Prediction of Massive Transfusion in Trauma

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KEYWORDS

• Massive transfusion • Damage control resuscitation • Coagulopathy • Trauma
• Hemorrhagic shock

KEY POINTS

- Damage control resuscitation with early activation of massive transfusion protocols improves the survival of the 25% or more of trauma patients who arrive with coagulopathy.
- Using the traditional definition of massive transfusion of receiving 10 or more units of red blood cells in 24 hours introduces survival bias to resuscitation studies.
- Use of contemporary concepts of substantial bleeding, resuscitation intensity, and critical administration threshold will improve the analysis of massive transfusion prediction methods in future studies.
- Several highly accurate and validated scores for the prediction of massive transfusion in trauma exist.
- The ABC score is an accurate, rapid, and simple score that can be used widely including in both the rural and the prehospital setting.

INTRODUCTION

Before 2005, reported mortalities for patients receiving a massive transfusion (MT) were 55% to 65%.[1,2] Mortality remained at this level through 2007, dropping to 45% to 50% with increased adoption of MT protocols (MTPs).[3,4] With the transition to damage control resuscitation (DCR) strategies and by making blood available in the emergency department (ED), mortalities continued to decrease to less than 30%.[5,6] Most recently, the Pragmatic Randomized Optimal Platelet and Plasma Ratios (PROPPR) study found that mortality among this patient population continues to decline; 26% for receiving plasma:platelet:red blood cell (RBCs) ratios of 1:1:2 and

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22% for those receiving 1:1:1.[7] Despite these reductions in mortality, hemorrhage remains the leading cause of preventable death in trauma and follows only severe central nervous injury as a cause of mortality in this setting.[8–10]

Although the overwhelming majority (>90%) of injured patients will not receive an MT, in those patients receiving large volume blood resuscitation, a mature and established MTP is critical. MTPs are designed to streamline balanced blood product delivery to bleeding patients and allow DCR to begin before the availability of laboratory results. Rapid identification of these patients and prompt MTP activation has been shown to be an independent predictor of survival.[11,12] However, blood products are both an expensive and a finite resource. The correct implementation of an MTP leads to more efficient use of blood bank resources and less product waste.[4] Therefore, trauma physicians must weigh the risks and benefits of using a precious resource in complex clinical situations. Because early implementation of MTPs improves patient outcomes, identifying which arrival parameters accurately predict the need for an MT is an area of increasing focus.

In this review, the authors discuss the evolving definition of MT and examine various parameters that can be used to predict the need for an MT in the trauma patient. Also evaluated are the role of the clinical gestalt and the predictive value of several MT scores. The article also assesses what role the prediction of MT may have in the prehospital environment, the indications for discontinuing an MT, and how the prediction of MT has performed in trauma trials.

DEFINING MASSIVE TRANSFUSION

Traditionally, MT has been defined as the transfusion of 10 or more units of RBCs within 24 hours of injury (**Table 1**). The origin of this definition is unclear, and although it is used commonly in both clinical and research realms, it has not been validated as a marker of bleeding severity. For example, a patient who receives 9 units of blood within a few hours who then progresses to either hemorrhage control or death, by this definition, has not had an MT despite clearly being in hemorrhagic shock. In contrast, the patient who receives their 10th RBC unit 23 hours after arrival would be defined as an MT, but is not likely to be the patient one would hope to identify with an MT prediction score.

As such, many have advocated for a change in the definition of MT to 10 units of RBCs within 6 hours, noting the clearly higher mortality of these patients compared with those who received that same amount over 24 hours.[13,14] Unfortunately, neither of these definitions captures the most severely injured patient who may receive only a few units of RBCs before dying. Use of such definitions introduces survival bias. Furthermore, both definitions ignore concomitant plasma and platelet transfusions.

Table 1
Transfusion terminology

Traditional Massive Transfusion	≥10 RBC units/24 h
Modern MT	≥10 RBC units/6 h
Substantial bleeding[20]	(1) ≥1 RBC unit within 2 h AND (2) ≥5 RBC units or death from hemorrhage within 4 h
Resuscitation intensity[16]	Number of units[a] infused within 30 min of arrival
CAT positive[17]	≥3 RBC units in any 1 h within 24 h of arrival

[a] 1 unit = 1 L crystalloid, 0.5 L colloid, 1 RBC, 1 plasma, OR 6 platelets.