Perioperative Blood Management: Nuts and Bolts, Pearls and Pitfalls

BCAS/WSSA meeting
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No financial disclosures

No conflicts of interest

- Transfusion Medicine Advisory Group (TMAG)
- Perioperative Blood Management Program, Vancouver General Hospital – Medical Director
Objectives

The learner will be able to:

- Describe the advantages of patient blood management (PBM)
- Know which surgical patients benefit from PBM treatment modalities
- Understand the pros and cons of various PBM treatment modalities
- Optimize anemia preoperatively
What do we know about anemia and transfusion?

- Preoperative anemia is associated with worse outcomes
- Perioperative transfusion is associated with worse outcomes
- Preoperative anemia + perioperative transfusion is associated with even worse outcomes
- Patients with preoperative anemia get transfused most often
- The reverse experiment — conservative vs liberal transfusion strategy
- Does correction of preoperative anemia reverse this risk?
39.0% of men and 39.5% of women met WHO criteria for anemia preoperatively.
Blood transfusion and adverse surgical outcomes: The good and the bad

Victor A. Ferraris, MD, PhD,\textsuperscript{a,b} Marion Hochstetler, MD,\textsuperscript{a} Jeremiah T. Martin, MBBCh, FRCSI,\textsuperscript{a} Angela Mahan, MD,\textsuperscript{a} and Sibu P. Saha, MD, MBA,\textsuperscript{a} Lexington, KY

\textit{Surgery}

\textit{Volume 158, Number 3}
Anemic patients get transfused more frequently

Incidence of anemia on admission at VGH:

ERAS populations (2013 – 2017):

- Colorectal: 22.6% (n = 422) → Transfusion rate: 21.4% vs 8.8%
- Radical cystectomy: 37.8% (n = 222) → 38.9% vs 26.6%
- Gyne oncology: 34.9% (n = 143) → 34.0% vs 14%
Things aren’t always as they seem: what the randomized trials of red blood cell transfusion tell us about adverse outcomes

Mark H. Yazer and Darrell J. Triulzi
Nine Landmark Randomized Clinical Trials Supporting Transfusion Triggers of 70 – 80 g/L
(Less is More)

Randomized Trials:
- All supporting Hgb triggers of 70 or 80 g/L

Hebert PC et al. NEJM 1999 (TRICC trial): Critically ill MICU patients
Lacroix J et al. NEJM 2007 (TRIPICU): Critically ill PICU patients
Villanueva C et al. NEJM 2013: Severe GI bleeding
Holst LB et al. NEJM 2014 (TRISS): Septic Shock
Robertson CS et al. JAMA 2014: Traumatic Brain Injury
Carson JL et al. NEJM 2011 (FOCUS trial): Elderly orthopedic surgery
Hajjar LA et al. JAMA 2010 (TRACS): Cardiac surgery patients
Murphy GJ et al. NEJM 2015 (TITRe2): Cardiac surgery patients
Mazer CD et al. NEJM 2017 (TRICCS III trial): Cardiac surgery patients

Versus higher trigger (90 – 100 g/L)
- Same/Worse
- Same
- Worse
- Same
- Same/Worse
- Same
- Same
- Same/Worse (age >75)
Improved outcomes and reduced costs associated with a health-system–wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals

Michael F. Leahy,1,2,3 Axel Hofmann,4,5,6 Simon Towler,7 Kevin M. Trentino,8 Sally A. Burrows,1 Stuart G. Swain,6 Jeffrey Hamdorf,9,10 Trudi Gallagher,11,12 Audrey Koay,11 Gary C. Geelhoed,11,13 and Shannon L. Farmer9,14
Patient Blood Management

