The Critical Role of Blood Replacement in the Management of Patients Suffering a Traumatic Injury

Traumatic injury accounts for 10% of all deaths worldwide, and is the leading cause of death among persons between 5 and 44 years of age. Trauma care has improved dramatically in the recent past; nevertheless, uncontrolled bleeding contributes to 30% to 40% of trauma-related deaths and is the leading cause of potentially preventable early in-hospital deaths. While there is a paucity of high level data to support or refute the contention, it is the experience of treating physicians that uncontrolled hemorrhage is associated with a poor outcome in trauma patients.

Resuscitation of trauma patients with uncontrolled bleeding requires early identification of potential sites of bleeding followed by prompt action to minimize blood loss, restore tissue perfusion and achieve hemodynamic stability. Massive blood loss (one blood volume in 24 hours or one-half a blood volume in three hours) is often caused by a combination of vascular injury and coagulopathy. Factors that contribute to traumatic hemorrhage include surgical and non-surgical bleeding, prior medication, co-morbidities, and acquired coagulopathy.

While there are a number of critical interventions that optimize the chances that a trauma patient will survive, including: minimizing the time between initial care and surgery (if indicated), utilizing all available diagnostic tools (focused abdominal sonography, computerized tomography) when the source of bleeding is not obvious, early, intensive fluid replacement, serum lactate and base deficit tests to monitor the extent of bleeding and shock, early bleeding control measures such as packing, direct surgical bleeding control and aortic cross-clamping, as well as maintenance of normothermia, the remainder of this discussion, as per its title, will focus on the important role of blood replacement in this setting.

Red blood cell (RBC) transfusion is important to help maintain oxygen transport in trauma patients. In addition, RBCs appear to play a role in hemostasis, as platelet function is compromised when hemoglobin levels decrease. Although there are a paucity of data regarding the optimal hemoglobin level in trauma patients, extrapolation from the study of critical care patients suggests that a target hemoglobin of between 7 and 9 g/dl would be reasonable. This, of course, may be individualized depending upon the site of traumatic injury (brain injuries, for example, are thought by some to require higher hemoglobin levels) or other measures of oxygen consumption. The use of pre-storage leukoreduced RBCs is recommended to decrease the risk of a transfusion reaction and eliminate the need for a bedside leukoreduction filter. Blood group specific blood is preferred (and ABO grouping takes only minutes), though universal donor RBCs (O Rh-negative) are acceptable.

Hemoglobin substitutes, also referred to as oxygen therapeutics, have long been sought (by the military) as the "holy Grail" of early trauma management (because they can be stored for long periods, can deliver oxygen effectively and compatibility is not an issue).

Several have been in development for years, and one is currently being evaluated in several metropolitan areas as part of first response to trauma. Data from this trial are not yet available.

Fresh frozen plasma (FFP) as a source of coagulation proteins is often required in patients with massive bleeding or significant bleeding complicated by coagulopathy (PT or aPTT more than 1.5 times control), in an initial dose of 10 to 15 ml/kg. Recently, a new component, "thawed plasma," (FFP that has been thawed and kept refrigerated for up to five days) has become available that offers the same coagulation-promoting ability as FFP (though with slightly lower levels of Factors V and VIII), but has the advantage of already being liquid so that the 30-45 minute (thawing time) delay can be avoided. All hospitals with trauma responsibilities should keep several units of thawed plasma on hand at all times.

Given recent concerns about the risk of plasma components causing transfusion-related acute lung injury (TRALI), the implication of tissue antibodies in the pathogenesis, and the fact that females (usually via pregnancy) are more likely to have these antibodies, all plasma components in the U.S. are (or soon will be) prepared exclusively from male donors.

Platelet transfusion may also be indicated in trauma patients with uncontrolled bleeding and thrombocytopenia. While no good controlled studies exist, extrapolation from other studies suggests that platelets be transfused to keep the patient's platelet count above 50×10^9/l. When the patient has increased fibrin degradation products, or hyperfibrinolysis, a higher threshold may be appropriate. Platelets can either be given from a single donor (an apheresis concentrate, which has the advantage of limiting donor exposures as well as being leukoreduced) or from a pool of four to six random donors (which may be more readily available).

Patients with significant bleeding and a fibrinogen level of less than 1 g/l should be given cryoprecipitate (50 mg/kg, or approximately 15-20 units). Laboratory assessment of fibrinogen levels should be used to determine if repeat doses are necessary.

Finally, trauma patients with uncontrolled bleeding can be given pharmacologic agents such as the anti-fibrinolytics (tranexamic acid, ε-aminocaproic acid and aprotinin) and/or activated coagulation factor VII (rFVIIa). But these are the subject of another discussion.

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