Transfusion Practice, Policy and Prevention

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Trauma Surgery → Acute Care Surgery
Objectives

1. Understand current evidence and best practice for RBC transfusion
2. Know UK policies on transfusion
3. Outline anemia prevention strategies
No disclosures.
Transfusion Practice

1. Morbidity of RBC Transfusion
2. Background
3. Recommendations
Effect of blood transfusions on subsequent kidney transplants.


792 Citations
Effect of Restrictive versus Liberal RBC Transfusion Regimens in Critically Ill Patients

Hebert PG et.al. NEJM 1999;340(6):409-17

Prospect randomized study of Critically Ill Patients
(“TRICC” study-Transfusion Requirements in Critical Care)

838 patients with Hgb < 9.0

Randomized to:

Restrictive regimen 22% Hospital Mortality
Transfused if hemoglobin < 7.0, maintained at 7-9

Liberal regimen 28% Hospital Mortality
Transfused if < 10.0, maintained 10-12
Table 1—Transfusion Recommendations

<table>
<thead>
<tr>
<th>Variables</th>
<th>Transfusion Trigger, g/L*</th>
<th>Goal, g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>General critically ill (no acute bleeding)</td>
<td>70</td>
<td>70–90</td>
</tr>
<tr>
<td>Critically ill with septic shock (≥ 6 h)</td>
<td>70</td>
<td>70–90</td>
</tr>
<tr>
<td>Critically ill with septic shock (&lt; 6 h)</td>
<td>80–100</td>
<td>100</td>
</tr>
<tr>
<td>Critically ill with chronic cardiac disease</td>
<td>70</td>
<td>70–90</td>
</tr>
<tr>
<td>Critically ill with acute cardiac disease</td>
<td>80–100</td>
<td>100</td>
</tr>
</tbody>
</table>

*Administer 1 U of RBCs at a time and remeasure hemoglobin concentrations.
**Vincent, et al**
(146 European ICUs; 3534 patients)

Logistic Regression Analysis for Mortality

<table>
<thead>
<tr>
<th>Factor</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfusion</td>
<td>1.37</td>
</tr>
<tr>
<td>SOFA score</td>
<td>1.3</td>
</tr>
<tr>
<td>APACHE II score</td>
<td>1.1</td>
</tr>
<tr>
<td>Age</td>
<td>1.01 (NS)</td>
</tr>
<tr>
<td>Hgb</td>
<td>1.04 (NS)</td>
</tr>
</tbody>
</table>

JAMA 2002; 288(12): 1499-1507
Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery: The Society of Thoracic Surgeons and The Society of Cardiovascular Anesthesiologists Clinical Practice Guideline

The Society of Thoracic Surgeons Blood Conservation Guideline Task Force: Victor A. Ferraris, MD, PhD (Chair), Suellen P. Ferraris, PhD, Sibu P. Saha, MD, Eugene A. Hessel II, MD, Constance K. Haan, MD, MS, B. David Royston, MD, Charles R. Bridges, MD, ScD, Robert S. D. Higgins, MD, George Despotis, MD, and Jeremiah R. Brown, PhD

The Society of Cardiovascular Anesthesiologists Special Task Force on Blood Transfusion: Bruce D. Spiess, MD, FAHA (Chair), Linda Shore-Lesserson, MD, Mark Stafford-Smith, MD, C. David Mazer, MD, Elliott Bennett-Guerrero, MD, Steven E. Hill, MD, and Simon Body, MB, ChB
Intraoperative Transfusion of 1 U to 2 U Packed Red Blood Cells Is Associated with Increased 30-Day Mortality, Surgical-Site Infection, Pneumonia, and Sepsis in General Surgery Patients

Andrew C Bernard, MD, FACS, Daniel L Davenport, PhD, Phillip K Chang, MD, FACS, Taylor B Vaughan, BS, Joseph B Zwischenberger, MD, FACS
Stored PRBCs behave in this manner!

