Multidisciplinary Multimodality Approaches to Autologous Blood Management

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Global Blood Resources LLC

www.mybloodfirst.com
Roadmap

Discuss Blood Conservation
- Where we are today with blood
- The multidisciplinary players
- Their multimodality approaches
- What Perfusionists Can Do
- Changing the Paradigm
- What else can we do !

Disclosure statement:
- President and Founder of GBR
- Maker of the Hemobag® for Autotransfusion
- Still a practicing and Licensed Perfusionist
First, A Surprise Quiz!

Don’t ponder, just think about if you Generally Agree with the question

- Do you feel like you have an excellent report with your Surgeons in surgery? Do they listen?
- Do you feel like you have an excellent report with Anesth in surgery and do they listen?
- Do your Anesthesiologists use pressors to keep the SVR up instead of Volume?
- Do you feel like your Anesthesiologists gives too much crystalloid volume in general?
- Do you feel that most of your Surgeons really try to avoid giving any donor products?
- Do you feel that most of your Anes really try to avoid giving any donor blood products?
- Do you RAP before going on bypass and does Anesthesia help and the Surgeon wait?
- Do you use Osmitrol/Mannitol or Albumin? More than once?
- Do you use the pump sucker during the case to return blood to the ECC in Valve cases?
- Do you use the pump sucker during the case to return blood to the ECC in CABG cases?
- Do you use the pump sucker during the case to return blood to the ECC in Aortic cases?
- Do you feel that your processing too much cell washer volume by the end of the case?
- Does your team have a waste sucker in the field, and do they use it?
- Do you use a Hemoconcentrator on at least 20% of your cases, 40%, >40% of the time?
- Do you use a Hemoconcentrator to salvage the ECC at the end of the case, or Bag the Vol?
- Is your Transfusion trigger on CPB generally < 7gm Hgb or < 8gm Hgb?
- Do you feel that a transfusion is an organ transplant?
Bank Blood Costs

- Cost of blood products rising with no direct reimbursement. MC does not pay until 4th unit...

  Red Blood Cell Units: $500 – $1,000
  Platelet Pheresis pack: $536
  Plasma Units FFP: (4) $300+
  Cryoprecipitate: (5+fee) $250

- Transfusion reactions: Infections, viruses and most importantly Immunosupression / Immunomodulation
- Incidence of TRALI (>1:2,000 donor exposures)
- Nationwide range of “blood admin charges per discharge:” $2,240

- JC will be evaluating blood management as part of Accreditation
**Allogeneic Blood Problems!**

**Transfusions blamed for deaths after heart bypass**
Wed Jan 3, 2007 9:06 PM GMT

NEW YORK (Reuters Life) - Getting a blood transfusion during or after heart bypass surgery may raise the risk of dying in the next few months after the operation, new research suggests.

Moreover, this may explain in part why women are more likely than men to die after coronary artery bypass grafting (CABG), since women more commonly need transfusions than men do.

"To the best of our knowledge, this is the first study to state that ... transfusions may be the reason why women have a greater post-CABG mortality than men," Dr. Mary A. M. Rogers, from the University of Michigan in Ann Arbor, said in a statement.

In a study of Michigan Medicare beneficiaries, 88 percent of female CABG patients received a blood transfusion compared with 67 percent of male patients. Patients who received a blood transfusion were 5.6-times more likely to die within 100 days of undergoing heart bypass surgery than were non-transfused patients, the report indicates. © Reuters 2007. All Rights Reserved.
Blood transfusions may be killing some of the people they are intended to save

Dr. Sunny Rao Duke Cardiologist 2004

IF THERE were any sure bets in medicine, you might think that “blood transfusions save lives” would be one of them. But there aren't. Even though deaths caused in the 1980s by accidental HIV infection mean that donated blood is now screened meticulously to keep it free of infectious agents, there is still a nagging feeling that something is wrong.

