Paediatric Major Haemorrhage - Full Clinical Guideline

Reference no.: CH CLIN C53

1. Introduction

Paediatric Major Haemorrhage is a rare event at UHDB. Notwithstanding it is essential that a clear protocol exists to support clinical decision making and management of process during what is likely to be a busy resuscitation. This guidance can be accessed in combination with local and regional major trauma pathways and specific injury guidance available on the trust intranet.

2. Aim and Purpose

Establish a defined protocol for management of major haemorrhage in children of UHDB based on national and international guidance as well as more recent studies with a summation of the evidence behind them.

3. Definitions, Keywords

Major Haemorrhage, Major Trauma, Tranexamic acid, Jehovah's witness

4. Main body of Guidelines

University Hospitals of Derby and Burton NHS Foundation Trust

Paediatric Massive Haemorrhage Action Card (Derby site)

Activate when evidence of hypovolaemia + suspected massive haemorrhage

Activate Major Haemorrhage via 2222

Declare a **Paediatric Massive Haemorrhage**

Designate a Runner to collect **all** products

Designate a Blood Bank Liaison

Blood Bank Liaison Calls Blood Bank and states "**Paediatric Massive Haemorrhage Alert**

Provide Patient ID (if arrived), Weight, Location and Contact Number

General Measures

Control Haemorrhage

Strongly Consider Tranexamic Acid

Avoid Hypothermia, Hypocalcaemia, Acidosis, Take bloods ^

Initial Requests (Verbal) *

20ml/kg Red Cells (up to 4 adult units)

20ml/kg FFP (up to 4 adult units)

If Continuing Bleeding Request

Further Red cells and FFP (20ml/kg)

20ml/kg (up to 1 adult unit) Platelets

10ml/kg Cryoprecipitate (up to 2 pools)

- Then –

Consult the Massive Haemorrhage Pathway

Contact on-call Haematology consultant for advice on transfusion management

*If G&S (Group and Save) Available – Request Group specific Red Cells (5 minutes) and Compatible plasma (20 minutes)
If No G&S Available – 20ml/kg O Negative Uncrossmatched Red Cells (immediately available in level 5 issue fridge. Emergency Plasma (20 minutes)

Transfuse in a 1:1 of FFP:RBC awaiting blood results
CMV Negative for infants < 6 months of age

ALWAYS – Complete checking procedures. Blue Traceability tabs MUST be completed

University Hospitals of Derby and Burton NHS Foundation Trust

Paediatric Massive Haemorrhage Action Card (BURTON SITE)

Activate when evidence of hypovolaemia + suspected massive haemorrhage

Activate Major Haemorrhage via 2222

Declare a **Paediatric Massive Haemorrhage to blood bank**

Designate a Runner to collect **all** products

Designate a Blood Bank Liaison

Blood Bank Liaison Calls Blood Bank and states "**Paediatric Massive Haemorrhage Alert**

Provide Patient ID (if arrived), Weight, Location and Contact Number

General Measures

Control Haemorrhage

Strongly Consider Tranexamic Acid

Avoid Hypothermia, Hypocalcaemia, Acidosis, Take bloods ^

Initial Requests (Verbal) *

20ml/kg Red Cells (up to 4 adult units)

20ml/kg FFP (up to 4 adult units)

If Continuing Bleeding Request

Further Red cells and FFP (20ml/kg)

20ml/kg (up to 1 adult unit) Platelets

10ml/kg Cryoprecipitate (up to 2 pools)

- Then –

Consult the Massive Haemorrhage Pathway

Contact on-call Haematology consultant for advice on transfusion management

*If G&S (Group and Save) Available – Request Group specific Red Cells (5 minutes) and Compatible plasma (20 minutes)
If No G&S Available – 20ml/kg O Negative Uncrossmatched Red Cells (available in the blood issue fridge in pathology. Emergency Plasma (20 minutes)

Transfuse in a 1:1 of FFP:RBC awaiting blood results
CMV Negative for infants < 6 months of age

ALWAYS – Complete blood checking procedures and traceability information

University Hospitals of Derby and Burton NHS Foundation Trust

Transfusion Management of Massive Haemorrhage in Children

"MASSIVE HAEMORRHAGE ALERT"

Activation Number(s):
2222

Emergency Mobile
07384914100 (Derby)
07385516944 (Burton)