Anemic patients with NL RBCs can at least behave in these ways.
Human T cell Proliferation with Fresh Autologous PRBC

Proliferation (CPM)
What hgb do you need?
Policy

1. New UK Guidelines for Transfusion
2. Massive Transfusion Protocol
3. Getting Blood for Direct Admits
4. Using Uncrossmatched Blood
UK Healthcare
2010 Guide for Blood Component Transfusion
July 2010

**PRBC’s**
Hct < 21% + symptoms/signs of inadequate oxygen delivery

**FFP**
INR ≥ 1.5 or PTT ≥ 46sec + active bleeding and can’t be corrected by Vitamin K

**Platelets**
<50,000 during and for 24 hours following surgery
<10,000 in non-bleeding patient

**Cryoprecipitate**
Fibrinogen <100 mg/dl
So Hgb 7 is the trigger?

“trigger to begin thinking about it.”
Rationale and Purpose of new (lower) threshold.

**Rationale**

1. Many risks associated with transfusion
2. Little evidence that transfusion above this threshold improves outcome in normal and many critically ill patients
3. Considerable evidence that more liberal threshold may compromise outcome.

**Purpose**

1. Improve patient outcomes
2. Conserve valuable resources
3. Save money for institution
1988 - Perioperative RBC Transfusions, NIH
Consensus Development Statement:

• SUGGESTED Hgb = 7 !
• But most compromised on Hgb = 8
EDC-cell transfusions are a cornerstone of critical care practice, but there are divergent views on the risks of anemia and the benefits of transfusion in this setting. One important concern is that anemia may not be well tolerated by critically ill patients. Indeed, two prospective cohort studies suggested that anemia increases the risk of death after surgery in patients with cardiac disease and in critically ill patients. Red-cell transfusions are used to augment the delivery of oxygen in the hope of avoiding the detrimental effects of oxygen debt. This view prompted the routine use of transfusion in patients with hemoglobin concentrations that were often more than 10.0 g per deciliter in studies evaluating resection patterns. Critically ill patients may, however, be at increased risk for the immunomodulatory and microcirculatory complications of red-cell transfusions. In addition, concerns about the supply and safety of blood also encourage a conservative approach to transfusions. For these reasons, the optimal transfusion practice for various types of critically ill patients with anemia has not been established.

To elucidate the potential risks of anemia and possible benefits of transfusions in critically ill patients, we conducted a randomized, controlled clinical trial to determine whether a restrictive approach to red-cell transfusion that maintains hemoglobin concentrations between 7.0 and 9.0 g per deciliter is equivalent to a liberal transfusion strategy produced equivalent results in critically ill patients, we compared the rates of death from all causes at 30 days and the severity of organ dysfunction.

**Methods** We enrolled 828 critically ill patients with anemia after initial treatment who had hemoglobin concentrations of less than 9.0 g per deciliter within 72 hours after admission to the intensive care unit and randomly assigned 418 patients to a restrictive strategy of transfusion, in which red cells were transfused if the hemoglobin concentration dropped below 7.0 g per deciliter and hemoglobin concentrations were maintained at 7.0 to 9.0 g per deciliter, and 410 patients to a liberal strategy, in which transfusions were given when the hemoglobin concentration fell below 10.0 g per deciliter and hemoglobin concentrations were maintained at 10.0 to 12.0 g per deciliter.

**Results** Overall, 30-day mortality was similar in the two groups (16.7 percent vs. 23.3 percent; P = 0.11). However, the rates were significantly lower with the restrictive transfusion strategy among patients who were less acutely ill — those with an acute physiology and chronic health evaluation II score of ≤20 (5.7 percent vs. 16.1 percent in the liberal-strategy group; P = 0.03) — and among patients who were less than 55 years of age (5.7 percent vs. 13.0 percent, respectively; P = 0.02), but not among patients with clinically significant cardiac disease (20.5 percent and 26.2 percent, respectively; P = 0.69). The mortality rate during hospitalization was significantly lower in the restrictive-strategy group (22.6 percent vs. 29.1 percent, respectively; P = 0.06).

**Conclusions** A restrictive strategy of red-cell transfusion is at least as effective as and possibly superior to a liberal transfusion strategy in critically ill patients, with the possible exception of patients with acute myocardial infarction and unstable angina.