In 2004, Sunil Rao of Duke University Medical Centre, in North Carolina, carried out a retro study of 24K people suffering from acute coronary syndrome. One conclusion drawn from his research was that unnecessary blood transfusions might be causing tens of thousands of deaths in America alone. Rao found that patients who had had a transfusion because of a low red blood-cell count had an 8% chance of dying within 30 days, and those without a transfusion, only 3% died. Those numbers need to be treated with caution. As Dr Rao points out, the patients who underwent transfusion were, on average, sicker and older than those who did not. Nevertheless, this study is not the only indication of something amiss with transfused Allogeneic blood products.
What are expert thoughts about the recent articles on Nitric Oxide and banked blood?

Neil Blumberg, Prof of Path & Lab Med, Univ of Rochester MC

"I think it is well established in the scientific literature that stored red cells do weird things to the microcirculation. It is also well established in observational studies that patients with acute coronary syndromes (e.g., MI, unstable angina) seem to do markedly worse when transfused than not transfused at similar hematocrits. Red cells that are nitric oxide poor will presumably scavenge nitric oxide, a vasodilator, and thus cause vasoconstriction and reduced oxygen delivery and thus impair its delivery. Most of the clinical correlative studies in the literature mentioned above involve patients getting non-leukoreduced transfusions rich in inflammatory, pro-thrombotic mediators, as well as residual platelet microparticles, white cell membranes and microparticles, and Lord knows what else. So it's not clear how much either factor, nitric oxide scavenging and infusion of a mixture of deleterious mediators contributes to the clinical observations. My bet is on both. What is clear to me and some others in the field is that fewer patients should be transfused and we are doing more harm than good with our current transfusion practices in many cases."
So how can we manage blood better and who are the Multidisciplinary Players involved?

- Primary Doctor
- Cardiologist
- Admission Care Team
- Pre Game Plan with the Big Three
  - *Surgeon, Anesthesia, Perfusion*
- Anesthesia
- Surgeon
- Perfusion (It’s not your fault !) GWH
- ICU Care Team, Nurses
- Administrators
The Primary Doctors Office

- Baseline lab work (preferably 6 wks early)
- Micro-sampling (Peds Tubes)
- Iron therapy 50% of the Population are Low
- Epo therapy 2-3 weeks to raise Hct 2-3%
- Help patient to select best Hospital
- Help patient to select best Cardiologist
- Help guide patient to select best Surgeon
Minimal Labs with Micro Sampling at all times
Meticulous attn to blood loss during Cath, Rao MD
Minimize the use of Heparin and ACT’s < 999
The Use of Anti-Platelet drugs like Plavix < is best
Identify the best hospital to have Surgery done at
Identify the best Surgeon to do the Case (specialist)
No more than 2 easy Stents w/o Stent Jail please
or send me to Surgery as grafts last longer!
DES=5.5% BMS=7.8% On Pump CABG= 2.8%@3yr
The Admission Care Team

- Preferably the day of surgery
- Micro Sampling for Labs (a must)
- That first I.V. Line (Let the games begin)
- For every 1 liter of Crystalloid given
  Only **250 mls** will stay Intravascular within 30 minutes, the rest of the 750mls will cross extravascularly causing Organ Edema/Dysfx dropping the Viscosity and COP. **It’s a lot easier to add volume than it is to take it off!**
Capillary "Type"

Permeability varies with type of capillary

Capillary type varies with organ function

1. Tight (brain)
2. Continuous (skeletal muscle, skin)
3. Fenestrated (secretory glands, kidney, gut)
4. Discontinuous (liver, spleen, bone marrow)
MOVEMENT OF FLUID FROM IVC TO ISC

Filtration - BP forces smaller molecules through tiny openings in capillary walls.

Larger molecules

Smaller molecules

Blood pressure

Capillary membrane

Tissue fluid
Edema: Most common clinical manifestation of an imbalance of forces at the capillary wall

Excess accumulation of fluid in the interstitial space that has not been reabsorbed into capillaries or taken up by the lymphatics

Causes include

- Obstruction
- Permeability or change in reflection coefficient
  - Increased protein permeability results in an imbalance
    - Occurs in trauma, thermal injury, inflammation
    - Life threatening manifestations - endotoxic shock, ARDS
- Plasma Protein
  - Reduction in circulating plasma proteins, especially albumin
  - Liver dysfunction, malnutrition, or acute alteration of fluid status
    - Albumin attenuates extravasation of fluid out of intravascular space to interstitial space
- Capillary pressure
Pre Game Plan (The Big 3)

• When ever possible the members of the Cardiac surgical team (The Surgeon, Anesthesia, and Perfusion) should meet prior to surgery and discuss the best course of action for optimizing the case and avoiding Allogeneic Blood Products.

