Identifying Unnecessary Blood Transfusions in Patients Undergoing Craniofacial Surgery Using National Craniosynostosis Registry Dataset

Presenting Author: Lillian Zamora MD[1]
Co-Authors: Allison Fernandez MD[1], Zara Azhar MD[1], Ali Jalali PhD[1], Luis Ahumada PhD[1], Jim Fackler MD[1,2], Mohamed Rehman MD[1], Pediatric Craniofacial Collaborative Group (PCCG)
[1] Johns Hopkins All Children's Hospital, St Petersburg, FL
[2] Johns Hopkins Hospital, Baltimore, MD

Background: Craniosynostosis is the premature fusion of one or more cranial sutures that often requires surgical intervention. Surgery often involves extensive osteotomies which can lead to substantial blood loss. The aim of this study is to use a national craniosynostosis dataset to compare blood transfusion use for patients undergoing a wide range of craniosynostosis repairs in order to identify patients that were potentially inappropriately transfused and compare the risk factors for postoperative events (ASA 3 or 4, weight ≤ 10 kg, tranexamic acid use (TXA), and syndromic patients) established by Goobie et al.[2]. The broader aim is to decrease the amount of inappropriate transfusions.

Methods: The national Pediatric Craniofacial Collaborative dataset contains data from 2390 patients in the pre-, intra-, and post-operative phases of perioperative care[1]. Patients with comorbidities such as congenital heart disease as defined in the dataset were excluded from our study. To identify patients who received inappropriate or unnecessary transfusions, we made two assumptions: 1) the lowest acceptable intraoperative hematocrit is either 24% or 30% and 2) the estimated allowable blood loss (EABL) was calculated using the following equation:

$$EABL = \frac{H_1 - H_2}{H_1} \times EBV \qquad (1)$$

where, H_1 is the starting hematocrit level, H_2 is the acceptable hematocrit (i.e. 24% or 30%), and EBV is estimated blood volume.

From the EABL we subtracted the total blood transfused during the surgery to estimate the blood transfusion difference (BTD). Finally, we compared the BTD during surgery to the EABL and established thresholds to separate the patients into 3 distinct categories: no transfusion, inappropriate transfusion (transfusion (ml/kg) less than EABL), appropriate transfusions (transfusion >60ml/kg).

To identify patients as having received an inappropriate transfusion we based our criteria as follows: (i) pre-operative hemoglobin (Hb) >10, (ii) BTD ≤ 0 and (iii) total intraoperative crystalloid administration > 3 times EABL. Using this criteria we removed patients that were anemic and patients that were potentially hemodiluted.

Results: Among the 2390 patients, 2157 patients had all the required fields for calculation of EABL and BTD. None of these patients had preoperative anemia. Table 1 represents the number of patients in each group based on the defined criteria for acceptable hematocrit levels. In Table 2 we compared the percentage of patients with ASA 3-4, body weight < 10 Kg, use of tranexamic acid (TXA) and presence of a craniosynostosis syndrome as previously published studies show these features are associated with an increased risk of major post-operative complications[2].

Conclusion: We found based on our calculation assumptions of a hematocrit of 24% and 30%, 271 and 616 cases respectively of inappropriate transfusion. These numbers account for 13% and 29% of the craniosynostosis population respectively which is relatively high numbers especially for hematocrit levels of 30%. We also found 370 cases did not require blood product transfusion. The data demonstrated that patient's weight less than ten kilograms were more likely to receive an inappropriate transfusion. Many clinical factors require consideration when deciding to transfuse any patient during the intraoperative period. However, a patient weighing less than 10 kg are likely to loose a significant amount of circulating blood volume quickly during cranial vault reconstruction surgery. It is possible that many providers are transfusing blood product in anticipation of large blood loss. Although our blood product transfusion threshold calculations are subjective, the findings of this study present an opportunity to support consensus guidelines and protocols to reduce inappropriate transfusions and hence reducing the morbidity associated with transfusions in patients undergoing surgery for craniosynostosis.

Table1: Number of patients in each category.

Group	H_2= Hematocrit 24	H_2= Hematocrit 30
No Transfusion	370	370
Inappropriate Transfusion	271	616
Appropriate Transfusion	1516	1171

Table 2: Percentage of patients with risk factors for postoperative events.

Group	ASA 3-4	Weight < 10kg	No TXA	Syndromic Patients
All	31%	55%	55%	14%
No Transfusion	26%	41%	54%	13%
Inappropriate Transfusion	28%	92%	46%	10%
Appropriate Transfusion	32%	48%	55%	15%

References

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