Lena M. Napolitano, MD; Stanley Kurek, DO; Fred A. Luchette, MD; Howard L. Conwit, MD; Philip S. Barie, MD; Samuel A. Tisherman, MD; Paul C. Hebert, MD; MHCSc; Gary L. Anderson, DO; Michael D. Babin, MD; William Bronberg, MD; William C. Chiu, MD; MHCSc; Maureen D. Clark, MD, PhD; Keith D. Clancy, MD; Lawrence Diebel, MD; William S. Hoff, MD; K. Michael Hughes, DO; Imtiaz Munshi, MD; Donna Nayduch, RN, MSN, ACNP; Rovindra Sandhu, MD; Jay A. Yelon, MD; for the American College of Critical Care Medicine of the Society of Critical Care Medicine and the Eastern Association for the Surgery of Trauma Practice Management Workgroup.

**Objective** To develop a clinical practice guideline for red blood cell transfusion in adult trauma and critical care patients.

**Design** Meetings, teleconferences and e-mail-based communication to achieve grading of the published evidence, discussion, and consensus among the entire committee members.

**Method** This practice management guideline was developed by a joint task force of EAST (Eastern Association for the Surgery of Trauma) and the American College of Critical Care Medicine (ACCM) of the Society of Critical Care Medicine (SCCM). We performed a comprehensive literature review of the topic and graded the evidence using scientific assessment methods employed by the Canadian U.S. Preventative Health Care Task Force. Class I, II, Grade B Grading of Recommendations, Level I, II, III. A list of guideline recommendations were compiled by the members of the guidelines committee for the two societies. Following an extensive review process by external reviewers, the final guideline manuscript was reviewed and approved by the EAST Board of Directors, the Board of Regents of the ACCM, and the SCCM.

**Results** Key recommendations are listed by category, including (A) Indications for RBC in general critically ill patients, (B) RBC transfusion in surgery, (C) RBC transfusion in patients at risk for or with acute lung injury and acute respiratory distress syndrome, (D) RBC transfusion in patients with neurologic injury and diseases, (E) RBC transfusion risks; (F) Alternatives to RBC transfusion, and (G) Strategies to reduce RBC transfusion.

**Conclusions** Evidence-based recommendations regarding the use of RBC transfusion in adult trauma and critical care will provide important information to critical care practitioners.

**Keywords** transfusion; red blood cell transfusion; blood; anemia; hemorrhage; critical care; trauma

**I. STATEMENT OF THE PROBLEM**

Red blood cell (RBC) transfusion is common in critically ill and injured patients.

Many studies (Table I (1-9)) have documented the widespread use of RBC transfusion in critically ill patients and the data from these studies from diverse locations in Western Europe, Canada, the United Kingdom, and the United States reveal remarkably similar findings, with approximately 40% of patients receiving RBC transfusions, with a mean of 5 RBC units transfused per patient, and a transfusion hemoglobin (Hb) of 8 g/dL. RBC transfusions are utilized to treat hemorrhage and anemia as well as to improve oxygen delivery to tissues. RBC transfusion is clearly indicated for the...
Indicators for Considering RBC Transfusion (in absence of continued bleeding)

Normovolemic anemia (Hgb≤7) WITH signs or symptoms of inadequate oxygen delivery

What are signs or symptoms of inadequate oxygen delivery?

**Signs**
1. ScvO\textsubscript{2} < 70% [nl=80%] (central line)
2. SvO\textsubscript{2} < 65% [nl=75%] (PA catheter)
3. Low cerebral or tissue oximetry
4. Base deficit – ABG
5. Lactic acidosis - lab
6. ST changes - EKG
7. ↓ LV contractility by trans esoph echo

**SYMPTOMS**
1. Mental status alteration
2. Dyspnea
3. Chest pain
4. New arrhythmias
5. Tachycardia (not from hypovolemia)


Possible EXCEPTIONS to Hb=7

**CNS**

Neurologic injury/disease

**Acute MI or Acute Coronary Syndrome**

**NICU**

Sick premature babies
Decreased hematologic reserve
Risk of intraventricular hemorrhage.

**Septic shock**

With low ScvO$_2$
More Possible EXCEPTIONS to Hb=7

Hematologic disease
Selected patients with chronic anemia
Bone marrow failure
Myelosuppressive/myeloablative therapy
Infiltrative bone marrow disease

Pediatric cardiac surgery
HEMOGLOBIN = 7
Implemented in the following Medical Institutions

- Brigham and Women’s Boston
- UAB
- U Iowa
- U Kansas
- U Penn
- Good Samaritan Hospital
1 RBC Preferable to 2
(in hemodynamically stable anemic patients)

Consider 2\textsuperscript{nd} unit based upon Hb/hct and physiology.