• The Team Approach to Blood Management!
Anesthesia

*M 8 gm – 10 gm Hgb DUKE

No Benefit and No Harm

- Meticulous placement of Lines to function correctly and not lose any blood or make any extra holes.
- Limit the amount of Crystalloid given during the case and opt for Colloids like Albumin instead for Volume.
- Vascular Tone (SVR) use Pressors as tolerated by cardiac output to achieve a normal SVR of between 800-1200.
- ANH, Acute Normovolemic Hemodilution, usually 1-2 units or more can be removed safely and still keep a good Hct while on Pump. This should be the first vol seen post CPB.
- Targeted Pharmacotherapy (Amicar, Aprotinin, DDAVP, rFVIIa Novo 7, Vitamin K and other recombinant factors)
The Surgeon

- Communicate clearly during the case and work diligently
- Have patience with the Perfusionists while they are RAP’ing
- Refrain from cooling as much, as it stuns/hurts the Platelets
- Meticulous surgical technique should be employed throughout the surgical procedure when bleeding
  - When ever there is obvious surgical bleeding the surgeon should stop to tie down or cauterize the area to reduce the waste of blood. (And also fix the venous air) Micro-bubbles!
- Remember that transfusion of any Allogeneic blood or blood products is an “Organ Transplant", and not just another medication that is without side-effects. Treat everyone like a JW!
**The Perfusionist**

- Condense your Circuit Prime down safely to 1500mls or less!
- Calculate the Post-Dilutional Hct, Protein, COP values
- RAP / Auto Prime both sides of your Circuit with the help of Anesthesia and the Surgeon. This is not only proven very effective in many studies, and its economical as well as it costs nothing.
- Add Albumin / Osmirol to Increase the COP / Diuresis of the patient.
- Limit the Cell Washer to the Pre and Post Heparinization periods!
- Use a lower MAP on CPB 50 vs 70 as tolerated by patient’s needs.
- Use the pump’s Coronary Sucker during the Heparinization period to preserve frank Autologous Whole Blood lost in the field and return it to back to the patient’s circulation. Newer Cardiotomy’s have 3 stage.
- A waste sucker should be kept in the field for undesirable shed blood and irrigant solutions (or a cell washer for this as well).
On-site coagulation monitoring like the thromboelastography TEG, Sonoclot and Heparin concentration determination like the Hepcon are essential tools in determining the Hemostasis.

Targeted pharmacotherapy (antifibrinolytics and desmopressin acetate) are an integral part to prevent empiric transfusions of allogenic blood and blood products.

Hemoconcentration should be considered for use to reverse excess fluid administration perioperatively, eliminate undesirable byproducts including antiplatelet medications and concentrate the patient’s red cell mass and plasma proteins during the case.

Once safely off bypass Salvage the CPB circuit with Ultrafiltration so you don’t waste any of the patient’s OWN viable and vital blood cell fractions and components to a waste bag.
“The Big Bang of Hemofiltration: The Re-Beginning of a new era…”

• Selective, rapid removal of plasma water & dissolved solutes, (<50K Daltons) including drugs. i.e. Integrilin, ReoPro, Aggrestat, Plavix

• Conservation cellular blood components & proteins.
  – Hct

• Reduces anaphylatoxins
  – C3a, C4a, C5a
  – IL-1, IL-2, IL-6, IL-8,
  – TNF$\alpha$, TNF$\beta$
  – MDF, bradykinins

• Improves organ fx
  – myocardial fx
  – cerebral oxygenation
  – pulmonary compliance

• Reduces post-op blood loss & transfusions

• Removes platelet-activating

…A majority of platelets having functional aggregation activity still exist in residual blood in the CPB circuit.”