- Appropriate transfusion practice
- Anemia management
- Blood conservation

**Patient Blood Management (PBM)** is the timely application of evidence-based medical and surgical concepts designed to maintain hemoglobin concentration, optimize hemostasis and minimize blood loss in an effort to improve patient outcome.
<table>
<thead>
<tr>
<th>1st Pillar</th>
<th>2nd Pillar</th>
<th>3rd Pillar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimise red cell mass</strong></td>
<td><strong>Minimise blood loss &amp; bleeding</strong></td>
<td><strong>Harness &amp; optimise physiological reserve of anaemia</strong></td>
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<td></td>
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<tr>
<td>* Detect anaemia</td>
<td>* Identify and manage bleeding risk</td>
<td>* Assess/optimise patient’s physiological reserve and risk factors</td>
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<tr>
<td>* Identify underlying disorder(s) causing anaemia</td>
<td>* Minimise iatrogenic blood loss</td>
<td>* Compare estimated blood loss with patient-specific tolerable blood loss</td>
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<tr>
<td>* Manage disorder(s)</td>
<td>* Procedure planning and rehearsal</td>
<td>* Formulate patient-specific management plan using appropriate blood conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia</td>
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<tr>
<td>* Refer for further evaluation if necessary</td>
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<tr>
<td>* Treat suboptimal iron stores/iron deficiency/anaemia of chronic disease/iron-restricted erythropoiesis</td>
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<tr>
<td>* Treat other haematological deficiencies</td>
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<tr>
<td>* Note: Anaemia is a contraindication for elective surgery</td>
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<tr>
<td><strong>PREOP</strong></td>
<td><strong>INTRAOP</strong></td>
<td><strong>POSTOP</strong></td>
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<tr>
<td></td>
<td>* Meticulous haemostasis and surgical techniques</td>
<td>* Assess anaemia reserve</td>
</tr>
<tr>
<td></td>
<td>* Time surgery with haematological optimisation</td>
<td>* Maximise oxygen delivery</td>
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<td></td>
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<td>* Minimise oxygen consumption</td>
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<td></td>
<td></td>
<td>* Avoid/treat infections promptly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Restrictive transfusion thresholds</td>
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<td></td>
<td>* Optimise cardiac output</td>
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<td></td>
<td>* Optimise ventilation and oxygenation</td>
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<tr>
<td></td>
<td>* Vigilant monitoring and management of post-operative bleeding</td>
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<td></td>
<td>* Avoid secondary haemorrhage</td>
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<td></td>
<td>* Rapid warming/maintain normothermia (unless hypothermia specifically indicated)</td>
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<tr>
<td></td>
<td>* Autologous blood salvage</td>
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</tr>
<tr>
<td></td>
<td>* Minimise iatrogenic blood loss</td>
<td></td>
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<tr>
<td></td>
<td>* Haemostasis/anticoagulation management</td>
<td></td>
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<tr>
<td></td>
<td>* Prophylaxis of upper GI haemorrhage</td>
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<tr>
<td></td>
<td>* Avoid/treat infections promptly</td>
<td></td>
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<tr>
<td></td>
<td>* Be aware of adverse effects of medication</td>
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</tbody>
</table>

Patient Blood Management

Preoperative Optimization
• Timing of elective cases
  • Delay?
• Diagnosis and management of anemia
  • Iron, EPO
• Management of complicated cases
• Planning and recommendations
• *Special considerations:
  • Signed refusal
  • Bleeding disorders
  • alloantibodies

Perioperative Factors
• Planning, education, awareness
• Appropriate transfusion practice
  • Transfusion Triggers
  • The basics (T, Ca, pH, positioning)
  • Transfusion triggers
  • Antifibrinolytics
  • Cell salvage
  • ANH/phlebotomy
• Anesthetic and surgical factors

Post-operative Recovery
• Planning, education, awareness
• Appropriate transfusion practice
  • Minimize phlebotomy
  • Salvaged blood return
Improved outcomes and reduced costs associated with a health-system–wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals

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Western Australia
2008 – initiated a comprehensive health system-wide PBM program
Retrospective study of 605,046 patients over an 6 year period (2008 – 2014)

Proportion of elective surgical patients admitted anemic:

