Transfusion practice varies widely in cardiac surgery: Results from a national registry

Zoe K. McQuilten, MBBS,[a,b] Nick Andrianopoulos, MBBS, MBiostat,[a] Erica M. Wood, MBBS,[a,c] Merrole F. Cole-Sinclair, MBBS,[d] John J. McNeil, PhD, MBBS,[a] Peter A. Cameron, MD, MBBS,[a] Christopher M. Reid, PhD,[a] Andrew E. Newcomb, MBBS,[e] Julian A. Smith, MBBS, MS,[f,g] and Louise E. Phillips, PhD[a]

Objectives: Evidence is accumulating of adverse outcomes associated with transfusion of blood components. If there are differences in perioperative transfusion rates in cardiac surgery, and what hospital factors may contribute, requires further investigation.

Methods: Analysis of 42,743 adult patients who underwent 43,482 procedures from 2005 to 2011 at 25 Australian hospitals, according to the Australian and New Zealand Society of Cardiac and Thoracic Surgeons Cardiac Surgery Database. Multiple logistic regression examined associations of patient and hospital characteristics with transfusion of ≥1 red blood cell (RBC) unit; platelet (PLT), fresh frozen plasma (FFP), and cryoprecipitate (CRYO) doses; and ≥5 RBC units, from surgery until hospital discharge.

Results: Procedures included 24,222 (55%) isolated coronary artery bypass grafts, 7299 (17%) isolated valve, 4714 (11%) coronary artery bypass graft and valve, and 7247 (17%) other procedures. After adjustment for various patient and procedure characteristics, transfusion rates varied across hospitals for ≥1 RBC unit from 22% to 67%, ≥5 RBC units from 5% to 25%, ≥1 PLT dose from 11% to 39%, ≥1 FFP dose from 11% to 48% and ≥1 CRYO dose from 1% to 20%. Hospital characteristics, including state or territory, private versus public, and teaching versus nonteaching, were not associated with variation in transfusion rates.

Conclusions: Variation in transfusion of all components and large volume RBC was identified, even after adjustment for patient and procedural factors known to influence transfusion, and this was not explained by hospital characteristics. (J Thorac Cardiovasc Surg 2014;147:1684-90)

Supplemental material is available online.

A substantial proportion of blood components worldwide are issued to patients undergoing cardiac surgery. In Australia this is the second most common surgical indication for red blood cell (RBC) use; the largest single indication for fresh frozen plasma (FFP), accounting for approximately 15% of all plasma use; and the second largest indication for platelet (PLT) transfusion after hematology and oncology.[1,2] Despite the significant use of blood components by patients undergoing cardiac surgery, the evidence to guide transfusion therapy is limited, particularly for components other than RBCs. There have been few studies on the optimal triggers for RBC transfusion, and these have been mostly in other clinical settings.[3,4] Studies on the use of FFP and PLT in cardiac surgery are also limited, with varying results regarding outcomes.[5-8]

There is evidence of significant variation in the transfusion rates of blood components in cardiac surgery between institutions and individual clinicians,[9-12] and this variation has been shown to continue following publication of

From the Department of Epidemiology and Preventive Medicine,[a] Monash University, Melbourne, Victoria, Australia; Transfusion Medicine Services and Research and Development,[b] Australian Red Cross Blood Service, Melbourne, Victoria, Australia; Department of Clinical Haematology,[c] Monash University, Melbourne, Victoria, Australia; Haematology Department,[d] St Vincent's Hospital, Fitzroy, Victoria, Australia; University of Melbourne Department of Surgery (Cardiothoracic Surgery),[e] St Vincent's Hospital, Melbourne, Fitzroy, Victoria, Australia; Department of Surgery,[f] Monash Medical Centre, Monash University, Victoria, Australia; and Department of Cardiothoracic Surgery,[g] Monash Medical Centre, Victoria, Australia.

Z.M. is the recipient of an Australian National Health and Medical Research Council (NHMRC) Postgraduate Scholarship (No. APP1017942). C.R. is the recipient of an Australian NHRMC Senior Research Fellowship (No. APP 1045862). This project was funded as part of an Australian NHMRC Partnership grant between the Australian Red Cross Blood Service, the Victorian Government Department of Health, and Monash University. NHMRC ID No. 546291. The Australian and New Zealand Society of Cardiac and Thoracic Surgeons National Cardiac Surgery Database Program is funded by the Department of Health Victoria, and the Health Administration Corporation and the Clinical Excellence Commission, New South Wales, Australia. The Australian government fully funds the Australian Red Cross Blood Service for the provision of blood products and services to the Australian Community.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication March 17, 2013; revisions received Oct 6, 2013; accepted for publication Oct 29, 2013; available ahead of print Dec 12, 2013.

Address for reprints: Zoe K. McQuilten, MBBS, The Alfred Centre, 99 Commercial Rd, Melbourne, Victoria 3004, Australia (E-mail: zoe.mcquilten@monash.edu).

