Leukapheresis

White Cell Depletion for Leukocytosis
Objectives

- Discuss the indication for leukoreduction
- Identify IV access needs for patients receiving leukapheresis
- Outline ways to maintain fluid and electrolyte balance
Hyperleukocytosis = WBC > 100,000/µl
Leukostasis refers to end organ complications that result from high WBC count
  - The risk of leukostasis occurs with WBC count > 100,000/µl in AML
  - In ALL risk for leukostasis occurs with WBC count > 400,000/µl
Signs and Symptoms:
  - Respiratory distress/hypoxemia
  - CNS deterioration
  - Renal or Cardiac compromise, limb ischemia, priapism, fever, coagulopathy
Prophylaxis vs Treatment

- Leukostasis is an ASFA category I indication for leukoreduction
- Prophylaxis of leukostasis is a category III indication
- Retrospective studies show little impact on long term survival.
- Some indication that short term survival is improved by early intervention with apheresis therapy
- Safe procedure with volume replacement
Leukoreduction

Procedural Considerations

- Uses Spectra MNC platform

- Collect rates are much higher, resulting in significant fluid volume deficits

- Rinseback should be avoided if possible

- Plan must include fluid and possibly cellular replacement.
IV access

- Dual lumen, apheresis or dialysis catheter
- Permanent types-ideal but not realistic:
  - 5 fr Powerline-Ok for patients less than 10kg
  - 6 Fr Powerline-patients 10-25kg
  - 9.5 Fr Power Hickman-patients >25kg
  - 8 Fr Hemocath-bulky, difficult to dress, Hx of hub crackage. Provide adequate flow for apheresis in all sizes up to ~50kg.

- Temporary types-IJ or femoral
  - 5 fr cook-OK for patients less than 10kg
  - 6 Fr Powerhohn-patients 10-25kg
  - 7Fr Medcomp-patients up to 40kg
  - 9 Fr Medcomp-fine for anyone
Additional IV access requirements

- DL catheter will be used by apheresis team during procedure
- Additional access needed for replacement fluids, blood products, medications.
- Peripheral IV, PICC
Case Study:

- 3 year old presented to outside ER with petechiae, mucous membrane oozing, lymphadenopathy.
- CBC revealed WBC count >600,000
- Patient identified as at risk for leukostasis due to small size, high WBC count.
Case Study

**Size**
- 20.3kg
- 94cm
- TBV: 1421 ml

**Labs**
- Hct: 26%
- Plt: 44k
- WBC: 584k
- Ionized Ca+: 0.99
- K+: 6 mg/dl

**Procedure**
- 1 unit CMV- irradiated PRBC for prime.
- No premeds needed
- 7Fr Medcomp IJ
- Anticoagulation: ACD-A plus 6u/mL Heparin
- AC ratio 25:1
- Goal: WBC count <100k
- Machine: COBE Spectra
Fluid Balance: Collect flow for TBV

\[ > 3L \]

<table>
<thead>
<tr>
<th>Inlet Rate in mL/min</th>
<th>40</th>
<th>60</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC precount (000)/μL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>200</td>
<td>5</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>300</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>400</td>
<td>11</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>500</td>
<td>13</td>
<td>20</td>
<td>27</td>
</tr>
</tbody>
</table>

Collect flow rate in mL/min

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**Legend:**

- TBV: Total Blood Volume
- WBC: White Blood Cells
Case Study

Fluid Balance

• Collect Flow rate calculated by Spectra OM:
  0.0003 x Inlet rate x WBC count
  • 7mL/min at start (420ml/hr!), adjusted down to
    2mL/minute based on WBC count
• CBC’s done hourly or q 2 blood volumes. Collect rate
  and replacement fluid rate recalculated.
• Replacement fluids: Apheresis output replaced with
  5% albumin, NS, and bicarb fluids.
REPLACEMENT FLUIDS

• Estimate Hourly Apheresis Output and replace with:
  • 5% Albumin or blood products
  • IVF’s

• Replacement fluid considerations:
  • Always plan on platelets
  • Watch K+
  • Hematocrit will increase as WBC decreases

• MUST BE AT BEDSIDE WITH IV ACCESS!
Case Study
Preventing Citrate Toxicity

• Inlet rate started at 38mL/minute, decreased to 28mL/min to maintain citrate infusion rate
• Citrate Infusion Rates 0.8 - 0.9 mL/L TBV/min
• Heparin infusion rate 25-27u/kg/hour
• Lytes, ionized Ca+ monitored q 1 hour
• Calcium Gluconate Infusion 0.37-0.47mg/kg/min
  • Bolused x 2: 100mg over 5” (5mg/kg)
# Case Study

## Better Blood?

<table>
<thead>
<tr>
<th>Pre Procedure</th>
<th>Post Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC: 584</td>
<td>WBC: 83</td>
</tr>
<tr>
<td>Hgb/Hct: 8.6/26</td>
<td>Hgb/Hct: 9.1/28</td>
</tr>
<tr>
<td>Plt: 44</td>
<td>Plt: 69 (rec’ d 1 unit  for plt 9k)</td>
</tr>
<tr>
<td>Ionized Ca+: 0.99</td>
<td>Ionized Ca+: 0.95 (bolused for 0.8)</td>
</tr>
<tr>
<td>K+: 6.0</td>
<td>K+: 3.1</td>
</tr>
<tr>
<td>LDH: 6992</td>
<td>LDH: 2943</td>
</tr>
</tbody>
</table>

- Volume Processed: 11,249mL (8 x TBV)
- Volume Removed: 1,219mL (86 %TBV)
- Calm, interacting with parents throughout procedure
• Diagnostic LP and BMA completed next morning
• Methylprednisalone started 12 hours later for WBC count 92K
• Chemo started ~36 hours after procedure completed
• Renal function 4 hours after start of chemo: Uric Acid 10.3, Creatinine 1.0, BUN 54.
• Patient completed T Cell ALL protocol AALL0434 in November 2013. Continues in remission to date.
Conclusion

• Pediatric Leukoreduction can be performed safely
• Short term Survival = Long Term Survival
References


- Becker, J. L. (2013), Leukapheresis: have we been looking at the right outcome?. Transfusion, 53: 2603–2604. doi: 10.1111/trf.12387