20.8%  →  14.4%

• ↓ In-hospital mortality
• ↓ Length of stay
• ↓ Hospital – acquired complications
• Cost benefit

*p-value < 0.05, indicating the mean units transfused per 1000 discharges decreased significantly when compared to the reference year (2008-2009).
Case #1
Preoperative referral to Perioperative Blood Management Program (PBMP)

- 70M, 68kg, with 6.8cm infrarenal aortic aneurysm – surgery to be done in 4 weeks
- Complicated anatomy requiring open resection
- Signed refusal for blood products (Jehovah’s Witness)

PMHx and Bloodwork:

- Quite fit and well
- No symptoms or history of cardiac or pulmonary disease
- HTN – well treated with 1 medication
- Normal renal function
- Hgb 128, plts 263, normal coagulation screen
- Ferritin 128 ng/L, Tsat 0.23%, TIBC 51
Included in consent discussion:
- Risk of transfusion and possibility of death
- Inclusive of all products
  - RBC
  - FP
  - Platelets
  - Cryoprecipitate
  - Albumin
  - Other plasma protein products (vs recombinant factors, TXA)
  - Cell salvage
  - ANH
  - EPO
### Whole Blood

#### Fractions

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Choices You Need to Make</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Albumin</strong>—up to 4% of Plasma</td>
<td>I accept albumin or I refuse albumin</td>
</tr>
<tr>
<td><strong>Immunoglobulins</strong>—up to 3% of Plasma</td>
<td>I accept immunoglobulins or I refuse immunoglobulins</td>
</tr>
<tr>
<td><strong>Clotting Factors</strong>—less than 1% of Plasma</td>
<td>I accept blood-derived clotting factors or I refuse blood-derived clotting factors</td>
</tr>
<tr>
<td><strong>Hemoglobin</strong>—33% of Red Cells</td>
<td>I accept hemoglobin or I refuse hemoglobin</td>
</tr>
<tr>
<td><strong>Hemin</strong>—less than 2% of Red Cells</td>
<td>I accept hemin or I refuse hemin</td>
</tr>
<tr>
<td><strong>Interferons</strong>—a tiny fraction of White Cells</td>
<td>I accept blood-derived interferons or I refuse blood-derived interferons</td>
</tr>
</tbody>
</table>

#### Notes

- **Whole Blood** is the complete blood pool that includes red cells, white cells, platelets, and plasma.
- **Plasma** is the liquid part of the blood that remains after all the cells have been removed.
- **Whole Blood** contains all components of blood.
- **Red Cells** carry oxygen throughout the body.
- **White Cells** are involved in the immune system.
- **Platelets** are responsible for blood clotting.

#### Natural Language Question

What influence does Jesus have on your life?
### JEHOVAH'S WITNESSES
**MEDICAL ALTERNATIVES TO BLOOD**

#### NOT ACCEPTABLE
- Whole Blood
- Platelets
- Packed Red Blood Cells
- Plasma
- Any technique that involves blood storage

#### ACCEPTABLE ALTERNATIVES

**Blood-Oxygen Monitoring Devices:**
- Transcutaneous Pulse Oximeter
- Pediatric ultra-micromensing equipment
- Multiple tests per blood draw (batching)

**Hemostatic Agents:**
- Iron Oxide (Feroloc, Infed, Velcor, IV Form)
- Folic Acid
- Vitamin B-12
- Vitamin C
- Granulocyte Colony Stimulating Factor (Neupogen)
- Granulocyte Macrophage Colony Stimulating Factor
- Interleukin-1 (Neumega)
- Antibiotic Androgenic Hormones
- Recombinant Stem-Cell Factor (Stromogen)

**Hemostatic Agents to Promote Clotting:**
- Topical: Autogen, Gelbeaxm, Oxycell, Sutures
- Hemostatic: Desmopressin (DDAVP), e-amino-capric acid (Antiam), Thrombin (Cysteamin), Vasopressin (Pitressin, conjugated estrogens, ApoProstin (Trasyla), Vinpocetine (Cynosan), Vitamin K (Phytoponadone)

