North Memorial
Trauma Update
North Memorial Medical Center is a *Level I Trauma Center*

North Memorial

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Welcome to the fifth edition of the *North Memorial Trauma Update*. In this edition, discussion will center on the changes that have been seen in resuscitation strategies.

We also want to announce that *Trauma Update* is **GOING GREEN in 2010!** Starting with the first quarter issue in 2010, *Trauma Update* will only be distributed by email. For providers receiving *Trauma Update* in the mail, please send your email address to traumaupdate@northmemorial.com so you can be added to the list. If you are already receiving *Trauma Update* by email either directly or as a forward you don't need to do a thing.

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Resuscitation Strategies:

Use of Blood Products in Traumatic Hemorrhage

Uncontrolled hemorrhage after traumatic injury is the most common cause of potentially preventable death. Compared to other major causes of traumatic death, (head injury and multiple organ failure) hemorrhagic deaths occur quickly often within the first few hours after injury and these patients often require massive transfusion (>10 units of RBC's in 24 hours). Therefore, any effective resuscitation strategy strives to stop the ongoing hemorrhage as rapidly as possible and to concurrently replace the lost blood volume as well as clotting factors and platelets needed to provide surgical or angiographic hemostasis.

Since the 1980s, resuscitation algorithms have used the sequence which resulted in crystalloids, followed by red blood cells and then plasma and platelet transfusion. These protocols were approved and reinforced by the American College of Surgeons in the Advanced Trauma Life Support course and manual. Because coagulopathy was believed to only develop from dilution and hypothermia over the course of several hours, standard resuscitation approaches emphasized the use of crystalloids and RBCs to improve cardiac output and oxygen delivery. The use of plasma and platelets was reserved for patients with persistent hypotension unresponsive to crystalloid infusion, transfusion of six units of RBCs, documented abnormal coagulation laboratory parameters, or obvious microvascular bleeding. In 2003, Brohi et al and MacCloud et al demonstrated that the early coagulopathy of trauma is present on admission to the emergency department in 25% of victims of trauma and when present was associated with increased mortality. With this evidence, clinicians treating soldiers in Iraq and Afghanistan began to try using nontraditional strategies.

Recent military experience has reported that in cases where victims of trauma received greater than 10 units of

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packed red blood cells (RBCs) in 24 hours, there was an improvement in the survival rate from 20% to 65% when fresh frozen plasma was given in a ratio that approached 1:1 to packed RBCs. In fact patients who received high plasma and high platelet to RBC ratios were found to have decreased hemorrhage of the trunk, increased survival at 6 hours, 24 hours and 30 days. They also found patients receiving high plasma and platelet to RBC ratios required fewer days in the intensive care unit as well as fewer ventilator days and total hospital-length of stay but that this did not result in an increase in multiple organ failure deaths. In addition, the lethal triad of hypothermia, acidosis and hypocalcemia were avoided using this resuscitation strategy.

Recent reviews of massive transfusion protocols for trauma patients in the US recommend plasma to RBCs ratios between 1:1 to 1:2. The potential benefits of this ratio include replacing coagulation proteins, which prevents or treats the coagulopathy associated with hemorrhage and shock. The improved outcomes associated with decreasing crystalloid and increased plasma and platelet use is more than simply a reversal or prevention of this early coagulapathy alone. It is probable that differences in injury, endothelial structure, alterations in thrombomodulin and protein C, adhesion, systemic inflammation, clotting factor consumption, hemodilution, acidosis, hypothermia, hypocalcemia, fibrinolysis, and many other mechanisms are important. Each unit of plasma contains 400 mg of fibrinogen, which is essential for clot formation and fibrinogen has been shown to decrease early in patients with hemorrhage. Plasma also acts as a buffer, improving the acid base status of patients who are already acidotic. In addition, plasma and RBCs are both excellent volume expanders. While the risk of blood-borne diseases prevents us from using component therapy indiscriminately, the risks continue to decrease and using more plasma in massive transfusion situations has survival benefits. This also allows us to use RBCs to treat oxygen debt and crystalloid as a smaller component of the resuscitation algorithm.

In summary, improving our use of blood products when using a massive transfusion protocol can result in improved survival for critically injured patients. We at North Memorial still start our resuscitation with crystalloid, but are now using plasma and RBCs in a 1:1 ratio. Secondary to a lack of availability however, we are using a unit of platelets for every two units of RBCs. We add cryoprecipitate based on laboratory measurement and consider calcium replacement for every six units of RBCs transfused. This model will likely evolve over time as further developments become apparent, but for now aggressive use of our massive transfusion protocol will hopefully give us a chance to develop some uniformity in our approach to resuscitation and make us a better trauma center when it really matters.

Objectives:

QUESTION #1:
What is the ratio of plasma:packed RBCs that should be used in massive transfusion situations?

a. 1:1 or 1:2
b. 1:4
c. 1:8
d. There is no optimal ratio

QUESTION #2:
A trauma patient can only get a coagulopathy from dilutional resuscitation?

a. True
b. False

QUESTION #3:
Using a massive transfusion protocol has not resulted in improved survival.

a. True
b. False

QUESTION #4:
Contributing factors to a coagulopathy include:

a. Hypocalcemia
b. Hypothermia
c. Acidosis
d. Dilutional resuscitation
e. All of the above

QUESTION #5:
The optimal ratio of platelets:packed RBCs used during resuscitation is:

a. 1:2
b. 1:4
c. 1:8
d. There is no optimal ratio.

Answers (1: a, 2: b, 3: b, 4: e, 5: a)

References:

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Oct. 22-23, Dec 3-4, 2009

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For more information and to register online for classes, please visit us at northmemorial.com/healthcareprof.

For questions please call (763) 520-5451.

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Oct. 26, 2009

Designed to build on the basics presented in Trauma 101. Discussions and case presentations on the critical care needs of the injured patient. Trauma 101 is strongly recommended as a prerequisite to this class.

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