

When time is of the Essence?

**Paediatric massive
haemorrhage.**

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- **Major haemorrhage is associated with a very high mortality in severely injured children.**
- **In the paediatric setting there is little time for error.**
- **Over a 4 year period the NPSA had reports of 11 deaths and 83 other blood loss incidents where patients came close to death due to delays in the provision of blood products in the acute phase of the patients care**
 - **Early recognition**
 - **Effective actions**
 - **Rapid response**
 - **Communication**
 - **Focussed approach**
- **In 2009, the North West Regional Transfusion Committee brought together key stakeholders to address these issues.**

Seven steps for successful coordination in Massive haemorrhage

- **Recognise trigger and activate pathway for management of massive haemorrhage; assemble the emergency response team.**
- **Allocate team roles**
- **Complete request forms / take blood samples, label samples correctly / recheck labelling.**
- **Request blood / blood components according to the algorithm.**
- **The clinical / laboratory interface**

Recognise trigger & activate response team.

Activate the protocol when a massive haemorrhage situation is recognised.

Massive haemorrhage may be defined as a situation where 1 to 1.5 blood volumes may need to be infused either acutely or within a 24 hour period.

Estimate the patient's blood volume

Preterm neonate 100 ml/kg

Term neonate 90 ml/kg

Infant 85 ml/kg

Children 80 ml/kg

Adult 70 ml/kg.

Anticipate the need for blood products:

- **Acute loss of 10% of the blood volume in a neonate → transfuse red cells.**
- **Acute loss of 30 - 40% of the blood volume in any other child → red cell transfusion is likely to be required.**
- **After replacement of 100 – 150% of the blood volume → anticipate coagulation factor deficit (25% activity after 200% blood volume replacement).**
- **After replacement of 150% of the blood volume → fibrinogen is likely to be < 1g/l.**
- **After replacement of 150 – 200% of the blood volume → anticipate a platelet count of < 50 x 10⁹ l.**

Activate the protocol by contacting switchboard (dial **).**

Switchboard operator: call the following via Massive Haemorrhage Alert Code:

Switchboard operator: inform each of the following individuals

Early consultant involvement is important and the anaesthetic, surgical and PICU registrars must inform and involve their consultants as soon as possible

The transfusion laboratory biomedical scientist must inform the consultant haematologist as appropriate and in a timely manner

Allocate team roles

- **Team leader**
- **Communication Lead**
- **Sample taker / investigation organiser / documenter**
- **Transporter**

Take blood samples

MHP BLOOD TESTS

**U&E, FBC, PT, APTT, Fib,
Blood Gas, Calcium,
Lactate**

**Consider Thromboelastography if
available.**

Order blood products

Table 1 – Major Haemorrhage pack 1 (MHP 1)

Weight	Red cells	FFP	LVT- large volume red cell pack, CMV negative, suitable for neonate and children < 44 wks corrected gestational age.
<5kg	1 adult unit(standard or LVT (250ml)	2 'neonatal' unit FFP (100ml)	
5-10kg	1 adult unit(standard or LVT (250ml)	1 unit FFP (225ml)	
10-20kg	2 adult units(standard or LVT (500ml)	2 units FFP (450ml)	
> 20 kg	4 adult units (1000ml)	4 units FFP (900ml)	

Table 2 – Major Haemorrhage pack 2 (MHP 2)

Weight	Red cells	FFP	Cryoprecipitate	Platelets
<5kg	1 adult unit (250ml)	2 'neonatal' units FFP (100ml)	1 single donor unit (40ml)	1 paediatric pack of platelets (30ml)
5-10kg	1 adult unit (250ml)	1 unit FFP (225ml)	2 single donor units (80ml)	2 paediatric packs of platelets (60ml)
10-20kg	2 adult units (500ml)	2 units FFP (450ml)	5 units (200ml)	1 adult pack (200ml)
> 20 kg	4 adult units (1000ml)	4 units FFP (900ml)	10 units (400ml)	1 adult pack (200ml)

New for 2014

**Table 1 – Major Haemorrhage pack 1
(MHP 1)**

Red cells	OCT
4 adult units (1000ml)	4 units (800ml)

**Table 2 – Major Haemorrhage pack 2
(MHP 2)**

Red cells	OCT	Cryoprecipitate	Platelets
4 adult units (1000ml)	4 units (800ml)	10 units (400ml)	1 adult pack (200ml)

and FFP, at least every hour if bleeding is on going, after replacement of 1/3 of the blood volume and after giving blood products.

