

Massive Transfusion

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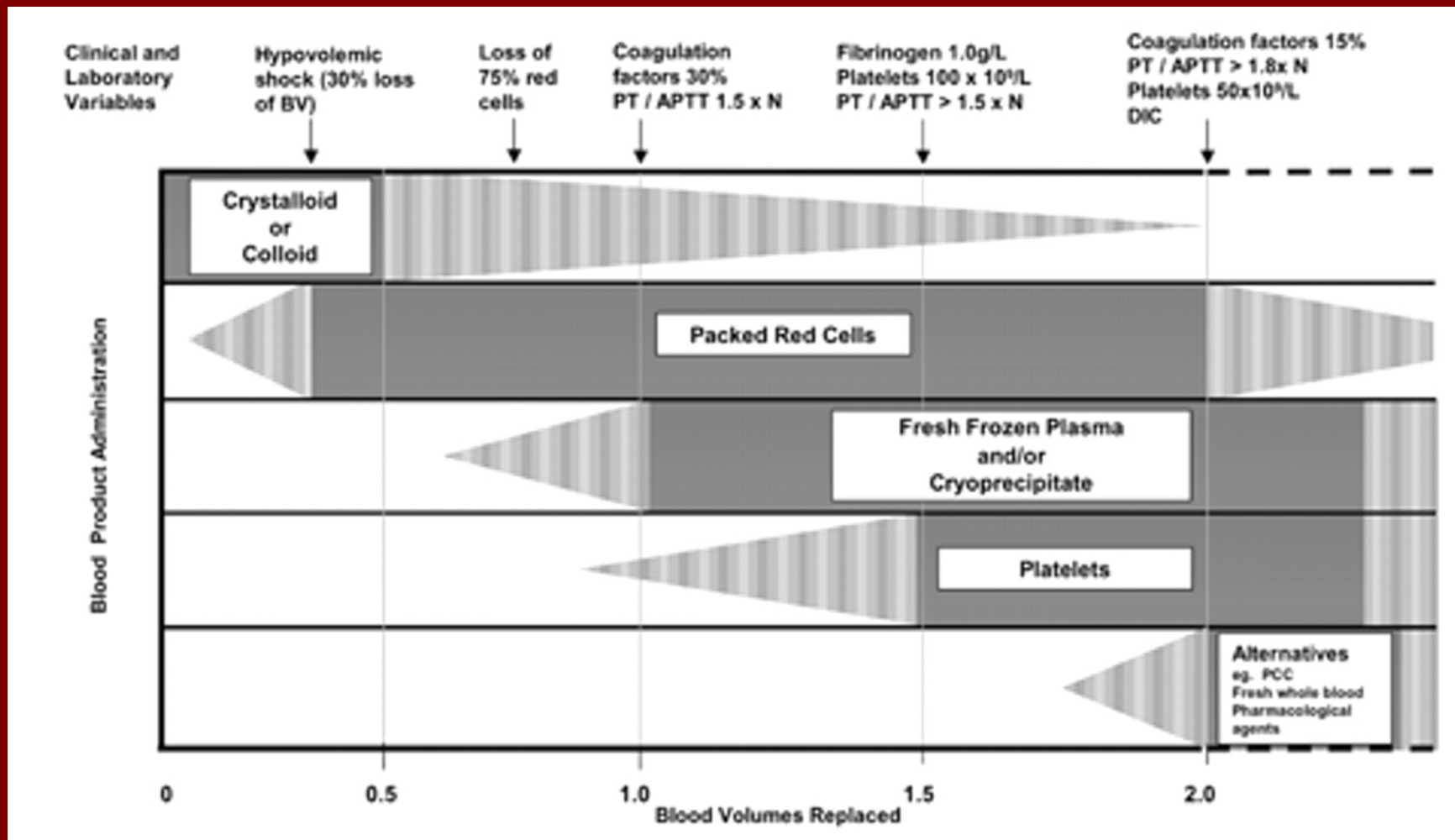
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Objectives

- Definition of massive transfusion
- Coagulopathy of massive transfusion
- Controversies in massive transfusion- FP
- Framework for a massive transfusion protocol

Massive Transfusion

- Can be defined as:
 - Greater than 1 blood volume transfused in 24 hours
- Dynamic definition:
 - Transfusion of 4+ RCC in 4 hours
 - Replacement of 50% of blood volume in 3 hours



Erber WN. Massive blood transfusion in the elective surgical setting. *Transfus Apheresis Sci* 2002; 27: 83–92.

