Transfusion Requirements and Management in Trauma

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Overview

- Haemostatic resuscitation
- Massive Transfusion Protocol
- Overview of NBA research guidelines

Haemostatic resuscitation

- Permissive hypotension (SBP 80-100)
- Correct acidosis
- Correct hypothermia
- Correct hypocalcaemia

Massive Transfusion

- Definition variable:
  - Volume:
    1. Replacement of entire circulating volume
    2. 7% of persons body weight
    3. Approx. 10 units PRBCs
  - Time-defined Criteria:
    1. Half of circulating blood volume over 4 hours
    2. Rate of blood loss over 150ml/min

Deranged Physiology, 2015

Massive Transfusion

- The NBA template:
  - 4 units of PRBCs
  - 2 units of FFP (15ml/kg)
  - 1 adult dose of platelets
  - 3-4g of fibrinogen (in cryoprecipitate).

NBA, 2012

Massive transfusion protocol (MTP) template

The information below, developed by consensus, broadly covers areas that should be included in a local MTP. This template can be used to develop an MTP to meet the needs of the local institution's patient population and resources

Senior clinician determines that patient meets criteria for MTP activation

Baseline:
Full blood count, coagulation screen (PT, INR, APTT, fibrinogen), biochemistry, arterial blood gases

Notify transfusion laboratory (*insert contact no.*) **to:**
'Activate MTP'

Laboratory staff
- Notify haematologist/transfusion specialist
- Prepare and issue blood components as requested
- Anticipate repeat testing and blood component requirements
- Minimise test turnaround times
- Consider staff resources

Haematologist/transfusion specialist
- Liaise regularly with laboratory and clinical team
- Assist in interpretation of results, and advise on blood component support

Senior clinician
- **Request:**[a]
  - 4 units RBC
  - 2 units FFP
- **Consider:**[a]
  - 1 adult therapeutic dose platelets
  - tranexamic acid in trauma patients
- **Include:**[a]
  - cryoprecipitate if fibrinogen < 1 g/L

a Or locally agreed configuration

Bleeding controlled?

YES

Notify transfusion laboratory to:
'Cease MTP'

NO

OPTIMISE:
- oxygenation
- cardiac output
- tissue perfusion
- metabolic state

MONITOR
(every 30–60 mins):
- full blood count
- coagulation screen
- ionised calcium
- arterial blood gases

AIM FOR:
- temperature > 35^0C
- pH > 7.2
- base excess < –6
- lactate < 4 mmol/L
- Ca^{2+} > 1.1 mmol/L
- platelets > 50×10^9/L
- PT/APTT < 1.5 × normal
- INR ≤ 1.5
- fibrinogen > 1.0 g/L

NBA, 2012

Suggested criteria for activation of MTP

- Actual or anticipated 4 units RBC in < 4 hrs, + haemodynamically unstable, +/– anticipated ongoing bleeding
- Severe thoracic, abdominal, pelvic or multiple long bone trauma
- Major obstetric, gastrointestinal or surgical bleeding

Initial management of bleeding

- Identify cause
- Initial measures:
  - compression
  - tourniquet
  - packing
- Surgical assessment:
  - early surgery or angiography to stop bleeding

Specific surgical considerations

- If significant physiological derangement, consider damage control surgery or angiography

Cell salvage

- Consider use of cell salvage where appropriate

Dosage

Platelet count < 50 x 10^9/L	1 adult therapeutic dose
INR > 1.5	FFP 15 mL/kg[a]
Fibrinogen < 1.0 g/L	cryoprecipitate 3–4 g[a]
Tranexamic acid	loading dose 1 g over 10 min, then infusion of 1 g over 8 hrs

a Local transfusion laboratory to advise on number of units needed to provide this dose

Resuscitation

- Avoid hypothermia, institute active warming
- Avoid excessive crystalloid
- Tolerate permissive hypotension (BP 80–100 mmHg systolic) until active bleeding controlled
- Do not use haemoglobin alone as a transfusion trigger

