A Comparison of Whole Blood with Reconstituted Blood in Pediatric Craniofacial Reconstruction Surgery

Thottathil P, Sesok-Pizzini D, Foadjee JE, Taylor JA, Vincent A, Stricker PA

Department of Anesthesiology and Critical Care Medicine, The Children’s Hospital of Philadelphia
University of Pennsylvania School of Medicine

BACKGROUND

Craniofacial reconstruction procedures involve wide scalp dissections with multiple cranial osteotomies and have been associated with significant blood loss and morbidity.1-4 We previously described our experience in this population using reconstituted blood composed of 1:1 FFP and PRBCs, where we found that postoperative coagulopathy was nearly eliminated and perioperative blood donor exposures (BDEs) were reduced.5 We have since changed our approach to using whole blood for replacement of blood loss instead of reconstituted blood. The aim of this study was to assess the effects of this practice change on intraoperative blood loss, perioperative blood donor exposures, and the incidence of derangements in laboratory markers of coagulation in the immediate postoperative period.

METHODS (continued)

We performed a query of the Pediatric Craniofacial Surgery Perioperative Registry (PCSPR) for our local institutional data for children less than 4 years old who underwent fronto-orbital advancement or posterior cranial vault reconstruction procedures who received either whole blood or reconstituted blood for intraoperative blood loss replacement. All children included received aminocaproic acid intraoperatively. IRB approval for the creation of the PCSPR was obtained and a waiver for informed consent for local data collection was granted. Data collected from the registry included demographic data and data pertaining to the medical management and perioperative hospital course, including transfusion and laboratory data. No modifications in surgical technique or anesthetic technique occurred over the study interval. The calculated blood loss (using the method described by Kearney6), the incidence of immediate postoperative coagulation laboratory test derangements, and the total number of perioperative blood donor exposures incurred were compared between the two cohorts. A hematocrit of 36% for reconstituted blood6 and 35% for whole blood6 were used to calculate the estimated intraoperative blood loss. Abnormal coagulation tests were defined as: PT ≥18.75, PTT ≥45.75, fibrinogen ≤100 mg/dL, and a platelet count ≤50,000 per μL.

RESULTS (continued)

There were no subjects with abnormal immediate coagulation test results in the WB cohort. Postoperative surgical drain output over the first 24 hours was 29 ± 14 mL/kg in the WB cohort vs. 29 ± 18 mL/kg in the RB cohort (p = 0.94).

Table 1. Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Blood (n = 73)</th>
<th>Reconstituted Blood (n = 64)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)*</td>
<td>14.5 ± 11.0</td>
<td>13.3 ± 9.8</td>
<td>0.47</td>
</tr>
<tr>
<td>Weight (kg)*</td>
<td>9.9 ± 2.4</td>
<td>9.4 ± 2.8</td>
<td>0.25</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>33</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syrondic synostosis</td>
<td>15</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Non-syndric synostosis</td>
<td>58</td>
<td>47</td>
<td>0.41</td>
</tr>
<tr>
<td>Procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fronto-orbital advancement</td>
<td>49</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Posterior vault</td>
<td>24</td>
<td>21</td>
<td>0.99</td>
</tr>
<tr>
<td>Primary surgery</td>
<td>59</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Craniofacial reoperation</td>
<td>14</td>
<td>13</td>
<td>0.87</td>
</tr>
</tbody>
</table>

*Reported as median (IQR)

Table 2. Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Whole Blood</th>
<th>Reconstituted Blood</th>
<th>P value, [RRR (95%CI)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated Blood Loss, mL/kg</td>
<td>62.5 ± 34.1</td>
<td>84.8 ± 42.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Total Perioperative Blood Donor Exposures, median (IQR)</td>
<td>1 (1, 2)</td>
<td>2 (1, 2)</td>
<td>0.03</td>
</tr>
<tr>
<td>Any abnormal postop coagulation lab test</td>
<td>0/73 (0%)</td>
<td>2/64 (3%)</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>0.97 (0.93-1.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Perioperative Blood Donor Exposures ≤1</td>
<td>43/73 (59%)</td>
<td>25/64 (39%)</td>
<td>1.51 (1.05-2.2)</td>
</tr>
</tbody>
</table>

DISCUSSION

In a population that continues to have significant intraoperative blood loss, we found that no children had significant postoperative coagulopathy when intraoperative blood loss was replaced with whole blood. Whole blood was also associated with a reduction in the total number of perioperative blood donor exposures. Whole blood in this study was as effective as reconstituted blood in preventing coagulopathy during replacement of massive blood loss in craniofacial surgery.

Whole blood contains platelets in addition to soluble clotting factors. Although refrigerated platelets are more rapidly cleared from the circulation and have a short circulating half-life compared to non-refrigerated platelets, refrigeration of platelets in stored whole blood results in platelet activation and may promote hemostatic activity in the immediate term. We hypothesize that the reduced calculated blood loss and reduced blood donor exposures we observed with blood loss replacement using stored whole blood may be a result of superior hemostatic activity of this blood product. The associations observed in this cohort study require prospective study for confirmation.

REFERENCES