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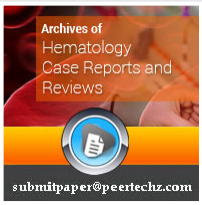


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Mini Review

# Massive transfusion protocol

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## Abstract

Hemorrhage from trauma, surgery, obstetric emergencies, and gastrointestinal bleeds remain a cause of potentially preventable deaths for patients. However, transfusions of large amounts of blood products may lead to complications. The development of Massive Transfusion Protocols (MTP), a proactive treatment protocol to manage profound blood loss, has shown improved outcomes for patients requiring immediate and multiple blood transfusions. These guidelines help to recognize hemorrhagic patients in need of an MTP as well as how to best manage this complex protocol.

## What are blood transfusions ?

Blood transfusions are common medical procedures and are considered typically safe. Like any medical intervention, there are multiple complications a healthcare professional needs to be aware of and treat [1]. While fresh whole blood is thought of as the "standard ideal" for transfusion, blood is usually stored in components. These include Packed Red Blood Cells (PRCBs), Fresh Frozen Plasma (FFP), platelet concentrates, individual factor concentrates, and cryoprecipitate. A standard blood transfusion typically is one unit of PRBCs at a time [2].

Fresh frozen plasma has specific and limited indications for use. It helps replace lost coagulation factors. It is used in cardiopulmonary bypass, decompensated liver disease, acute disseminated intravascular coagulation, and extracorporeal pulmonary support techniques. It is also used in massive transfusion protocols [3]. FFP was used together with vitamin K for warfarin-caused life-threatening hemorrhage. Today, prothrombin complex concentrate is used instead [4].

Platelet transfusion is useful for platelet dysfunction or deficiency such as bone marrow failure. It is also used for massive transfusions where platelets are less than 50 ×10/L or where thrombocytopenia contributes to hemorrhaging [5].

Cryoprecipitate is made from FFP but is frozen and thawed multiple times to produce concentrated clotting factors including Factor VIII, von Willebrand factor, and fibrinogen. A cryo transfusion is typically used for dysfibrinogenemia or fibrinogen deficiency in massive bleeding, injury, invasive procedures, or acute disseminated intravascular coagulation [6].

### What's the difference between a massive transfusion and a massive transfusion protocol ?

A massive transfusion was commonly defined as a patient who needs 10 units of PRBCs or the replacement of one entire blood volume in 24 hours. Currently, it is regarded that the transfusion of more than 4 units of PRBCs in an hour when the need for ongoing transfusions is apparent or the replacement of 50% of the total blood volume in 3 hours activates a massive transfusion protocol [7].

Patients who may require a massive transfusion include traumatic injuries, especially penetrating trauma, obstetric



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emergencies, certain surgeries, and gastrointestinal bleeding [8].

In the past, hemorrhaging patients were reactively treated: assessed with laboratory reports and treated with crystalloids, PRBCs, and coagulation factors based on their numbers. Today, massive transfusion protocols, or MTPs are proactive treatments that manage blood transfusion in hemorrhaging patients. MTPs interrupt the devastating trifecta of acidosis, coagulopathy, and hypothermia that develop with massive transfusions with proper management of significant blood loss to improve patient outcomes [7].

Estimates of patients who need massive transfusions are 10 percent military trauma and 3 to 5 percent civilian trauma patients. Although the incidence of patients requiring massive transfusions is low, mortality for these patients is high [8].

There are multiple criteria to consider when initiating an MTP including acid-base balance, volume status, bleeding management, coagulation abnormalities, and tissue oxygenation [7].

The goal of an MTP is to limit critical hypoperfusion to vital organs and complications as much as possible [8].

## Where did the idea come from ?

Healthcare professionals who treated traumatic war injuries requiring massive blood transfusions found early administration of FFP improved patient survival. Further studies in the early aughts showed using FFP and RBC transfusion also improved survival rates [9]. While the ideal is to transfuse fresh whole blood, the time needed to ascertain blood type and other safety factors is too long. This causes the patient to suffer substantial depletion of coagulation factors. Giving platelets, coagulation factors, and PRBCs preserves the constitution of blood [7].