- **Emergency O red cells**
  - Level 5 Fridge room: 2 units
  - Blood Bank Level 5
- *** Time to receive at this clinical area:**
- Group specific red cells: 5 Mins
- XM red cells 40 mins

Transfusion lab ☎ **88532**

Consultant Haematologist ☎ **87973/83376 or Switchboard**

Major blood loss expected
Severe or impending traumatic haemorrhagic shock

Activate Massive Haemorrhage Pathway

Call for help
'Massive Haemorrhage Alert, Location, Specialty'
Alert emergency response team (including Blood Transfusion Laboratory, portering/ transport staff)
Consultant involvement essential

RESUSCITATE
Airway
Breathing
Circulation

Take bloods and send to lab by hand:
XM, FBC, PT, APTT, Fibrinogen, U+E, Ca^{2+}
Blood gas

Strongly Consider TXA

Order as deemed necessary:

Red cells*	20mls/kg
FFP	20mls/kg
Platelets	20mls/kg

Aims for therapy
Aim for:

Hb	80 g/l
Platelets>	75 x 10^9/l
PT ratio	< 1.5
APTT ratio	<1.5
Fibrinogen	>1.5 g/l
Ca^{2+}	>1 mmol/l
Temp	> 36°C
pH	> 7.35
Lactate	< 1mmol/l

Monitor for hyperkalaemia

Transfuse via active warming device – consider giving in 10ml/kg aliquots

Aim for 1:1 ratio of FFP to RBC
Aim for 20ml/kg platelets and 10ml/kg cryoprecipitate for every 40mls/kg RBC

Reassess
Suspected continuing haemorrhage requiring further transfusion
Take bloods and send to lab:
FBC, PT, APTT, Fibrinogen, U+E, Ca^{2+}
Venous gas

Order as deemed necessary:

Red cells	20mls/kg
FFP	20mls.kg
Platelets	20mls/kg
Cryoprecipitate	10ml/kg

Prevent Hypothermia
Use fluid warming device
Used forced air warming blanket

Transfuse via active warming device

Once administered, repeat bloods:
FBC, PT, APTT, Fibrinogen, U+E, Blood gas
To assess further blood component requirements

STOP THE BLEEDING

Haemorrhage Control
Direct pressure / tourniquet if appropriate
Stabilise fractures
Surgical intervention– consider damage control surgery
Interventional radiology
Endoscopic techniques

Haemostatic Drugs:
Tranexamic acid 30mg/kg iv bolus over 10 mins (max 2G)

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

Cell salvage if available and appropriate
Consider ratios of other components:
1 unit of red cells = c.250 mls salvaged blood

STAND DOWN

Inform lab
Return unused components
Complete Traceability documentation

Early use of blood products as opposed to crystalloid infusion has been shown to reduce the rate of mortality in major haemorrhage [7].

When a paediatric major haemorrhage has been recognised the major haemorrhage protocol should be activated. The first steps to be taken are outlined on the major haemorrhage action card. NB Major Haemorrhage can be declared prior to arrival if massive haemorrhage expected.

- Senior clinician declares a major haemorrhage
- A runner is assigned to take all samples and collect all blood products from the lab
- A named blood bank liaison (to request products) is assigned.
- Blood bank is contacted via telephone or pager and “Paediatric Massive Haemorrhage Alert” must be stated
- Inform blood bank of the patient id (if known), Weight, Location and contact number
- Request initial products (see below)

Haemorrhage Control

As part of the trauma primary survey control of life threatening haemorrhage should be an early priority [7]. This may be via direct pressure, application of a tourniquet, splinting of fractures or application of a pelvic binder. In the case of massive internal bleeding early consideration of damage control surgery or interventional radiology is essential. Recommendations for management of specific injuries are contained within local, regional and national trauma guidance.

Requesting Products

Initial requests during major haemorrhage should be made verbally via the contact details on the massive haemorrhage action card.

In the case of no group and save sample being available O RhD-ve red cells are available on the level 5 issue fridge at all times. Emergency Plasma can be made available within 20 minutes.

If a group and save is already available group specific red cells can be requested from blood bank (5 minutes) and group compatible plasma (20 minutes)

Fully compatible (cross-matched) red cells are available 40 minutes after group and save samples are received. If the patient is eligible for electronic issue then subsequent red cells are available in 5 minutes.