Adjunct to diuretics for the treatment of fluid retention.

Naik, 1991. Hospital for the Sick, Great Ormond St. UK.
Tanemoto, 2004, Platelet activity of residual blood remained in the cardiopulmonary bypass circuit after cardiac surgery.
## Processing Residual Circuit Whole Blood

### Three re-infusion methods

### Final Infusion Volume Contents

<table>
<thead>
<tr>
<th>Technique</th>
<th>Volume cc</th>
<th>% HCT</th>
<th>Plt Cnt 10⁹/L</th>
<th>[Fib] mg/dL</th>
<th>% Clot Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>700-1800</td>
<td>17-25</td>
<td>50-140</td>
<td>80-135</td>
<td>15-40</td>
</tr>
<tr>
<td>Cell-wash</td>
<td>225-450</td>
<td>40-58</td>
<td>5-25</td>
<td>10-30</td>
<td>2-10</td>
</tr>
<tr>
<td>Ultrafiltration</td>
<td>450-1000</td>
<td>45-50</td>
<td>125-325</td>
<td>225-385</td>
<td>85-259</td>
</tr>
</tbody>
</table>

**Note:** 90 percent confidence limits for pre-protamine infusion volumes and blood component values ( [*Proc Amer Soc Extra Corpor Technol.* 2006 ](http://www.mybloodfirst.com/))
<table>
<thead>
<tr>
<th>Issue</th>
<th>Ultrafiltration</th>
<th>Cell-Washing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clotting factor preservation</td>
<td>Concentrates remaining factors</td>
<td>Wastes clotting factors</td>
</tr>
<tr>
<td>Protein (fibrinogen) preservation</td>
<td>Concentrates albumin and fibrinogen</td>
<td>Wastes albumin and fibrinogen</td>
</tr>
<tr>
<td>Allogeneic transfusion avoidance</td>
<td>Helps to avoid use of PRBCs and other blood component therapy</td>
<td>Helps to avoid use of PRBCs; May increase use of component therapy</td>
</tr>
<tr>
<td>Heparin / drug removal</td>
<td>Concentrates some drugs</td>
<td>Removes many drugs</td>
</tr>
<tr>
<td>Platelet / RBC / WBC preservation</td>
<td>Concentrates functional blood cells</td>
<td>May waste or activate platelets, WBCs and RBCs</td>
</tr>
<tr>
<td>Interleukin / complement removal</td>
<td>Removes some ILs or complements</td>
<td>Removes some ILs or complements</td>
</tr>
<tr>
<td>Contamination</td>
<td>Should not introduce bacteria</td>
<td>CW product contains bacteria</td>
</tr>
<tr>
<td>Fat removal</td>
<td>May remove some fat</td>
<td>Removes some fat</td>
</tr>
<tr>
<td>Cost-savings</td>
<td>Cost savings with decreased allogeneic component therapy</td>
<td>Some cost savings with reduced allogeneic PRBC use</td>
</tr>
</tbody>
</table>

#3. …transfusion must be in the best interest of the patient.

#15. Blood is a costly public resource
   Blood Industry, USA ~ $20 Billion / yr!

#16. As far as possible the patient should receive only those particular components that are clinically appropriate and afford optimal safety and outcome.

#17. Wastage should be avoided in order to safeguard the interest of all potential recipients and the donor pool.

Cell Washing Devices Inherent waste by discarding all viable platelets & plasma ~280-300ml / bowl
## ATS Waste Cost Estimator for Residual CPB Circuit Volume

### Patient's ECC Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit %</td>
<td>25</td>
</tr>
<tr>
<td>Platelet count K/mm³</td>
<td>140</td>
</tr>
<tr>
<td>Protein gm/dL</td>
<td>4</td>
</tr>
<tr>
<td>Fibrinogen mg/dL</td>
<td>120</td>
</tr>
</tbody>
</table>

