Damage Control Resuscitation in Trauma

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Massive Transfusion

• Trauma is most common situation
• Ruptured abdominal aortic aneurysms
Massive Transfusion

- High volume transfusions and IVF can cause hemostatic and metabolic complications
Massive Transfusion

- MTP considers how the amounts and types of blood components can minimize these complications
- Coagulopathy
Coagulopathy

- Incidence as high as 25-35% of trauma patients on arrival
Coagulopathy

- Affected patients:
  - Higher transfusion requirements
  - Longer ICU/hospital stays
  - More vent dependent days
Coagulopathy

- Affected patients:
  - Higher incidence of multiorgan dysfunction
  - 3-4x greater mortality
  - Eight times more likely to die in the first 24 hours
Coagulopathy

- Etiology is multifactorial
  - Acidosis
  - Hypothermia
  - Dilutional coagulopathy
Coagulopathy

- Acidosis
  - Caused by inadequate tissue perfusion in hypovolemic shock
Coagulopathy

- Acidosis
  - Interferes with assembly of coagulation factor complexes involving calcium and negatively charged phospholipids
Coagulopathy

- Acidosis
  - Significant clotting dysfunction at pH < 7.2
  - Different clotting factors are affected to differing degrees
Coagulopathy

- Acidosis
  - Factor Xa/Va prothrombinase activity reduction
    - 50% at pH 7.2
    - 70% at pH 7.0
    - 80% at pH 6.8
Coagulopathy

- Acidosis
  - Factor Xa/Va prothrombinase activity reduction
    - Reduced concentrations of thrombin
    - Delayed fibrin production
    - Altered fibrin structure
    - Increased susceptibility to fibrinolysis
Coagulopathy

- Acidosis
- Corrected by correcting hypovolemic shock
Coagulopathy

- Hypothermia
  - Cold exposure at time of injury
  - Transport
- Trauma exam
- IVF/transfusions
- Operating room
Coagulopathy

- Hypothermia
  - Mild (36-34°C)
  - Moderate (34-32°C)
  - Severe (<32°C)
Coagulopathy

- Hypothermia
  - Nearly 2/3 of trauma pts present < 36°C
  - 9% present < 33°C
Coagulopathy

- Hypothermia
  - At 33-37°C
    - Impaired tissue factor activity
    - Impaired platelet aggregation/adhesion
Coagulopathy

- Hypothermia
  - Not evident on blood tests without special handling of sample
  - Hypothermia and acidosis work synergistically
Coagulopathy

- Hypothermia
  - Corrective measures
    - Controlling exposure
    - Warmed IVF
    - Blankets/active warmers
Coagulopathy

- Dilutional
  - AKA resuscitation-associated coagulopathy
  - Involves the dilution plasma and clotting proteins
  - caused by large volumes of fluid and unbalanced blood component administration
Coagulopathy

- Dilutional
  - Present in > 50% of pts who received >3L of IVF prior to arrival
  - Also in 10% of pts given <500mL
Coagulopathy

- Dilutional
  - Class III hemorrhage
  - 30-40% blood volume loss (2L)
  - Tachycardia > 120
  - Tachypnea
  - SBP < 90
Coagulopathy

- Dilutional
  - Class III hemorrhage
  - Resuscitation with crystalloid will dilute coagulation factors by more than 50%
Coagulopathy

- Dilutional
  - 1:1:1:1 minimizes but doesn’t eliminate these issues
  - 1:1:1
    - Hematocrit 26
    - Plasma coagulation factor 65% of normal
    - Platelets 55 x 10^9
Coagulopathy

1:1:1
- Hematocrit 26
- Plasma coag factor 65%
- Platelets 55 x 10^9

2:1:1 Dilutional
- Hematocrit 36
- Plasma coag factor 52%
- Platelets 37 x 10^9
Coagulopathy

- Dilutional

- These numbers do not account for crystalloid administration
Massive transfusion

- Clinical studies
  - Retrospective, 246 pts
  - Pts were stratified by FFP:PRBC
  - 1:1.4 → 81% survival rate
  - 1:2.5 → 66% survival rate
  - 1:8 → 35% survival rate
Massive transfusion

• Clinical studies
  • Retrospective, 467 pts
  • FFP:PRBC > 1:2 increased 30 day survival
  • Platelet:PRBC > 1:2 increased 30 day survival
  • Together, demonstrated increased 6 hour, 24 hour, and 30 day survival
Massive transfusion

- Clinical studies
  - Retrospective, 694 pts
  - Apheresis platelets: PRBC were compared
  - >1:8 → 95% survival rate
  - 1:16 to 1:8 → 87% survival rate
  - <1:16 → 64% survival rate
Massive transfusion

- Defined as transfusion approximately equal to or exceeding the patient’s blood volume within 24 hours
Massive transfusion Protocol

- Purpose
  - To provide guidance for replacement of blood components
  - To prevent complications associated with large volume replacements
Massive transfusion Protocol

Procedure

- Nonresponse to IVF or obvious need for massive transfusion may prompt initiation
- Initiated by trauma surgeon, ED physician, or anesthesiologist by written or verbal order
Massive transfusion Protocol

- Procedure
  - ED/OR/ICU nurse notifies blood bank
  - ED/OR/ICU nurse ensures a type and cross is drawn before massive transfusion starts
Massive transfusion Protocol

• Procedure
  • Blood bank personnel prepare a transfusion package
    • 4 units PRBCs
    • 4 units FFP
    • 1 apheresis platelets
    • 5 pack cryoprecipitate
Massive transfusion Protocol

- Procedure
  - Blood bank stays at least one trauma pack ahead of pickup
Massive transfusion Protocol

- Procedure
  - Transfusionist ensures active rewarming measures in place (ED/OR/ICU)
    - 1. increase room temperature to 80°F
    - 2. Bair hugger
    - 3. Warm blankets
    - 4. Level 1 rapid infuser/warmer
Other considerations

- Damage control laparotomy
- Permissive hypotension
Damage control resuscitation

- Damage control laparotomy

- Goals
  - Control hemorrhage
  - Prevent contamination
  - Avoid further injury
Damage control laparotomy

- May staple bowel in discontinuity
- Prevents further contamination
- Shorter OR time
- Less abdominal exposure
Damage control laparotomy

- May pack venous injuries rather than definitively repair
- Shorter OR time
- Less abdominal exposure
Damage control laparotomy

- May place abdominal WV
- Shorter OR time
- Less abdominal exposure
- Allows follow up look at abdomen in more controlled circumstances
Thank you