Strategies to improve outcomes and reduce waste

Patrick D. Carroll, MD, MPH
Neonatologist

UMBILICAL CORD BLOOD, NO LONGER WASTE
Bill Johnson

- 61 year old
- Mild Abdominal pain
- ED Visit
- Routine labs ordered; 450 mL blood draw
UMBILICAL CORD BLOOD, NO LONGER WASTE

Strategies to improve outcomes and reduce waste

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CUMULATIVE NEONATAL BLOOD LOSS

Courtesy of Jack Widness
ANATOMY REVIEW

Fetal Circulation

• 33% of fetal blood is in the placenta
• Cord blood is often disposed
• Fetal and Maternal circulation are separate
## Admission Lab Volume

<table>
<thead>
<tr>
<th>Test Volume (mL)*</th>
<th>Percent of Circulating Blood Volume</th>
<th>Infant Birth weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>500 g</td>
</tr>
</tbody>
</table>

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Culture</td>
<td>1</td>
<td>2.5%</td>
<td>1.7%</td>
<td>1.3%</td>
<td>0.8%</td>
<td>0.5%</td>
</tr>
<tr>
<td>CBC/diff</td>
<td>0.3</td>
<td>0.8%</td>
<td>0.5%</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Type and Screen</td>
<td>1</td>
<td>2.5%</td>
<td>1.7%</td>
<td>1.3%</td>
<td>0.8%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Newborn Metabolic Screen</td>
<td>0.6</td>
<td>1.5%</td>
<td>1.0%</td>
<td>0.8%</td>
<td>0.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Chromosomes/microarray</td>
<td>3</td>
<td>7.5%</td>
<td>5.0%</td>
<td>3.8%</td>
<td>2.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5.9</td>
<td>14.8%</td>
<td>9.8%</td>
<td>7.4%</td>
<td>4.9%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>
UMBILICAL CORD BLOOD FOR ADMISSION LABS

Carroll et al 2011
**Table 2.** Cases (initial blood tests drawn from placenta/cord) were matched 1:1 with controls (initial blood tests drawn from neonate)

<table>
<thead>
<tr>
<th>Case/Control Description</th>
<th>Cases with delayed clamping or milking</th>
<th>Matched controls</th>
<th>P-value</th>
<th>Cases with no delayed clamping or milking</th>
<th>Matched controls</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in hgb in the first 12 to 24 h after birth (mean, interquartile range)</td>
<td>+2.0 g dl⁻¹; -0.2 to 3.5</td>
<td>-1.0 g dl⁻¹; -1.9 to -0.1</td>
<td>&lt;0.001</td>
<td>+0.5 g dl⁻¹; -0.7 to 2.0</td>
<td>-0.5 g dl⁻¹; -1.3 to 0.7</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>(n = 33)</td>
<td>(n = 33)</td>
<td></td>
<td></td>
<td>(n = 55)</td>
<td>(n = 55)</td>
<td></td>
</tr>
<tr>
<td><strong>Vasopressors</strong></td>
<td>17%</td>
<td>61%</td>
<td>&lt;0.001</td>
<td>8%</td>
<td>30%</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>6/36</td>
<td>22/36</td>
<td></td>
<td>5/60</td>
<td>18/60</td>
<td></td>
</tr>
<tr>
<td>One or more erythrocyte transfusions</td>
<td>25%</td>
<td>64%</td>
<td>&lt;0.001</td>
<td>25%</td>
<td>42%</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>9/36</td>
<td>23/36</td>
<td></td>
<td>15/60</td>
<td>25/60</td>
<td></td>
</tr>
<tr>
<td><strong>Number of erythrocyte transfusions per patient (mean; interquartile range)</strong></td>
<td>0.6; 0 to 0.5</td>
<td>2.2; 0 to 4</td>
<td>&lt;0.001</td>
<td>0.4; 0 to 0.5</td>
<td>1.2; 0 to 2</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Abbreviation: hgb, blood hemoglobin concentration.

Comparisons were; (1) change in blood hemoglobin concentration between birth and 12 to 24 h later, (2) proportion that received vasopressors in the seven days following birth, and (3) proportion that received erythrocyte transfusions in the seven days following birth. Data from all cases were included (intent-to-treat analysis) even though the procedure was unsuccessful in five. Cases subjected to delayed cord clamping or cord milking are compared with their matched controls. Similarly, cases not subjected to delayed cord clamping or milking are compared with their matched controls.
STUDY DESIGN

- Cross Sectional Study
- Paired, sequential samples
- Term infants
- Vaginal and Cesarean deliveries
## STUDY DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Cesarean Section</th>
<th>Vaginal Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cord Segment</strong></td>
<td>n=15 2, 10, 30 minutes (45 data points)</td>
<td>n=15 2, 10, 30, 60 minutes (60 data points)</td>
</tr>
<tr>
<td><strong>Placental Vein</strong></td>
<td>n=15 2, 10, 30 minutes (45 data points)</td>
<td>n=15 2, 10, 30 minutes (45 data points)</td>
</tr>
</tbody>
</table>
OPTIMAL TIMING OF OBTAINING CORD BLOOD

WBC

Hemoglobin

Platelet

2 minute 10 minute 30 minute

2 minute 10 minute 30 minute

2 minute 10 minute 30 minute
CONCLUSIONS

Cord blood can be used for admission CBC

- Obtain within 10 minutes from placental vein
- Obtain within 30 minutes from cord segment
- Additional Studies needed to validate in preterm infants
ACKNOWLEDGEMENTS

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DRMC Laboratory
Peggy Reed

Peggy Reed
1953-2016
Cumulative Phlebotomy Loss

- Cumulative with UAC
- Cumulative without UAC

Phlebotomy Loss (mL/kg)

Day of Life

- n=2
- n=39
- n=33
- n=8
- n=64
- n=70

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Phlebotomy Loss Before and After UAC Removal

- Phlebotomy Loss
- Expected Phlebotomy Loss
- 95% Confidence Interval
- AC Removal

Phlebotomy Loss (mL/kg-d) vs Time from UAC Removal (days)

- n=59
- n=62
- n=66
- n=70

Time from UAC Removal (days)

-4  -3  -2  -1  1  2  3  4