### Allogeneic Platelet Packs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet volume cc</td>
<td>75</td>
</tr>
<tr>
<td>Platelet K/mm³</td>
<td>300</td>
</tr>
<tr>
<td>Platelet M</td>
<td>22.50</td>
</tr>
<tr>
<td>Cost $</td>
<td>200</td>
</tr>
</tbody>
</table>

### Allogeneic FFP

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFP volume cc</td>
<td>125</td>
</tr>
<tr>
<td>Fibrinogen mg / dL</td>
<td>275</td>
</tr>
<tr>
<td>Fibrinogen mg</td>
<td>343.75</td>
</tr>
<tr>
<td>Cost $</td>
<td>175</td>
</tr>
</tbody>
</table>

### RBC Mass

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC Mass to process cc</td>
<td>375</td>
</tr>
<tr>
<td>Plasma mass cc</td>
<td>1,125</td>
</tr>
</tbody>
</table>

### ATS Blood Reservoir

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir volume cc</td>
<td>1,500</td>
</tr>
<tr>
<td>Irrigant cc</td>
<td>0</td>
</tr>
<tr>
<td>Heparinized saline cc</td>
<td>0</td>
</tr>
<tr>
<td>Patient's shed blood cc</td>
<td>1,500</td>
</tr>
</tbody>
</table>

### ATS Bowl

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowl volume cc</td>
<td>225</td>
</tr>
<tr>
<td>Bowl hematocrit %</td>
<td>55</td>
</tr>
<tr>
<td>Processed bowls #</td>
<td>3.0</td>
</tr>
<tr>
<td>Anesthesia pRBC cc</td>
<td>682</td>
</tr>
</tbody>
</table>

### ATS Waste Components

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet activation %</td>
<td>25</td>
</tr>
<tr>
<td>Wasted platelets M</td>
<td>157.5</td>
</tr>
<tr>
<td>Protein removal %</td>
<td>90</td>
</tr>
<tr>
<td>Wasted fibrinogen mg</td>
<td>1,620</td>
</tr>
<tr>
<td>Wasted protein gm</td>
<td>52</td>
</tr>
</tbody>
</table>

### ATS Waste Replacement Cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelets packs</td>
<td>7.0</td>
</tr>
<tr>
<td>Platelets $</td>
<td>1,400</td>
</tr>
<tr>
<td>FFP units</td>
<td>4.7</td>
</tr>
<tr>
<td>Fibrinogen $</td>
<td>825</td>
</tr>
<tr>
<td>Protein vials</td>
<td>4.2</td>
</tr>
<tr>
<td>Protein $</td>
<td>943</td>
</tr>
<tr>
<td>Total replacement $</td>
<td>3,168</td>
</tr>
<tr>
<td>Hemobag® / HC Costs</td>
<td>220</td>
</tr>
<tr>
<td>Recovered HB® Savings</td>
<td>2,948</td>
</tr>
</tbody>
</table>

### Instructions

- Enter data in green cells
- Press Update button
- See all explanatory comments and calculations

Cost Recovery of ATS Waste with the Hemobag®

www.mybloodfirst.com
Blood Salvaging With Ultrafiltration

- The HB tech is an easy way for Perfusionists to salvage any ECC circuit’s Whole Blood quickly, while still keeping your circuit safely primed in case you have to crash back on in an emergency.
- The process takes only 8-10 min from Aortic decannulation till Anesthesia is infusing back this powerful unit into the patient.
- The Hemobag® and its TS3 tubing set allows for Ultrafiltration both during the case and at the end for Whole Blood Autotransfusion.
- This is a device made for Perfusionists by a Perfusionist for easy salvaging of blood, helping avoid Allogenic Tx’s & Improve Pt Care.
- The end product is a hyperoncotic Autologous Whole Blood packed with viably functioning Platelets, Clotting Factors, Albumin, Plasma Proteins and RBC’s with no morbidity or side effects.
## Clotting Factors