**Operative & Anesthetic Techniques for Surgery:**
- Hypothermic Anesthesia
- Induced Hypothermia
- Mechanical evacuation of bleeding vessels

### PERSONAL DECISION

**Medical Products & Therapy:**
- Albumin
- Cryoprecipitate (contains small amount of plasma)
- EPO-Erythropoietin (contains small amount of albumin)
- Hemoglobin-based blood substitutes
- Hemophiliac preparations (non-synthetic)
- Immune Globulins
- Interferon (natural & synthetic buffered with albumin)
- Organ transplants and donations
- Plasma Protein Fraction (Plasmamate)
- Tissue adhesives
- Wound healing factors (platelet deriv)

**Medical Test:**
- Red & white blood cell tagging

**Recombinant Antihemophilic Factors:**
- Recombinant Factor VIII (Kogenate - small amount of albumin)

**Surgical Procedures** (non-blood primed & no storage):
- Dialysis & heart-lung equipment
- Hemodilution
- Intraoperative & postoperative blood salvage (cell saver)
- Therapeutic Apo-eresis
HEMOPURE® (HBOC-201)
[hemoglobin glutamer-250 (bovine)]

Hemoglobin Concentration: 13 ± 1 g/dL.
Volume: 250 mL.
Storage: Store at 2-30°C in overwrap. Use within 24 hours after opening overwrap. DO NOT FREEZE.

Directions: Administer intraveneously according to written instructions. Do not add medications or other solutions to this bag.

Caution: FOR INVESTIGATIONAL USE ONLY

Lot #: H11T04
Expiration Date: NOV 2017

Manufacturer:
OPK Biotech LLC
11 Hayley Street,
Cambridge, MA 02141
USA
1-817-21-a500

P/N: 49-0098A Rev 3
The variation of acceptable blood products and procedures amongst Jehovah’s Witness patients: analysis of a hospital pre-transfusion discussion tool

Asim Alam, MD · Yulia Lin, MD · Jeannie Callum, MD

Received: 15 August 2012 / Accepted: 28 August 2012 / Published online: 7 September 2012
© Canadian Anesthesiologists’ Society 2012
Hospital liaison officials from the JW organization always available

Also very useful (necessary) to ensure at least one consult re decision making with patient alone

<table>
<thead>
<tr>
<th>Description</th>
<th>Number of patients accepting treatment</th>
<th>Percent of patients accepting treatment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRBC*</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Fresh frozen plasma</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Platelets</td>
<td>1</td>
<td>4</td>
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<tr>
<td><strong>Fractionated Products</strong></td>
<td></td>
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<tr>
<td>Cryoprecipitate</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Albumin</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Plasma-derived clotting factors</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Immune globulins</td>
<td>13</td>
<td>52</td>
</tr>
<tr>
<td>Fibrin Sealants</td>
<td>14</td>
<td>56</td>
</tr>
<tr>
<td><strong>Drugs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epoetin alfa (or erythropoietin)</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Recombinant clotting factors</td>
<td>22</td>
<td>88</td>
</tr>
<tr>
<td><strong>Procedures</strong></td>
<td></td>
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<tr>
<td>Preoperative autologous blood donation</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Acute normovolemic hemodilution</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Intraoperative or postoperative cell salvage</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>Cardiopulmonary bypass, hemodialysis, or plasmapheresis</td>
<td>20</td>
<td>80</td>
</tr>
</tbody>
</table>

*This patient was indeed a Jehovah’s Witness patient who accepted RBCs amongst other products and procedures. PRBC = packed red blood cells
Is the patient optimized? Could he be optimized further? What are the options?

