HES, and the presence of MetHb in the fresh RBC did not change FCD or microvascular hemodynamics. Oxygen delivery and extraction were significantly lower for resuscitation with HES and MetRBC compared to OxyRBC. Incomplete re-establishment of perfusion after resuscitation with HES could also be a consequence of the inappropriate restoration of blood rheological properties which unbalance compensatory mechanisms, and appear to be independent of the reduction in oxygen carrying capacity.


Abstract: The indications for transfusion have never been evaluated in an adequately sized clinical trial. A pilot study was conducted to plan larger clinical trials. STUDY DESIGN AND METHODS: Hip fracture patients undergoing surgical repair who had postoperative hemoglobin levels less than 10 g per dL were randomly assigned to receive 1) symptomatic transfusion: that is, transfusion for symptoms of anemia or for a hemoglobin level that dropped below 8 g per dL or 2) threshold transfusion: that is, patients receive 1 unit of packed RBCs at the time of random assignment and as much blood as necessary to keep the hemoglobin level above 10 g per dL. Outcomes were 60-day mortality, morbidity, functional status, and place of residence. RESULTS: Among 84 eligible patients enrolled, mean (± SD) prerandomization hemoglobin was 9.1 (± 0.6) g/ dL. The median number of units transfused in the threshold transfusion group was 2 (interquartile range, = 1-2), and that in the symptomatic transfusion group was 0 (6; interquartile range, = 0-2) (p < 0.001). Mean hemoglobin levels were approximately 1 g per dL higher in the threshold group than in the symptomatic group: for example, on Day 2, 10.3 (± 0.9) g per dL versus 9.3 (± 1.2) g per dL, respectively (p < 0.001). At 60 days, death or inability to walk across the room without assistance occurred in 16 (39.0%) of the symptomatic transfusion group and 19 (45.2%) of the threshold transfusion group. Death occurred by 60 days in 5 (11.9%) of the symptomatic transfusion group and 2 (4.8%) in the threshold transfusion group (relative risk = 2.5; 95% CI, 0.5-12.2). Other outcomes were similar for the two groups. CONCLUSIONS: Symptomatic transfusion may be an effective blood-sparing protocol associated with the transfusion of appreciably fewer units of RBCs and lower mean hemoglobin levels than are
associated with the threshold transfusion policy. However, it is unknown whether these two clinical strategies have comparable mortality, morbidity, or functional status. A definitive trial is needed.


Abstract: BACKGROUND: This observational study explored the potential utility of oxygen extraction ratio (O2ER) as an adjunct to the hemoglobin (Hb) concentration for guiding red blood cell (RBC) transfusion decisions after cardiac surgery with cardiopulmonary bypass (CPB). STUDY DESIGN AND METHODS: Hb and O2ER measures were obtained before as well as at 15 and 120 minutes after RBC transfusion episodes (defined as 1-2 RBC units given in succession after CPB, within 24 hr. of surgery). Changes related to RBC transfusions among patients with normal (30%) and elevated (>30%) pretransfusion O2ERs were analyzed. RESULTS: Of the 176 patients enrolled, 74 received RBC transfusions. Of these, 50 had data available for 62 transfusion episodes. Pretransfusion episode O2ER values were elevated in 27 cases and normal in 35 (56%) cases. Among those who received transfusion for low Hb concentration, 43 percent (27/62) had normal pretransfusion O2ER values. While the posttransfusion O2ER values did not change in patients with normal pretransfusion O2ER values, they did decrease inpatients with elevated pretransfusion O2ER values (% change [+/-SD] at 15 and 120 min after transfusion was -5.2 +/- 7.8 and -3.8 +/- 8.0%, respectively; p < 0.05). CONCLUSION: If a normal O2ER in anemic patients with no evidence of organ dysfunction indicates adequate tissue oxygen delivery, then our findings suggest that incorporating O2ER into the transfusion decision will substantially reduce post-cardiac surgery RBC transfusions by allowing us to safely avoid transfusing this group of patients. Future studies are needed to assess the validity of this conclusion.