Hb < 70 g/L → transfuse red cells. Neonates with Hb < 100 g/L.

Vol req'd (mls) = (Desired Hb - actual Hb in g/L) x weight (kg) x 0.4.

Platelets < 75 x 10⁹ /L and actively bleeding → transfuse platelets. 20 ml/kg if < 10 kg; 1ATD if > 10 kg.

APTT ratio > 1.5 and actively bleeding → give FFP/OCT 10 ml/kg.

INR > 1.5 and actively bleeding → give FFP/OCT 10 ml/kg.

Fibrinogen < 1 g/L after FFP/OCT → give cryoprecipitate 10 ml/kg.

Widespread micro vascular oozing is a clinical marker of haemostatic failure irrespective of blood tests and should be treated aggressively.

The clinical/Laboratory interface

The nominated communication lead will liaise directly with the laboratory.

I. Communication lead to arrange for transport of samples / request forms to the laboratory.

II. BMS to ring communication lead with all results of urgent investigations until told to stand down.

III. BMS to ring communication lead when blood / blood components are ready.

IV. Communication lead to arrange to collect blood and blood components from the laboratory.

V. Any units of O emergency O negative blood that are taken from theatre fridge MUST be replaced as soon as possible by laboratory staff.

The transporter is the theatre porter carrying the bleep.

Tranexamic Acid.

Tranexamic acid is administered intravenously as an initial loading infusion of 15 mg/kg (up to a maximum of 1000 mg) over 10 min followed by a continuous intravenous infusion of 2 mg/kg/hr. (up to a maximum of 125 mg/hr.) for at least 8 hours or until bleeding controlled.

For trauma patients, commence within 3 hours of injury.

This dose regimen has been extrapolated from the CRASH-2 trial and follows the dosing recommendation of the RCPCH.

Recombinant FVIIa.

Consider use for persistent major bleeding in blunt trauma despite standard attempts to control bleeding and best practice use of blood component therapy

Preconditions: Fibrinogen ≥ 0.5 g/l, platelets $> 50 \times 10^9$ l⁻¹, pH ≥ 7.2 . Also correct hypothermia and hypocalcaemia.

Dose: 90 micrograms/kg. This should be rounded up or down to the nearest number of whole vials, except in very small babies.

The dose can be repeated after 1 hour if bleeding continues.

A multi-centre, randomised, double blind, placebo controlled study in trauma patients used a dose of 200 micrograms/kg followed by 100 micrograms /kg one and three hours later.

Expect clotting factors and platelets to be consumed rapidly after giving rFVIIa: be prepared to give more.

Likely to increase the risk of thromboembolic complications.

Novoseven is available as 1.2 mg, 2.4 mg and 4.8 mg vials.

Specific subgroups.

1. Gastrointestinal haemorrhage.

Resuscitation and stabilisation is essential prior to endoscopy.

Contact the general surgeons in the first instance. A gastroenterologist should be contacted for advice as required.

IV PPI (omeprazole) before endoscopy.

Emergency O Neg if not stabilised after initial resuscitation with fluids, otherwise crossmatched.

2. Trauma.

Small volume resuscitation may be appropriate in blunt or penetrating trauma, but not in the head injured patient. Small volume resuscitation involves giving volume in aliquots or 10ml/ kg and assessing response and need for further volume.

If the patient responds, maintains an adequate heart rate, blood pressure and mental status then no more fluid is given until definitive treatment or there is a deterioration in clinical condition necessitating further fluid resuscitation.

Note on specific requirements: CMV and Irradiated components.

In an emergency where CMV negative components are not available transfusion of leucodepleted components is an acceptable alternative.

All cellular blood components, except granulocyte concentrates, are leucodepleted.

In a massive haemorrhage situation the requirement for irradiated components is not absolute. Patients should not exsanguinate whilst waiting for irradiated products.

Consent

“You can provide emergency treatment without consent to save the life of, or prevent serious deterioration in the health of, a child or young person.”

This will obtain when implementing this protocol. This includes the children of parents of the Jehovah's Witness faith.