- Consider delaying/cancelling surgery
- Explore less invasive surgical options (EVAR)
- Identify and treat sources of blood loss
- Identify and treat anemia
- Stop anticoagulants (traditional and herbal)
- Identify strategies for further blood management: pre-, intra-, post op
Patient Blood Management

Preoperative Optimization       Perioperative Factors       Post-operative Recovery

- Timing of elective cases
  - Delay?
- Diagnosis and management of anemia
  - Iron, EPO
- Management of complicated cases
- Planning and recommendations
- *Special considerations:
  - Signed refusal
  - Bleeding disorders
  - alloantibodies
Preoperative Optimization

- EVAR not an option
- No evidence of iron deficiency – option to Hgb boost?
  - Oral iron
    - 40 000 U eprex given 14 days preop → Hgb 163 g/L
- Discussed case with surgeon

A preop hiccup:

2 days pre-op, surgeon wanted to delay case for non-patient related reasons.

We said no.

- Patient optimized
- Too high risk should Hgb continue to increase
Patient Blood Management

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- Appropriate transfusion practice
  - The basics (T, Ca, pH, positioning)
  - Transfusion triggers
  - Antifibrinolytics
  - Cell salvage
  - ANH/phlebotomy
- Anesthetic and surgical factors

Post-operative Recovery
Options for Intraoperative Management?

- Preop Hgb 156 g/L
- Regular monitors, pre-induction arterial line, central line, epidural;
- Fluid warmers, patient warmers (warm room)
- Non-invasive volume and Hgb monitors
Considerations in the JW patient for keeping units attached
Options for Intraoperative Management?

- 2 units of autologous RBC removed by phlebotomy
- 1500cc of plasmalyte given, to help maintain intravascular volume (caution coagulopathy), no pressors needed
- Cell salvage (all blood; > 1 suction?)
- TXA – 20cc/kg
- “motherhood” statements/actions:
  - Keep warm
  - Maintain calcium
  - Normal acid/base
  - Avoid dilutional coagulopathy
- What about “permissive hypotension”? → no! “minimum normotension”
- Meticulous surgical technique
- Good communication
Case Conclusion

- Aneurysm fixed
- Shed blood and phlebotomized blood returned to the patient
- Post operative Hgb = 134 g/L !!
Patient Blood Management

Preoperative Optimization

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Perioperative Factors

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Post-operative Recovery

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  - Cell salvage
  - ANH/phlebotomy
  - Anesthetic and surgical factors
Options for Post-operative Management?

- Minimize phlebotomy
- Consideration for shed blood return
Treatment of preoperative anemia
Evolution of iron deficiency:

- Depleted iron stores
- Decreased ferritin
- ↓ Serum iron, ↓ %sat
  - Microcytes appear on blood film
- Decreased MCV
- Decreased Hb

Note that iron deficiency occurs before overt anemia

*thanks Kristine Roland*
Oral Iron – working with patients is key

- Once a day

- Ferrous fumarate (100mg elemental iron)

- With tablet of vitamin C (oj)

- At night (empty stomach)
Fractional iron absorption decreases as you increase dose
Hepcidin level increases with oral iron, dose dependent
No benefit to BID as compared to OD dosing
Benefits with q48 hour dosing (hepcidin back to baseline)
Inhibits ferroportin expression
Decreases iron absorption
IV Iron

- Generally well tolerated

Side effects:
- Life threatening allergic reactions (now rare < 1/1,000,000 FDA reports)
- Hypotension (1–2%), monitored infusion
- Joint aches
- Muscle cramps
- Headache
- Chest discomfort
- Nausea/vomiting/diarrhea

More common, but even relatively rare (resolve 12-24 hrs)
IV Iron – Contraindications

- Previous intolerance, allergy
- active infection
Safety and efficacy of intravenous iron therapy in reducing requirement for allogeneic blood transfusion: systematic review and meta-analysis of randomised clinical trials

Conclusions Intravenous iron therapy is effective in increasing haemoglobin concentration and reducing the risk of allogeneic red blood cell transfusion and could have broad applicability to a range of acute care settings. This potential benefit is counterbalanced by a potential increased risk of infection.
IV Iron - formulations

1. Iron sucrose (Venofer): 300mg in 250cc NS over 2 hours
2. Ferumoxytol (Feraheme): 510mg over 15 – 60’*
3. Iron Dextran
4. Injectafer (US)