<table>
<thead>
<tr>
<th>Factor I</th>
<th>Fibrinogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor II</td>
<td>Pro-thrombin</td>
</tr>
<tr>
<td>Factor III</td>
<td>Tissue Thromboplastin (TT)</td>
</tr>
<tr>
<td>Factor IV</td>
<td>Calcium</td>
</tr>
<tr>
<td>Factor V</td>
<td>Labile factor (proaccelerin)</td>
</tr>
<tr>
<td>Factor VI</td>
<td>not assigned</td>
</tr>
<tr>
<td>Factor VII</td>
<td>Stable factor (proconvertin)</td>
</tr>
<tr>
<td>Factor VIII</td>
<td>Anti-hemophilic factor A (AHF)</td>
</tr>
<tr>
<td>Factor IX</td>
<td>Christmas Factor</td>
</tr>
<tr>
<td>Factor X</td>
<td>Stuart - Prower Factor</td>
</tr>
<tr>
<td>Factor XI</td>
<td>Plasma Thromboplastin antecedent</td>
</tr>
<tr>
<td>Factor XII</td>
<td>Hageman factor</td>
</tr>
<tr>
<td>Factor XIII</td>
<td>Fibrin Stabilizing factor</td>
</tr>
</tbody>
</table>

The higher up the cascade the clotting factor deficiency is, the worse and more detrimental the coagulopathy can be.
The Clotting Cascades

Intrinsic Pathway

- XII
- XIIa
- XI
- Xa
- IX
- IXa
- VIII
- VIIIa

Extrinsic Pathway

- VII
- VIIa + TF
- vascular injury

Ca^{2+}

PL

Prothrombin

Thrombin

Fibrinogen

Fibrin monomer

Fibrin polymer

XIII

XIIIa

Cross-linked fibrin polymer

copyright 1996 M.W. King
FFP & FIBRINOGEN FACTS

• Fibrinogen is produced by the Liver (340 kDa)
• It is the main protein of blood coagulation and the mainstay in treatment of inherited coagulopathies
• Frozen for up to 1 year, must be used within 24hrs of thawing
• Fibrinogen meshes with the Platelet plug and converts to a stable Fibrin clot
• Normal blood levels are 150- 400 mg/dl
• Normal concentrations in plasma are about 3mg/ml
• Ea unit of FFP 200-300mls has 1-2mg/ml of Fibrinogen
• It’s an important parameter in the diagnosis of CAD.
• FFP use is up over 40% here in the USA since 1979
• Use and demand has continued to grow each year
• The USA uses 3 times as much as Europe does!
• Plasma Tx is not benign it can cause TRALI, TACO, TRIM and other Immunological consequences!
Do *in vitro* coagulation tests predict bleeding?

The relationship between clotting factors and the PT is Exponential!

Equivalent Fibrinogen Volume Average from HB 500 cases

- Frozen Plasma:
  - 1 Average Hemobag $\approx$ 3.4 units of FFP (300ml @ 325mg) for Fbg. equivalency to one average Hemobag reinfusion (800ml @ 450mg/dl)

- Cryoprecipitate:
  - 1 Average Hemobag $\approx$ 37 units of Cryo. (60ml @150mg pooled units) for Fbg equivalency to one average Hemobag reinfusion (800ml @ 450mg/dl)

** FFP usage in the United States is rising each year and rising at a rate faster than RBC’s. 30% of FFP transfusions do not meet current guidelines.

[Transfusion Vol. 45: July, 2005. Dr. Dzik]

Current trend nationwide FFP usage:

'03: 2.7M u.
'04: 3.3M u.
'05: ↑ M u.
'06: ↑↑M.u
Albumin – Physiological role

• Major functions
  – Most abundant protein in plasma (69 kDa)
  – +/- 80% of plasma colloid osmotic pressure
    Normal COP is 18-22 mmHg (Hemodilution really drops it)
  – Transport and sequestration of bilirubin
  – Transport of fatty acids, hormones, vitamins, enzymes, drugs (Warfarin, Diazepam, Digoxin, NSAIDS, Midazolam, Thiopental and others)
  – Antioxidant and Free Radical Scavenger effect
  – Inhibit Endothelial Cell Apoptosis and may influence the Microcirculation by modifying the capillary permeability
  – Buffer in Acid Base Balance (fixes to H+ ions)
  – No Maximal Dose and No Effect on Hemostasis
Plasma Protein Effects on Total Colloid Osmotic Pressure

