Objectives

- To list risks and benefits of various blood products
- To discuss controversy over “liberal” vs “restrictive” blood transfusion
- To analyze new literature on Massive Transfusion

Components

- 1 Donor Unit of Whole Blood 500 cc
- 1 Unit of PRBC’s 250 cc
- 1 Unit of FFP (Plasma) 250 cc
- 1 Unit of Platelets 25 cc
- 1 Unit of Cryoprecipitate 25 cc

Packed Red Blood Cells

- Is “liberal” transfusion a good thing?
- Transfusion Reactions
- O-neg vs O-positive

Is transfusion always good?

- TRICC trial
  - Hebert, NEJM, 1999
  - Prospective, randomized
  - 838 ICU pts (Resp, Trauma, Cardiac)
  - Restrictive (7-9) vs Liberal (10-12)
  - In hosp mortality (22% vs 28%, p=.05)
  - 30 day mortality (19% vs 23%, p=.11)

TRICC trial (subgroups):

- Especially:
  - Pts < 55yo (6% vs 13%, p=.02)
  - APACHE II < 20 (9% vs 16%, p=.03)
- Exceptions:
  - Trauma (10% vs 9%, p=.81)
  - Cardiac ds (21% vs 23%, p=.69)
Non-randomized studies:

- CRIT trial
  - Corwin, Crit Care Med, 2004
  - 4,892 ICU pts, prospective observational
  - 44% were transfused, mean 5 units
  - Txn independently assoc with incr mort
- Several studies in Trauma, Critical Care
  - More transfusion = higher mortality
- Selection bias?

Why would it be bad?

- Hemolysis
- Oxygen delivery
- Anaphylaxis
- Volume expansion
- HIV, HCV
- Coagulation
- Volume overload
- TRALI
- TRIM

Minor Transfusion Reactions:

- Simple febrile (1%)
  - Antibody vs donor Leukocyte antigens
  - Acetaminophen
- Simple allergic (0.1%)
  - Antibody vs donor plasma proteins
  - Diphenhydramine

Severe Transfusion Reactions:

- Acute hemolysis
  - ABO error (non ABO)
  - 1 in 250K
- Anaphylaxis
  - Congenital IgA deficiency
  - 1 in 150K
- Bacterial contamination
  - Plts > PRBC
  - Babesia microti, S. aureus
  - 1 in 2-10K

Delayed Transfusion Reactions:

- HIV
  - 1 in 1 million
- Hepatitis B
  - 1 in 137K
- Hepatitis C
  - 1 in 1 million
- Graft vs Host disease

Transfusion Fatalities

2007-11 FDA data
TRALI – Transfusion related acute lung injury
- 1 in 5K. FFP > PRBC > Plts
- 50% transfusion related deaths
- Immune-related, donor antibodies vs patient WBC’s cytokines
- Prevention:
  - Reduce female plasma donors
  - Non-cardiogenic pulmonary edema

TACO – Transfusion assoc circulatory overload

TRIM – Transfusion related immunomodulation

TGIF – Thank God it’s Friday!

Overload vs TRALI
- PRBC vs FFP
- Cardiomegaly vs Normal
- High wedge/CVP vs Normal / low
- High BP vs Normal / low BP
- NTG, Diuresis vs Supportive

TRIM (Transfusion Related Immunomodulation)
- Immunosuppression, inflammatory
  - WBC’s and mediators (cytokines, IL)
- Benefit: organ transplant survival
- Harm:
  - Recurrence of malignancies
  - Pneumonia, post-op infections
  - Increased mortality
- Prevention: Leukoreduction

Is Old blood Bad blood?
- Storage lesion
- pH, pK, free Hgb
- Might scavenge nitric oxide
- NO vasodilators for tissue perfusion
- Multiple studies: worse outcomes
  - Cardiac surg, Trauma, Critical care
- Multiple studies: no difference

**So what should I do?**
- Napolitano, CCM and J Trauma, 2009:
  - Guideline from ACCCM and EAST
  - Txn indicated for hemorrhagic shock
  - Restrictive strategy (Hgb<7) for stable anemia (except ACS)
  - Sepsis: EGDT 1st 6 hrs (Hgb 10)
    - Then Restrictive (Hgb 7)
CCM / Trauma Guideline (cont.)

- One unit at a time
  - Except acute hemorrhage
- Must also consider clinical indicators
  » Hemodynamics, ongoing loss
- Txn incr risk of Infxn, SIRS, ARDS

EXAMPLE

- 50 yo M alcoholic, GI bleeding, BP 80/40, HR 130, Hgb 8.1
  - Should I transfuse, or use restrictive trigger of Hgb<7?
  - TRANSFUSE
    - Acute hemorrhage
    - Hemodynamically compromised

EXAMPLE

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2 Units of O-negative, Stat!

- O-neg to women of childbearing age
  - Alloimmunization
  - Hemolytic disease of newborn
- O-positive to men, older women
  - Tiny chance of hemolysis if Rh negative
  - Future emergency transfusion

O+ blood transfusion

- Dutton, J Trauma, 2005:
  - Maryland Shock Trauma, one year
  - O- to young women, O+ all others
  - 581 units type O to 161 patients
  - No transfusion reactions
  - One Rh- male developed Ab

Type and Screen vs Type and Cross

- T&S: test for atypical Ab in serum
- T&C: mix pt serum and donor RBCs
- Electronic cross matching

Massive transfusion

- Definition:
  - Entire blood volume in 24 hrs
    (75 cc/kg, 5L, 10 units PRBC)
  - 5 units in 3 hrs + ongoing hemorrhage
- Problems:
  - Coagulopathy, DIC
  - Hypothermia
  - Acidosis
  - Hypocalcemia (citrate toxicity)
Coagulopathy:

- Multi-factorial
  - Dilution
  - Hypothermia, acidosis
- 2 approaches:
  1) treat problems as they arise
  2) treat prophylactically (Protocol)
    - 5 PRBC / 5 U FFP / 1 apheresis Plts
    - Approximates Whole blood
- No randomized trials

Ho, Can J Surg, 2005:

- Mathematical model
  - Ongoing loss, various ratios of transfusion
- Assumptions:
  - 30% blood loss, IVF, 2 U PRBC
  - Clotting factors already 50%
- Only way to maintain or “catch up” is 1:1 or higher (more FFP)

Ho, Can J Surg, 2005 (cont):

- Only way to maintain or “catch up” is 1:1 or higher (more FFP)

Borgman, J Trauma, 2007:

- Retro, 246 pts, > 10 U PRBC
- Higher FFP:PRBC, higher survival
- Low ratio (1:8) Survival 35%
- High ratio (1:1.4) Survival 81%
- Supports 1:1 massive transfusion

Holcomb, Ann Surg, 2008:

- Retro, 466 massive transfusion pts
- High FFP:PRBC ratio (>1:2) vs low
- 30 day survival: 60% vs 40%
- Same effect with Plt:PRBC ratio
- Recommended 1:1:1
Massive Transfusion Pack

- 5 U PRBC (O-negative)
- 5 U FFP (AB, pre-thawed)
- 1 U Apheresis Platelets

Summary

- Transfusion indications and controversies
- Transfusion reactions
- Massive Transfusion

Thank you!

And don’t worry . . .
All bleeding eventually stops!