Efficacy and safety of iron isomaltoside (Monofer®) in the management of patients with iron deficiency anemia
Situations where you may choose IV over oral iron:

- Oral iron not tolerated
- Inability to absorb oral iron (IBD, extensive bowel resection, celiac disease)
- High hepcidin levels (systemic inflammation or infection)
- Rate of bleeding >> maximal oral absorption rate
- Severe anemia (Hgb < 90g/L, esp with ongoing bleeding)
- Time constraints
IV Iron – ideal response

• Hgb start to rise 3 – 7 days post infusion; after that 1 – 2 point rise / day
• By 2 – 4 weeks, Hgb should have risen 20 – 30 g/L
• Reassess @ 2 and 4 wks – additional dosing? or po maintenance
• Versus oral iron ~ 6 – 8 weeks (concomitant longer term therapy)
EPREx® 4000 UI/0,4 mL

Uso pediátrico e adulto

6 seringas preenchidas de 0,4 mL
Listed indications for EPO

- Anemia in chronic renal failure (both dialysis and non-dialysis)
  - Target Hb 100-120
- Anemia in HIV patients treated with zidovudine
- Anemia in pts with non-hematologic malignancy undergoing chemotherapy
  - But transfusion preferred if pt has long life expectancy
- Elective surgery when pretreatment Hb is 100-130
- Elective surgery and PAD

- Virtually all pts will require iron supplementation
  - Aim for Tsat >20% and ferritin > 100

* Thanks Kristine Roland
Listed Contraindications:

• Hx of pure red cell aplasia with ESAs
• Uncontrolled HTN
• Hx of severe CAD, recent MI or stroke and going for elective surgery (with no PAD)
  • Thromboembolic complications; use periop thromboprophylaxis
• Use with caution if Hx of seizure disorder
  • Seizures noted in first 90 days of therapy in CRF patients

* Thanks Kristine Roland
EPO use in the perioperative period

EPO

Potential benefit = avoidance of allogeneic transfusion and associated risks

Potential harm = As yet unquantified side effect profile

Allogeneic Transfusion

Potential benefit = dependable correction of anemia; The devil that you know??

Potential harm = Demonstrable, dose dependent increase in patient morbidity and mortality associated with use perioperatively
EPO use in the perioperative period

EPO

Potential benefit = avoidance of allogeneic transfusion and associated risks

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Allogeneic Transfusion

Potential benefit = dependable correction of anemia; The devil that you know??

Potential harm = Demonstrable, dose dependent increase in patient morbidity and mortality associated with use perioperatively
If blood also came with a black box warning about potential complications associated with use . . . which would you choose?
Our experience with Eprex:

- Tend to not give in the context of cancer (efficacy, risk)
- If given, usually given with (IV) iron
Factors affecting decision to treat anemia preoperatively:

**Patient:**
- Baseline Hgb
- Etiology of anemia
- Previous response to treatment
- Estimated blood volume
- Age
- Tolerance of anemia
- Social factors
- Signed refusal/beliefs
- Time available
- Resources
- Funds

**Procedural:**
- Procedure, anticipated blood loss
- Surgeon
- Duration
- Availability and logistics of other PBM techniques (ANH, cell salvage, TXA)
- Previous surgery, radiation
- Anticipated postoperative course
Perioperative Blood Management Program (PBMP)

In 2000, the blood conservation program was introduced to VGH (Growe, Feenstra, Brar)

In 2018:

- 1 full time RN (3-4 full time RNs rotate through)
- 4 anesthesiologist volunteers
- Medical direction – anesthesiology (J. Trudeau)
- Manage ~600 referrals/year (orthopedics, cardiac surgery, spine, urology, gynecology, general surgery)
What is the effectiveness of various treatment modalities in preoperative patients? Are there factors that predict treatment efficacy?