For infants under the age of 4 months a maternal sample (if available) should also be sent).

Selection of Products and Transfusion Ratio

In children with major haemorrhage in the context of trauma there is clear evidence that crystalloid resuscitation is associated with increased mortality [1,3,5-6]. Early transfusion of blood products is therefore recommended. UHDB does not have set ‘packs’, meaning clinicians are expected to request the blood products that they need as per the process

outlined above. The evidence base for which products to give and in what ratios are either based upon registry studies or extrapolated from randomised control trials in adults [1-6].

Early goal directed therapy is recommended by international consensus guidelines [3] and may be associated with an increase in survival. Near patient testing is not available at UHDB therefore regular laboratory samples should be sent to guide requests. Clinicians should aim for the following parameters when giving massive transfusion [1]

- Hb > 80
- Platelets > 75
- Fibrinogen > 1.5
- PT Ratio or APTT ratio < 1.5
- Ionised Calcium > 1 mmol/L
- pH > 7.35

During early resuscitation – prior to receiving laboratory results red blood cells and fresh frozen plasma should be given in a 1:1 ratio in 20ml/kg aliquots. After each 40ml/kg consider transfusing platelets at a dose of 20ml/kg (upto 1 adult unit) and cryoprecipitate 10ml/kg. The evidence base for these recommendations is summarised below.

The British Committee for Standards in Haematology Guidelines (revised 2015) [1] advises that Fresh Frozen Plasma: Red Cells should be transfused in a 1:1 or 1:2 ratio and 20ml/kg of platelets to be given after each 40ml/kg of red cells.

The PROPRR trial 2015 [2] in adults demonstrated no statistically significant difference in mortality between patients transfused in 1:1:1 and 1:1:2 ratio although more patients in 1:1:1 group achieved homeostasis. Akl et al [5] undertook a retrospective review of US trauma data and demonstrated increased 24 hour survival and reduced 24 hour red cell transfusion requirements when a 1:1 ratio of FFP:RBC was used as opposed to 1:2 or 1:3.

Data from the US based Trauma Quality Improvement Project [4] (a US trauma registry) examined children receiving more than 40ml/kg of blood products post traumatic haemorrhage. Those who received cryoprecipitate within the first 4 hours had a lower 24 hour mortality compared to propensity matched controls who did not. Cryostat-2 is a randomised control trial in adults examining the timing of cryoprecipitate administration on mortality which will shortly be reporting its findings.

Tranexamic Acid (TXA)

The evidence base behind tranexamic acid in children is mainly extrapolated from the adult literature. The CRASH-2 study [9] demonstrated a 10% reduction in 28 day all-cause mortality in adults given TXA within 3 hours of injury resulting in major haemorrhage. The follow-up CRASH-3 Study [10] was unable to demonstrate a statistically significant difference in mortality in isolated traumatic brain injury when adults were given TXA within 3 hours. However in a subgroup with mild-moderate head injury (GCS > 8) the risk of head injury related death tended towards significant (0.81-1.0) with no increase in complications. A retrospective propensity matched cohort study of paediatric warzone victims in Camp Bastion demonstrated a survival benefit for those treated with TXA [11]. A meta-analysis combining studies in paediatric combat and civilian trauma [12] failed to demonstrate a

survival benefit when giving TXA, whilst noting the wide heterogeneity of studies and their retrospective nature.

Consensus guidance [8] therefore recommends in children that are injured with suspected bleeding that demonstrate either:

- Significant tachycardia (age specific)
- Hypotension
- Known significant bleeding

Should receive tranexamic acid within the first 3 hours of injury. UHDB has a TXA monograph for use in paediatric trauma. The recommended dose in major trauma is 30mg/kg for a single dose (max 2g).

Trauma Induced Coagulopathy

In multiply injured patients a systemic endotheliopathy due to tissue damage, hypoperfusion and systemic inflammation leads to the traumatic coagulopathy which is associated with increased mortality [3]. Systemic hypothermia, acidosis and dilution of coagulation factors in combination with consumption of coagulation factors are risk factors for traumatic coagulopathy and should therefore be avoided.

