

Wessex children's major trauma guidelines

Children's major haemorrhage guideline

Introduction

Massive Transfusion has a number of retrospective definitions looking at blood product requirement over the preceding 24 hours; none of which guide immediate management of massive haemorrhage.

A volume requirement associated with trauma of more than 20ml/kg in the first hour of treatment is massive haemorrhage. Such blood loss is rare in children's trauma, which increases the need for protocolised therapy.

In children with major trauma, hypoperfusion, hyperfibrinolysis, activation of protein C and up-regulation of thrombomodulin pathways all contribute to an Acute Coagulopathy of Trauma Shock (ACoTS). Aggressive treatment of the lethal triad of hypothermia, acidosis and coagulopathy is essential to countering ACoTS. The combination of these treatment strategies is termed **Damage Control Resuscitation (DCR)**. Damage control resuscitation (DCR) and damage control surgery (DCS) are now well recognised in military and civilian trauma practice.

Management principles

1) Control of massive haemorrhage

- Control massive external haemorrhage with direct pressure and elevation, pressure dressings, haemostatic gauze or tourniquets
- Search for sources of internal haemorrhage in the chest, abdomen, pelvis and femori. In children with a patent fontanelle (generally less than 18 months old), consider intracerebral haemorrhage.
- Use a pelvic sling/binder to splint suspected pelvic fractures.

2) Control of the airway

- In the presence of massive haemorrhage a definitive airway (cuffed endotracheal tube) is mandatory.

3) Vascular access

- Intra-osseous (IO) access is suitable if peripheral IV access is poor, inaccessible or delayed.
- In lower limb, pelvic or abdominal trauma, beware of use of lower limb venous access – as infused products may simply be lost through damaged vessels.
- Take baseline blood samples on admission for blood group and X-Match, venous blood gas including ionized calcium and glucose, full blood count, urea and electrolytes, lactate, coagulation including fibrinogen.
- Do not delay medical or surgical treatment to obtain arterial access.

4) Massive transfusion guideline used at Southampton Children's Hospital (This may be different in your Trauma Unit)

Wessex children's major trauma guidelines

- Initial resuscitation is aimed at normalisation of physiology and control of haemorrhage.
- Informing haematology of a 'paediatric code red' request for a major trauma patient will result initially in: a Pack of 20ml/kg of O RhD negative packed red cells and 20ml/kg of thawed AB Octaplas (FFP96) (unless the blood group is known).
- Manage major trauma proactively with boluses of 5-10ml/kg of **warmed** Octaplas (FFP96) and **warmed** packed red cells. Aim for equal volumes of infused packed cells and Octaplas (FFP96) (1:1 ratio).
- Change to type-specific blood components as soon as available.
- Ensure the availability of platelets and aim to keep platelet count above $75 \times 10^9/l$. Provide a dose of platelets after every 20ml/kg of packed cells transfused. For children weighing less than 15kg, the platelet dose is 10ml/kg. In children weighing more than 15kg, the dose is 1 adult therapeutic pack of platelets.
- Give 15mg/kg of tranexamic acid as soon as possible, if within 3 hours of injury.
- Aim for a palpable radial pulse or a systolic blood pressure of no more than 90mmHg until haemorrhage is controlled.
- Avoid vasoconstrictors in the early resuscitation period and instead use blood products to support blood pressure.
- Further resuscitation should be guided by repeat FBC, base deficit/lactate clearance and RoTEM thromboelastography (Goal directed Therapy) where available.
- After 40ml/kg of blood products consider administering 10ml/kg of cryoprecipitate to provide fibrinogen.

5) Biochemical management

- Hypocalcaemia management.

Calcium levels are frequently low in major trauma and associated with worsening clotting and mortality. Give 0.1ml/kg of 10% Calcium Chloride every 20ml/kg of blood products or if ionised calcium level is less than 1.0mmol/l on blood gas analysis. Or 0.1mmol/kg (0.5ml/kg) of Calcium Gluconate could be used to correct the hypocalcaemia instead.

- Hyperkalaemia management.

Potassium levels can rise to dangerous levels quickly. Use a bolus of 10mls/kg of 10% Dextrose and 0.1 units/kg of insulin actrapid to maintain potassium below 6 mmol/l.

Point of care blood gas equipment allows frequent blood sampling and facilitates the evolving resuscitation.

