

Blood Transfusion Strategies for Hemostatic Resuscitation in Massive Trauma



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KEYWORDS

- Lethal triad • Trauma • Hemorrhage • Whole blood • 1:1:1 component therapy
- Hemostatic resuscitation • Massive transfusion protocol

KEY POINTS

- Nonhemostatic resuscitation in the face of preventable massive hemorrhage results in a greater than 40% mortality rate.
- Forty years ago blood transfusion practice moved from fresh whole blood to stored components without evidence comparing the benefits or risks of either approach.
- Fresh whole blood has demonstrated superior effectiveness in treating early or acute coagulopathy of trauma in studies from the most recent theaters of war.
- The blood transfusion practices modified by the US military have guided recent massive transfusion protocols (MTP) in civilian trauma facilities.
- Prospective, randomized trials are needed in civilian trauma centers to determine whether one resuscitation strategy is superior to the other.

INTRODUCTION

Hemorrhage is the major preventable cause of mortality among trauma patients with otherwise survivable injuries.¹ Trauma involving blood loss of greater than 40% blood volume is often associated with irreversible hemorrhagic shock. Collectively referred to as “the lethal triad,” irreversible physiologic derangements of acidosis, hypothermia, and coagulopathy lead to death in more than 50% of patients with hemorrhagic shock despite appropriate trauma care and multiple blood transfusions.^{1,2}

Forty years ago, blood transfusion was largely dependent on the use of whole blood. In the 1970s, transfusion procedures within civilian trauma practices switched from the use of whole blood to predominantly conventional component therapy following development of whole blood fractionation.^{3–5} Conventional component therapy is

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achieved by collecting whole blood from donors and processing the blood into separate red blood cells (RBC), platelets, and plasma components during fractionation. The change from whole blood to component transfusion occurred without evidence comparing the benefits or risks of either transfusion therapy among patients with traumatic hemorrhage.⁶ After component therapy was instituted, transfusion goals consisted of normalizing blood pressure after trauma by infusing large volumes of crystalloid resuscitation. Standard therapy for any patient with suspected bleeding was a 2-L crystalloid bolus as initial therapy. Additional crystalloid boluses were often repeated and blood transfusion therapy was used relatively late in resuscitation. Fresh frozen plasma (FFP) and platelets were also used relatively late, often after patients had received 10 U of red cells. In this conventional component resuscitation, dilutional anemia persisted and patients with large-volume blood loss often died of what has been called a “bloody vicious cycle.”⁷

The lethal triad, or bloody vicious cycle, is extremely difficult to reverse and is frequently worsened by nonhemostatic transfusion associated with conventional component therapy resuscitation.⁸ Effective treatment of life-threatening hemorrhage, which corrects lethal triad derangements, could potentially eradicate death by exsanguination related to severe trauma. The military experiences in Iraq and Afghanistan forced the use of fresh whole blood (FWB) transfusion during shortages of component therapy and as a last ditch effort to reverse exsanguination. The overwhelming success with FWB in the war zone has prompted civilian trauma teams to advocate for this new technique of hemostatic resuscitation as a means to stop exsanguination for life-threatening hemorrhage.^{4,8,9}

LETHAL TRIAD OF TRAUMA

The concept of the lethal triad (also known as the “trauma triad of death”) is a medical term describing the combination of three subconcepts or components of the triad: acidosis, hypothermia, and coagulopathy (Fig. 1). Cumulative effects of each subconcept are commonly seen in patients who have sustained severe traumatic injuries and result in a significant rise in mortality rate. When a traumatized patient presents with the lethal triad, damage control surgery is required to reverse the effects. Damage control surgery involves only those procedures that provide rapid control of life-threatening bleeding followed by correction of physiologic abnormalities, associated

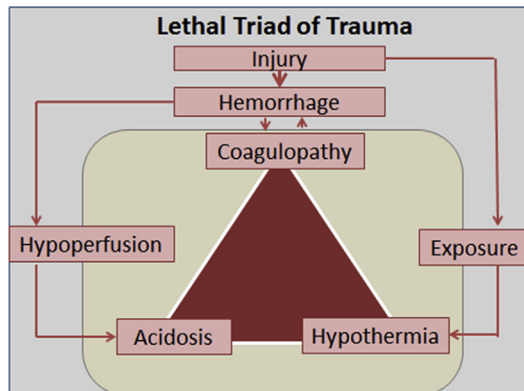


Fig. 1. Lethal triad of trauma. (Adapted from Dadhwal US, Pathak N. Damage control philosophy in polytrauma. *Med J Armed Forces India* 2010;66(4):348; with permission.)

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