Abstract: The transfusion practices of an 850-bed community hospital are reviewed from Jan 1, 1962, through Jan 1, 1963. Twenty-nine percent (855 of 2,921) transfused patients received a single unit of whole blood or packed red blood cells. Eighty-two percent of single-unit transfusions were given to women, and 93% were related to surgical or obstetric situations. In patients undergoing common operative procedures, 62% had normal vital signs and hematocrit readings before transfusion. Sixty-seven percent of all patients had normal hematocrit readings prior to transfusion. One third of the single-unit transfusions were considered justified, and two thirds were regarded as questionable or unnecessary.


Abstract: BACKGROUND: The optimal hemoglobin threshold for erythrocyte transfusions in critically ill children is unknown. We hypothesized that a restrictive transfusion strategy of using packed red cells that were leukocyte-reduced before storage would be as safe as a liberal transfusion strategy, as judged by the outcome of multiple-organ dysfunction. METHODS: In this noninferiority trial, we enrolled 637 stable, critically ill children who had hemoglobin concentrations below 9.5 g per deciliter within 7 days after admission to an intensive care unit. We randomly assigned 320 patients to a hemoglobin threshold of 7 g per deciliter for red-cell transfusion (restrictive-strategy group) and 317 patients to a threshold of 9.5 g per deciliter (liberal-strategy group). RESULTS: Hemoglobin concentrations were maintained at a mean (+/-SD) level that was 2.1+/-.2 g per deciliter lower in the restrictive-strategy group than in the liberal-strategy group (lowest average levels, 8.7+/-.04 and 10.8+/-.05 g per deciliter, respectively; P<0.001). Patients in the restrictive-strategy group received 44% fewer transfusions; 174 patients (54%) in that group did not receive any transfusions, as compared with 7 patients (2%) in the liberal-strategy group (P<0.001). New or progressive multiple-organ dysfunction syndrome (the primary outcome) developed in 38 patients in the restrictive-strategy group, as compared with 39 in the liberal-strategy group (12% in both groups) (absolute risk reduction with the restrictive strategy, 0.4%; 95% confidence interval, -6.6 to 5.4). There were 14 deaths in each group within 28 days after randomization. No significant differences were found in other outcomes, including adverse events. CONCLUSIONS: In stable, critically ill children a hemoglobin threshold of 7 g per deciliter for red-cell transfusion can decrease transfusion requirements without increasing adverse outcomes. (Controlled-trials.com number, ISRCTN37246456 [controlled-trials.com].)
Abstract: BACKGROUND: Most clinical practice guidelines recommend restrictive red cell transfusion practices with the goal of minimizing exposure to allogeneic blood (from an unrelated donor). The purpose of this review is to compare clinical outcomes in patients randomized to restrictive versus liberal transfusion thresholds (triggers). OBJECTIVES: To examine the evidence on the effect of transfusion thresholds, on the use of allogeneic and/or autologous blood, and the evidence for any effect on clinical outcomes. SEARCH STRATEGY: Trials were identified by: computer searches of OVID Medline (1966 to December 2000), Current Contents (1993 to Week 48 2000), and the Cochrane Controlled Trials Register (2000 Issue 4). References in identified trials and review articles were checked and authors contacted to identify any additional studies. SELECTION CRITERIA: Controlled trials in which patients were randomized to an intervention group or to a control group. Trials were included where the intervention groups were assigned on the basis of a clear transfusion “trigger”, described as a haemoglobin (Hb) or haematocrit (Hct) level below which a RBC transfusion was to be administered. DATA COLLECTION AND ANALYSIS: Trial quality was assessed using criteria proposed by Schulz et al. (1995). Relative risks of requiring allogeneic blood transfusion, transfused blood volumes and other clinical outcomes were pooled across trials using a random effects model. MAIN RESULTS: Ten trials were identified that reported outcomes for a total of 1780 patients. Restrictive transfusion strategies reduced the risk of receiving a red blood cell (RBC) transfusion by a relative 42% (RR=0.58: 95%CI=0.47,0.71). This equates to an average absolute risk reduction (ARR) of 40% (95%CI=24% to 56%). The volume of RBCs transfused was reduced on average by 0.93 units (95%CI=0.36,1.5 units). However, heterogeneity between these trials was statistically significant (p<0.00001) for these outcomes. Mortality, rates of cardiac events, morbidity, and length of hospital stay were unaffected. Trials were of poor methodological quality. REVIEWER’S CONCLUSIONS: The limited published evidence supports the use of restrictive transfusion triggers in patients who are free of serious cardiac disease. However, most of the data on clinical outcomes were generated by a single trial. The effects of conservative transfusion triggers on functional status, morbidity and mortality, particularly in patients with cardiac disease, need to be tested in further large clinical trials. In countries with inadequate screening of donor blood the data may constitute a stronger basis for avoiding transfusion with allogeneic red cells.


