Autologous Blood Transfusion: is Harmful and Unnecessary

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Professor of Surgery
Chief, Division of Trauma, Burns, Surgical Critical Care, and Emergency General Surgery
This Year’s Debate
Demetriades et al JACS 2005
Mortality After Trauma

- Hemorrhage: 39%
- CNS + Hem: 6%
- CNS: 42%
- MSOF: 7%
- Other: 6%

N = 289

Hemorrhage Control

1. Surgical Control.
2. Correct Systemic Coagulation Defects.
4. Balance Acid-Base Status.
5. Endovascular Assist.
Hemorrhage Control

1. Surgical Control.
2. Correct Systemic Coagulation Defects.
4. Balance Acid-Base Status.
5. Endovascular Assist.
The Coagulopathy of Trauma

- Tissue injury
- Shock
- Hemodilution
- Hypothermia
- Acidemia
- Inflammation
- Hyperfibrinolysis
- Hypocalcemia
What we know

- Damage control resuscitation (hemostatic)
  - Rapid hemorrhage control
  - Permissive hypotension
  - Minimize crystalloid
  - Immediate delivery of high ratio of plasma and platelets to RBC’s (1:1:1)
What we know

- Damage control resuscitation (hemostatic)
  - Rapid hemorrhage control
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Journal of Trauma 2007

Borgman et al., J Trauma 2007

Mortality

Plasma:RBC Ratio Groups

(Low) 1:8
(Medium) 1:2.5
(High) 1:1.4

65%
34%
19%

31%
46%
• Early administration of blood products like plasma and platelets lowers mortality
• Early administration of blood products like plasma and platelets lowers mortality

• With 1:1:1 ratio:
  • More patient achieved hemostasis
  • Fewer died from exsanguination
What we know

- Damage control resuscitation (hemostatic)
  - Rapid hemorrhage control
  - Permissive hypotension
  - Minimize crystalloid
  - Immediate delivery of high ratio of plasma and platelets to RBC’s (1:1:1)

Best replacement for whole blood loss may be fresh whole blood
Whole blood is great
Whole blood is great

- Is autologous blood = whole blood??
Whole blood is great

- Is autologous blood = whole blood??

But first, what is autologous blood??
What is autologous blood
What is autologous blood

- **Autos** – means self
What is autologous blood

- Autos – means self
- Logus – means relation
What is autologous blood

- **Autos** – means self
- **Logus** – means relation
- “related to self”
What is autologous blood

- **Autos** – means self
- **Logus** – means relation
- “related to self”

“Reinfusion of blood or blood components to the same individual from whom they were taken”
What is autologous blood

- Cell Saver
- Autotransfusion (chest tube)
Advantages of autologous blood

- Immediately available
- Technique for resuscitation
- Ease the need for allogeneic component transfusion
Advantages of autologous blood

- May lessen risks of
  - ARDS
  - Pneumonia
  - Transfusion reactions
  - Blood-borne pathogens
Advantages of autologous blood

- EAST and SCCM suggest autotransfusion
- Autotransfusion approved by AABB
Problems of autologous blood

- Inflammatory mediators
- Contamination
- Impact on coagulation?
Problems of autologous blood

- Inflammatory mediators
- Contamination

Impact on coagulation?
- ↑ clot formation
- ↓ clot formation
- No effect
Problems of autologous blood

- Inflammatory mediators
- Contamination

Impact on coagulation?
- ↑ clot formation
- ↓ clot formation
- Unclear
- No effect
Whole blood is great

- Is autologous blood = whole blood??
What is autologous blood

- Cell Saver
- Autotransfusion (chest tube)
What is autologous blood

- Cell Saver
- Autotransfusion (chest tube)
Autologous Blood Transfusion During Emergency Trauma Operations

Carlos V. R. Brown, MD; Kelli H. Foulkrod, MSc; Holli T. Sadler, MD; E. Kalem Richards, LP, CCP; Dennis P. Biggan, LP, CCP; Clea Czysz, RN; Tony Manuel, MD

- Autologous cell saver
  - Safe
  - ↓ transfusion of PRBC
  - ↓ transfusion of FFP
What is autologous blood

- Cell Saver
- Autotransfusion (chest tube)
What is autologous blood

- Cell Saver
- Autotransfusion (chest tube)
Autotransfusion
Autotransfusion
Autotransfusion
Early autologous fresh whole blood transfusion leads to less allogeneic transfusions and is safe

Peter Rhee, MD, Kenji Inaba, MD, Viraj Pandit, MD, Mazhar Khalil, MD, Stefano Siboni, MD, Gary Vercruysse, MD, Narong Kulvatunyou, MD, Andrew Tang, MD, Anum Asif, MD, Terence O’Keeffe, MD, and Bellal Joseph, MD, Tucson, Arizona