<table>
<thead>
<tr>
<th></th>
<th>gm/dl</th>
<th>mmHg</th>
<th>% of COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin</td>
<td>4.5</td>
<td>21.8</td>
<td>78</td>
</tr>
<tr>
<td>Globulins</td>
<td>2.5</td>
<td>6.0</td>
<td>21</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>0.3</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>7.3</td>
<td>28.0</td>
<td>100</td>
</tr>
</tbody>
</table>
FLUID MOVEMENT BETWEEN IVC AND ISC DUE TO HP & COP

FIG. 4-2 Movement of fluids and electrolytes between plasma and interstitial fluid caused by hydrostatic and colloid osmotic pressure.
Edema: Most common clinical manifestation of an imbalance of forces at the capillary wall

Excess accumulation of fluid in the interstitial space that has not been readsoorbed into capillaries or taken up by the lymphatics

Causes include

- Obstruction
- Permeability or change in reflection coefficient
  
  *Increased protein permeability results in an imbalance*
  
  - Occurs in trauma, thermal injury, inflammation
  - Life threatening manifestations - endotoxic shock, ARDS
- Plasma Protein
  
  *Reduction in circulating plasma proteins, especially albumin*
  
  - Liver dysfunction, malnutrition, or acute alteration of fluid status
  - Albumin attenuates extravasation of fluid out of intravascular space to interstitial space
- Capillary pressure

*It's important to have a good COP and a Albumin Level > 3.5 on CPB*
Back to the players!

POST-OP Nurses & The ICU Care Team

- Maintain Normothermia
- Micro-sampling as little as possible
  - Rely on Oximetry instead of draws
- Careful and judicious use of volume as needed
- Pressors instead of volume
- Albumin instead of crystalloids
- Diuretics if necessary
- Extubate ASAP!
- No “Drive-by Transfusions” from on-call staff!
Hospital Administrators

- Get to know them on a personal basis
- Suggest the benefits of a Blood Mgmt Prgm
- Get them involved in Blood Management!
- Encourage trials of New Equipment / Drugs
- Find a Champion for Blood Management!
- Show them the facts in $$$ savings for all!
Other Things You can Do!

- Join AmSECT & get involved with the PBM Taskforce!
- Take the PBMS exam & be a leader in your Hospital.
- Join the AABB, SABM, NATA or PNBC
  - These are finely tuned international organizations solely focused on better blood management and improved care!
- Surf the web & read current articles and share them with other members of the cardiac team (leave around).
- Get on your Hospital’s Transfusion Practices committee and make a difference (Go to the monthly meetings).
- Find and support a Champion MD who wants to change the paradigms of tx’s in your hospital’s Cardiac team.
- Work as a team that’s focused on improvement of care!
More Things You can Do!

- Visit these sites and learn more!
  - NoBlood.org
  - Bloodless Medicine Research (Univ of Pisa)
  - SABM (Society for the Advancement of Blood Mngmt)
  - NATA (Network for Advancement of Tx Alternatives)
  - PNBC (Physicians & Nurses for Blood Conservation)
  - Medical Society for Blood Management
  - Strategic Blood Management
  - Mybloodfirst.com (Excellent site for Perfusionists)
- Get Involved and Change the Paradigm of Blood Use!
Take Home Message of Blood Management Principles

- Multidisciplinary Communication is Jugular
- Find or become a champion in this effort!
- Maximize Preoperative Red Cell Mass
- Correct any Coag disorder prior to Sx
- Minimize blood loss in Sx (this is essential !)
- Avoid Allogeneic Tx (balance need vs risk)
- Salvage Autologous Whole Blood first then use alternatives if necessary
- If a Transfusion is necessary: use safest, freshest and most effective product available (wash it !)
- Remember you can’t start saving blood until you actually start saving blood!
But most Importantly remember!
“If it’s not yours it’s an Organ Transplant” with consequences, so try and do your best to avoid it!
Your decisions affect the patient for the rest of their life!
Thank you for your time!

Send Questions
To: info@mybloodfirst.com