PEDIATRIC POTPOURRI
TODAY’S GOAL

- Present current practice in pediatric transfusion medicine.
- Discuss what we do at SLCH
- Discuss what’s being done outside of SLCH

- What I’m not going to do...
  - Present a bunch of studies on pediatric transfusion medicine.
  - Current studies in pediatric transfusion medicine all end with the following statement...

MORE STUDIES NEED TO BE PERFORMED
TOUR OF THE BLOOD BANK-TESTING
PEDIATRIC VS ADULT TESTING

- **Type and Screen for patient’s < 4 months of age (120 days)**
  - Does not include a back type.
  - Includes an antibody screen for ABO antibodies at IgG.
  - No direct coombs. Ordered only if hemolysis is suspected.

- **Compatibility testing for patient’s < 4 months of age.**
  - Assign only. Assign tables are the same tables used for computer crossmatch.

- **All other testing is the same as adults.**
  - Antibodies are mostly Anti-D’s due to RhIg in newborns and common antibodies in our sickle cell population.
TOUR OF THE BLOOD BANK - STORAGE
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TRANSFUSION DATA

- **RBC transfusions**
  - 4095 whole RBC’s transfused
  - 1366 aliquots transfused
  - 4631 RBC’s purchased

- **SDP transfusions**
  - 1645 whole SDPs transfused
  - 794 aliquots transfused
  - 1957 platelets purchased

- **Plasma transfusions**
  - 460 whole units
  - 681 aliquots
100% Leukoreduced RBCs
- ~ 40/60 CMV seronegative vs untested
- We have an irradiator

100% Leukoreduced Single Donor Platelets
- No random donor platelets
- Aliquots are made from SDPs for small volume transfusions.

100% 24 Hour Plasma
- All patients receive 5 day plasma transfusion.

We provide single units of cryo and pooled cryo.
- Pools are used mostly for Massive Transfusion Protocol activations.
We keep a small inventory and turn it over frequently.

“Fresh” blood. We give blood < 8 days old for/to:
- Prime units for open heart cases
- New RBC units to be used for aliquoting
- Patient < 4 months old in surgery

Provide freshest available to:
- Cardiac OR cases for patients 4 months or older
- Chronically transfused sickle cell patients

And, platelet expirations are always short.
BOXES ARE PICKED UP DAILY
Numerous studies have been performed.
Numerous studies are being performed.

Our policies are in place to:
- Minimize known effects of stored blood in massively transfused patients.
- Limit donor exposure in infants.
- Maximize inventory.
- Minimize wastage.

If fresh is proven better we’ll be the model blood bank.
SPECIAL PROCESSING

- Leukoreduction
- CMV
- Irradiation
- Washing/Additive solutions
CMV SERONEGATIVE VS CMV SAFE

- Association Bulletin #02-4
  - CMV safe is equivalent to CMV Negative.
  - CMV surveillance and employment of preemptive therapy upon detection of CMV antigenemia has led to a broader acceptance of the interchangeable use of CMV-seronegative and prestorage leukocyte-reduced blood components in allogeneic bone marrow transplant patients where both the donor and recipient are CMV seronegative.
  - Early detection and treatment.

- Encourage hospital transfusion committees to evaluate policies for high risk patients.
CHILDREN’S FUTURE PLANS

- CMV sero-negative for:
  - Patient’s with birth weights < 1200g until 4 months of age.
  - CMV negative allogeneic transplant recipients during the period of immune suppression and immune incompetence – i.e. from the start of transplant conditioning until 1 year post transplant.
Prevention of Transfusion-associated Graft vs. Host Disease (TA-GVHD)

TA-GVHD is a usually fatal immunologic transfusion complication caused by engraftment and clonal expansion of donor lymphocytes in a susceptible host.