Retrospective analysis of patients 2010 – 2016
n = 4261

Exclusions:
- Preoperative transfusion
- Bleeding disorders or other blood disorders (hemoglobinopathy)
n = 274 (6.4%)

n = 3987 patients analyzed
Female = 2816 (71%)
Signed Refusal = 630 (15.8%)
Gyne patients referred to PBMP 2010 - 2016

n = 382
delta Hgb = 16.8 g/L
Gyne patients referred to PBMP 2010 – 2016
Treated with IV iron

n = 193
delta Hgb = 21.4 g/L
IV Iron Dosage Effect

- delta Hgb ≥3
- delta Hgb 2
- delta Hgb 1

Gyne n = 193
Gyne oncology patients referred to PBMP 2010 - 2016

$n = 372$

delta Hgb = 4.5 g/L
Gyne oncology patients referred to PBMP 2010 – 2016
Treated with IV iron

n = 88
delta Hgb = 8.7 g/L
IV Iron Dosage Effect

delta Hgb

≥3  2  1

Gyne oncology n = 88
Predicting Efficacy of Anemia Management in Preoperative Patients: Development and Validation of a Clinical Prediction Tool (TRE∆T)

- Age
- Gender
- Cancer
- Referral hemoglobin
- Referral ferritin
- Treatment (po iron, IV iron, EPO)
- Treatment duration
Methods

- Retrospective analysis of all primary hip and knee replacements from January 1, 2010 – October 31, 2017 (4 surgeons)
- Retrospective cohort analysis of those patients referred to our Perioperative Blood Management Program (January 1, 2010 – December 31, 2016)
- Transfusion Medicine Lab database queried for associated transfusion rates and antibody screen positivity
Number of Primary Joint Replacement Surgeries Per Year (VGH and UBCH)

- **Primary Hip**: 7382 total cases
- **Primary Knee**: 5760 total cases

*2017 data incomplete

Total n =
- 7382 hip
- 5760 knee
Change in Hemoglobin ($\delta$ Hgb) following referral to Perioperative Blood Management Program (Primary hip and knee replacement patients – All patients)

$n = 892$

$\delta$ Hgb = 8.3 g/L
Change in hemoglobin ($\delta$ Hgb) following referral to Perioperative Blood Management Program (Primary hip and knee replacement patients – Untreated patients)

$n = 77$

$\delta$ Hgb = 2.9 g/L
Change in hemoglobin ($\delta$ Hgb) following referral to Perioperative Blood Management Program (Primary hip and knee replacement patients – Patients with ferritin <30 ng/ml)

- **Pts Rx po iron:** $\delta$ Hgb = 8.8 g/L
- **Pts Rx IV iron:** $\delta$ Hgb = 9.5-14.3 g/L
- **Pts Rx EPO:** $\delta$ Hgb = 11.6 g/L

$n = 196$

$\delta$ Hgb = 13.1 g/L
Transfusion Rate (% patients transfused RBC) – OR to POD3

(almost) universal TXA use

Overall transfusion rate 2010 – 2017:
- Hip = 2.7%
- Knee = 1.6%

TXA use: 91% cases

% cases transfused vs. Year:
- Primary Hip
- Primary Knee
Which patients are getting transfused?

Transfusion rate 2016 - 2017:
- Hip = 1.2%
- Knee = 0.5%

15 patients (3 in OR)

* 2016 and 2017: 1741 hips, 1335 knees
Why do we group and screen?

- Provision of group specific blood
  - preserves group O and Rh- supply

- Detection of existing alloantibodies
  - attempt to avoid acute or delayed transfusion reactions
  - does not avoid risk of future alloantibody development (with the exception of anti-D)

<table>
<thead>
<tr>
<th></th>
<th>Cases (n)</th>
<th>% cases w G/Sc</th>
<th>Screen + (n)</th>
<th>% Screen +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Hip</td>
<td>7382</td>
<td>98.5</td>
<td>123</td>
<td>1.7</td>
</tr>
<tr>
<td>Primary Knee</td>
<td>5760</td>
<td>98.5</td>
<td>105</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Total cost savings/year = $26 300.01 CDN
What is the practice change?

