Trauma Service Guidelines

Title: **Massive Blood Transfusion in Trauma**

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See Also: **Unknown Patient; Trauma OPSTAT; Hypothermia Guideline**

Table of Contents

Introduction

Despite significant advances in the management of trauma, injury remains the fifth leading cause of death in Australia. Haemorrhage accounts for more than 80% of deaths in the operating room and exsanguination internationally remains the leading cause of early hospital death [1-7].

Uncontrolled haemorrhage can be caused by a combination of surgical and coagulopathic bleeding, frequently leading to wide spread cellular dysfunction and organ damage [2 - 8]. On admission to hospital, 25-36% of trauma patients already show signs of coagulopathy, with dilutional coagulopathy caused by as little as 5 units of Red Blood Cells (RBC's) [5, 8, 9, 10].

Major blood loss jeopardises the survival of patients and is a challenge for haematology and blood transfusion services [11]. Guidance is needed for bedside administration of blood products to optimise patients outcome [7, 10].

Transfusion Triggers

Early recognition of the need to activate the massive transfusion guideline is essential in the initial management phase; this will enable the laboratory to process blood products in time to facilitate production of the massive exsanguination packs (MEP) packs, thus allowing for early and rapid blood and blood product transfusion.

The Assessment of Blood Consumption Tool (ABC Tool) consists of 4 dichotomous components, which are readily available and assessed in all trauma patients on admission. The presence of any one component contributes one to the total score, with a range of zero to four. Vital signs and assessments are taken from those conducted in the emergency department [12].

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Transfusion Triggers

A score of ≥ 2 will trigger the MBT protocol (75% likelihood of MBT). Higher scores demonstrate an increased need for MBT eg. score of 4 = 100% likelihood [12].

Haemorrhagic shock is classified by the American College of Surgeons into 4 classifications. Class 3 or 4 signify the need for damage and haemorrhage control and trigger the need for a liberal transfusion strategy (1:1:1) [13].

Mechanism	**Yes=1 & No = 0**
Penetrating Mechanism	
ED SBP ≤ 90mmHg	
ED HR ≥ 120 bpm	
Positive Fast	
Total Score	

At the RMH the MEP packs contain: 4 units of RBC's, 4 units (2 bags or 600mls) of FFP & 4 units (1 pooled/ apheresed bag) of platelets, which is the equivalent of 1:1:1.

Signs of grade 3 or 4 haemorrhagic shock are [14]:

- Blood loss 1500-2000mls (30-40%)
- Tachycardia 120-140bpm
- Decreased BP & pulse pressure
- Respiratory rate 30-40
- Decreased urine output (0-15mls)
- Anxiety, confusion and lethargy

Haemorrhagic shock, acidosis, hypotension, haemodilution, fibrinolysis, and consumption and activation of clotting factors severely impair haemostasis. In this situation, surgical control is unlikely to be successful [3, 4, 8]. Hypothermia, acidosis & coagulopathy are described as the "lethal triad" for trauma patients.

Massive Haemorrhage/Massive Transfusion

The estimated need for transfusion is based on the percentage loss of circulating blood volume and the patients ability to compensate [2]. Estimated blood volume for an adult is estimated at 70ml/kg [2].

Massive haemorrhage is defined as[1-4, 8, 10, 15, 16] :

- Loss of patient's entire blood volume within 24 hours and/ or transfusion of more than 10 RBC's units in 24 hours

  and/or

- Loss or replacement of 50% of blood volume within 3 hours

Admission Policy to ICU Post a Massive Blood Transfusion

All RMH patients who have received a MBT as defined about should be admitted to ICU for ongoing monitoring and care

Aims [17]

1. Early diagnosis of hypovolaemic shock
2. Identification and arrest of the sources of bleeding
3. Restoration of blood volume to maintain tissue perfusion and oxygenation & to achieve haemostasis
4. Recognition of the need and trigger criteria for transfusion (using the ABC score)
5. Provision of guidelines for transfusion of blood and blood components

The Guideline

Initial resuscitation should be based on ATLS/EMST principles, which include early and empirical administration of RBC's in patients with severe shock. The trigger to administer or withhold RBC's should not be based on haematocrit or haemoglobin as values do not fall for several hours after acute haemorrhage. In the absence of active bleeding and other risk factors, the transfusion trigger in a stable patient should be Hb<70 g/L [15, 17].