Special clinical situations

- Warfarin:
  - add vitamin K, prothrombinex/FFP
- Obstetric haemorrhage:
  - early DIC often present; consider cryoprecipitate
- Head injury:
  - aim for platelet count > 100 × 10^9/L
  - permissive hypotension contraindicated

Considerations for use of rFVIIa[b]

The *routine* use of rFVIIa in trauma patients is not recommended due to its lack of effect on mortality (Grade B) and variable effect on morbidity (Grade C). Institutions may choose to develop a process for the use of rFVIIa where there is:

- uncontrolled haemorrhage in salvageable patient, and
- failed surgical or radiological measures to control bleeding, and
- adequate blood component replacement, and
- pH > 7.2, temperature > 34^0C.

Discuss dose with haematologist/transfusion specialist

[b] rFVIIa is not licensed for use in this situation; all use must be part of practice review.

ABG	arterial blood gas	FFP	fresh frozen plasma	APTT	activated partial thromboplastin time
INR	international normalised ratio	BP	blood pressure	MTP	massive transfusion protocol
DIC	disseminated intravascular coagulation	PT	prothrombin time	FBC	full blood count
RBC	red blood cell	rFVIIa	activated recombinant factor VII		

NBA, 2012

The evidence

- The NBA in formulating its guidelines developed an expert working group to rework existing transfusion guidelines.
  - *Question 1* – In critically ill patients, what is the effect of RBC transfusion on patient outcomes?
  - *Question 2* – In critically ill patients, what is the effect of non-transfusion interventions to increase haemoglobin concentration on morbidity, mortality and need for RBC blood transfusion?
  - *Question 3* – In critically ill patients, what is the effect of FFP, cryoprecipitate, fibrinogen concentrate, and/or platelet transfusion on patient outcomes?
  - *Question 4* – In critically ill patients, what is the effect of strategies that minimise blood loss on morbidity, mortality and blood transfusion?

NBA, 2012

The evidence

Table 2.4 Body of evidence matrix

Component	A	B	C	D
	Excellent	**Good**	**Satisfactory**	**Poor**
Evidence base	Several Level I or II studies with low risk of bias	One or two Level II studies with low risk of bias or a systematic review/multiple Level III studies with low risk of bias	Level III studies with low risk of bias, or Level I or II studies with moderate risk of bias	Level IV studies, or Level I to III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistency can be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population for the guidelines	Population/s studied in the body of evidence are similar to the target population for the guidelines	Population/s studied in the body of evidence are different to the target population but it is clinically sensible to apply this evidence to the target population for the guidelines	Population/s studied in the body of evidence are different to the target population, and hard to judge whether it is sensible to generalise to the target population for the guidelines
Applicability	Directly applicable to the Australian healthcare context	Applicable to Australian healthcare context with a few caveats	Probably applicable to Australian healthcare context with some caveats	Not applicable to Australian healthcare context

NBA, 2012

RBC transfusion:

1. Transfusion versus no transfusion, and
2. Restrictive transfusion versus liberal transfusion.

- Findings:
- In critically ill patients, liberal and restrictive RBC transfusion strategies have similar effects on:
  - Mortality (B, A, NA, A, B).
  - Organ failure and dysfunction (B, A, NA, A, B).
  - Pneumonia and ARDS (B, NA, NA, A, B).
  - Infection outcomes (B, NA, NA, A, B).

RBC Transfusion

- Recommendation: In critically ill patients, a *restrictive* transfusion strategy should be employed (Grade B)

- Practice Points:
  - Transfusion should not be dictated by Hb concentration.
  - (when indicated) transfusion of 1 unit should be followed by clinical assessment +/- repeat Hb
  - When Hb concentration:
    - <70, transfusion indicated.
    - 70 – 90 - should be clinically correlated. Transfusion acceptable to relieve signs and symptoms of anaemia.
    - >90, no improvement in mortality.

Fresh Frozen Plasma Transfusion

- Evidence Statements:
- In patients with trauma, the effect of FFP on mortality is uncertain. (D, C, D, B, B)
- In patients with trauma, FFP may be associated with transfusion-related serious adverse events. (D, B, C, B, B)

- No recommendations made.

