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Impact of packed red blood cell and platelet transfusions in patients undergoing dissection repair

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ABSTRACT

Background: Transfusion of blood products commonly occur in patients undergoing repair of acute type A aortic dissection (AADA).

Materials and methods: The medical records of 102 AADA patients were retrospectively reviewed and stratified into cohorts by packed red blood cell (PRBC) and platelet units received: PRBC ≤2 units ($n = 68$) *versus* PRBC >2 units ($n = 34$); platelets ≤1 unit ($n = 74$) *versus* platelets >1 unit ($n = 28$). Continuous and categorical variables were assessed by analysis of variance testing and chi-square or Fisher's testing as appropriate. Multivariate logistic regression was applied to derive *P* values for post-transfusion complications. Kaplan–Meier survival analyses were used to compare the hospital length of stay (LOS) and survival rate at 1 mo and 1 y.

Results: Patients receiving >2 units of PRBC had a median LOS of 14 d *versus* 9 d for those receiving ≤2 units ($P < 0.002$). Transfusion of >2 units of PRBC was a risk factor for post-operative infection (odds ratio [OR] = 5.4, 95% confidence interval [CI]: 1.5-19.0, $P = 0.009$). Survival at 1 mo was 91% *versus* 94% ($P = 0.783$) and 1 y survival was 82% *versus* 93% ($P = 0.269$) between the two groups. Patients receiving >1 unit of platelets had a median LOS of 15 d *versus* 10 d for those receiving ≤1 unit ($P = 0.005$). Transfusion of >1 unit of platelets was a risk factor for postoperative atrial fibrillation and acute kidney injury (OR = 2.9, 95% CI: 1.1-7.6, $P = 0.031$; OR = 3.3, 95% CI: 1.2-9.4, $P = 0.025$, respectively). Survival at 1 mo was 93% *versus* 93% ($P = 0.872$) and 1 y survival was 81% *versus* 92% ($P = 0.582$) between the two groups.

Conclusions: Transfusion of PRBC and platelets above a threshold increases the incidence of postoperative complications and hospital LOS among patients undergoing repair of AADA.

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Introduction

Stanford type A acute aortic dissection (AADA) remains a life-threatening cardiovascular condition involving the ascending aorta that requires emergent surgical intervention.[1,2] After repair of the aorta, the need for packed red blood cells (PRBCs) and platelets are expected, given the nature of the pathology and the corrective procedure.[3] The rationale and criteria for intraoperative and/or postoperative blood product transfusion depends on a variety of clinical factors, many of which are not universally agreed on.[4,5] With that said, blood product transfusion has been associated with higher rates of morbidity and mortality, along with increased hospital cost in patients undergoing cardiac surgery.[6,7] Furthermore, others have reported independent relationships between perioperative transfusions and postoperative complications such as infections, atrial fibrillation (AF), pneumonia, acute kidney injury (AKI), and increase hospital length of stay (LOS).[1,4,8-10] Despite studies showing improved outcomes after early repair of AADA, both early and 1-y mortality and morbidity remain high. The 30-d hospital mortality has been shown to vary from 9% to 30%, while 5-y survival rates vary from 50% to 80%.[11-15] In this study, our objective was to observe the clinical effect of blood product transfusion on patients undergoing repair of AADA.

Material and methods

Study design

The collection of data presented in this article was approved for use in research by the Lifespan Institutional Review Board at Rhode Island Hospital with patient consent waived. The diagnosis of AADA in all our patients was made using computed tomography. The medical records of patients surgically treated for AADA at our institution from 2002 to 2016 were retrospectively reviewed. Patients with AADA, who died before arrival to the operating room or declined surgery, were excluded from the analyses. Patients were stratified into cohorts by number of PRBC and platelet units received: PRBC $\leq$2 units ($n = 68$) *versus* PRBC >2 units ($n = 34$); platelets $\leq$1 unit ($n = 74$) *versus* platelets >1 unit ($n = 28$). The same data set was also categorized into four groups: group 0 = no transfusion ($n = 6$); group 1 = platelets only ($n = 11$); group 2 = PRBC and platelets ($n = 75$); group 3 = PRBC only ($n = 10$). Data were reported as mean $\pm$ standard deviations or median for continuous variables and as frequencies (percentages) for categorical variables. To model the differences between the group receiving >2 units of PRBC *versus* $\leq$2 units of PRBC and for the group receiving >1 unit of platelets *versus* $\leq$1 unit of platelets, we used analysis of variance testing for continuous variable and chi-square or Fisher's testing for categorical variables. Multivariate logistic regression was applied to derive *P* values for the primary endpoints of the study, that is, post-transfusion complications, after adjusting for age, gender, history of hypertension, and diabetes. For secondary endpoint, Kaplan–Meier survival analyses were used to compare the median hospital LOS and survival rate at 1 mo and 1 y using log-rank test for the group receiving >2 units of PRBC *versus* $\leq$2 units of PRBC and for the group receiving >1 unit of platelets *versus* $\leq$1 unit of platelet, respectively. We used Cox proportional hazards regression to test for the instantaneous hazards for all-cause mortality in patients receiving >2 units of PRBC and in patients receiving >1 unit of platelets. Analyses were performed with SPSS 21 software (SPSS, Chicago, IL) and SAS statistical software. Statistical significance was defined as two-sided $P < 0.05$.

Operative procedure

All surgical procedures were performed under general endotracheal anesthesia; patients underwent median sternotomy, pericardiotomy, and cardiopulmonary bypass (CPB). The patients were prepped and draped in the standard fashion, and perioperative antibiotics were administered along with systemic heparinization. The femoral and right axillary arteries were more frequently used for arterial cannulation, and the right atrium and/or common femoral vein were used to establish venous drainage. A cross-clamp was applied to the ascending aorta and cold blood cardioplegia was administered either directly into the coronary ostia or retrograde, until diastolic arrest was achieved. Repeat doses of cardioplegia were administered throughout the procedure at varying intervals. The majority of patients were cooled to 18°C for deep hypothermic circulatory arrest. Repair was achieved through replacement of the ascending aorta using a tube graft from the sino-tubular junction or replacement of the aortic root and ascending aorta using a valve conduit. The distal portion of the repair included a hemiarch reconstruction in some instances. After completion of the aortic repair, the heart was thoroughly deaired, and the patient was weaned from CPB. Protamine was administered, and patients were decannulated. All cannulation sites were oversewn. Once hemostasis was satisfactory, the chest was closed. PRBC and platelets were transfused according to the patient's clinical condition, volume status, and hemoglobin concentration.

Clinical outcomes

In-hospital complications and mortality were determined. Major complications reported were postoperative infection, AKI, altered consciousness, myocardial ischemia, cardiac tamponade, pneumonia, pleural effusion, pneumothorax, limb ischemia, AF, and stroke. Patients were followed up at 1 mo and 1 y. Death was determined by chart death certificates or notification of death by referring doctors through the EPIC life-chart database.

Results

One hundred two consecutive patients undergoing aortic repair were identified. Patients were predominantly male (63%) with a median age of 56.1 $\pm$ 11.1 y. Of the 102 patients, 34 (33%) received >2 units of PRBC and 28 (27%) received >1 unit of platelets. Baseline characteristics of the transfusion groups are seen in Table 1. Male gender and a history of chronic