Irradiation of cellular products with 2500 rads has been shown to be effective to prevent TA-GVHD.
IRRADIATION INDICATIONS

- Intra-uterine transfusion
- Premature infants weighing <1200 g at birth.
- Patients with known or suspected cellular immune deficiencies
- Patients undergoing marrow or peripheral blood progenitor cell transplant.
- Patients rendered immunosuppressed by chemotherapy or radiation treatment.
- Recipient of components from blood relatives.
- Recipients of HLA-matched or platelet crossmatch-compatible components.
We have our own irradiator.

- Each aliquot is irradiated at the time of dispense vs. the mother unit.
  - Prevents changes in expiration
  - Keeps K+ leak from accelerating

- 24 hour rule for infants
WASHING ALIQUOTS

- Aliquots for simple transfusions are not washed.
  - K+, mannitol, glucose, etc. have limited affects with simple transfusions. 10-15 mls/kg.
  - We currently use mostly AS-1 units.
    - AS-3 units lack mannitol.

- Units for neonatal exchange transfusions are washed.
  - Removes bi-products but also allows for higher volumes of plasma in the final product.
  - SLCH performs almost no exchange transfusions. < 1/year.
    - Pre-natal care
    - UV therapy.
OUR PATIENTS ARE UNIQUE
OUR UNITS ARE NOT (ADULT SIZES ONLY)
PRODUCT ORDERS

- Products are order by dose.
  - RBCs and Plasma: 10-15 ml/kg, up to 1 unit.
  - Platelets: 5-10 ml/kg, up to 1 unit.

- A 1000g newborn will get a syringe with 12-17 mls of blood.
The Debate: RBC donor exposure vs. product utilization

- We utilize one unit for all chronically transfused neonates
- We will assign a patient to a unit if we suspect multiple transfusions
  - ECMO
  - Post cardiac surgery.
- Studies have shown that ~85% of premature infants will receive either 1 or 2 transfusions. Our own experience supports that data.
- Infants <1000g may receive 10+ transfusions but may do so over 2-3 months time.

- Platelets
  - Aliquot from SDPs

- Plasma
  - Aliquot from 5 day plasma
MAKING AN ALIQUOT
TRADITIONAL: STEP 1
TRADITIONAL WAY: STEP 2
TRADITIONAL: FINAL PRODUCT
SLCH WAY: STEP 1
SLCH WAY: STEP 2
SLCH WAY: STEP 2 CONT.
You save ~ 3-5 mls of blood for each aliquot.
- We often make 7 or more aliquots from a single unit.
- That’s 35mls saved or 3 extra transfusions for a 1kg infant.
- Limited to no air in mother bag.
Single Donor Platelets are:
- Bacterial tested by supplier
- Platelet yields typically exceed $3 \times 10^{11}$
- If you provide CMV sero-negative units you only pay once.

At SLCH we use SDPs only
PLATELET CALCULATION

- Using our example...

We take the volume and divide it by the absolute platelet count.

\[
259\text{ml}/3.9 \times 10^{11} = 67\text{ml}/1.0 \times 10^{11}
\]

We then multiple \(67 \times 3.0 = 199\text{ml}\) to provide \(3.0 \times 10^{11}\)

Thus:

- 60mls are available for aliquots
- If the unit weighs at least 199mls we’ll give it as a whole unit.
<table>
<thead>
<tr>
<th>ABO</th>
<th>EXP</th>
<th>C</th>
<th>I</th>
<th>Full Prod Vol</th>
<th>Extra Vol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O+</td>
<td>X</td>
<td></td>
<td>9-20</td>
<td>NO</td>
</tr>
<tr>
<td>2</td>
<td>AB+</td>
<td></td>
<td>X</td>
<td>X</td>
<td>152</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td></td>
<td>X</td>
<td>9-20</td>
<td>201 85</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td></td>
<td>X</td>
<td>9-18</td>
<td>199 61</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td></td>
<td>X</td>
<td>9-18</td>
<td>174 53</td>
</tr>
</tbody>
</table>

**NAME** | **ABO** | **DATE NEEDED** | **CI** | **INDICATION**
---|---|---|---|---

What would David do?
- Provide rapid transfusion of bank platelets.
- If the mother has a history of NAIT, then maybe have a platelet antigen negative unit available.
- Don’t give the moms platelets.

