# Use of a Massive Transfusion Protocol in Nontrauma Patients: Activate Away

Lauren M McDaniel, BS, Matthew D Neal, MD, Jason L Sperry, MD, FACS, Louis H Alarcon, MD, FACS, Raquel M Forsythe, MD, FACS, Darrell Triulzi, MD, Andrew B Peitzman, MD, FACS, Jay S Raval, MD

**BACKGROUND:** Recently, concern has been raised that the use of massive transfusion protocols (MTPs) in nontrauma (ie, general medical/surgical [GMS]) patients might be inefficient due to protocol overactivation (activation in patients who do not ultimately receive massive transfusion). The current study was designed to investigate whether an MTP could be used effectively in GMS patients without detrimentally impacting resource allocation.

**STUDY DESIGN:** A retrospective analysis was performed using institutional blood bank records from 2011. Trauma and GMS patients who had ≥10 U packed RBC issued to them in a single release were identified and categorized into MTP and no MTP (nMTP) cohorts.

**RESULTS:** The protocol was overactivated in 53.8% of GMS patients. Activation of the MTP accelerated the delivery of component products for all patients. In GMS MTP patients, fresh frozen plasma units were issued a median of 7 minutes earlier than in GMS nMTP patients (MTP: median 1.0 minute; interquartile range [IQR] 0.0 to 2.0 minutes vs nMTP: median 8.0 minutes; IQR 0.0 to 37.5 minutes; $p = 0.009$), and platelet units were issued 17 minutes earlier (MTP: median 7.0 minutes; IQR 0.0 to 15.0 minutes vs nMTP: median 24.0 minutes; IQR 9.0 to 96.0 minutes; $p = 0.010$). In GMS MTP patients, there was a statistically significant increase in the percentage of platelet units wasted (MTP 12.8% vs nMTP 8.1%; $p = 0.046$). This increase was also seen in trauma MTP patients (MTP 12.2% vs nMTP 4.0%; $p < 0.001$).

**CONCLUSIONS:** Despite finding that our MTP is overactivated in GMS patients, we could identify no unique disadvantages to its use with respect to resource allocation. In fact, a potential advantage to MTP activation exists, as products are issued more quickly with less variability. Our findings of increased platelet waste were not unique to GMS patients and should be used as a metric for quality improvement. (J Am Coll Surg 2013;216:1103−1109. © 2013 by the American College of Surgeons)

In trauma patients requiring massive transfusion (defined as the delivery of ≥10 U packed red blood cell [PRBC] in a 24-hour period), there is a growing body of evidence emphasizing the importance of earlier, more aggressive transfusion of fresh frozen plasma (FFP) and platelets (PLT).[1-8] Referred to as hemostatic resuscitation, this transfusion strategy has been recommended to prevent hemodilution and to restore normal coagulation function, potentially providing better control of hemorrhage and a reduction in complications. As a result, many institutions have implemented massive transfusion protocols (MTPs) designed to efficiently deliver predesignated ratios of FFP and PLT.

Recent literature evaluating the effectiveness of these protocols in trauma patients has demonstrated an association with decreased morbidity and mortality.[7,9-13] Considerably fewer studies, however, have investigated the use of these protocols outside of the trauma setting. In gastrointestinal hemorrhage, the implementation of an MTP has been associated with decreased PRBC transfusion without increased incidence of adverse outcomes.[14] Massive transfusion protocols have also been developed for use in obstetrical bleeding.[15] In postpartum hemorrhage, MTP activation has been associated with early access to products and favorable hematologic indices.[16]

Recently, however, there has been concern that the use of MTPs in nontrauma (general medical/surgical [GMS])

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From the Departments of Surgery (McDaniel, Neal, Sperry, Alarcon, Forsythe, Peitzman) and Pathology (Triulzi), University of Pittsburgh, and The Institute for Transfusion Medicine (Triulzi), Pittsburgh, PA and Department of Pathology and Laboratory Medicine, University of North Carolina, Chapel Hill, NC (Raval).