## When is an MTP activated ?

An MTP is activated in response to massive bleeding. Predicting the need for an MTP may be challenging. Many facilities have a single MTP protocol used for traumatic hemorrhage in the ER or trauma unit or operative bleeding, gastrointestinal bleeding, and obstetric hemorrhage. Not every patient who is bleeding activates an MTP [8].

There are several predictive scoring instruments that help gauge the need to activate an MTP. All include hemorrhagic shock and severe blunt or penetrative trauma. Some facilities use an Assessment of Blood Consumption (ABC) score. This well-validated instrument uses four criteria to determine the need for an MTP: pulse greater than beats per minute (bpm), systolic blood pressure less than 90 mmHg, a penetrating torso injury, and a positive FAST (focused assessment with sonography in trauma). Each variable counts for one point; a score of two or more activates an MTP. While the ABC scoring may overestimate the need to activate an MTP by close to 50%, it is an outstanding predictor of who will not need a massive transfusion (negative predictive value of < five percent with positive predictor of > 95% of those who will need a massive transfusion) [10].

## The presence of the following should activate an MTP: [10]

- ABC score of two and higher
- Active bleeding that requires surgery or angioembolization
- Multiple blood transfusions (especially in the trauma unit)
- Persistent hemodynamic instability

Your facility may not have a written policy of when to activate an MTP in the absence of traumatic, surgical, or obstetric bleed. In such a case, you can use your clinical judgment based on the following: [11] Figure 1.

- Patient stability
- Type of bleeding
- How rapid is the bleeding and expected trajectory of the bleeding?
- Is the patient in hemorrhagic shock?

## What does an MTP help ?

It is critical to ascertain and control the source of the bleeding. Depending on the situation, surgical packing, interventional radiology, or a surgical repair may be needed as the MTP is activated or ongoing [11].

Patients that are on oral anticoagulants, like warfarin, require immediate reversal with a prothrombin complex concentrate. They may still require an MTP. Patients with

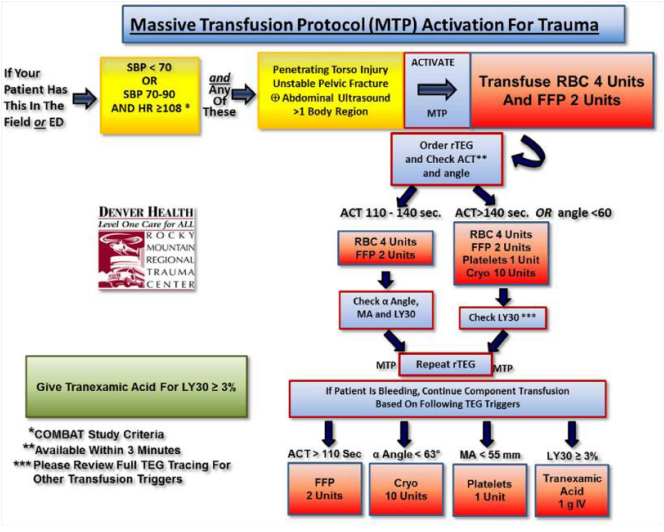


**Figure 1:** Retrieved from: Gonzalez E, Moore EE, Moore HB, Chapman MP, Silliman CC, Banerjee A. Trauma-induced coagulopathy: An institution's 35-year perspective on practice and research. Scandinavian Journal of Surgery: SJS: official organ for the Finnish Surgical Society and the Scandinavian Surgical Society. 2014. 103. https://journals.sagepub.com/doi/full/10.1177/1457496914531927



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platelet dysfunction are commonly given desmopressin emergently [11].

Besides acute blood loss, there is hypovolemic shock. An MTP helps to expand the intravascular volume and ensure oxygen delivery to the tissues. Another concern is acidosis. Patients with significant blood loss are usually acidotic as prolonged hypoperfusion leads to acidosis. Low and decreasing pH also reduces the activity of coagulation factors. This compounds coagulopathy by delaying and thinning fibrin clot formation [8].

Patients with acute blood loss/decreased blood volume are more vulnerable to hypothermia. A body temperature of 34 degrees C affects coagulation by reducing the enzymatic activity of coagulation proteins and platelet plug formation. At 30 degrees C, approximately 50% of platelets show reduced activation [8].

