

# Perioperative outcomes and surgical case volume in pediatric complex cranial vault reconstruction: a multicenter observational study from the Pediatric Craniofacial Collaborative Group

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## Introduction

Complex cranial vault reconstruction (CCVR) performed to treat craniosynostosis can be associated with significant blood loss, transfusion, and perioperative complications. The aim of this study was to examine the effect of CCVR surgical case volume on perioperative outcomes. We hypothesized that surgical case volume is not associated with differences in perioperative outcomes. The study primary outcome was total perioperative blood donor exposures. Secondary outcomes included the total perioperative transfusion volume, major complications, and ICU and hospital length of stay.

## Methods

The multicenter Pediatric Surgery Perioperative Registry (PCSPR) was queried for infants and children undergoing CCVR between June 2012 and September 2016. Institutions were categorized into Low, Middle, or High surgical case volume groups based on tertiles of the average number of cases performed per month. Primary and secondary outcomes were analyzed with respect to these groupings as well as perioperative characteristics.

## Results

The PCSPR query yielded 1814 CCVR cases from 33 institutions. While demographics were similar among the three study groups, there were some differences in perioperative characteristics (Table 1). An inverse relationship between surgical case volume and total perioperative blood donor exposures was observed ( $p < 0.001$ ). The Low volume group had higher perioperative transfusion volumes ( $p = 0.02$  vs Middle;  $p = 0.01$  vs High). There was no significant relationship between surgical case volume and the incidence of major postoperative complications or hospital length of stay (Table 2).

**Table 1: Perioperative Characteristics**

Characteristic	Low volume centers (N=170)	Middle volume centers (N=586)	High volume centers (N=1058)	p-value
<b>Procedure Classification</b>				
Anterior vault/Fronto-orbital advancement	66%	64%	61%	<b>&lt;0.001</b>
Mid/Posterior vault	20%	23%	30%	
Total vault	14%	14%	9%	
<b>Distractor placement</b>	7%	10%	14%	0.006
<b>Antifibrinolytic therapy</b>	48%	52%	80%	<b>&lt;0.001</b>
<b>Central line insertion</b>	35%	22%	10%	<b>&lt;0.001</b>
<b>Duration of surgery (min)</b>				Low vs. High ( <b>p&lt;0.001</b> )
Median (IQR)	268 (212, 324)	250 (189, 318)	207 (154, 266)	Middle vs. High ( <b>p&lt;0.001</b> )
<b>First postoperative Hb (g/dL) Mean ± SD</b>	12.0 ± 1.92	11.3 ± 2.06	11.2 ± 1.96	0.24
<b>Last Hb prior to discharge (g/dL) Mean ± SD</b>	10.4 ± 1.75	10.8 ± 1.78	10.4 ± 1.77	Middle vs. High ( <b>p&lt;0.001</b> )
<b>Postoperative intubation</b>	13%	8%	15%	<b>&lt;0.001</b>

**Table 2: Primary and Secondary Outcomes**

Outcome	Center Category	Outcome: Median (IQR) or %	IRR or OR*	95% CI	p-value (vs. Low)	p-value (Middle vs. High)
<b>Total perioperative blood donor exposures</b>	Low	2 (1, 3)	1.00			
	Middle	1 (1, 2)	0.77	0.67 – 0.88	<b>&lt;0.001</b>	<b>0.028</b>
	High	1 (1, 2)	0.69	0.61 – 0.79	<b>&lt;0.001</b>	
<b>Total perioperative blood products (mL/kg)</b>	Low	30 (13.3, 65.5)	1.00			
	Middle	29 (16.6, 47.5)	0.82	0.69 – 0.97	<b>0.021</b>	0.87
	High	29 (15.9, 53.4)	0.81	0.69 – 0.95	<b>0.011</b>	
<b>Major intraoperative complications</b>	Low	9%	1.00			
	Middle	13%	1.56	0.87 – 2.80	0.13	<b>0.041</b>
	High	10%	1.23	0.64 – 1.99	0.68	
<b>Major postoperative complications</b>	Low	6%	1.00			
	Middle	5%	0.83	0.40 – 1.75	0.63	0.57
	High	4.4%	0.73	0.36 – 1.47	0.38	
<b>ICU length of stay (days)</b>	Low	2 (2, 3)	1.00			
	Middle	2 (1, 2)	0.78	0.68 – 0.89	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	High	2 (2, 3)	1.01	0.90 – 1.14	0.84	
<b>Hospital length of stay (days)</b>	Low	4 (4, 5)	1.00			
	Middle	4 (4, 5)	1.00	0.91 – 1.10	0.99	0.68
	High	4 (4, 5)	0.99	0.90 – 1.08	0.81	

\*IRR applies to the negative binomial models and generalized linear regression models, and the OR to the logistic models.

## Conclusion

In this study, low surgical case volumes were associated with increased total blood donor exposures and increased perioperative transfusion volumes. Hospital length of stay was homogeneous in the three groups, suggesting a limited overall clinical impact of the observed transfusion outcome differences.