Disclosure Statements

• This purpose of this debate is to increase public and prehospital provider knowledge about current studies and evidence-based practice guidelines for prehospital versus in-hospital blood administration in trauma resuscitation.

• The ‘pros and cons’ discussed are for the sake of weighing the argument using available evidence. These arguments may not directly reflect the personal opinions of the speakers or the modulator.

• No compensation was provided for the discussion of any products, studies, or information included in this debate.
Blood Products
Back to the Basics

• Packed Red Blood Cells (PRBCs):
  – Rh factor matters
  – No clotting factors, plasma, or platelets

• Fresh Frozen Plasma (FFP):
  – Separated from RBCs and platelets
  – Contains clotting factors II, V, VIII, IX, X, XII and antithrombin III

• Liquid Plasma (LP):
  – Never frozen
  – Less clotting factor concentration than FFP but longer time to expiration
Blood Products
Back to the Basics

• Cryoprecipitate
  – FFP thawed and centrifuged
  – Concentrated to include factors VIII, XIII, vWB factor, fibrinogen, and fibronectin

• Platelets
  – Tiny, plate-shaped cells
  – Sticky to help with clot formation and maintenance

• Whole Blood
  – Contains proportion of RBCs, plasma, and platelets as would be gained from blood drawn directly from a donor without processing, separation, or alteration
Blood Transfusions:
The Lethal Triad

- In performing traumatic resuscitation (regardless of setting), healthcare providers often fight against the “LETHAL TRIAD”

- Coagulopathy
- Hypothermia
- Acidosis
Should We Be Giving Blood?
This might just get interesting...

NEVER RIGHT, A MAN IS

ALWAYS AGREE
WITH WIFE, HE MUST
Feasibility of Prehospital Blood Administration

“But where will I put my lunch?”

• Availability
  – Assurance that blood centers will have products available in a timely manner
  – Variable expiration dates between products (5 days, 21 days, 25+ days)
  – Availability of products during times of critical shortage (natural disasters, MCIs)
  – Ground units may not use enough blood to make it worth the hassle.
Feasibility of Prehospital Blood Administration

“But where will I put my lunch?”

• Blood product storage:
  – Ensuring proper temperatures for products both at the station and while in transport
  – Tedious logging of temperatures and times, maintaining records
  – Expense of regulated coolers, refrigerators, and thermoregulators
  – Loss or waste of products due to misuse or lack of use prior to expiration
The **Struggle** is Real.

Choose your battles with your wife or take Devon to school.
Feasibility of Prehospital Blood Administration

“IT CAN BE DONE!”

- Several prehospital programs have been successful in collaborative agreements with local blood banks to facilitate blood administration
  - Blood not utilized in prehospital administration can be recirculated into blood bank supply for use before expiration.
    - Recommended life span for PRBCs is 35 days
    - Recommended life span for LP is 26 days
    - Recommended life span for WB is 10-21 days
    - Recommended life span for thawed FFP is 5 days

(AABB, 2018)
Feasibility of Prehospital Blood Administration

Storage Options

• Multiple options for storage are available based on the prehospital environment.
  - Target storage temperature is 35.0 – 39.0 degrees Fahrenheit (Rehn et al., 2017)
  - Electronic data collection easily documented and monitored with digital thermometer systems (Holcomb et al., 2015)
  - Minimal wastage of blood products reported across studies < 1.9% (Holcomb et al., 2015)
Feasibility of Prehospital Blood Administration

Storage Options

- Data logger
- Transfusion paperwork
- Sealed by blood bank
- 4 units of O Rh negative packed red blood cells

Golden hour box™

Maintain steady state temperature of 2-4°C for 48-72 hours
Feasibility of Prehospital Blood Administration

Storage Options

Move over "other life saving" products

MAKE ROOM FOR BLOOD!
Feasibility of Prehospital Blood Administration Storage Options

You can even put it in your Lunch Box!
Feasibility of Prehospital Blood Administration

Who is going to carry the blood?

- Air Medical Resources
- Strategic Deployment for Ground-Based EMS
Type and Screening

Does blood type matter?