Fresh Frozen Plasma Transfusion

- The routine use of FFP in critically ill patients with coagulopathy is not advised.
- The underlying causes of coagulopathy should be identified.
- The administration of FFP may be independently associated with adverse events, including ARDS and ALI. The decision to transfuse these products to an individual patient should take into account the relative risks and benefits.
- Assessment of bleeding risk is complex and requires careful consideration of patients' clinical status and laboratory parameters. Specialist haematology advice may also be required. However, patients with an INR ≤2 may not benefit from the administration of FFP and can generally undergo invasive procedures within the ICU without any serious bleeding; higher INRs may be tolerated in certain clinical situations.

Cryoprecipitate Transfusion

- In patients with trauma, the effect of cryoprecipitate on mortality is uncertain. (D, NA, NA, B, B)
- In patients with trauma, the effect of cryoprecipitate on transfusion-related serious adverse events is uncertain. (D, NA, D, B, B)

- No recommendations made.

Platelet Transfusion

- In patients with trauma, the effect of platelet transfusion on mortality is uncertain. (D, A, NA, B, B)
- In patients with trauma, the effect of platelet transfusion on transfusion-related serious adverse events is uncertain. (D, C, C, B, B)

- No recommendations.

Platelet Transfusion

- The effect of platelet transfusion on transfusion-related serious adverse events is uncertain. The decision to transfuse platelets to an individual patient should take into account the relative risks and benefits.
- In critically ill patients, in the absence of acute bleeding, the administration of platelets may be considered appropriate at a platelet count of <20 × 109.
- Assessment of bleeding risk is complex and requires careful consideration of patients' clinical status and laboratory parameters. Specialist haematology advice may also be required. However, patients with a platelet count ≥50 × 109 can generally undergo invasive procedures within the ICU without any serious bleeding; lower platelet counts may be tolerated in certain clinical situations.

Non-transfusion Interventions

- In critically ill trauma patients, Erythropoiesis Stimulating Agents:
  - may be associated with decreased mortality (A, A, B, B, B).
  - had no effect on the incidence of RBC transfusion (A, C, C, A, B).

- Iron Transfusions:
  - Effect on mortality is uncertain (D, A, NA, A, B).

- Recommendations: ESAs should not be routinely used in critically ill anaemic patients (Grade B)

Tranexamic Acid

- In acutely bleeding critically ill trauma patients, treatment with TXA:
  - Reduces the risk of mortality when used within 3 hours of injury (A, B, B, A, A).
  - Does not have an effect on allogeneic transfusion incidence or volume (A, NA, D, A, A).
  - does not have an effect on the risk of stroke, pulmonary embolism or deep vein thrombosis, and reduces the incidence of myocardial infarction (A, NA, C, A, A).

- Recommendations: In acutely bleeding critically ill trauma patients, TXA should be administered within 3 hours of injury (Grade B).

Tranexamic Acid

- TXA should be given as early as possible, preferably within 3 hours of injury. The late administration of TXA is less effective and may be harmful.
- The suggested dose of TXA administered is a 1 g bolus followed by a 1 g infusion over 8 hours (This is the dose administered in the large multicentre RCT CRASH-2).

In Summary

- Adequate evidence to make recommendations about the use of a restrictive transfusion strategy, ESAs and TXA.
- The benefit of RBC transfusions in the critically ill has not been established. Thus, it has been difficult to provide guidance on RBC transfusion thresholds while ensuring a patient focus.
- The systematic review identified ***little*** evidence regarding the use of FFP, cryoprecipitate, fibrinogen concentrate and platelets in this population.

References

- Massive Blood Product Transfusion, http://www.derangedphysiology.com/main/required-reading/haematology-and-oncology/Chapter%203.0.3/massive-blood-product-transfusion, accessed 13/03/2016
- National Blood Authority (2012), Patient Blood Management Guidelines: Module 4, Critical Care.