The Impact of Storage Techniques on Platelet Count and Function after Acute Normovolemic Hemodilution

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Disclosures

• The author has no conflicts of interest
Introduction

• Debate with blood management during congenital cardiac surgery
  – Whether higher HCT values optimizes perioperative and neurodevelopmental outcomes
  – Risks and cost associated with blood product transfusions
  – Blood transfusion parameters
Randomized trial with blinded assessment of outcome.

147 patients total with 74 patients in the lower HCT group (HCT 21.5%) and 73 patients in the higher HCT group (HCT 27.8%)

Lower HCT was associated with lower CI, higher lactate at 60 minutes after CPB and higher percentage of increased TBW on POD 1.

At 1 year lower HCT had lower PDI, but similar MDI and neurological exam.

Lower HCT (<20%) is associated with adverse perioperative results and lower developmental outcomes in infants.
• 124 subjects, 56 were assigned to the lower-hematocrit strategy (24.8%) and 68 to the higher-hematocrit strategy (32.6%).

• Infants randomized to the 25% strategy, had a more positive intraoperative fluid balance (P 0.007) and lower regional cerebral oxygen saturation at 10 minutes after cooling (P 0.04) and onset of low flow (P 0.03). Blood product usage, and adverse events were similar in the treatment groups.

• At 1 year of age, there again was no difference between the two groups related to the PDI and MDI scores
Research
Wypij et al J Thorac Cardiovasc 2008; 135: 355-60

• 271 infants who underwent biventricular repair, not involving aortic arch.
• Lower HCT was associated with more positive intraoperative fluid balance and marginal association with increased serum lactate at 60 minutes after CPB.
• PDI at 1 year was a non linear correlation with HCT, and a plateau effect was seen beyond HCT of 23.5%.
• HCT of 24% or higher on CPB was associated with higher PDI and reduced lactate.
• ***Could not ascertain a universally “safe” hemodilution level.
A single-center strategy to minimize blood transfusion in neonates and children undergoing cardiac surgery.

*Paediatr Anaesth.* 2015 Jan 12. [Epub ahead of print]
Naguib AN, Winch PD, Tobias JD, Simsic J, Hersey D, Nicol K, Preston T, Gomez D, McConnell P, Galantowicz M.

<table>
<thead>
<tr>
<th>Weight category</th>
<th>Transfused</th>
<th>Not transfused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>128 (61.1%)</td>
<td>81 (38.8%)</td>
</tr>
<tr>
<td>Group 1 (&lt; 6 Kg)</td>
<td>73 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Group 2 (6-18 Kg)</td>
<td>42 (63.6%)</td>
<td>24 (36%)</td>
</tr>
<tr>
<td>Group 3 (&gt; 18 Kg)</td>
<td>13 (18.6%)</td>
<td>57 (81.4%)</td>
</tr>
</tbody>
</table>

Overall incidence of transfusion in the three weight categories
Introduction

• Our institution is a referral center for JW patients
  – This population has driven techniques to achieve bloodless congenital cardiac surgery
  – Benefit to utilizing these techniques throughout all congenital cardiac surgery patients
Introduction

• Purpose of our study
  – Show that bloodless cardiothoracic procedures are possible when utilizing current blood management techniques
  – Examine the effect of storage on both platelet count and function
  – Examine any potential changes to these parameters over time/method of storage (syringe or bag)
Methods

• ANH protocol (goal)
  - 10-20ml/kg for patients <5kg
  - 10-20% CBV for patients >5kg

• Ultimately based on starting HCT and estimated target HCT on CPB (>20)
Introduction

• **Blood conservation techniques**
  – Acute normovolemic hemodilution (ANH)
  – Retrograde autologous prime (RAP)
  – Venous antegrade prime (VAP)
  – Modified ultrafiltration (MUF)
  – Flow based circuits
  – Cellsaver for all cases
Methods

- Anesthesia minimizes volume replacement and maintain hemodynamics during ANH collection
  - Parameters monitored; HR, EKG, MAP, CrO2 (CASMED®)
  - 5% Albumin
  - Anesthesia utilizes vasopressor
    - Phenylephrine
    - Epinephrine
Methods

• Data collection included:
  – ANH volume
  – ACD volume
  – method of collection (Syringe or bag)
  – platelet count/function upon collection and prior to reinfusion of ANH
Methods

• Data collection included:
  – length of storage
  – quantity of all blood products given in OR/ensuing 24 hrs
  – CT output 24hrs
  – LOS in ICU and hospital
Methods

• Storage
  – ANH was stored at room temperature in blood bank container
  • Temperature probe was placed within container
  • Temperature range during storage (21.4°C - 25.5°C)
## Results

<table>
<thead>
<tr>
<th></th>
<th>ANH Bag</th>
<th>ANH Syringe</th>
<th>ANH All</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>14.9±8</td>
<td>3.5±2.8</td>
<td>10±8</td>
</tr>
<tr>
<td><strong>Weight (Kg)</strong></td>
<td>56±29</td>
<td>12±5</td>
<td>37±31</td>
</tr>
<tr>
<td><strong>ANH volume (ml)</strong></td>
<td>466±141</td>
<td>130±31</td>
<td>10±3 ml/kg</td>
</tr>
<tr>
<td><strong>Chest tube output</strong></td>
<td>17±22</td>
<td>19±16</td>
<td>18±19</td>
</tr>
</tbody>
</table>
Results

• 21 patients received no blood products throughout perioperative course

• 10 patients received blood products in OR:
  • 8 patients received PRBC
  • 3 patients received platelets
  • 2 patients received cryoprecipitate
  • 3 patients received FFP
Results

• 13 patients received blood products post-op (ICU)
  – 5 PRBC
  – 9 platelets
  – 4 cryoprecipitate
  – 5 FFP

• Patients who received platelets transfusion were excluded from the platelet’s count data.
Results

PAT | ANH post draw | ANH pre infusion | CTICU-arrived | CTICU-24hrs
--- | --- | --- | --- | ---
0 | 50 | 100 | 150 | 200 | 250

Platelet Count
Conclusion

• While several studies have challenged the role of ANH in reducing blood transfusion in pediatric CPB patients, our experience concludes that patients who underwent ANH were less likely to receive blood products.

• Post bypass ANH is a valuable blood conservation technique which can decrease blood transfusions.
Conclusion

• Results indicate that storage of ANH with current methods (syringe/bag) does not effect platelet count/function

• Our current ANH protocol represents a very valuable and low-cost method of improving hemostasis, and reducing the need for blood products.
Questions