What’s wrong with mom?
- Most patient’s respond well to just one untested banked unit... moms collected product is rarely transfused because the patient responded.
- Mom’s platelets must be spun and washed.
- Mom just had a traumatic event and may not be in the best shape for donating.

Management of infants born with severe neonatal alloimmune thrombocytopenia: the role of platelet transfusions and intravenous immunoglobulin

Transfusion 19 Jul 2013 Tamam Bakchoul
- Compared random donor platelets, random donor platelets with IVIG, and platelet antigen negative platelets.
- CONCLUSION: Transfusion of random-donor PLTs alone was effective at correcting critically low PLT counts and should be considered as first-line treatment of newborns with unexpected severe NAIT.
WHAT SHOULD YOU KNOW WHEN YOU LEAVE?

- If you are an adult hospital and you’re not sure what to do you can:
  - Give CMV negative, Irradiate, fresh blood products
  - Wash if time permits... especially if 25ml/kg is ordered.
  - For a simple transfusion give 10-15 ml/kg for all products.
I asked some of my pediatric blood bank friends what they are doing... here’s what they said.

Participants included:
- Miami Children’s Hospital
- Children’s of Chicago
- Children’s Mercy Kansas City
- Phoenix Children’s
- Dallas Children’s
- Children’s Hospital New Orleans
- Children’s Hospital Central California
DO YOU GIVE CMV SAFE OR SERONEGATIVE?

- Leukoreduced as CMV Safe = 5 participants
- CMV Seronegative = 3 participants
DO YOU GIVE FRESH BLOOD TO SPECIFIC PATIENTS?

- All Neonates=6
- All Cardiac Surgery=5
- Sickle Cell Patients=3
- Trauma=1

- The definition of “fresh” was between 5-10 days old
DO YOU USE AS-3 UNITS FOR SPECIFIC PATIENTS?

- CPDA units for neonates=2
- CP2D units or washed for exchange transfusions=1
- CPDA1 or if fresh volume reduced AS-1 for surgery=1
- Normal inventory=2
- CPD until the patient reaches 20kg=1
- CPD for neo surgery=1
DO YOU USE SINGLE DONOR OR RANDOM DONOR PLATELETS FOR INFANTS?

- Single donor = 7
- Random donor = 0
- Both = 1
WHAT TYPE OF PLASMA DO YOU USE FOR NEONATES?

- FFP=3
- 5 day plasma=5
DO YOU ASSIGN YOUR CHRONICALLY TRANSFUSED INFANTS A UNIT OR USE A BANK UNIT FOR ALL INFANTS?

- Assign each patient a unit=2
- Bank unit for all=4
- A mixture=2
BLOOD CONSERVATION
WHAT’S BEING DONE

- Transfusion Indications
  - Avoiding unnecessary transfusions
  - Avoiding unnecessary cost

- Crit Study

- Specimen Collection Guidelines
This alert will appear:

- When the last hemoglobin result (within 48 hours) on a child is greater than 7 g/dL AND

- A normal SBP for patient has been documented in the past 6 hours. (defined by 70+ (2x age in years) up to the age of 10. Kids older than 10 are hypotensive if their SBP is less than 90.)
The following orders in KiDDOS now have a required field included for the provider to select indications for transfusion from a restricted list

- Prepare and Hold PRBC’s
- Prepare and Transfuse PRBC’s
Pre-transfusion Hgb by floor