Why Is Massive Transfusion Important?

- Massively transfused patients will show evidence of coagulopathy in a majority of cases- perpetuates the cycle resulting in even more blood products transfused
- Results in a considerable amount of both medical and technical time to manage these patients

Massive Transfusion

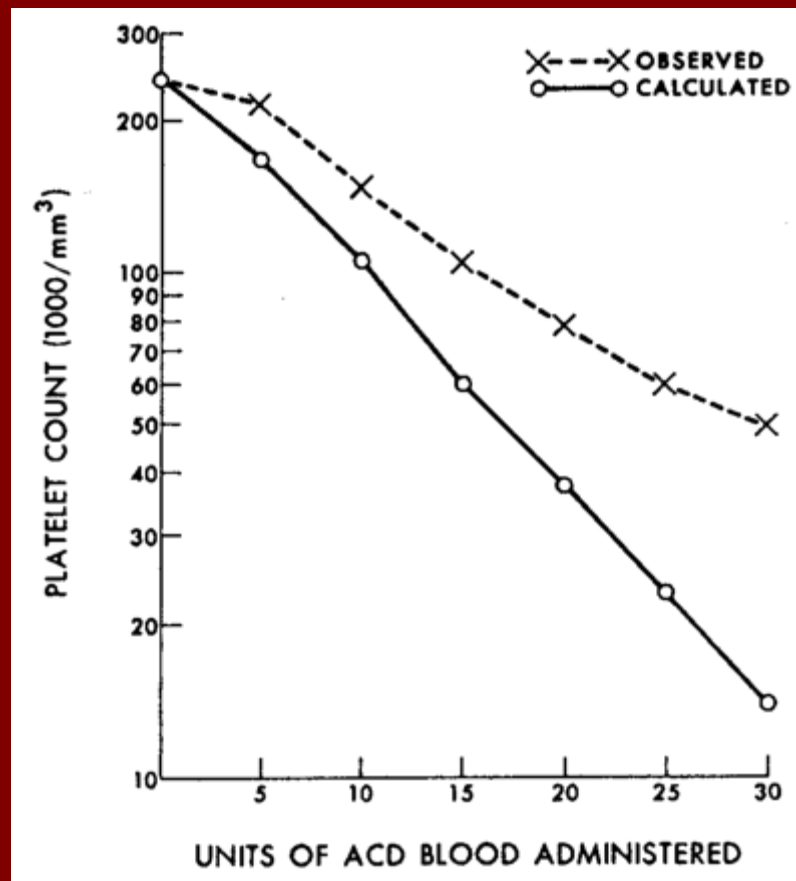
- Can be the result of either trauma or elective surgery
- Less commonly it can be the result of a medical condition causing bleeding (UGI bleed)

Coagulopathy in Massive Transfusion

- Volume replacement results in hemodilution compromising hemostasis
- Colloids may interfere with coagulation
- Hypothermia causes reversible platelet dysfunction, alters coagulation, and enhances fibrinolysis (note: lab tests may underestimate since done at 37°C)
- Tissue damage activates coagulation

Coagulopathy in Massive Transfusion- cont'd

- Dilution/loss of red cells leads to:
 - Decreased platelet margination
 - Decreased thrombin generation
 - Decreased platelet responsiveness
- Thrombocytopenia plays a role, but not as important a role as once believed



Coagulation defects associated with massive blood transfusions. Ann Surg 1971; 174: 794–801

Coagulopathy in Massive Transfusion- cont'd

- Trauma patients can also have overt disseminated intravascular coagulation (DIC)
- DIC is defined as an acquired syndrome of systemic activation of the clotting system that leads to secondary low levels of clotting factors and thrombocytopenia
- DIC is caused by direct tissue trauma and tissue hypoxia

Blood Products Have Changed in Massive Transfusion

- Used to give whole blood - greater plasma to red cell concentration than currently used RCC
 - Coagulation parameters less affected when whole blood was used
- Now, INR and aPTT can be affected quite dramatically, even after a few RCC are used
- Platelet counts drop slower