Abstract: BACKGROUND: The transfusion trigger that physicians use to determine whether a patient requires a red blood cell (RBC) transfusion is the peripheral venous hematocrit (Hct) value. Although this measurement is an indicator of the concentration of RBCs in the blood, it does not reveal the RBC volume, plasma volume, or total blood volume, nor does it give any indication of whether the patient is hypovolemic, normovolemic, or hypervolemic. STUDY DESIGN AND METHODS: Two patient populations were studied: 41 consecutive patients subjected to elective vascular surgery and 20 consecutive patients subjected to cardiopulmonary bypass surgery. The RBC volume was measured with (51)Cr- or (99m)Tc-labeled autologous fresh RBCs, and the plasma volume and total blood volume were estimated from the measured RBC volume and the total body Hct level. Measurements made 1 to 2 and 24 hours after surgery were compared to the preoperative values for these two groups of patients. RESULTS: During the 24-hour postoperative period, the RBC, plasma, and total blood volumes were reduced compared to the preoperative volumes. These patients were hypovolemic and anemic, and their Hct values during the 24-hour postoperative period were increased by a mean of 4 to 5 volume-percent compared to values that would be expected if they were normovolemic and anemic. CONCLUSIONS: The Hct values in hypovolemic anemic patients are elevated because the plasma volume does not increase to achieve the normovolemic anemic state.


Abstract: OBJECTIVE: To develop a clinical practice guideline for red blood cell transfusion in adult trauma and critical care. DESIGN: Meetings, teleconferences and electronic-based communication to achieve grading of the published evidence, discussion and consensus among the entire committee members.
METHODS: This practice management guideline was developed by a joint taskforce of EAST (Eastern Association for Surgery of Trauma) and the American College of Critical Care Medicine (ACCM) of the Society of Critical Care Medicine (SCCM). We performed a comprehensive literature review of the topic and graded the evidence using scientific assessment methods employed by the Canadian and U.S. Preventive Task Force (Grading of Evidence, Class I, II, III; Grading of Recommendations, Level I, II, III). A list of guideline recommendations was compiled by the members of the guidelines committees for the two societies. Following an extensive review process by external reviewers, the final guideline manuscript was reviewed and approved by the EAST Board of Directors, the Board of Regents of the ACCM and the Council of SCCM. RESULTS: Key recommendations are listed by category, including (A) Indications for RBC transfusion in the general critically ill patient; (B) RBC transfusion in sepsis; (C) RBC transfusion in patients at risk for or with acute lung injury and acute respiratory distress syndrome; (D) RBC transfusion in patients with neurologic injury and diseases; (E) RBC transfusion risks; (F) Alternatives to RBC transfusion; and (G) Strategies to reduce RBC transfusion. CONCLUSIONS: Evidence-based recommendations regarding the use of RBC transfusion in adult trauma and critical care will provide important information to critical care practitioners.