<table>
<thead>
<tr>
<th>Floor</th>
<th>#Trans</th>
<th>≥7 g/dL</th>
<th>≥8 g/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 E/W</td>
<td>129</td>
<td>73%</td>
<td>57%</td>
</tr>
<tr>
<td>8 E/W</td>
<td>327</td>
<td>48%</td>
<td>17%</td>
</tr>
<tr>
<td>9 BMT/E/W</td>
<td>1005</td>
<td>81%</td>
<td>28%</td>
</tr>
<tr>
<td>10 E/W</td>
<td>126</td>
<td>62%</td>
<td>24%</td>
</tr>
<tr>
<td>12 E/W</td>
<td>35</td>
<td>66%</td>
<td>29%</td>
</tr>
<tr>
<td>7 PICU</td>
<td>942</td>
<td>63%</td>
<td>35%</td>
</tr>
<tr>
<td>7 CICU</td>
<td>588</td>
<td>96%</td>
<td>85%</td>
</tr>
</tbody>
</table>

#Trans: Total number of pRBC transfusions in patients > 5 mo, Jan 2012 – June 2013
≥X g/dL: Percent of transfusions for which the documented pre-transfusion Hgb was ≥ X
Implementation of a Comprehensive Blood Conservation Program

Jennifer York, MD1; Julie Heorr, RN, PCCNP2; Manuel Silva, MD1; Nikoleta Kolovos, MD1; Jennifer Jaffe, MPH, CCRP2; Richard Griffey, MD2; Nabil Hassan, MD2; Stacey Valentine, MD2; Allan Doctor, MD1; Philip C. Spinella, MD, FCCM3; Enola Proctor, PhD2

BACKGROUND

• Monitoring of critically ill children in a Pediatric Intensive Care Unit (PICU) includes repeated phlebotomy, putting patients at risk for anemia, transfusions, and longer length of stay.
• Upon PICU admission
  • 33% of children are anemic
  • 41% more become anemic
• Anemic patients
  • Stay nearly twice as long in the PICU
  • Require mechanical ventilation 2-3 times longer

AIMS:
• Demonstrate the need for Blood Conservation (BC)
• Guidelines by documenting incidence of anemia, transfusion and blood waste
• Inform the development and implementation of a Comprehensive Blood Conservation Program

METHODS

• Single center, prospective, observational study.
• Inclusion:
  • <18 years old
  • PICU stay > 48 hours
  • English speaking
• Exclusion:
  • Premature neonates
  • Wards of the state
  • Prenatal participation
  • Refusal of transfusions
  • Pregnancy
  • Impending brain death
  • Recent PICU stay
  • ECMO
  • Involvement in other transfusion research

• 6 month Pre-Implementation Phase
  • Characterized blood draws on 112 patients
  • Overdraw was defined as the volume of blood removed in excess of minimal requirements for any given lab test
  • Overdraw was calculated for the 97 most frequent lab groups, representing >70% of blood draws
  • Wilcoxon rank-sum and Kruskal-Wallis tests used to test for statistical significance

• Preparation phase to identify driving forces of current practice and barriers to change
  • PICU Nursing Staff Survey
  • PICU Nursing Staff Focus Groups

• Implementation phase
  • BC guidelines informed by pre-implementation data
  • Implementation strategies informed by preparation phase

• Data analysis phase
  • Blood draws, anemia incidence and transfusion frequency will be re-characterized for comparison
  • Implementation effectiveness will be evaluated on staff acceptability and adoption outcomes

RESULTS

87% of samples were overdrawn
Mean overdraw 0.8 ± 1 ml
3.3 ± 2.5 ml blood/kg was removed (0.5 ± 0.2 ml blood/kg/day)
32% of study patients transfused

Mean Volume Overdrawn by # Tests

Mean Volume Overdrawn by Site

More blood is overdrawn with greater number of tests

More blood is overdrawn from central venous catheters

Adapted Conceptual Model of Implementation Research

CONCLUSIONS

• Blood overdraw is common in the PICU
• Need for transfusion was associated with 0.3 ml/kg/dl more blood removed for laboratory testing
• Blood overdraw is influenced by site and number of tests

References
THANK YOU