Appendix 2: **Blood Avoidance Protocol**

**Protocol for Minimizing the need for Blood Transfusions in Pediatric Scoliosis Surgery**
(and other extensive orthopedic procedures)

**Disclaimer:**
Blood losses and transfusion requirements of children undergoing extensive orthopedic procedures vary depending on their pathology (Idiopathic versus Neuromuscular Scoliosis), background medical risks (bleeding tendencies) and surgical techniques utilized.

This protocol will serve as a framework to provide perioperative medical care. It is neither binding nor a standard of care but rather an extensive list of options to be tailored or revised as deemed necessary by the managing surgical and medical team members.

**Introduction:**
Extensive orthopedic procedures like scoliosis surgery are associated with significant blood losses and very often patients require transfusion with blood products due to anemia and coagulopathy.

Blood transfusions are costly, dependent on the availability of the blood products and are associated with several complications including: 1) transmission of infections (viral, bacterial and protozoal), 2) immunomodulation with risks of inflammatory response, lung injury and post-operative infection, and 3) volume overload.

The above mentioned complications increase patient mortality, morbidity, hospital stay and the cost of medical care.

**Objectives:**
The objective is to devise a working medical management protocol to minimize the need for blood transfusions. The strategy will be to:
1. Screen patients for excessive bleeding risks
2. Recognize other risk factors like hypertension, renal, hepatic, cardiac & vascular or pulmonary problems
3. Diagnose and treat off pre-operative anemia
4. Minimize operative and post-operative blood losses
5. Lower transfusion thresholds without compromising patient’s safety

Interventions aim to minimize the need for transfusion carry some associated risks.
- Excessive hemodilution: carries the risk of ischemic neurologic deficits in few case reports given the excessive applications in various settings
- Procrit: associated with DVT in spinal surgery and worse outcome in oncologic populations (Recurrence & metastasis)
Trasylol is associated with higher incidence of renal failure, and thrombotic accidents in CABG surgeries. (Bayer is not actively marketing it at the time due to FDA warnings and reports of side effects in adults.)

Cell savers of all modalities are known to carry the risk of bacterial contamination. That risk is decreased with red cell washing and was never shown to translate into clinical post-operative infection.

All the above complications were reported in adults who are a much higher risk population than pediatric patients but nevertheless caution will be taken utilizing these modalities given their usefulness.

### Scoliosis Consult/Screen Guidelines

**Obligatory Consults: dictated**

1. Neurogenic/Neuromuscular scoliosis
2. Any patient with a defined syndrome
3. Jehovah’s Witness patient
4. Suspected risks on telephone screening questions

**Labs**

1. **1st Orthopedic visit**
   1. Labs: CBC with retic, Coags, von Willebrands panel
   2. To send Demographics to BAS Coordinator

**Screen by BAS nurse**

1. Review the demographics and orthopedic physical exam
2. Telephone screening
3. Review Lab data
4. Discuss potential interventions with family
   a. Pre-op meds
   b. Intra-op interventions
   c. Expected post-op course
5. **Refer for formal BAS consult if indicated**
6. Dictate letter to surgical and anesthesia services

**2nd Orthopedic visit**

1. Possible BAS physician consults
2. Further lab work: iron studies, etc if indicated

**Time of Surgery**

1. BAS available pre-/intraoperatively
2. BAS team will follow while in PICU
3. BAS team will continue to follow on Pediatric unit only if needed
**Telephone Screen Questions**  
**PMH**  

<table>
<thead>
<tr>
<th><strong>Bleeding problems in the patient:</strong></th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Blood loss when umbilical stump fell off</td>
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<td>Nosebleeds</td>
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<td>Blood loss during tooth loss</td>
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<td>Unusual bleeding with prior surgeries/injuries</td>
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<td>Blood in stool/urine</td>
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<td>Menstrual history</td>
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<tr>
<th><strong>Rashes</strong></th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
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<tr>
<td>Petechiae - small purple spots</td>
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<td>Unusual bruising</td>
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<td><strong>Ever been told patient was anemic, thrombocytopenic</strong></td>
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<tr>
<th><strong>List of medications, especially NSAIDS, BCP, herbal supplements or vitamins</strong></th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
<th>Notes</th>
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<tr>
<th><strong>Family History of bleeding/clotting problems</strong></th>
<th>Y</th>
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<th>N/A</th>
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<td><strong>Maternal history</strong></td>
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<td>Bleeding at birth (several generations)</td>
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<td>Unexpected pregnancy loss</td>
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<td>Excessive menses</td>
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<tr>
<td><strong>Bleeding history</strong></td>
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<tr>
<td>Hemophilia</td>
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<tr>
<td>Von Willebrands disease</td>
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<tr>
<td><strong>Clotting history</strong></td>
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<tr>
<td>Lupus, anti-cardiolipin antibodies, antiphospholipid antibodies</td>
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<td>Factor V leiden defect</td>
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<td>MTHFR defect</td>
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<tr>
<td>Deep venous thrombosis (leg clots)</td>
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<td>Pulmonary emboli</td>
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*Remind NOT to give any NSAIDS 2 weeks prior to surgery - Tylenol okay*
**Pre-Operative:**
Done by the "BAS"