6) Hypothermia management

- Essential to keep temp $>36^{\circ}\text{C}$ to reduce coagulopathy
- Use an oesophageal temperature probe in unconscious patients
- Fluid warming is the first priority – ranger or Belmont device
- Under patient mattress warmer
- Forced warm air blankets (bair hugger)
- Warm humidified breathing circuit

Wessex children's major trauma guidelines

- Hat

7) Patients born after 1996 and precautions against the transmission of vCJD

- In order to minimise the risk of transmitting new variant CJD, patients who are born after January 1996 should receive pathogen reduced FFP and cryoprecipitate sourced from outside the UK.
- This would either be methylene blue or solvent detergent treated FFP (octoplas) and cryoprecipitate.
- The rationale for this cut off date is that children born since 1996 are considered to have received minimal exposure to the BSE agent because of the effectiveness of the animal feed ban which was fully implemented from 1996 and the exclusion of animals above 30 months entering the food chain.

Wessex children's major trauma guidelines

This is currently used at Southampton Children's Hospital but may differ in Trauma Units.

Paediatric Major Haemorrhage Protocol – CODE RED

ACTIVATION – Senior Clinician

Suspected major haemorrhage

HR> normal range, BP< normal range, absent radial pulse or poor organ perfusion

No alternative cause for hypotension

ACTION

1. Allocate **Code Red** practitioner – direct communication with blood transfusion service, give **age/weight** of child to blood bank
2. Send baseline investigations; FBC, G+S, Coag, U+E, glucose + VBG/ABG.
3. Give Tranexamic acid 15mg/kg IV
4. Call on-call haematology registrar/consultant for advice and on-going decision support (bleep 9145 9am-5pm weekdays or via switchboard out of hours)



REQUEST

MAJOR HAEMORRHAGE PACK 1

1. Immediate blood transfusion (O –ve from nearest fridge or units from lab)
2. FFP96 (Octoplast) – up to 40 mins thawing time (type A until group specific available)
3. Give 5ml/kg boluses of RBCs or FFP96 and re-assess after each bolus (aim for 1:1 ratio)



MAJOR HAEMORRHAGE PACK 2

1. Blood (O –ve until group/type specific available) + FFP96
2. 1 pooled unit of platelets – give 10ml/kg after 20ml/kg of RBCs
3. Give 5ml/kg boluses of blood or FFP96 and re-assess after each
4. Give 10ml/kg of cryoprecipitate if fibrinogen <2g/l

ONGOING BLEEDING

1. Alternate pack 1 & pack 2 until bleeding controlled – use thromboelastography to guide haemostatic resuscitation where available
2. Discussion with a Haematologist to consider use of rFVIIa (if no reversible surgical cause, platelets > $75 \times 10^9/l$ + fibrinogen >2g/l)

AIMS OF TRANSFUSION (NB Monitor lab tests closely)

Hb $\geq 80\text{g/L}$

Platelets $\geq 75 \times 10^9/\text{L}$

INR and APTR ≤ 1.5

Fibrinogen $\geq 2\text{ g/L}$

iCa²⁺ $\geq 1.0\text{ mmol/L}$

Temperature $\geq 35^\circ\text{C}$
pH ≥ 7.2

Lactate $\leq 4\text{ mmol/L}$

PACK 1		
Age/Wt	RBC Units	FFP96
0-2 yrs/ $\leq 11\text{ kg}$	1	1
3-8 yrs/12-25kg	2	2
9-15 yrs/25-40kg	3	3
>16 yrs/>40kg	6	4

PACK 2				
Age/Wt	RBC Units	FFP96	Cryoprecipitate	Platelets
0-2 yrs/ $\leq 11\text{ kg}$	1	1	1-2 baby packs	1
3-8 yrs/12-25kg	2	2	3 baby packs	1
9-15 yrs/25-40kg	3	3	1 standard pack	1
>16 yrs/>40kg	6	4	2 standard packs	1

Wessex children's major trauma guidelines

Suggested constituents of major haemorrhage packs

These blood packs are supplied by blood bank according to the age or weight of the child. This may vary depending on your hospital.