Correspondence address: Matthew D Neal, MD, Department of Surgery, University of Pittsburgh, F675 WSEC 6th Floor PUH, 200 Lothrop St, Pittsburgh, PA 15213. email: nealm2@upmc.edu





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**Abbreviations and Acronyms**

FFP = fresh frozen plasma
GMS = general medical/surgical
MTP = massive transfusion protocol
PLT = platelet
PRBC = packed red blood cells

patients can be inefficient due to their overactivation in patients who do not ultimately require massive transfusion.[17] Given the paucity of data on massive transfusion outside of the trauma setting, the current study was designed to investigate the hypothesis that an MTP could be used effectively in GMS patients without detrimentally impacting resource allocation.

## METHODS

A retrospective analysis was performed using blood bank emergency release records at the University of Pittsburgh Medical Center and the Institute for Transfusion Medicine from January 1, 2011 to December 31, 2011 after approval of the University of Pittsburgh Medical Center Quality Assurance committee (QIRB878). An emergency release was defined as a request for the immediate release of PRBCs, which might have included the issuing of uncrossmatched blood products if there was insufficient time to obtain a patient sample and/or perform a crossmatch. At our institution, in response to a patient with massive hemorrhage, a physician in any location of the hospital has the option to order $\geq$10 U emergent PRBC in a 24-hour period with or without activation of the MTP. The FFP and PLT units are provided automatically in predetermined ratios after MTP activation, but must be specifically ordered when the protocol is not activated. At the time of data collection, the University of Pittsburgh Medical Center MTP called for transfusion of PRBCs, FFP, and PLT in a ratio of 1:1:0.5.

Patients who had $\geq$10 U PRBC issued to them in a single release were identified from the emergency release records and represented the inclusion criteria for the current study. Using information from the electronic medical records, patients with an issue of $\geq$10 U PRBC were categorized based on whether the MTP was activated during their care. If patients were initially resuscitated without activation of the MTP, but subsequently had MTP activation, they were classified in the MTP cohort and the analysis began at the time of MTP activation. Trauma and GMS patients were classified based on the indication for the emergent release of products, as detailed in the medical record. Patient demographic information was also obtained from these records.

A prospectively collected blood bank transfusion database was used to determine the frequency and timing for all products issued, as well as the number of products transfused and wasted in the 24 hours, including and after the emergency release of the PRBC units. Importantly, not all patients who had $\geq$10 U PRBCs issued to them were transfused with all of these units, as some of these units might have been returned. Massive transfusion was defined as receiving $\geq$10 U PRBC in 24 hours.

Only patients who met criteria for massive transfusion as defined here were included in calculations of mean transfused FFP:PRBC and PLT:PRBC ratios. Ratios were calculated at the end of the 24-hour period. Pooled whole blood–derived PLT units were converted to individual PLT units for calculations (1 pooled whole blood–derived PLT unit or 1 apheresis PLT unit = 5 individual PLT units), and all PLT values and ratios are representative of individual PLT units.

The time to return a given blood product was determined by subtracting the time a unit was returned from the time the product was issued. Patients were excluded from these analyses if the blood products were either not issued or if they were transfused with all of the issued units. The "time to issue FFP" and the "time to issue PLT" were measured by calculating the difference in time from the issue of the first FFP or PLT unit to the issue of the 10 emergent PRBC units. The time to issue was used as opposed to the "time to transfusion" because the exact time of administration was unavailable in the existing dataset.

Data are summarized as mean $\pm$ SD, median (interquartile range), or percentage (%). Mann-Whitney *U* tests were used to compare continuous variables, and chi-square or Fischer's exact tests were used for categorical variables. Statistical analyses were performed using SPSS software, version 19 (SPSS, Inc). Statistical significance was defined as $p < 0.05$.

## RESULTS

One hundred and sixty-four patients met entry criteria and constituted the study group. For each of these patients, $\geq$10 U emergent, uncrossmatched PRBC were issued in a single release of products. Of these patients, 100 (61%) sustained traumatic injuries and 64 (39%) were issued blood for nontraumatic indications. The indications for GMS emergency release of blood included gastrointestinal bleeding (n = 21 [32.8%]), medical bleeding for other reasons (n = 6 [9.4%]), postsurgical/procedural complications (n = 18 [28.1%]), vascular emergencies (n = 18 [28.1%]), and cerebral hemorrhage (n = 1 [1.6%]). Prospectively collected blood bank data indicated a total of 65 MTP activations during the study