Massive Transfusion Protocol for Trauma

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apidly exsanguinating trauma patients have both quantitative and qualitative transfusion requirements that must be met to provide adequate volume and coagulation support. Patients who are hypovolemic and hypotensive on arrival usually receive large volumes of crystalloid (lactated Ringer's solution) during initial stabilization and transport and need transfusion immediately upon arrival. Throughout triage, initial stabilization and transfer to the operating room, the trauma team must focus on establishing adequate fluid lines for resuscitation while the anesthesiologist inserts necessary invasive monitoring on arrival in surgery. Surgical staff and nursing personnel are primarily involved with the effort to contain blood loss and stabilize the vital signs.

On top of all this activity, a steady supply of blood products may be needed, but the ordering, preparation and transport of these blood components requires communication and coordination between the blood bank and patient care areas. During complex and sometimes chaotic resuscitations, this communication often breaks down, and decisions concerning the appropriate blood products for a particular clinical situation may be neglected. Failure to provide sufficient volume and coagulation support increases the risk of hypovolemic shock, coagulopathy and disseminated intravascular coagulation, leading causes of death in trauma patients.

The Transfusion Service, under the Department of Pathology, Parkland Memorial Hospital, Dallas, Texas, suggested a cooperative effort between pathology, anesthesiology and trauma surgery to develop a protocol for massive transfusion, which was implemented on a trial basis in the summer of 2004. The protocol was designed to support rapid transfusion in the emergency room and operating rooms with regular shipments of blood products released automatically on a timed basis **[Figure 1]**. These products were organized in basic shipments of five packed red cell units combined with two units of fresh thawed plasma, which would be dispensed every 30 minutes from the blood bank. Platelet units (apheresis, equal to five pooled units) were added to every other shipment, and cryoprecipitate (10 pooled units) was included in every third shipment. Human recombinant Factor VIIa was included early in the protocol at the third shipment (sent with red cell units 11-15). In situations where more than five units of blood are needed each half-hour, a request to "double up" can be made to the blood bank to provide a maximum of 20 units of packed red cells per hour.

Massive transfusion is defined by the American Association of Blood Banks as the replacement of one blood volume (equivalent to 10 units of blood) in any 24-hour period, or half of the blood volume (five units of blood) in any

four-hour period. Patients who are likely to need this level of replacement can be placed on the massive transfusion protocol at the request of the involved anesthesiologist or surgeon by a simple telephone call to the blood bank. Blood shipments are then immediately prepared and dispensed, on schedule and without specific orders, until the bleeding is controlled or the patient exsanguinates. The protocol can be continued into the intensive care unit as needed.

This design for a massive transfusion protocol is based on patterns of coagulopathy that may develop during trauma care.**1,2** The decision for immediate transfusion and volume replacement with packed red cells is based on assessment of vital signs and acid-base status as reflected in blood gas determinations. During continued blood loss and transfusion, qualitative changes in coagulation can only be assumed because specific coagulation assays provided by the hospital laboratory are too slow to reflect rapidly changing conditions in the trauma patient and basically serve to confirm the effects of ongoing therapy rather than to guide future therapy in the acute situation. The protocol is designed to provide early coagulation support with fresh thawed plasma and to raise fibrinogen and clotting factor levels. Platelets are included with the second shipment and cryoprecipitate and recombinant Factor VIIa with the third shipment. This design was suggested by studies that showed onset of thrombocytopenia and clotting factor deficiencies in occasional trauma patients as early as loss of one to one and a half blood volume (10 to 15 units).

The use of human recombinant Factor VIIa in trauma patients is supported by numerous case reports and small series that have been reported recently.2,3 The Transfusion Service suggested that the product should be used early since the plasma levels of Factor VII decline rapidly in trauma. Most studies have reported the use of this expensive factor only for treatment of generalized ooze on the surgical field in the absence of thrombocytopenia. Prophylactic support of coagulation with rFVIIa is an off-label use of the preparation, and it has not been proven whether the expense can be justified by better control of coagulopathy.

Provision of blood products during more than 100 episodes of the massive transfusion protocol has been sufficient to stabilize most patients, even during rapid exsanguination. Patient survival to date with the protocol has been roughly 50 percent, which does not at this time appear to represent any improvement in survival compared with previous trauma experience at Parkland Memorial Hospital. There is, however, general approval among anesthesiologists and trauma surgeons using the protocol, who have a general impression that blood products are provided more efficiently under the protocol and that more thawed plasma, platelets and cryoprecipitate are being given than previously. Whether this has any effect on the incidence of coagulopathy in our trauma patients will require further study.

Designing studies to prove the utility of regular and early administration of thawed plasma, cryoprecipitate and platelets in trauma patients will be difficult given the considerable variation in type and extent of injury in this population.

We plan to assay clotting functions at fixed blood loss points in trauma patients to ascertain whether coagulation remains normalized under the protocol through the range of one to five blood volume losses. Classic studies of coagulopathy in massive transfusion and limited historical controls will be compared to this data to prove any beneficial effect of the protocol.**1,2,3**

We are generally pleased with the performance of the massive transfusion protocol to date, and the delivery of blood products to operating rooms during trauma cases is clearly improved. Relieving the anesthesia and nursing personnel of continual worry about blood supplies during urgent trauma surgery has been of great benefit in the opinion of most involved personnel. Outcome data to show that the protocol is of benefit to patients and not just to the hospital staff may take some time to assemble, but we hope that improved coagulation and higher survival rates will be proven eventually.

References:

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