Whole Blood Transfusion for Trauma Resuscitation

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Learning Objectives

• Gain insight into the evolution of Transfusion in resuscitation
• Gain knowledge regarding the indications for whole blood administration
• Gain understanding of the benefits/risk of whole blood
• Gain insight into the processes and challenges of establishing whole blood program and guidelines
Disclosure Statement

- I have nothing in conflict of interest relative to this educational activity.
Successful Completion

- To successfully complete this course, participants must attend the entire event and complete/submit the evaluation at the end of the session.
- Society of Trauma Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.
Introduction

• Hemorrhage is the primary cause of preventable death on the battlefield and in civilian trauma. Military conflicts, natural disasters, mass casualty events and traumatic injury of all kinds have required treatment of injury and blood replacement. Whole blood administration has long been a staple in combat medicine and is making resurgence in civilian trauma care.
Significant Events in Transfusion Medicine

• 1628 the discovery of circulation
• 1795 first human blood transfusion
• 1818 first successful blood transfusion for treatment of hemorrhage
• 1867 antiseptics to control infection
• 1900 discovery of blood typing ABO
• 1907 cross matching
• 1912 universal donor 0
• 1912-1920s Development of anticoagulants to aid in storage
• 1916 First Blood Bank in Britain during WWI
• 1939 Rh blood group discovered
• 1940 Nationwide program for blood collection WWII
• 1941 Albumin used to treat shock
• 1950-1970 advancements in component development
American Association of Blood Banks AABB

- Guidelines
- Donor Safety
- Distribution
- Storage
Blood Facts

• Makes up 7-8% of total body weight
• Specialized tissue 4,000 different kinds of components
• Women have 4-5 liters
• Men have 5-6
• Artificial substitute has never been developed
Blood Functions

- Transport
  - Oxygen and Carbon dioxide carriage
  - Nutrients from the digestive tract
  - Waste products from liver and kidney
  - Hormones to target cells
  - Heat to the skin, temperature regulation
Blood Functions

• Protection roles in inflammation
  • Leukocytes white blood cells destroy invading organisms
  • Antibodies and other proteins destroy pathogens
  • Platelet factors initiate clotting and minimize blood loss

• Regulation
  • pH through interaction with acids and bases
  • Fluid balance
Blood Components

• Four most important components
  • Plasma
  • Red blood cells
  • White blood cells
  • Platelets
Plasma

- 55% of total blood volume
- Contains lipids, hormones, enzymes, antibodies
- Contains 500 different proteins

Plasma Protein
- Albumin
  - Fluid balance
  - Cell nutrition
  - Hormone, medication and fatty acid transport
- Globulins
  - Transport of fats
  - Energy metabolism
  - Cell membrane reconstruction
  - Hormone function
- Fibrinogen
  - Coagulation
Red blood cells

- 40-50% total blood volume
- Produced continually in bone marrow
- Hemoglobin 95% of each cell
- Oxygen carriage
- Carbon dioxide transport
White blood cells

- Destruction of bacteria, chemical inhibit bacterial growth
- Destruction of allergens and inflammatory chemicals
- Histamine and anticoagulant release
- Release of antigens
- Trigger immune responses
Platelets

- Secretion of vasoconstrictors
- Form platelet plugs
- Secrete clotting factors
- Dissolve dead blood cells
- Digest and destroy bacteria
- Secrete chemicals to attract white cells to site of inflammation
- Secrete growth factor to support vascular structure
Component Development

• Sustainability optimal storage
• Minimizes Hemolytic reactions
• Supports precision treatments
Blood Transfusion

- Life-saving procedure, Better surgical outcomes with pre treatment of anemia. Decreased and better resilience from infection with the aid of blood from healthy persons. Spectacular results in shock treatment. Life saving, restoration of circulating volume with whole blood is logical in theory and efficacious in practice (DeGowin, 1945)
Blood Transfusion

- Volume replacement
- Tissue oxygenation
- Treatment of acidosis
- Coagulant replacement
Whole Blood vs. Component

- Whole Blood delivers all necessary elements in one product
- Component therapy requires multiple products and storage modalities
- Component therapy requires multiple modalities for preparation
Military Experience

• Hemorrhage is primary cause of preventable death on the battlefield
• Hemorrhage control at point of injury
• Whole Blood resuscitation
• Damage Control Resuscitation DCR
Battlefield

- Walking Blood Banks  WBB
- Fresh Whole Blood  FWB
- Tourniquets
- Hemostatic dressings
Walking Blood Bank

- Pre-screen personnel prior
- Maintain accurate roster
- Note 50% of the population is type O
- Clearly defined process
- Readily available supplies/kits

- Implications for civilian mass casualty event.
Military Hospital

- Damage control surgery
- Hemostatic resuscitation
- Reboa
- Embolization
Civilian Trauma Care

