To MUF or Not to MUF: What are the considerations?
Colette S. Calame CCP LP FPP

Disclosures
No Disclosures
Overview

- Brief Overview of MUF and prior survey results
- Why MUF Survey and Survey Results
- Pediatric Circuit Primes vs MUF Circuit Primes.
- Illustration of current circuit and MUF practice at OU Children’s
- Questions and Discussion

Update on Pediatric Perfusion Practice in North America: 2005 Survey
Robert C. Groen, CCP; Shane Froebel, CCP, [...], and Reed D. Quinn, MD

Abstract:

"Modified ultrafiltration is used at 75% of Centers Surveyed". Modified ultrafiltration techniques and devices are adopted into clinical practice at pediatric heart centers are not well described. We conducted a mail survey of North American pediatric cardiac surgery centers to gain perspective on the extent to which various devices and techniques were used for CPB along with program demographic data. In January 2005, surveys were mailed to 180 North American open heart centers. The survey was nearly identical in format and content to three earlier surveys completed in 1989, 1994, and 1999, with the exception that new questions were added to address new technique and

"Modified ultrafiltration was reported by 71% of centers". New extracorporeal bypass devices and new innovative methods are frequently reported in the literature; however, the actual extent to which they are adopted into clinical practice is not well known. We distributed an electronic survey to 288


Abstract

"Modified ultrafiltration was reported by 71% of centers" and South America, Canada, Europe, and Asia. Most of the responding centers reported use of hard shell venous reservoirs. Closed venous systems were used in 85% of centers and South America as compared with 91% in North America and 99% in Canada and South America as compared with 91% in North America and Canada. "The Maze" cannula is more common in North America (30%) than any other continent, whereas Custodial Teflon solution is more prevalent in Europe (35%). While variation in practice was evident across geographic regions, suggesting opportunities for further investigation and improvement.
### 2016 MUF Survey

**45 Centers Responded**

<table>
<thead>
<tr>
<th></th>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>We use MUF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUF Everyone</td>
<td>29%</td>
<td>10</td>
</tr>
<tr>
<td>MUF Criteria or (one surgeon of the group didn't)</td>
<td>71%</td>
<td>25</td>
</tr>
<tr>
<td><strong>We don't MUF</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We previously used MUF, but stopped</td>
<td>11%</td>
<td>5-50%</td>
</tr>
<tr>
<td>Never Have Done MUF</td>
<td>11%</td>
<td>5-50%</td>
</tr>
<tr>
<td><strong>Increase in HCT</strong></td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Range 3% to 15 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median answer 5-10%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**2016 MUF Survey**

**35 Centers Responded**

<table>
<thead>
<tr>
<th></th>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who decides if MUF</td>
<td>100%</td>
<td>35</td>
</tr>
<tr>
<td>Perfusion/Surgeon</td>
<td>34%</td>
<td>12</td>
</tr>
<tr>
<td>All Three (perfusion, surgeon, anesthesia)</td>
<td>31%</td>
<td>11</td>
</tr>
<tr>
<td>Protocol</td>
<td>20%</td>
<td>7</td>
</tr>
<tr>
<td>Surgeon</td>
<td>11%</td>
<td>4</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>3 %</td>
<td>1</td>
</tr>
</tbody>
</table>

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### 2016 MUF Survey

**35 Centers Responded**

<table>
<thead>
<tr>
<th></th>
<th>Response</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td>71%</td>
<td>25</td>
</tr>
<tr>
<td>&lt; 10 kg</td>
<td>-10%</td>
<td>2</td>
</tr>
<tr>
<td>&lt; 15 kg</td>
<td>-10%</td>
<td>2</td>
</tr>
<tr>
<td>&lt; 20 kg</td>
<td>-10%</td>
<td>2</td>
</tr>
<tr>
<td>&lt; 25 kg</td>
<td>-0.4%</td>
<td>1</td>
</tr>
<tr>
<td>&lt; 40 kg</td>
<td>-10%</td>
<td>2</td>
</tr>
<tr>
<td>Age &lt; 1 year</td>
<td>-0.4%</td>
<td>1</td>
</tr>
<tr>
<td>Everyone except single ventricle patients</td>
<td>-10%</td>
<td>2</td>
</tr>
<tr>
<td>Several criteria</td>
<td>-52%</td>
<td>13</td>
</tr>
</tbody>
</table>
MUF Considerations

- MUF Circuit Prime relative to Pump Circuit
- Surface Area of Hemoconcentrator
  - How fast volume can be removed
- Is Patient Bleeding
- HCT prior to MUF
- Is The Patient Stable (A-V)
- Is The Surgeon Patient

Additional MUF Considerations

- A-V vs V-V (A-A)
- Care to not “dry the patient out”
- MUF rate is dictated by the patient’s hemodynamics
- Inflammatory mediator removal is ZBUF better
- Increase of clotting factors and PLT numbers
- What is the real benefit??
MUF Circuit Prime
Terumo Conducare Prime - 7 cc
Mostly 3/16" (0.42 cc/inch) tubing = 13 cc
3/16" (0.21 cc/inch) 16" Table line = 1.1 cc
Total = 22.4 cc

Hemocor
Terumo HPH® 400 = 34 cc = 36.4 cc
Terumo (Dideco) DHF0.2 = 30 cc = 62.4 ml
Hemocon HPH* Junior = 8 cc = 30.4 cc

Temperature Port
One way valve
"bubble trap"
Pressure Monitor line

Sorin (Dideco) DHF0.6 = 60 cc = 82.8 cc
Sorin (Dideco) DHF0.6 = 60 cc = 82.8 cc
Hemocon HPH® Junior = 8 cc = 30.4 cc
**Tubing pack**
Oxygenator FX 05 SP = 43 ml
1⁄4” race way 28” = 23 ml
3/16” arterial line 40” = 17 ml
3/16” venous line 40” = 17 ml
1/16”-1/8” purge line (CDI) = 4 ml
Total = 104 ml

**MUF Circuit Prime**
Terumo Conducer Prime = 7 ml
Tubing 3/16” (0.42 cc/inch) = 12 ml
1/8” Table line (0.21 cc/inch) 16” = 3.4 ml
Total = 22.4 ml

**Hemoconcentrator**
Sorin (Dideco) DHF0.6 - 60 cc = 82.4 ml
Sorin (Dideco) DHF0.2 - 30 cc = 62.4 ml
Hemocor HPH 400 - 34 cc = 56.4 ml
Hemocor HPH® Junior - 8 cc = 30.4 ml

**MUF volume removal**
\[ \text{TMP} = \frac{(P_i + P_o)}{2} + P \text{ (Suction)} \]

\[ P = \text{pressure (mmHg)} \]
Hct = 32%,
Total protein = 5%
Temp = 37 °C
Qb = 200 ml/min,
TMP = 200 mmHg.
Conclusions

- Majority of Pediatric Centers Still MUF
- Adoption of “Microcircuity” has had little impact on MUF Rates
- Custom Micro MUF Circuits Could be used for Maximum Blood Conservation