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2013.10.051

Abbreviations and Acronyms

ANZSCTS = Australian and New Zealand Society of Cardiac and Thoracic Surgeons
CABG = coronary artery bypass graft
CRYO = cryoprecipitate
FFP = fresh frozen plasma
PLT = platelet
RBC = red blood cell

transfusion practice guidelines.[13] A previous small Australian survey conducted in 2004 reported substantial variation in RBC use between institutions following cardiac surgery.[14] It is not known if these differences persist, if this also applies to the use of non-RBC components, and if hospital characteristics contribute to differences in practice. In our study, we investigated if significant variation exists in blood product use in cardiac surgery, after adjusting for patient-related variables that might reasonably influence the need for transfusion. We also investigated if hospital characteristics account for variation in transfusion rates after adjusting for patient-level characteristics.

METHODS

Patients

All cardiac surgery patients aged 18 years or older reported to the Australian and New Zealand Society for Cardiac and Thoracic Surgery (ANZSCTS) Cardiac Surgery Database, between January 1, 2005, and December 31, 2011, from 25 Australian hospitals, were included in the study. Not all 25 hospitals reported for the entire study duration; however, once reporting commenced all consecutive cases were included.

During this period there were a total of 43,482 procedures recorded in 42,743 adult patients at the 25 hospitals. These included isolated coronary artery bypass graft (CABG) in 24,222 (55%), isolated valve in 7299 (17%), CABG and valve in 4714 (11%), and other procedure in 7247 (17%). Procedures (n = 147) in patients younger than age 18 years were excluded.

ANZSCTS Cardiac Surgery Database

The ANZSCTS Cardiac Surgery Database prospectively collects information on all adult patients undergoing cardiac surgery at participating hospitals using a standardized data set and definitions, including patient demographics, preoperative risk factors, preoperative medications, intraoperative details, transfusion therapy received (including number of units of RBCs, PLTs, FFP, and cryoprecipitate [CRYO]), length of stay, complications, and patient outcomes.[15]

Statistical Methods

Summary statistics for continuous data are reported as mean and standard deviation or median and interquartile range as appropriate, and as number and percent for categorical variables.

Binary categorical variables for the outcomes of interest were created: ≥1 RBC unit, large-volume RBC transfusion (≥5 RBC units), low-volume RBC transfusion (1 or 2 RBC units), ≥1 FFP adult equivalent dose, ≥1 PLT adult equivalent dose, and ≥1 CRYO adult equivalent dose. Logistic regression analyses explored the association between covariates, including hospital site, and outcomes, using a backward stepwise approach. Variables that were associated with the outcomes of interest with a P value <.25 were considered for the multiple logistic regression models. Pearson's correlation was used to assess variables for potential colinearity, with the more clinically relevant variable selected where present. Covariates considered for the models were those which that reasonably influence a decision to transfuse and included hospital site, patient age, sex, body mass index, peripheral or cerebrovascular disease, prior myocardial infarction, diabetes, New York Heart Association functional class, lung disease, infective endocarditis, preoperative creatinine, medications (including antiplatelet agents within 5 days, anticoagulants, and immunosuppressive therapy), previous cardiothoracic procedure, procedure type and urgency, preoperative shock, and use of intra-aortic balloon pump. Correlation of hospital-adjusted rates of RBC versus PLT and RBC versus FFP were also assessed. Analysis was performed on all procedures and repeated for first-time CABG only.

To explore the association of hospital-level characteristics and outcome, variables for the type of institution (academic affiliation and private or public) and in which area they were located, the median number of cardiac procedures performed annually, and previous covariates were added in multiple multilevel logistic regression models, where hospital site was now modeled as a random effect.[16]

All analyses were performed using the statistical software packages Stata 11.2 (Statacorp LP, College Station, Tex).

RESULTS

Patient demographics, comorbidities, and surgical and hospital characteristics for all procedures are shown in Table 1. The total number of cardiac surgeries performed at each hospital ranged from 312 to 4193 (median, 1327; IQR, 669-2557) and the median annual number of cardiac surgeries performed at each hospital ranged from 154 to 588 (median, 238; IQR, 164-353).

The most important patient characteristics associated with RBC transfusion in multivariate analysis based on effect size included patient age (odds ratio [OR], 1.1; 95% confidence interval [CI], 1.0-1.1), New York Heart Association functional class II or greater heart failure (class IV OR, 1.7; 95% CI, 1.5-1.9) procedure other than isolated CABG or valve (OR, 2.2; 95% CI, 1.9-2.3), previous cardiac surgery (OR, 1.3; 95% CI, 1.2-1.4), urgent (OR, 2.9; 95% CI, 2.5-3.2) or emergency surgery (OR, 3.7; 95% CI, 2.1-6.5), and the use of acetylsalicylic acid (OR, 1.2; 95% CI, 1.1-1.2) or clopidogrel (OR, 1.1; 95% CI, 1.1-1.2) within 7 days before surgery.

The rate of transfusion, after adjusting for patient and surgical characteristics, of any RBC unit ranged between hospitals from 22% to 67%, ≥5 RBC units from 5% to 24%, 1 or 2 RBC units from 10% to 34%, ≥1 PLT dose from 10% to 39%, ≥1 FFP dose from 10% to 44%, and ≥1 CRYO dose from 1% to 21%. The hospital-adjusted rates of transfusion of RBC, PLTs, FFP, and CRYO for all procedures are shown in Figure 1. Similar variation in adjusted rates of blood product use was also present when the analysis was limited to only isolated CABG procedures with no history of previous cardiac surgery (Figure E1). Hospital rates of RBC versus PLT transfusion and RBC versus FFP transfusion after adjustment for patient and surgical characteristics are shown in Figure 2.

PM