### TABLE 2. Primary Outcomes: In-hospital Complications and Mortality

<table>
<thead>
<tr>
<th>Variables</th>
<th>AT (n = 136)</th>
<th>No-AT (n = 136)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hospital complication,% (n)</td>
<td>12.5 (17)</td>
<td>10.3 (14)</td>
<td>0.6</td>
</tr>
<tr>
<td>ARDS,% (n)</td>
<td>2.2 (3)</td>
<td>1.5 (2)</td>
<td>0.67</td>
</tr>
<tr>
<td>DIC,% (n)</td>
<td>2.9 (4)</td>
<td>2.9 (4)</td>
<td>0.9</td>
</tr>
<tr>
<td>Sepsis,% (n)</td>
<td>2.9 (4)</td>
<td>2.2 (3)</td>
<td>0.71</td>
</tr>
<tr>
<td>Renal insufficiency,% (n)</td>
<td>2.2 (3)</td>
<td>2.2 (3)</td>
<td>0.89</td>
</tr>
<tr>
<td>TRALI,% (n)</td>
<td>2.2 (3)</td>
<td>1.5 (2)</td>
<td>0.67</td>
</tr>
<tr>
<td>Mortality,% (n)</td>
<td>18.3 (25)</td>
<td>15.4 (21)</td>
<td>0.51</td>
</tr>
<tr>
<td>24-h INR, mean (SD)</td>
<td>1.3 (1.1)</td>
<td>1.1 (1)</td>
<td>0.12</td>
</tr>
</tbody>
</table>
Autologous Blood Transfusion

- ↓ use of blood products
- Is safe
Early autologous fresh whole blood transfusion leads to less allogeneic transfusions and is safe

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However......
Autotransfusion of hemothorax blood in trauma patients: is it the same as fresh whole blood?

Marc Salhanick, B.S., Michael Corneille, M.D., Russell Higgins, M.D., John Olson, M.D., Joel Michalek, Ph.D., Chantal Harrison, M.D., Ronald Stewart, M.D., Daniel Dent, M.D.*

To describe coagulation, hematologic, and electrolyte profiles of blood from evacuated hemothorax
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pleural Blood</th>
<th>Venous Blood</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit</td>
<td>26.4</td>
<td>33.9</td>
<td>.003</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>9.2</td>
<td>11.7</td>
<td>.004</td>
</tr>
<tr>
<td>Platelet</td>
<td>53</td>
<td>174.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>INR</td>
<td>&gt;9</td>
<td>1.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>aPTT</td>
<td>&gt;180</td>
<td>28.5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>&lt;50</td>
<td>288</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>D-Dimer</td>
<td>&gt;7,360</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sufficient concentration of RBC’s

Extremely deficient in coagulation factors

Contains products of fibrinogen degradation
“direct transfusion of pleural blood raises safety concerns.”
Early autologous fresh whole blood transfusion leads to less allogeneic transfusions and is safe

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Does time make a difference??
Analyzed at 1, 2, 3 and 4 hours

Mixed with normal pooled plasma to evaluate effect on coagulation
No difference at different time points
Hemothorax is hypercoagulable when mixed with normal pooled plasma.
An experimental model of hemothorax autotransfusion: impact on coagulation

Hannah B. Harrison, M.S.*, William Zachary Smith, B.S., Marc A. Salhanick, M.D., Russell A. Higgins, M.D., Alfonso Ortiz, B.S., John D. Olson, M.D., Ph.D., Martin G. Schwacha, Ph.D., Chantal R. Harrison, M.D., Jayson D. Aydelotte, M.D., Ronald M. Stewart, M.D., Daniel L. Dent, M.D.

Simulate hemothorax autotransfusion
Mixture becomes hypercoagulable
“...we cannot recommend autotransfusion of HTX when banked blood is available.”
Shed pleural blood from traumatic hemothorax contains elevated levels of pro-inflammatory cytokines

Marc A. Salhanick, Valere G. Sams, Heather F. Pidcocke, Chriselda G. Fedyk, Michael R. Scherer, Michael A. Dubick, Daniel L. Dent, Andrew P. Cap, Martin G. Schwacha

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RH: Hemothorax blood and cytokines

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The authors have no conflicts of interest.
**IL-2**

![IL-2 Bar Graph](image)

- **pg/mL**
- **Control**
- **Time after Thoracostomy (hrs)**
  - 1
  - 2
  - 3
  - 4

**IFN-γ**

![IFN-γ Bar Graph](image)

- **pg/mL**
- **Control**
- **Time after Thoracostomy (hrs)**
  - 1
  - 2
  - 3
  - 4

*Note: Data points marked with an asterisk (*) and dagger (†) indicate statistically significant differences.*
Cytokine Levels

- ↑ pro-inflammatory cytokines
- ↑ anti-inflammatory cytokines
- 10 to 100 fold higher
Cytokine Levels

- ↑ pro-inflammatory cytokines
- ↑ anti-inflammatory cytokines
- 10 to 100 fold higher

Potential for deleterious effects??
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Autologous Blood

- Safe??
- Evidence to support its use??
Autologous Blood

- Safe??
- Evidence to support its use??
- Practicing West Virginia Medicine??