- What about transfusion reactions?
  - Universal donor types are different for different products (AABB, 2018)
  - What if you’ve already used your O negative?
- Do various products pose a risk for different reactions?
  - Anaphylaxis
  - Circulatory overload
  - Lung injury
Transfusion Reactions
This Just Doesn’t Feel Right…

• PRBC transfusion associated with highest rates of transfusion-related acute lung injuries (TRALI)
  – Permeability edema
  – S/S include acute onset of hypoxemia within 6 hours of transfusion without evidence of circulatory overload

• Plasma can cause significant transfusion-associated circulatory overload (TACO)
  – Hydrostatic edema
  – S/S include acute respiratory distress, hypoxia, pulmonary edema, increased SBP

(Pandey & Vyas, 2012)
Type and Screening/Transfusion Reactions

The Sky IS NOT Falling!

PREHOSPITAL BLOOD ADMINISTRATION!? WHAT ABOUT TRANSFUSION REACTIONS? TACO? TRALI?
Type and Screening/Transfusion Reactions
Let’s Keep It Real

• **O+ PRBCs:**
  – Can be administered to males and females of child bearing age
  – Can be given to females in life-or-death situations (but may increase risk of hemolytic disease of the newborn in future pregnancies)

• **O- PRBCs:**
  – Universal donor type for RBCs
  – Can be given to females of child bearing age and males.

• **Fresh Frozen Plasma:**
  – AB is the universal donor
  – Often given to reverse INR

(AABB, 2018)
• Cryoprecipitate:
  – Used when fibrinogen levels are depleted
  – Compatibility preferred but not required

• Platelets:
  – Typically given after PRBCs and FFP administered
  – Reserved for patients who are thrombocytopenic

• Whole Blood:
  – O+ or O- can be safely transfused to both adult males and females
Very few patients had reported complications from blood product administration including anaphylaxis, TRALI, or TACO (Sperry et al., 2018).

Reported transfusion reactions were minimal, mostly mild, and easily treated (Smith et al., 2015).
Evidentiary Support
Show me the science

- Current studies fail to justify significant variabilities in various other prehospital treatments such as IVF administration, TXA, tourniquet use (Smith et al., 2015)
- Lack of comparable control groups in prehospital setting studies (Smith et al., 2015)
- Military data often lacks initial vital signs such as SBP, HR, RR prior to blood product initiation (O’Reilly et al., 2014)
- No large, reliable, high-level studies that show overall survival rates from blood product transfusion when compared to traditional crystalloid resuscitation in the prehospital setting (Holcomb et al., 2015)
Evidentiary Support
Show me the science

• How do we know which blood products are best if we don’t have the evidence showing that prehospital transfusions definitively improve outcomes?
  – What is the best order of blood product administration?
  – Are blood products consistently warmed to prevent hypothermia? Are crystalloids warmed?
  – Have current studies controlled for other cofounding prehospital treatments such as amount of crystalloids infused, patient temperature, use of other hemostatic agents, and consistency in number and type of blood products used?

(Sperry et al., 2018)
COMBAT Trial

COMBAT TRIAL
CONTROL OF MAJOR BLEEDING AFTER TRAUMA TRIAL

Prehospital Hemorrhagic Shock
SBP ≤ 70 mmHg OR
SBP 70-90 mmHg + HR > 108

2U FFP → SALINE

65 TOTAL PATIENTS
19 MIN TRANSPORT TIME
12% MORTALITY @ 24 HOURS
15% MOTALITY @ 28 DAYS

60
16 MIN
16%
10%

*** DISCONTINUED DUE TO FUTILITY ***

Limitations
Frozen plasma: defrosting → distract EMS provider and delays admin
A single, integrated, hospital-based EMS system and trauma center
Thawed plasma immediately available at trauma center


Does prehospital resuscitation with plasma improve survival of patients in hemorrhagic shock being transferred by ground ambulance from scene to an urban level 1 trauma center?