Giving volume expanders to a hypothermic and acidotic patient may lead to severely altered hemostasis. This continued bleeding creates a vicious positive feedback loop and increases hypothermia and acidosis, further consuming coagulation factors [8].

Once the MTP is activated in most facilities, the blood bank provides swift and timely delivery of all the required blood components. This streamlines the process decreasing dependency on lab testing and the need for communication between the lab, blood bank, and medical team [11].

Most MTPs have a predefined ratio of components in each pack. These include FFP/cryoprecipitate, platelets (random donor) and PRBCs in a balanced transfusion [12].

While an MTP can be given in a peripheral IV catheter, some facilities prefer to use a central access IV. These include a hemodialysis catheter, multi-lumen access catheter (MAC), or a standard central line with a level-1 pressure infuser to increase the flow rate. An arterial catheter is ideal because it also provides immediate blood pressure readings at the same time. In certain situations, it may be optimal to place a femoral central lime and arterial line right next to each other on the same side (aka the "dirty double"). With a rapidly exsanguinating patient, it is challenging to place 100% sterile central or arterial lines. In such cases, place semi-sterile lines to remove within 24 hours. In many cases, the bleeding will have been controlled and the patient will not require an ongoing central/arterial line. If the patient does require such access, they will be more stable to place a pristine 100% sterile central or arterial line [11].

### Post-MTP care

During a massive transfusion, adjusting blood components related to lab values is almost impossible. By the time labs are available, they will already be obsolete. Once the MTP is completed, you'll need to check labs and adjust as needed [11].

Post-MTP evaluation includes checking the patient's temperature, blood pressure, EKG to check volume status, and specific labs including a CBC (complete blood count), INR, PTT, fibrinogen, and electrolytes including ionized calcium and potassium [11].

## Conclusion

Many institutions have adopted a massive transfusion protocol to prevent death from trauma, obstetrical emergencies, gastrointestinal bleeding, and massive blood loss in surgery. In trauma centers, hemorrhage accounts for the most common cause of death within the first hour of patient arrival. While only three percent of non-military trauma patients require a massive transfusion, they use about 70% of all blood transfused at a trauma center.

While the process isn't perfect, MTPs help patients survive devastating blood loss and hemorrhagic shock. It is important to familiarize yourself with your institution's protocols and guidelines to ensure the best outcome for your patient. Knowing the basics of when an MTP is activated and what to look for deepens your understanding of this complex protocol and helps deliver better care to your bleeding patient.

### Massive transfusion protocol checklist

Labs (order them, but don't delay treatment while you wait)

- Type & crossmatch.
- CBC, INR, PT, PTT, fibrinogen (TEG if available).
- Electrolytes, Ca/Mg/Phos, ionized calcium.
- VBG or ABG if concern for significant acidemia.

Activate MTP and communicate with the blood bank

- Triggers for initiation & termination are clinical.
- Designate a specific person to call the blood bank immediately.

Consider additional fibrinogen (e.g., cryoprecipitate)

- Consider a 1:1:1:1 ratio of PRBC, FFP, Platelets, & Cryo.
- Fibrinogen may be especially important in obstetric hemorrhage.

Calcium

- 1-2 gram Ca chloride or 3-6 grams Ca gluconate per MTP round (6 units PRBC).
- Follow iCa if possible, target normal to mildly elevated iCa (e.g., ~ 1-3 mM).

Tranexamic acid

- Consider 1 gram IV, if difficulty achieving hemostasis.
- May continue infusion at a rate of 1 gram over 8 hours – especially in obstetric or early traumatic hemorrhage.

IV desmopressin (DDAVP)



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- Consider using in renal failure, thrombocytopenia, or antiplatelet drugs.
- The dose is 0.3 mcg/kg (max 21 mcg) IV.

Review anticoagulant medications & consider reversal

- Warfarin reversal
- Dabigatran reversal
- Xaban reversal
- Thrombolysis reversal
- Heparin reversal
- Antiplatelet reversal

Avoid acidosis

- For intubated patients, adjust the ventilator to optimize pH.

Avoid hypothermia

- Use warmed fluids if possible.
- Follow temp and consider pre-emptive warming (e.g., with heated air blankets).

Hemodynamics

- Target lower than typical MAP, pending source control.
- Stop MTP when the patient is hemodynamically stable.

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