Damage control resuscitation should be rapidly commenced; therefore IV access should be established as soon as possible. If peripheral access is difficult due to shocked state insertion of rapid infusion catheters (RIC) should be the undertaken. [18] Intraosseous is a temporary measure if unable to gain other IV access. The first insertion site preference is the humeral head which can achieve more rapid fluid administration than the tibia.

After establishing a patent airway, ensure that there is adequate breathing, ventilation and oxygenation. Secure 2 large bore IV access. The highest priority in the patient suffering from haemorrhagic shock is controlling the haemorrhage [4, 15].

Sources of bleeding must be identified and managed; they can be broadly classified as:

External Bleeding

Fractures and lacerations can result in a significant amount of blood loss; 10-30% from a single fracture and present in ~40% of cases with a long bone fracture. Signs include swelling and haematoma formation [4, 15]. Bleeding can be controlled with direct pressure with absorbent dressings and compression bandages [19].

The Chest

Intrathoracic injuries such as a large haemothorax have an incidence of 4-19% and should be identified on a chest x-ray taken within the first 10 minutes of arrival. Management is by early chest decompression via either finger or catheter insertion [4].

The Pelvis

The decision as to whether the blood loss is from the abdomen or the pelvic retroperitoneum is crucial. An AP pelvic x-ray should be done at the same time as the CXR. Pelvic arterial bleeding is present in up to 52% of unstable pelvic fractures with ligament disruption[20]. Current hospital guidelines advocate external pelvic binding with early surgical or radiological intervention.

The Abdomen

Assessment of the abdomen should include the use of FAST (Focused Abdominal Sonography in Trauma) or DPA (Diagnostic Peritoneal Aspiration). About 78% of intraperitoneal injuries result in haemorrhage [4].

Decision making [21-25]:

1. Pelvic haemorrhage without intraperitoneal bleeding requires immediate angiography and embolisation.
2. Intraperitoneal bleeding requires immediate laparotomy and concomitant external pelvic stabilization in the operating theatre.
3. Non- invasive external stabilization in the resuscitation room aids to control small venous and cancellous bone bleeding.

For every three minutes of haemodynamic instability without haemorrhage control there is an increase in mortality of 1% [14]. Immediate operative haemostasis is the optimal treatment for internal bleeding [26].

Volume Replacement

Early base line blood samples should be taken and sent to the laboratory as soon as possible, these should include: grouping and crossmatch, coagulation profile, full blood count (FBC) and biochemistry [4, 15].

Aggressive fluid resuscitation in the bleeding patient can lead to additional haemorrhage by increasing blood pressure and dislodging early thrombus. It can also change microvascular permeability through activation of cascade systems leading to pathologic shifts of fluid, hydraulic acceleration of bleeding and dilution of clotting factors [26].

While aggressive fluid resuscitation may still be considered appropriate in the unconscious patient with no blood pressure, it is suggested to limit or delay intravenous resuscitation prior to surgical control even if the patient is hypotensive, there is however no consensus decision about the role of hypotensive resuscitation [26].

Traumatic Brain Injury

In the presence of uncontrolled haemorrhage in a patient with a known or suspected traumatic brain injury one of the important goals is prevention of secondary brain injury from hypotension. Therefore a systolic blood pressure (SBP) of at least 90mmHg should be maintained, using fluid resuscitation and/or inotropic support [4, 26].

No traumatic Brain Injury
Fluid resuscitation to maintain SBP 80-90mmHg [4].

Blood Component Therapy

Red Blood Cells (RBC)

RBC's carry oxygen to the tissues and should not be used as a primary volume expander. Red cells are likely to be required when 30-40% of blood volume has been lost. Be aware that in the young, the fit and the obstetric patient blood loss can be underestimated [1, 15].

Blood replacement should be clinically guided and based on the patient's response, ensure pre-warming of all resuscitation solutions [1, 15].