Realities of Massive Transfusion

- RCC are used- less plasma/unit
- The CBC, INR, aPTT and fibrinogen should be monitored
 - However, due to the emergent nature of the situation clinicians don't send these lab tests frequently enough and there is a lag time before results are available
- Results in a delay in the administration of FP and sometimes platelets

It Has Been Proposed That:

- Perhaps we should be resuscitating patients using a 1:1:1 ratio of 1 RCC:1 AFP unit and 1 apheresis platelet unit
- Some retrospective studies that suggest that mimicking whole blood transfusion with blood components in trauma patients results in improved overall survival

Theoretical Risks/Benefits of FP

More FP

1. Control coagulopathy
2. Reduce bleeding
3. Reduce RBC transfusion
4. Obviate the need for laboratory monitoring

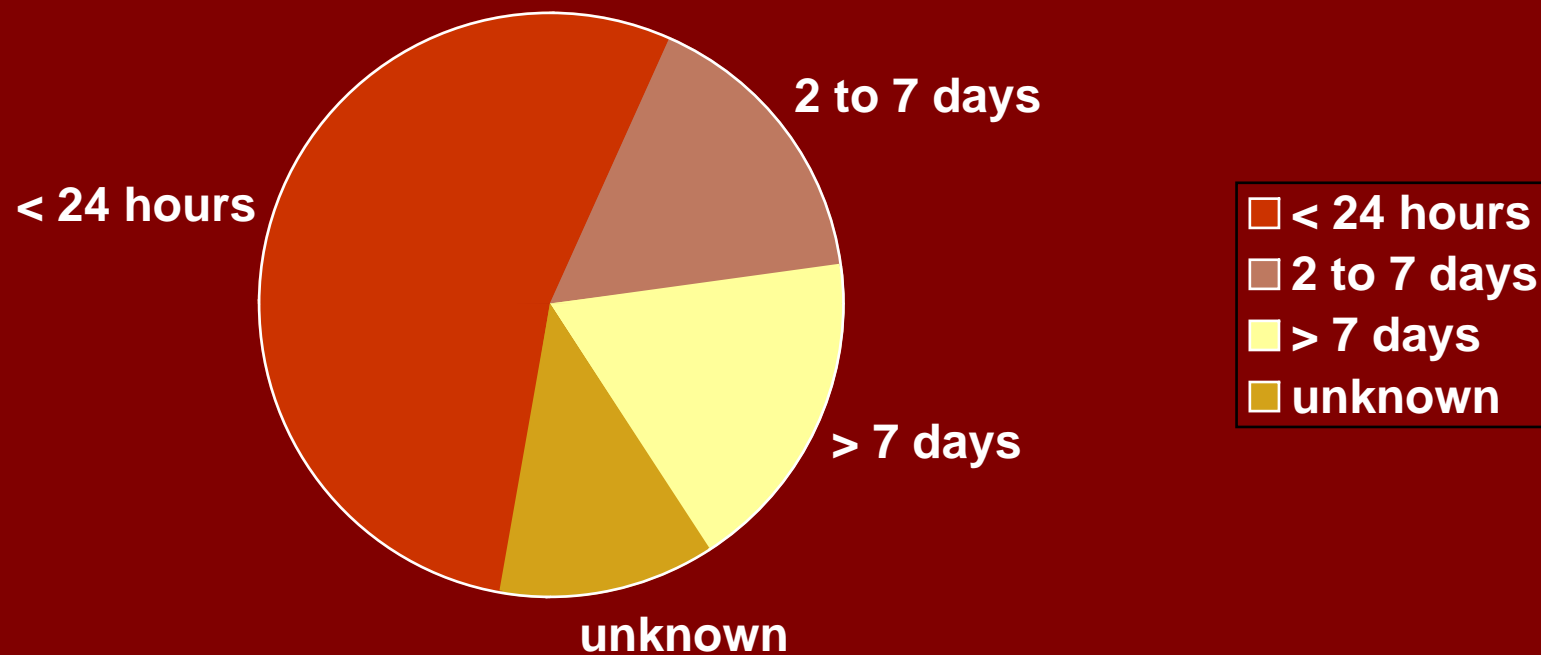
Less FP

1. Minimize risk of ALI
2. Minimize circulatory overload
3. Minimize the risk of abdominal compartment syndrome
4. Minimize the risk of transfusion-related complications

Order of illness in trauma patients

When do patients die after injury?

