Transfusion Ratios in Trauma

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Epidemiology
- ~180,000 deaths 2007 due to trauma
- 25% trauma patients require 1 unit of PRBC and only 25% of those require more than 4 units of PRBC
- Hemorrhagic shock – cause of 86% of all civilian preventable deaths due to trauma
- 2/3 of hemorrhagic deaths occurred in the first 6 hours

Case
Paramedics ring down: 32 yo M shot in butt, run over by car and then beaten with a snow shovel.
SBP= 85, HR = 110, RR = 20

- Is the patient likely to be:
  1. manageable with fluid resuscitation
  2. in hemorrhagic shock
  3. in shock and require only a couple of units of blood
  4. in shock and require Massive Transfusion

Pre-Hospital SI and Massive Transfusion
- Shock Index - HR/SBP – normal 0.5 to 0.7
- Journal of Trauma 2011 70(2): 384-390
- 8,111 patients with non-penetrating trauma & SBP >90 in the field had calculated SI. 3.4% require MT.
- SI:
  - >0.9 – 1.1 --- 1.5 RR of MT
  - >1.1 – 1.3 --- 5.6 RR of MT
  - >1.3 --- 8.1 RR of MT
- Our patient’s SI is 1.29
**ABC score for MT**

- ABC score (>2 predicts MT):
  - HR >120 – 1 point
  - SBP < 90 – 1 point
  - Penetrating injury – 1 point
  - Positive FAST – 1 point
- 75% sensitive and 86% specific for MT requirement

**PROMMTT**

- Feasibility study for PROPR
- ABC > 2 predicts MT
- ABC score – 73% sensitive and 86% specific for MT
- ABC score and clinician gestalt – 85% sensitive and 89% specific

**Case - continued**

32 yo M poly trauma (shot, beaten and run over)

Field SI of 1.29
Vitals: 85/P 110 20
FAST negative
Patient clearly injured but no active exsanguination
ABC = 2 (BP and HR)

Do you want to:
1. Give 2 L NS and re-assess
2. Do nothing and go to CT
3. Give 2 units PRBC and re-assess
4. Activate MT protocol

**ACS Committee on Trauma Recommendations**

Give 2 L NS and re-assess

"An initial fluid bolus is given as rapidly as possible. The usual dose is one to two liters for an adult and 20 ml/kilogram for a pediatric patient."

-Advanced trauma life support course for physicians, student manual.
Traditional Rationale

- Animal studies by Shires et al. (1964) and Dillon et al. (1966) found that following a severe hemorrhage:
  - Animals receiving volume expansion had a greater incidence of survival
  - Animals receiving no volume expansion had both a greater incidence of mortality and major organ injury
- Furthermore, time to normalize blood pressure correlated with good outcomes

The Counter Argument

- Bickell et al. (1989) series of animal studies show worsening outcome with fluid resuscitation, which is thought due to:
  - Increasing blood pressure increased the rate of bleeding
  - Increased blood pressure dislodged clot
  - Fluid resuscitation diluted circulating clotting factor

Why the Difference?

- The studies by Shires et al. (1964) and Dillon et al. (1966) used a standardized hemorrhage from which the animals were resuscitated
- Bickell et al. (1989) used an uncontrolled hemorrhage model with continuing hemorrhage during the resuscitation
- The earlier model may more accurately mimic the situation in blunt trauma, whereas the uncontrolled hemorrhage model may more accurately mimic the situation of penetrating trauma patients

**Bickell et al. (1994)**

Do Nothing and go to CT

- Randomized 598 patients
- Entrance criteria:
  - Penetrating torso injury due to GSW or SW
  - Initial systolic blood pressure less than or equal to 90 mm Hg
- 289 patients were assigned to the delayed resuscitation group
- 309 patients were assigned to the immediate resuscitation group
Results

• Survival to the operating room:
  • Immediate resuscitation - 87%
  • Delayed resuscitation - 90%
• Post operative complications (p=.08):
  • Immediate resuscitation - 30%
  • Delayed resuscitation - 23%
• Survival to discharge (p=.04):
  • Immediate resuscitation - 62.4%
  • Delayed resuscitation - 70.2%
• Mean pre-OR fluid resuscitation:
  • Immediate resuscitation - 2478 cc
  • Delayed resuscitation - 375 cc

Limitations of Bickell et al.’s Data

• Excluded those randomized in the field, but dead on arrival or in the ED
• Only looked at patients with isolated penetrating torso injuries
  • Patients with multi-system injuries may have other indications for blood pressure support, especially patients with concomitant head injuries
  • Can’t be easily generalized to the management of blunt trauma

What about blood?

• Early 1940’s – blood components with different shelf lives
• Vietnam War - increased blood demand and misreading of Shires data drives switch to component resuscitation
• Component shelf life:
  • Fresh whole blood – 24 hours at room temperature
  • PRBC – 42 days at 4 degrees C.
  • FFP – 12 months at -20 degrees C.
  • Platelets – 5 days room temperature
• One unit whole blood = 1 unit PRBC, 1 unit FFP & 1 unit platelet

Data from Iraq/Afghanistan

• Holcomb et al. (2007) take a retrospective sample of 246 MT patients (>10 PRBC in 24 hours)
• 80-85% combat death non-preventable, 70% of the remaining deaths due to hemorrhagic shock
• Divide into 3 groups:
  1. 1:8 plasma-RBC ratio
  2. 1:2.5 plasma-RBC ratio
  3. 1:1.4 plasma-RBC ratio
Iraq Data

- Overall Mortality:
  1. 1:8 ratio – 85%
  2. 1:2.5 ratio – 34%
  3. 1:1.4 ratio – 19%
- Mortality due to hemorrhage:
  1. 1:8 ratio – 92.5%
  2. 1:2.5 ratio – 78%
  3. 1:1.4 ratio – 37%
- Most current MT protocols aim for a 1:3 ratio

PROPPR

- Emergency waiver of consent randomized trial to start in July
- Prospectively compare 1:1:1 vs. 1:1:2 ratios of plasma:platelets:rbc
- Multiple endpoints to the study
  - 24 hour survival benefit
  - Survival to discharge benefit
  - Evidence of trauma induced coagulopathy
  - If TIC, does resuscitation ratio change 6 hour TIC

Conclusion

- ABC score with clinical gestalt is the best predictor of who needs Massive Transfusion
- Normal saline is not what is coming out of the patient... we are moving back to something close to whole blood resuscitation in hemorrhagic shock.
  - PROPPR may not be able to demonstrate survival difference between 1:1:1 and 1:1:2 ratio
  - Early data suggests both ratios are better than current practice

Conclusion

- Reasonable to delay aggressive pre-hospital resuscitation in mentating isolated penetrating torso injuries
  - Study similar to Bickell et al.’s will probably never be done in blunt trauma
  - In the absence of evidence to the contrary, controlled hemorrhage may be the best model for blunt trauma
  - For now these patients should receive aggressive volume resuscitation