Determinants of transfusion decisions in a mixed Medical-Surgical Intensive Care Unit: a prospective cohort study

Alexander P.J. Vlaar\textsuperscript{1,2}, Anne L. In der Maur\textsuperscript{1}, Jan M. Binnekade\textsuperscript{1}, Marcus J. Schultz\textsuperscript{1,2}, Nicole P. Juffermans\textsuperscript{1,2}

Reasons for ordering more than one RBC transfusion

- Expected post-transfusion Hb 58 %
- Ongoing bleeding 33 %
- Pre-operative/pre-intervention 3 %
- Other 6 %
UK’s Blood Management Program

**PHASE I** - Sept. 1, 2010
- Hb ≤ 7
- Pts ≤ 45
- Healthy

**PHASE II** - Jan. 1, 2011
- All ages and categories
- Exceptions noted in this presentation.
- Other evidenced based exceptions will be considered.
Hypothesis:
Pre-ICU MTP (FFP after 6 units PRBC) is inadequate for correcting coagulopathy.
The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving Massive Transfusions at a Combat Support Hospital

Matthew A. Borgman, MD, Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Thomas Repine, MD, Alec C. Beekley, MD, James Sebesta, MD, Donald Jenkins, MD, Charles E. Wade, PhD, and John B. Holcomb, MD

*J Trauma. 2007;63:805–813.*
UK Trauma Massive Transfusion Protocol

Clinical Criteria (Admission)
- SBP ≤ 70mmHg
- Crystallloid > 4L
- Estimated blood loss > 1000cc
- SBP < 90mmHg despite 3.5L crystalloid (50mL/kg)
- Temp < 34°C
- ISS > 25

Clinical Criteria (Trauma OR)
- Non-surgical hemorrhage
- EBL > 150 mL/minute

Laboratory Criteria (Any Time)
- Base Deficit > 8
- INR > 1.4
- PT > 18 seconds
- PTT > 60 seconds
- Admission Hct < 30
- pH < 7.1

1. Contact Blood Bank: (Attending, Fellow or Chief Resident) “Activate Trauma MTP”
2. Contact OR: ‘Send OR Tech to BB to Stand Quietly Outside Door and Wait for Cooler’
3. Submit Specimen for Crossmatch immediately

Hemogram, Coags, Fgn (Consider TEG)

Controlled Resuscitation (Limited Crystalloid, Avoid HTN):
RBC from Blood Refrigerator

Cooler #1: 4 PRBC/2 FFP
Consider rFVIIa (90mcg/kg IVP) if Fgn ≥ 100

Bleeding Controlled?

Yes. Contact Blood Bank.
“Stop MTP”

No

Send OR Tech to BB to Stand Quietly Outside Door and Wait for Cooler.

Cooler Next (#2): 4 PRBC/4 FFP/Single Donor Pheresis Platelet

Bleeding Controlled?

Yes. Stop MTP

No

Bleeding Controlled?

No

Send OR Tech to BB to Stand Quietly Outside Door and Wait for Cooler.

Cooler Next (#3): 4 PRBC/4 FFP

Bleeding Controlled?
SUBJECT: Operating Room Direct Admission Notification Procedure

SEE ALSO: Hospital policies HP02-01, Inpatient Admissions; HP08-21, Blood Transfusions; Emergency Department policies ED02-03, Operating Room Direct Admissions Notification Procedure; ED08-101, Adult Trauma Alert; ED08-102, Pediatric Trauma Alert

Information
The Hospital recognizes the need to provide efficient and timely notification of departments in order to provide potentially life-saving resources to the critically ill or injured.

For trauma patients requiring direct admission to an operating room, follow ED trauma alert activation protocols.

Instructions
Upon acceptance of the patient from a referring facility, the attending or admitting physician will:

- Notify the Operating Rooms (OR) control desk coordinator at 3-5631 with the patient’s name, age, and diagnosis or general injury description.

The OR charge nurse or front desk will:
- Contact the Capacity Command Center at 3-2233 with patient information and estimated time of arrival.