Cothren CC et al. World J of Surg 2007; 31: 1507-1511



Of the patients that die in the first 24 hours; 35 percent die in the first 15 minutes and the vast majority happen in the first four hours

What Do Trauma Patients Die of After 2 Days?

- Multisystem organ failure
 - ARDS
 - ARF
 - Acute liver failure
 - Septic Shock
 - Non-survivable organ injury

Retrospective Studies Looking At Massive Transfusion

- Spinella PC et al. J Trauma 2008; 64: S69 to S78
- Borgman MA et al. J Trauma 2007; 63: 805-813
- Cotton BA et al. J Trauma 2008; 64: 1177-1183
- Maegele M et al. Vox Sang 2008; 95: 112-119 *

Retrospective Studies Looking At Massive Transfusion- cont'd

- Gonzalez EA et al. J Trauma 2007; 62: 112-119
- Kashuk JL et al. J Trauma 2008; 65: 261-271

Early/Lots FP Studies Have Survivorship Bias

- Patients that would normally survive longer have a greater chance of receiving FP than those who don't
- As such, a retrospective analysis can show that FP improves survival, where no such relationship exists
- There is a need to do a prospective randomized controlled trial that excludes those patients that die within the first few hours

Other Issues With Early/Lots FP Studies

- No transfusion protocols are defined
- Transfusion and surgical practices have changed over time
- Transfusion needs to be tracked on an hourly basis (difficult but necessary to do) in order to ensure that the groups are comparable

FP Use in Manitoba

- Has gone up considerably in the past year, on the basis of the 1:1:1 RCC:FP:Plt studies
- However, even despite their flaws, all authors of these studies agree that massive transfusion should apply only to a minority of patients that are transfused (4 to 5 percent)

FP Use in Manitoba- cont'd

- Therefore,
 - Is the principle of 1:1:1 being applied to patients who don't need it? OR
 - Is the number of true massive transfusion patients on the rise?
- The answer is likely a combination of the two

FP in Massive Transfusion

- In the past, FP was likely underused, due to delays in lab monitoring and delays in obtaining thawed plasma
- New literature gives credibility (albeit flawed) to use plasma and platelets empirically
- So the question is: How can you marry the two ideas rationally?

Massive Transfusion Protocol

- Activated by the clinical service
 - Usually use one of the functional definitions of massive transfusion
 - Transfusion of 4+ RCC in 4 hours
 - Replacement of 50% of blood volume in 3 hours
- STAT lab tests drawn (CBC, coags)
- Once activated, a MTP pack is issued
 - 6 units RCC:4 units FP:1 apheresis platelet

Massive Transfusion Protocol

- Blood warming device to be used to minimize hypothermia
- If continued bleeding after the first MTP pack, repeat lab tests are sent and a second MTP pack is sent
- This continues as long as the patient is actively bleeding
- Once bleeding is under control, the MTP is deactivated

Advantages of a Massive Transfusion Protocol

- Blood products are given in a timed systematic fashion
- Laboratory tests are also drawn at regular intervals
 - Trending of results
 - Allows for the rational use of other blood products if needed (cryo, recombinant activated factor VII)

Advantages of a Massive Transfusion Protocol- cont'd

- Allows for both clinicians and lab staff to plan and anticipate
 - the lab staff know that they need to prepare the next MTP pack as soon as the last one has been released
 - The clinicians know that the next MTP pack will be available when they need it

Disadvantages of a Massive Transfusion Protocol

- Potential for waste, particularly if there isn't proper communication between the clinical staff and the lab
- Potential for overuse, if activation criteria of the massive transfusion protocol aren't adhered to
- Potential for increased blood product use (however, isn't an issue as long as strict definitions are kept)

Conclusions

- Massive transfusion occurs in a small proportion of the number of patients transfused, but it consumes time and resources
- These patients can become coagulopathic which makes the bleeding worse
- Controversy exists as to how to best manage these patients

Conclusions- cont'd

- A Massive Transfusion Protocol is one way of systematically improving the delivery of blood products to these patients