Pre transfusion compatibility should be performed where possible. If a pre transfusion crossmatch is unable to be completed prior to the patient needing blood product transfusion, then un-crossmatched Group O Rhesus (Rh) D negative red cells should be used in all females of childbearing age (<50 years). If Group O Rh D negative red cells are in short supply Group O Rh D positive should be used in males [1-3, 8, 15].

Fresh Frozen Plasma (FFP)
Impaired haemostasis is most probably multifactorial in origin and results from the adverse haemostatic effect of multiple concurrent coagulation factor deficits combined with anaemia, thrombocytopenia, acidosis and hypothermia.

The level of fibrinogen falls first; the critical level of 1.0 g/l is likely to be reached after 150% blood volume replacement, followed by the fall of other labile coagulation factors with continued blood loss.

Prolongation of the activated partial thromboplastin time (APTT) and prothrombin time (PT) to 1.5 times the mean normal value is correlated with an increased risk of clinical coagulopathy.

Infusion of FFP should be guided by the volume of blood lost, fluid replaced and by PT, APTT (>1.5 times mean normal value) and fibrinogen levels. Transfusion of plasma components should be large enough to maintain coagulation factors above the critical level (30%), when there may be inadequate time to obtain results of PT and APTT.

Cryoprecipitate
Cryoprecipitate is most useful in massive haemorrhage as a rapid source of fibrinogen when the fibrinogen is <1.0 g/L. It can be used:

- early in massive haemorrhage as first-line therapy as a source of fibrinogen
- management of dilutional hypofibrinogenemia
- following FFP (if there is persistent hypofibrinogenemia)
- when the fibrinogen level is disproportionately low compared with other factors

(e.g. as occurs with fibrinogenolysis).

The dose of cryoprecipitate is generally 2 mL/kg body weight and one unit should increase the fibrinogen level by 0.1 g/L. (roughly 10 bags/70kg individual)

Platelets
Thrombocytopenia can occur reasonably quickly and usually results from haemodilution but maybe due to increased consumption. The rate of decline in patient platelet counts is individual; however the number of platelets each patient has does not correlate with the ability to coagulate.

Platelet count should be maintained above the critical level of 50 x 10^9/L in a bleeding patient. This level may be anticipated when 2 blood volumes have been replaced[10].

The amount should be based on a combination of clinical criteria and laboratory values.

A higher target level of 100 x 10^9/L is recommended for patients with head injury and high velocity trauma. Empirical platelet transfusion may be required when platelet function is abnormal (secondary to antiplatelet therapy).

Procedure

Patient admitted with known or suspected high risk of massive blood loss or ABC Tool score ≥2