1. Phone screen by coordinator with review by physician for need of preoperative BAS office consult.
2. History and physical exam: to elicit bleeding disorders and medical conditions predisposing to excessive bleeding.
3. Testing:
   - CBC with reticulocyte count to detect anemia and its type
   - Iron studies if indicated
   - PT, INR, PTT and Fibrinogen
   - Urine analysis and comprehensive metabolic profile
   - Blood type and cross match just before surgery
   - Other tests as needed (e.g. PF-100, VW screen, etc.)
4. Hematinics:
   - Procrit, folic acid, vitamin C, oral iron as needed with goal of HB 13 g/dl.
   - Will need 3 weeks of therapy if initial HB 10-13 grams/dl
   - Will need 6 weeks of therapy if initial HB <10 grams/dl

**Operative Care:**
- **Anesthesia Role**
  - Vascular access and pre-operative CBC, PT, PTT, Fibrinogen, Type & Screen
  - Pre-op Procrit 300 u/kg IV if HB <13gm
  - Procoagulants
    - Trasylol (see Aprotinin protocol), the preferred drug (Bayer is not actively marketing at the time due to FDA warnings and reports of side effects in adults).
      - Full Hammersmith
      - Half Hammersmith
  - Tranexamic Acid (limited data in scoliosis patients)
    - 100mg/kg IV over 15 – 30 minutes followed by
      - 10mg/kg / hr IV infusion until the end of the case
  - Amicar
    - Much less effective, but safer and cheaper
    - Dose 100 mg/kg IV over 30 minutes prior to surgery followed by
      - 10mg/kg / hr IV infusion for 24h post-op
  - Activated Factor VII
    - 30-90 mcg/kg for uncontrollable bleeding
    - Should be used as a rescue therapy unless the patient has Factor VII deficiency or hemophilia with high antibody titer.
    - Amicar or Aprotinin with Activated Factor VII carries the risk of widespread intravascular clotting, so use with caution.
Avoid excessive hypotension to minimize the risks of hypoperfusion and intravascular clotting. Avoid excessive hypervolemia to minimize dilutional coagulopathy.

- **Perfusionist’s Role:**
  - To set up intraoperative blood salvage machine (unless declined by the surgeon)

- **Surgeon’s Role:**
  - Surgical Hemostasis
  - Topical Hemostasis

- **O.R. Nursing:**
  - To set up the orthopat system for post-operative blood salvage

**Post-Operative:** (by PICU Team)
- Post-operative cell salvage for the first 12 hours
- Amicar infusion 10 mg / kg / hour for 24º post-op
- Procrit and iron (PO or IV) if HB <10gm% in the first 24 hours
- Microsampling and minimal blood draws
- Remove arterial line as soon as it is no longer needed
- CMP, CBC, PT, PTT, Fibrinogen, care set labs
- Other labs as needed
- Day of discharge, care set labs, CBC, PT, PTT, Fibrinogen

**Transfusion Trigger:**
- **Packed Red Blood Cells**
  - Hemoglobin <7 and stable
  - Hemoglobin <9 if having significant ongoing loss, heart failure, arrhythmia, high ventilatory settings or high oxygen requirements
- **Fresh Frozen Platelets**
  - INR or PTT ≥ 2 times normal, or
  - INR and PTT ≥ 1½ times normal in the presence of significant bleeding
- **Platelets**
  - If <100k intraoperatively
  - If <50k post-operatively and bleeding, or
  - If <25k
- **Cryoprecipitate**
  - Fibrinogen <150 mg/dl intraoperatively, or
  - <100 and bleeding post-operatively

The above are guidelines. Management physician can transfuse at lower thresholds, but documentation of the rationale will be helpful to monitor for practice progress.
References:


FDA Blackbox warning for Epoetin/Procrit and Aranesp


Transfusion Alternatives in Orthopedic Surgery. Transfusion Alternatives in Transfusion Medicine 2008; 1 Suppl:16-17