- EMS/ALS rapid transport to ED or Trauma Center
- Trauma systems
- National blood bank systems
- Specialty trained physicians, nurses and technicians
- OR availability
- Tertiary care
Damage Control Resuscitation DCR

• Pre-hospital
  • Rapid recognition of hemorrhagic shock
  • Prevent hypothermia
  • Hemorrhage control
  • Hemostatic resuscitation
  • Consider TXA
Damage Control Resuscitation  DCR

- Hospital
  - Rapid surgical intervention
  - Hemostatic resuscitation (whole blood)
  - Permissive hypotension
  - Intravenous hemostatic adjuncts
  - Avoid crystalloid resuscitation
  - BP goals post hemorrhage control
Massive Transfusion Protocol  MTP

- Structured systems for efficient blood delivery
- Established guidelines for activation
- Trauma pack 1:1:1
- Decreased need for crystalloids
- Decreased number of blood products
Pediatric MTP

- Uncommon in children
- 50% replacement of total blood volume within 3 hours
- 100% replacement within 24 hours
- Component and adjunct therapy
- Whole blood
Adjuncts

- Tranexamic Acid  TXA
- Fibrinogen concentrate
- Prothrombin
- Factor VII  rFVIIa
Tranexamic Acid  TXA

• Effective in treatment and prevention of excessive blood loss

• Method of Action:
  • Inhibits the enzymatic breakdown of fibrin
  • Anti-fibrinolytic and anti-inflammatory

• Consider TXA when administering Whole Blood

• Decreases the need for massive transfusion
Indications

• Obvious uncontrolled hemorrhage
• Penetrating torso, neck, proximal extremity trauma with evidence of bleeding
• Major pelvic fracture
• Non-operative management of liver, spleen, or kidney injuries undergoing embolization
Adult

Tranexamic Acid
Loading dose
1gm/50 ml NSS over 10 minutes
(ADULT BOLUS doses available in ER, TAA, TSCU Omnicells)

Followed by

Tranexamic Acid
Maintenance Dose
1gm/50 ml NSS over 8 hours
(ALL maintenance doses prepared by pharmacy)

Pediatric

Tranexamic Acid
Loading dose
15 mg/kg (max 1000 mg) over 10 minutes
(ALL PEDIATRIC doses prepared by pharmacy)

Followed by

Tranexamic Acid
Maintenance Dose
2 mg/kg/hr (max 125mg/hr) over 8 hours
(ALL PEDIATRIC doses prepared by pharmacy)
TXA Contraindications

• Isolated traumatic brain injury
• Subarachnoid hemorrhage
• Sensitivity to Tranexamic acid
• Recent coronary stents
• History of stroke within the last 6 months
Transfusion Guidance

- ABG
- Lactate
- Hemoglobin
- Base deficit
- INR
- TEM
Thromboelastometry TEM

- Hemostasis testing in whole blood
- Investigates interaction between coagulation factors and inhibitors
- Results assist/support decisions in therapy
- Detects functional stages of the clotting process
- Discriminates surgical bleeding from hemostasis disorders
- Improves therapy with blood products and factors
- Reduces the number of blood products required
Transfusion Complications

- Febrile non-hemolytic
- Allergic
- Hemolytic

- Transfusion related acute lung injury TRALI
- Transfusion associated circulatory overload TACO
Teamwork

Work performed with a combined effort to produce organized cooperation working together or all to achieve better results.
Protocol Development

• AABB approval
• Kiosk unit storage
• Criteria
• Criteria expansion

• Processes
• QI
• Research
Preparation

• Compose procedure and quality plan
• Present to Transfusion committee
• Find manufacturer (collect, process, distribute)
• Obtain AABB variance
• Obtain permission from NJ state
• Identify resources
• Train and educate all staff
Clinical Processes

- Develop criteria
- Develop clinical guidelines, policy and procedure
- Staff education
- Develop audit metric and tools
- Monitor performance
- Evaluate opportunities
Whole Blood Criteria

- Females > 50 years of age
- Males > 16 years of age

* Systolic Blood Pressure < 90
* Massive hemothorax or chest tube output > 1000
* Markedly Positive Fast
* Open book Pelvis fracture
* Vascular injury to extremity with tourniquet in use

4 units can be given
Resources

- Monitored Blood refrigerator
- Regulated contents and removal
- Emergency release forms/transfusion tags
- Temperature indicators
- Computer software/interfaces
- Scanners
- Employee badge bar codes
Quality Control

• Blood Storage
  • Daily inventory management
  • Daily temperature documentation
  • Product

• Clinical criteria review
  • Clinical documentation
  • Whole blood
  • Subsequent component Therapy
Outcomes

- 112 units of whole blood administered
- No transfusion complications
- Decreased coagulopathies
- Less component treatment required
Next Steps

• Pre hospital
  • Protocol development
  • Training
• Research
  • Challenges with supply and demand
  • Implications civilian mass casualty events
  • Disaster preparedness
“What’s old is new again”