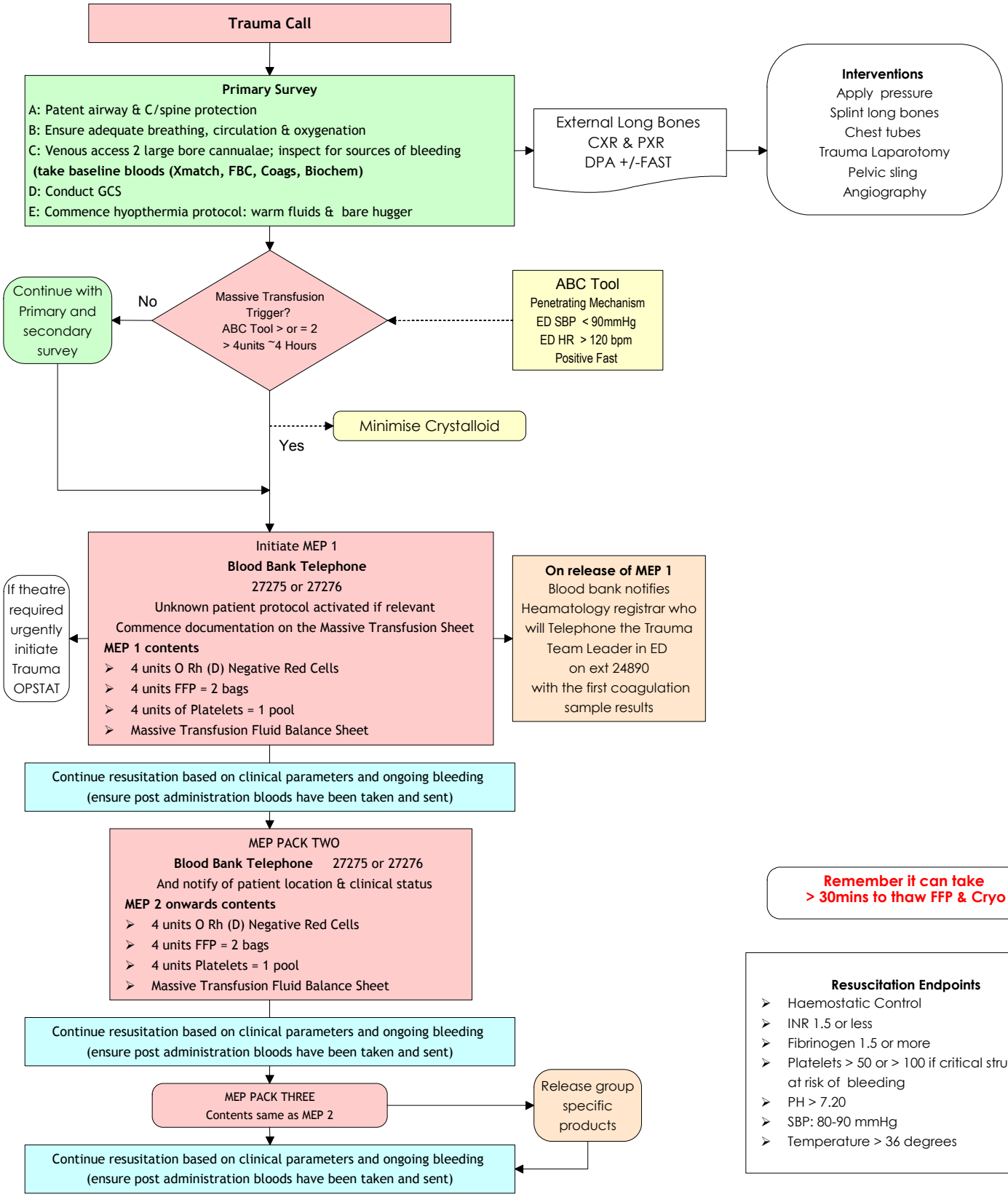
- Activate Massive Transfusion in Trauma Guideline
- ED consultant, Registrar and/or Nursing Team Leader either call blood bank or send a copy of page 1 of the ED Trauma Resuscitation form with the following details:
  - *Activation of MBT guideline, patients name (if known), age, sex, injuries, time expected and request MEP*
- Emergency Department Assistant attends blood bank to pick up MEP ~ 30mins prior to arrival; with a copy of page 1 of the ED Trauma Resuscitation form
- Patient arrives
  - *Ensure baseline blood taken and sent urgently via chute prior to transfusion*
- Commence transfusion (ensure hypothermia protocol in progress) of RBC's; documentation of the Trauma Massive Transfusion Fluid Balance Sheet (in the MEP pack)
- Transfusion ratio 1:1:1 { 4 units of RBC's, 4 units (2 bags or 600mls) of FFP & 4 units (1 pooled/ apheresed bag) of platelets} [6]
  - *First MEP has 1 bag (2 units) of FFP the Second MEP will have 2 bags (4 units)*
  - *Bloods should be sent in between each MEP*

Endpoints

- Haemostatic Control
- INR 1.5 or less
- Fib 1.5 normal or more
- Plts > 50 or > 100 if critical structures at risk of bleeding
- PH > 7.20
- SBP: 80-90 mmHg
- Temperature > 36 degrees

Exit criteria

- Stabilisation of haemodynamic
- Control and normalisation of haemorrhage



Remember it can take > 30mins to thaw FFP & Cryo

Resuscitation Endpoints

- Haemostatic Control
- INR 1.5 or less
- Fibrinogen 1.5 or more
- Platelets > 50 or > 100 if critical structures at risk of bleeding
- PH > 7.20
- SBP: 80-90 mmHg
- Temperature > 36 degrees

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