- Only patients with Hgb < 115 g/L referred to PBMP (67% reduction)
- No group and screen for patients with preoperative Hgb ≥ 115 g/L
- All patients go home on oral iron
5.14.5 There shall be two determinations of the recipient’s ABO group as specified in Standard 5.14.1. The first determination shall be performed on a current sample, and the second determination by one of the following methods: 1) Testing a second current sample, 2) Comparison with previous records, or 3) Retesting the same sample if patient identification was verified using an electronic identification system or another process validated to reduce the risk of misidentification. In the previous edition of Standards, this requirement only applied to samples used for electronic “the second sample” rule

- Patient inconvenience
- OR workflow
- (almost) double the cost (storage, workload)
Change in hemoglobin ($\delta$ Hgb) – if referred only patients with Hgb < 115 g/L

$n = 289$

$\delta$ Hgb = 14.9 g/L
What is the risk that a patient will form an anti-D from emergency transfusion of O+ blood?

- If Hgb $\geq$ 115, 0.4% chance of getting transfused
- 15% chance of being Rh-
- 25-50% chance of forming anti-D

$\Rightarrow 0.4 \times 0.15 \times 0.50 = 0.03\%$ chance (1 in 3000)
Take away points:

- Patient blood management is a worthwhile endeavor
  - Identify and treat preoperative anemia (look for iron deficiency)
  - Oral iron works well for many patients — use it wisely!
  - Refer early to your PBM if you have one
  - Advocate for IV iron in your hospital
  - Think about postoperative oral iron replacement
  - Know your transfusion rates

- Advocate for PBM in your hospital
  - formal clinic?
  - Out of the box solution?
Useful Resources:

- Society for the Advancement of Blood Management (sabm.org)
- Choosing Wisely Canada (choosingwiselycanada.org)
- Thrombosis Canada (thrombosiscanada.ca)
- ORBCoN (transfusionontario.org)
  - Blood utilization
  - Bloody Easy

- ?? The BC PBM toolkit . . .
  - Database, website, prediction tool, treatment algorithms
WHY GIVE TWO
WHEN ONE WILL DO?

(C87/1/I2)

Make Choosing Wisely your next improvement project. Join the campaign to prevent 10 million unnecessary tests and treatments by 2020.
Ten Things Physicians and Patients Should Question

1. **Don’t transfuse blood if other non-transfusion therapies or observation would be just as effective.**
   
   Blood transfusion should not be given if other safer non-transfusion alternatives are available. For example, patients with iron deficiency without hemodynamic instability should be given iron therapy.

2. **Don’t transfuse more than one Red cell unit at a time when transfusion is required in stable, non-bleeding patients.**
   
   Indications for red blood transfusion depend on clinical assessment and the cause of the anemia. In a stable, non-bleeding patient, often a single unit of blood is adequate to relieve patient symptoms or to raise the hemoglobin to an acceptable level. Transfusions are associated with increased morbidity and mortality in high-risk hospitalized inpatients. Transfusion decisions should be influenced by symptoms and hemoglobin concentration. Single unit red cell transfusions should be the standard for non-bleeding, hospitalized patients. Additional units should only be prescribed after re-assessment of the patient and their hemoglobin value.

3. **Don’t transfuse plasma to correct a mildly elevated (<1.8) international normalized ratio (INR) or activated partial thromboplastin time (aPTT) before a procedure.**
   
   A mildly elevated INR is not predictive of an increased risk of bleeding. Furthermore, transfusion of plasma has not been demonstrated to significantly change the INR value when the INR was only minimally elevated (<1.8).
http://transfusionontario.org/en/documents/?cat=bloody_easy
http://transfusionontario.org/en/documents/?cat=bloody_easy
University of Toronto Transfusion Camp
Brought to you by:

Centre for Blood Research
UBC Depts. of Anesthesiology and Hematopathology