A Comparison of Intraoperative versus ICU Blood Utilization on Outcomes in Pediatric Cardiac Surgical Patients

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INTRODUCTION

Pediatric cardiac surgery patients account for a large portion of the blood utilization in a children's hospital. The majority of pediatric cardiac surgical patients undergoing bypass get transfused, and transfusion is an isolated risk factor for morbidity and mortality. There is little evidence on OR transfusion practices and effect on morbidity for congenital cardiac patients. The purpose of this study is to evaluate the morbidity and mortality risks in cardiac surgical patients based on volume transfused in cyanotic and acyanotic patients in the intensive care unit and operating room.. Our hypothesis is that escalating OR transfusions will not have a similar effect on morbidity and mortality as escalating ICU transfusions. Our secondary hypothesis is that cyanotic patients will receive more transfusions in both the OR and the ICU than acyanotic patients.

METHODS

After IRB approval, we reviewed our cardiac surgical cases occurring from 2010-2017. We used our previously reported database that merged our institutional STS database with our blood management and outcome database. The medians for transfused red cells were obtained for cyanotic and acyanotic patients in both the ICU and OR. Patients were excluded if they received no transfusion or those greater than the 95% percentile. These groups were then separated into low- and high-transfusion cohorts. The primary outcome measures were infection, mortality and length of stay. We completed our analysis using chi-squared test via JMP Pro statistical program.

Table-1: Baseline Characteristics

	Acyanotic OR		Acyanotic ICU	
	LOW (n-195)	HIGH (n=253)	LOW (n=163)	HIGH (n=200)
Male	92 (51.1%)	119 (52%)	84 (57.9%)	94 (51.9%)
Female	88 (48.9%)	110 (48.0%)	61 (42.1%)	87(48.1%)
Neonate	18 (9.2%)	15 (6%)	21 (13%)	46 (23%)
Infant	77(39.5%)	114 (45%)	79(48%)	64 (32%)
Child	100(51.3%)	124 (49%)	63 (39%)	90(45%)
STAT 1-2	161(83.4%)	159 (66%)	130 (80%)	132 (70.5%)
STAT 3-5	32(16.6%)	82 (34%)	32 (20%)	55 (29.4%)
Redo	19(9.7%)	41 (18%)	43 (12.7%)	29 (14.5%)
Bypass[a,b]	101 (72-129)	139 (100-189)	126 (88-166)	132 (104-183.5)
X-clamp[a,b]	55 (35-84)	72 (52-109)	74 (46-105)	72 (49-108)
RBC units[b]	1(1-1)	2(2-3)	1 (1-1)	3 (2-6)
Length of stay[c]	6 (4-8)	8 (5-13)	6 (5-8)	11 (7-26)

[a] Time in minutes [b]Median values with interquartile range [c]Measured in days

Table-2: Infection and mortality in low and high transfusion groups

Acyanotic OR Patients

	LOW	HIGH	P Value[a]
Infection*	6.5	5.9	0.594
Mortality	1.8	0.5	0.960

Cyanotic OR Patients

	LOW	HIGH	P Value[a]
Infection*	16.3	19.2	0.529
Mortality	1.7	10	0.003

Acyanotic ICU Patients

	LOW	HIGH	P Value[a]
Infection*	6.1	17	0.0016
Mortality	0	4.4	0.0472

Cyanotic ICU Patients

	LOW	HIGH	P Value[a]
Infection*	8.18	19.9	0.0096
Mortality	0	4.1	0.0472

Infection and mortality expressed as percentages

*Sepsis, wound infection, clostridium difficile, pneumonia

[a]Chi-square test

RESULTS

The study population included 448 and 363 patients with acyanotic congenital heart disease in the OR and ICU respectively and 306 and 251 patients with cyanotic congenital heart disease in the OR and ICU respectively. Baseline demographic and clinical characteristics of each subgroup are described in Table-1. There was an observed statistically significant difference ($p < 0.05$) in the rate of clinically suspected infection (pneumonia, sepsis, wound infection, and C. Difficile) and mortality among the low versus high transfusion groups in the ICU for both acyanotic and cyanotic patients (Table-2). The only statistical difference in the OR was mortality in cyanotic patients.

DISCUSSION

The results support our hypothesis that escalating transfusions do not have a similar effect in the OR when compared to the ICU. Our data also supported our secondary hypothesis that cyanotic patients receive increased transfusions. Our study suggests that outcomes from OR transfusions may not be as simple as a direct association with the number of transfusions. This may be due to the filtration that occurs on bypass or the physiologic effects of transfusing for active hemorrhage rather than an isolated hemoglobin level as in the ICU. There were also differences seen in outcomes when comparing cyanotic and acyanotic patients. Further studies are needed to isolate OR transfusion risk factors in acyanotic and cyanotic congenital heart disease.

REFERENCES

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