(Moore et al., 2018)
Failure to Change
Benefits of Prehospital Intervention

Patients who received a prehospital intervention had a significantly lower incidence of mortality than those who did not (23% vs 43% p = 0.021)

- University of Miami/Jackson Memorial Hospital Ryder Trauma Center
- Compares Patient mortality with Prehospital ALS Intervention vs Without ALS Prehospital Intervention
- 7 Prehospital Ground EMS Agencies + Air Medical Units
- 3,733 Trauma Activations/patients enrolled

(Meizoso et al., 2015)
Benefits of Prehospital Intervention

The best way to fight against the “Lethal Triad” is to be prepared for the fight!
London Air Ambulance

Pre-hospital transfusion of red blood cells in civilian trauma patients

- Studied the effects of early PRBC administration to civilian trauma patients that met current in hospital criteria for blood product administration.
- 265 Patients Enrolled
- Control 137 vs PRBC 128
- Showed significant decrease in overall blood product administration within the initial 24 hour period of care.
- Showed merit in fighting against Lethal Triad (Rehn et al., 2017)

The best way to fight against the “Lethal Triad” is to be prepared for the fight!
The best way to fight against the “Lethal Triad” is to be prepared for the fight!
Shock Index
The Tool We Should Be Using

- Calculated by dividing HR by SBP
- Shock Index >1.0 indicates need for transfusion
- SI shows greater prediction for patients requiring Massive Transfusion Protocol when compared to ABC score
- Less false negatives than ABC score

(Schroll et al., 2017)

The best way to fight against the “Lethal Triad” is to be prepared for the fight!
Shock Index
The Tool We Should Be Using

Waiting on an TEG, ABC, H&H, results like:

The best way to fight against the “Lethal Triad” is to be prepared for the fight!
PAMPER Trial

Clinical Question:
- In severely injured patients at risk for haemorrhagic shock, does prehospital plasma resuscitation, compared with standard-care resuscitation (not including plasma administration), reduce 30-day mortality?

Context:
- Bleeding in trauma, traditionally managed with the prehospital infusion of crystalloids.
- Component transfusion started once patient arrives in hospital.
- Recent evidence that suggests the early institution of blood components may help prevent trauma coagulopathy, downstream traumatic shock, and improve outcomes.

Inclusion:
- Blunt or penetrating trauma
- Transported to trauma centre from scene or from outside referral ED
- At risk of haemorrhagic shock, as defined by at least one episode of:
  - Hypotension (systolic blood pressure <90mmHg) and tachycardia (HR >106/min)
  - Severe hypotension (systolic blood pressure <70mmHg)

Exclusion:
- >90yr or <18yr / Unable to establish IV or IO access / Isolated fall from standing / Documented C-spine injury / prisoner / pregnant / Traumatic cardiac arrest >5 minutes / Penetrating brain injury / Isolated drowning or hanging / >20% TBSA burns / Admitted to an outside referral hospital
- Patient or family member objected to participation in the trial at the scene.

Plasma arm:
2 units thawed plasma initiated in prehospital setting by air transport team before any other fluid. After this goal directed resuscitation with crystalloids or RBC’s until arrival in ED.

Randomisation:
- Randomisation was of air medical services / not individual patients.
- Block randomized for 1mth at a time to:
  - Plasma arm
  - Standard care (control) arm

Primary Outcome:
- 30 day mortality
  - Plasma - 23%
  - Std Care - 33%
  - P=0.03

Secondary Outcomes:
- 24hr mortality 13.9% vs 22.1% (NS)
- In-hosp. mortality 22.2% vs 32.5% (NS)
- Median 24hr Vol. RBCs 3 vs 4 (NS)
- Median 24hr Vol. crystalloid 4388 vs 320 vs 4800 (9NS)
- Vasopressors received in first 24 hours 45.3% vs 50.9% (NS)
- Multorgan failure 63.0% vs 57.6% (NS)
- Median initial INR lower 1.2 vs 1.3 P<0.001

Goal Directed arm:
- Targeting BP >90 (not standardised but guided by local protocol)
PAMPER Trial

- Focused on prehospital administration of plasma for hemorrhagic shock in trauma patients (in conjunction with PRBC and NS resuscitation)
- Total patients – 501
  - Control = 271 vs Plasma = 230
- **Significantly decreased 30 day mortality**
- **Plasma = 23.2% vs 33%**

(Sperry et al., 2018)
TAKING IT HOME

• Studies for prehospital blood administration are limited at this time and more research is needed.
• The available data is promising and makes physiologic sense.
• We owe it to our patients to search for answers, lean forward, and keep up the fight in decreasing mortality.

“It appears that the best way to improve outcomes in bleeding trauma patients is to stop bleeding earlier, resuscitate them with blood products ‘while’ moving rapidly to the hospital.” (Holcomb, 2018)
Questions?

There's nothing wrong with being unsure.

Clever people ask the most questions.


References