Major haemorrhage pack 1

	Childs age or weight			Adult code red
	0 to 2 years 0 to 11kg	3 to 8 years 12 to 25kg	9 to 15 years 25 to 40kg	16 years and above More than 40kg
Units of packed red cells supplied	1	2	3	6
Units of Octaplas (FFP96) supplied	1	2	3	4

Major haemorrhage pack 2

	Childs age or weight			Adult code red
	0 to 2 years 0 to 11kg	3 to 8 years 12 to 25kg	9 to 15 years 25 to 40kg	16 years and above More than 40kg
Units of packed red cells supplied	1	2	3	6
Units of Octaplas (FFP96) supplied	1	2	3	4
Units of platelets supplied	1	1	1	1
Units of cryoprecipitate supplied	1-2 Baby packs*	3 Baby packs*	1 Adult pack**	2 Adult packs**

* Baby pack contains 35-40mls per pack

** Standard adult pack contains 280-300mls per pack

Wessex children's major trauma guidelines

Children's traumatic haemorrhagic shock check list

Action point	Completed?	Time
Haemostatic dressings and limb tourniquets, if appropriate		
Sources of bleeding searched for in chest, abdomen, pelvis, long bones		
Plan for haemorrhage control – surgical, interventional radiology		
2 x vascular access IV or IO		
Tranexamic acid - 15mg/kg		
Bair hugger		
Warmed 0.9% sodium chloride 5ml/kg	1. 2.	
Warmed Packed Red Cells 5ml/kg	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	
Warmed Octaplas (FFP96) 5ml/kg	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	
Warmed Cryoprecipitate 10ml/kg	1. 2. 3.	
Calcium chloride 10%, 0.1ml/kg	1. 2. 3.	
Platelets 10ml/kg	1. 2. 3.	

Wessex children's major trauma guidelines

Warming fluids given to severely injured children

Fluid boluses (saline or blood products) given to injured children should be warmed.

Warming can be achieved simply through external plate warming devices such as 'ranger fluid warmer' or through rapid infusor devices. The choice of device depends on the patient's size.

Choice of warming device

Rapid infusion devices commonly have a minimum volume delivery. The Belmont rapid infusor delivers a minimum of 100ml of warmed fluid. Therefore, working on a 5ml/kg delivery volume, the Belmont should be used for children weighing greater than 20kg.

External plate warming devices require fluid to be passed between 2 warm plates prior to entering the patient. The amount of fluid delivered is entirely controlled by the operator manually, making it ideal for smaller volume infusions. The 'ranger' fluid warmer is a commonly available device which can be used with a high flow 'ranger' warming set to deliver rapid boluses of fluid.

	Warming device	Additional notes
Child greater than 20kg	Belmont rapid infusor	Careful observation of vascular access site for features of tussing.
Child less than 20kg	Ranger fluid warmer	Use a high flow warming circuit. Use a pressure bag to assist drawing up through syringe.

Using the ranger device to deliver warmed fluid

- 1) The 'ranger' high flow giving set is placed into the slot in the front of the ranger.
- 2) 0.9% sodium chloride is spiked with a blood giving set and then attached to the ranger giving set. The saline can then be used to run through the whole giving circuit. Ensuring it is free of air. The circuit is then clamped.
- 3) The fluid to be delivered to the patient is then spiked onto the circuit replacing the saline bag. A pressure bag is inflated around the fluid bag to assist in driving fluid through the warming circuit.
- 3) A three way tap is added at the patient end of the circuit and then the circuit (still clamped) is attached to the patient's intravenous or intra-osseous access.
- 4) A 50 ml syringe can be used on the three way tap to repeatedly draw fluid through the warmer and then push the fluid into the patient using the syringe. The 50 ml syringe delivery enables accurate volume fluid boluses to be delivered.

Wessex children's major trauma guidelines

Tranexamic acid use in children's major trauma

A dose of 15mg/kg of tranexamic acid (TXA) should be given to all injured children with suspected or confirmed major haemorrhage.

This dose should be delivered as soon as possible and within 3 hours of the original injury. It can be given by intravenous or intra-osseous routes.

Initial dose of tranexamic acid

15mg/kg (maximum 1g) tranexamic acid diluted into 20ml 0.9% sodium chloride and delivered over 10 minutes.

On-going infusion of tranexamic acid

Children with ongoing bleeding should continue to receive an infusion of tranexamic acid at a rate of 2mg/kg/hour. The infusion should be continued until bleeding stops or for 8 hours whichever is sooner.

The infusion can be made up with 16mg/kg of tranexamic acid in 20ml 0.9% sodium chloride and delivered at a rate of 2.5ml/hour for up to 8 hours.