Transfusion Management of Massive Haemorrhage

Ensure a consultant is aware of the massive haemorrhage and a senior member of staff is available to take charge of resuscitation if not already present

**Protocol Activation:
Via Switchboard on 2222**

•Emergency O red cells
Theatre fridge outside the male changing room

* Time to receive at this clinical area:
Group specific red cells: 30mins
Cross Matched red cells: 90mins

Transfusion lab:

☎2492 (preferred)
☎2491 (alternative)
☎Bleep 289

☎Theatre Porter bleep 498

Consultant Haematologist:
☎Via Switchboard (0)

STOP THE BLEEDING

Haemorrhage Control

Direct pressure / tourniquet if appropriate
Stabilise fractures
Surgical intervention
Interventional radiology
Endoscopic techniques

Haemostatic Drugs

Vitamin K and Prothrombin complex concentrate for warfarinised patients
Other haemostatic agents: discuss with Consultant Haematologist

(A)BG - (Arterial) Blood Gas

APTT - Activated partial thromboplastin time

FFP- Fresh Frozen plasma

MHP - Massive Haemorrhage Pack

NPT - Near patient Testing

PT- Prothrombin Time

ROTEM- Thromboelastometry

TEG- Thromboelastography

XM - Crossmatch

OCT - Octaplas

Ongoing severe bleeding (overt / covert) and received 20ml/kg of red cells or 40ml/kg of any fluid for resuscitation in preceding hour.

Signs of hypovolaemic shock and / or coagulopathy

Consider Tranexamic acid (mandatory in trauma – give within 3 hours of injury)

15mg/kg (max 1000mg) intravenously over 10 minutes, then infuse 2mg/kg/hr (max 125mg/hr) intravenously for at least 8 hours or until bleeding is controlled.

Activate Massive Haemorrhage Pathway

Call for help

Call Switchboard (2222) and declare:
'Massive Haemorrhage, Location, Specialty'
Assemble team and allocate roles
Consultant involvement essential

RESUSCITATE
Airway
Breathing
Circulation

Take bloods and send to lab:

Meditech Order Set:
At enter order (EO) category:/MHP F9 look-up and

Order MHP 1 (see table 1)

Includes XM, FBC, PT, APTT, fibrinogen, Biochemistry profile, Blood Gas, Lactate

MHP 1

Red cells and FFP: Give aliquots of 10ml/kg in a 1:1 ratio. Reassess rate of blood loss & response to treatment & repeat as necessary.

When half of MHP1 has been used consider ordering MHP2

Reassess

Suspected continuing haemorrhage requiring further transfusion

Take bloods and send to lab:

Meditech Order Set:
At enter order (EO) category:/MHP F9 look-up and

Order MHP 2 (see table 2)

Includes XM, FBC, PT, APTT, fibrinogen, Biochemistry profile, Blood Gas, Lactate

MHP 2

Red cells and FFP: give aliquots of 10ml/kg in a 1:1 ratio. Reassess rate of blood loss and response to treatment & repeat as necessary.
Platelets: give 20ml/kg if this is < 200ml otherwise give 1 adult dose.
Cryoprecipitate: give 10ml/kg

When half of MHP2 has been used consider ordering another MHP2

Reassess

Take bloods and send to lab:

At enter order (EO) category:/MHP F9 look-up and

Order MHP 2

If blood tests only are required to re-assess patient, choose 'MHP Blood Tests' when doing F9 look-up

Continuous cardiac monitoring

Prevent Hypothermia
Use fluid warming device
Used forced air warming blanket

Consider 0.2 ml/kg 10% calcium chloride (max 10ml) over 30 min

Further cryoprecipitate (10ml/kg) if fibrinogen < 1.5g/l or as guided by TEG/ROTEM

Aims for therapy

Aim for:
Hb 80-100g/l
Platelets >75 x 10⁹/l
PT ratio < 1.5
APTT ratio <1.5
Fibrinogen >1g/l
Ionised Ca²⁺ >1.0 mmol/l
Temp > 36°C
pH > 7.35 (on ABG)
pH > 7.25 (cap/venous BG)
Monitor for hyperkalaemia

STAND DOWN

Inform lab
Return unused components
Complete documentation including audit proforma