The Capacity Command Center will, upon notification:
- Register and admit patient to an OR location.
  - If patient is not a UK patient of record, the Capacity Center will obtain a new medical record number.
  - If patient name and demographic information is unknown, the Capacity Center will contact the Emergency Department to request a trauma name and medical record number.
- Notify the Blood Bank at 3-5401 or 3-5403 with the patient’s name and medical record number, and state that this is an OR direct admission.
  - Print a green card and face sheet.
  - Contact the OR front desk at 3-5631 when the green card is ready.

The Blood Bank will:
- Assemble a cooler of uncrossmatched blood.
- Contact OR front desk at 3-5631 when cooler is ready.
What does the bottom of the blood transfusion form say?
Trauma Transfusion-Orders for Uncrossed
Trauma Transfusion-Frig not Cooler
Prevention

1. Avoiding unnecessary tests
2. Using the lowest volume to run the test
3. Avoiding waste
4. Using smaller tubes
Patients aren’t bleeding...

..but we’re transfusing.

Evidence Indicates:

1. Pediatric tubes:
   • Reduce phlebotomy volume
   • Reduce transfusions

2. Blood conservation devices
   • Reduce phlebotomy volume

3. Reduction in lab testing:
   • Reduces phlebotomy volume
   • Reduces transfusions
61-70cc/day
(2oz, ¼ cup)

1. Only Perform Necessary Draws

Add tests to blood in the lab.
2. Use the Lowest Volume Per Draw

<table>
<thead>
<tr>
<th>Test</th>
<th>Cost</th>
<th>Volume</th>
</tr>
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<tbody>
<tr>
<td>Hemogram</td>
<td>$0.32</td>
<td>3ml</td>
</tr>
<tr>
<td>Hct</td>
<td>$0.32</td>
<td>3ml</td>
</tr>
<tr>
<td>Plt</td>
<td>$0.35</td>
<td>3ml</td>
</tr>
<tr>
<td>ABG</td>
<td>$0.12</td>
<td>1ml</td>
</tr>
<tr>
<td>ABG Panel (Full)</td>
<td>$0.72</td>
<td>1ml</td>
</tr>
<tr>
<td>ABG + Hct</td>
<td>$0.24</td>
<td>1ml</td>
</tr>
</tbody>
</table>
3. Minimize Waste/Flush-
The Safe Set (aka ‘Cell Saver’)

- 100 patients
- Less blood drawn and discarded (6 vs 96cc)
- Higher Hgb in Safe Set group (1.2g/dl, p<0.0001 on day 9)
- Discarded blood volume predicted Hgb decrement
- No difference in transfusions

Blood Conservation Devices in ICU

• Blood ‘waste’ at UK (Pam Branson):
  – 3 day stay → 1-1.5 units of waste

• Safe Set can be used with a central line
  – Standard a-line set- $8
  – Safe Set- $18

• Can you reinfuse flush otherwise?
  – Most nursing literature says ‘no’
  – UK Nursing policy: ‘Discard’

Why not use smaller tubes?

Standard instruments cannot accommodate pediatric tubes.
4. Use small-volume tubes.

• New tubes:
  – Hemograms (2.0 vs 3.0 ml)
  – Coags (1.8 vs 2.7 ml)
Does 1ml matter?

<table>
<thead>
<tr>
<th>Lab Test</th>
<th>June 2010</th>
<th>FY2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemogram</td>
<td>15,704</td>
<td>188,343</td>
</tr>
<tr>
<td>HCT</td>
<td>972</td>
<td>11,176</td>
</tr>
<tr>
<td>PLT</td>
<td>363</td>
<td>3841</td>
</tr>
<tr>
<td>Total Tests</td>
<td>17,039</td>
<td>203,360</td>
</tr>
<tr>
<td>ml saved with new tubes (1ml per tube/test)</td>
<td>17,039</td>
<td>203,360</td>
</tr>
</tbody>
</table>

More than 200 liters of blood annually.
1. Transfusion carries risk
2. Indication must be:
   - Appropriate
   - Documented
3. Threshold if healthy: 7g/dl
4. Dose: 1 unit
5. Policies in place to protect patients
6. Strategies to prevent anemia work