

Factors and Outcomes Associated with Blood Product Transfusion Ratios During Massive Postpartum Hemorrhage



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Background

There is limited consensus on optimal transfusion ratios in postpartum hemorrhage as bleeding and resuscitation escalate

Large-volume transfusion strategies may not account for the unique coagulation profiles in the peripartum period

What drives transfusion ratios in massive obstetric hemorrhage?

Can variation in transfusion ratios impact outcomes?



Study Aims

Primary Aim

Identify the patient, case, and institutional factors associated variations in FFP:PRBC transfusion ratios

Secondary Aim

Estimate the association between FFP:PRBC transfusion ratios and maternal clinical outcomes





"Overbalanced"

1.34 ≤ FFP:PRBC

Statistical Methods

Transfusion Ratios (Binary): GLMM Transfusion Ratios (Continuous): Log₁₀-transformed LMM Clinical Outcomes (Binary + Continuous): GLMM / LMM Coagulation Profile: Descriptive analysis

GLMM: Generalized Linear Mixed Model LMM: Linear Mixed Model



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Results

Factors Associated with FFP:PRBC Transfusion Ratios

	Underbalanced vs Balanced		Continuous Ratio	
Characteristics	Adjusted Odds Ratio (95% CI)	P-Value	B-coefficient (95% CI)	P-Value
BMI	1.02 (0.997, 1.03)	0.101	-0.01 (-0.02, 0.01)	0.463
ASA Physical Status (Ref: I/II)				
ш	1.02 (0.76, 1.38)	0.881	0.33 (0.07, 0.58)	0.013
IV	1.77 (1.15, 2.73)	0.01	0.91 (0.53, 1.29)	<0.001
Estimated Units of RBCS	1.01 (0.98, 1.04)	0.405	0.06 (0.03, 0.083) <	
Cryoprecipitate/PRBC Ratio	1.24 (1.13, 1.36)	<0.001	0.27 (0.19, 0.35)	<0.001
Method of Delivery (Ref: Vaginal)				
Labor to Cesarean Conversion	1.72 (1.06, 2.80)	0.028	0.50 (0.10, 0.90)	0.014
Scheduled Cesarean Delivery	1.26 (0.70, 2.30)	0.441	0.22 (-0.28, 0.71)	0.386
Comorbidities				
Preterm Delivery	0.76 (0.52, 1.12)	0.169	-0.36 (-0.69, -0.03)	0.031
Multiple Gestation	1.29 (0.77, 2.15)	0.337	0.15 (-0.31, 0.60) 0.52	
Preeclampsia	1.02 (0.73, 1.43)	0.907	-0.06 (-0.36, 0.23) 0.68	
Chorioamnionitis	1.07 (0.70, 1.66)	0.748	0.14 (-0.23, 0.51)	0.473
Abruption	1.25 (0.82, 1.90)	0.301	0.19 (-0.18, 0.56)	0.308
Placenta Previa and PAS	1.42 (1.04, 1.94)	0.026	0.75 (0.48, 1.02)	<0.001
Fibrinogen Concentrate Used	1.51 (0.75, 3.05)	0.244	1.14 (0.56, 1.73)	<0.001
Viscoelastic Testing Used	0.55 (0.29, 1.05)	0.072	-0.65 (-1.19, -0.12)	0.017
Academic Affiliation	1.18 (0.50, 2.79)	0.701	-0.07 (-1.19, 1.04) 0.9	
Annual Delivery Volume	1.15 (0.94, 1.41)	0.171	0.26 (-0.04, 0.55)	0.093
Cell-Salvage Used	0.68 (0.46, 0.997)	0.0484	-0.53 (-0.86, -0.19)	0.002

FFP:PRBC Transfusion and Clinical Outcomes

	Underbalanced vs Balanced		Continuous Ratio		
	Adjusted Odds Ratio (95% CI)	P-Value	Adjusted Odds Ratio (95% CI)	P-Value	
Length of Stay*	0.21 (-0.52, 0.95)	0.571	-0.10 (34, 0.15)	0.439	
ICU Admission	1.46 (0.90, 2.37)	0.124	1.18 (1.01, 1.36)	0.033	
DVT / PE	Ø	Ø	0.84 (0.39, 1.81)	0.653	
Acute Renal Failure	0.91 (0.57, 1.44)	0.680	1.00 (0.88, 1.15)	0.943	
Hysterectomy	0.95 (0.67, 1.35)	0.758	1.08 (0.97, 1.20)	0.169	
Respiratory Composite [†]	1.26 (0.87, 1.83)	0.226	1.16 (1.04, 1.31)	0.011	
Mortality	Ø	Ø	0.85 (0.54, 1.32)	0.466	

*Beta-coefficient in place of odds ratio

Ø Insufficient data for model

⁺ Respiratory Composite: mechanical ventilation, acute respiratory distress syndrome,

transfusion-related acute lung injury, transfusion-associated circulatory overload

Coagulation Parameters

New INR ≥ 1.5 (n, %)	No FFP°	Underbalanced	Balanced
4-7 RBCs	11 (7.3)	54 (13.8)	37 (18.0)
8-11 RBCs	5 (29.4)	21 (27.6)	8 (14.5)
12-23 RBCs	4 (50.0)	18 (45.0)	11 (36.7)
24+ RBCs		7 (87.5)	1 (100.0)

° A subset of 'Underbalanced' which received no FFP transfusions

Cases with measured intraoperative INR. Known preoperative INR ≥ 1.5 excluded





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Conclusions



There is significant variability in transfusion management of massive PPH, even when adjusting for multiple patient, case, and management factors



Transfusion volume (hemorrhage severity) may play a bigger role in developing new-onset coagulopathy than transfusion ratios do



There is evidence of potential harm with higher FFP ratios; each additional FFP per 4 RBCs increased odds of respiratory complications by ~16% and ICU admission by ~18%

Targeted approaches to transfusion ratios in PPH are needed as resuscitation escalates in order to avoid harm

Unanswered: What is the optimal product ratio, and when does it matter?