- Avoid hypothermia. Replace clothing or blankets following examination and use active warming measures (e.g forced air warming) for trauma patients. Transfuse blood via active warming devices.
- Avoid acidosis – monitor blood gas aiming pH > 7.35 and lactate < 1.
- Avoid Hypocalcaemia – Blood products contain calcium chelating agents (citrate). Calcium may require replacement. Can be given as Calcium Gluconate 10% at a dose of 0.11mmol/kg (max 4.5mmol) over 10 minutes. Dilute to 0.045mmol/mL if given peripherally. (Further details in pharmacopoeia)

Jehovah's Witnesses

Children are defined as those under the age of 18. No child should die due to not receiving a blood transfusion. It may therefore be required to treat children against parental wishes in an emergency. The trust policy on managing such situations can be found on Koha: Trust Policy and Procedures for Managing Requests of Exclusion from Treatment with Blood Components / Products

References

1. New, H.V. et al. (2016) 'Guidelines on transfusion for fetuses, neonates and older children', British Journal of Haematology, 175(5), pp. 784–828. doi:10.1111/bjh.14233.
2. Holcomb, J.B. et al. (2015) 'Transfusion of plasma, platelets, and red blood cells in a 1:1:1 vs a 1:1:2 ratio and mortality in patients with severe trauma', JAMA, 313(5), p. 471. doi:10.1001/jama.2015.12.
3. Spahn, D.R. et al. (2019) 'The European guideline on management of major bleeding and coagulopathy following trauma: Fifth Edition', Critical Care, 23(1). doi:10.1186/s13054-019-2347-3.
4. Tama, M.A. et al. (2021) 'Association of cryoprecipitate use with survival after major trauma in children receiving massive transfusion', JAMA Surgery, 156(5), p. 453. doi:10.1001/jamasurg.2020.7199.
5. Akl, M. et al. (2022) 'Balanced hemostatic resuscitation for bleeding pediatric trauma patients: A nationwide quantitative analysis of outcomes', Journal of Pediatric Surgery, 57(12), pp. 986–993. doi:10.1016/j.jpedsurg.2022.07.005.
6. Butler, E.K. et al. (2019) 'Association of Blood Component ratios with 24-hour mortality in injured children receiving massive transfusion', Critical Care Medicine, 47(7), pp. 975–983. doi:10.1097/ccm.0000000000003708.
7. Advanced trauma life support: Student course manual (2018). Chicago, IL: American College of Surgeons.
8. Evidence Statement: Major trauma and the use of tranexamic acid in children (November 2012), Royal College of Paediatrics and Child Health
9. 'Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): A randomised, placebo-controlled trial' (2010) The Lancet, 376(9734), pp. 23–32. doi:10.1016/s0140-6736(10)60835-5.
10. 'Effects of tranexamic acid on death, disability, Vascular occlusive events and other morbidities in patients with acute traumatic brain injury (crash-3): A randomised, placebo-controlled trial' (2019) The Lancet, 394(10210), pp. 1713–1723. doi:10.1016/s0140-6736(19)32233-0.
11. Eckert, M.J. et al. (2014) 'Tranexamic acid administration to pediatric trauma patients in a combat setting', Journal of Trauma and Acute Care Surgery, 77(6), pp. 852–858. doi:10.1097/ta.0000000000000443.
12. Kornelsen, E. et al. (2022) 'Effectiveness and safety of tranexamic acid in pediatric trauma: A systematic review and meta-analysis', The American Journal of Emergency Medicine, 55, pp. 103–110. doi:10.1016/j.ajem.2022.01.069.

Documentation Controls

Reference Number CH CLIN C53	**Version** **V002**		**Status** Final	
Version / Amendment History	Version	Date	Author	Reason
	V001	Dec 2018	Dr G Robinson	Routine Review and Update
	V002	Nov 2023	Dr J Riley	Review and Update
	V003	August 24	Dr J Riley	Change in activation number
Intended Recipients: All Paediatric Medical Staff All Paediatric Nursing Staff Emergency Department Staff				
Training and Dissemination: Cascade the information via BU newsletter and address training				
Development of Guideline: Dr Jon Riley **Job Title:** ST8 Paediatric Emergency Medicine				
In Consultation with: Transfusion Committee				
Linked Documents: (Nice guidance/Current national guidelines)				
Keywords: (Search term for KOHA) Haemorrhage, Transfusion, Major Haemorrhage				

Business Unit Sign Off	**Group:** Paediatric Guidelines Group **Date:**
Divisional Sign Off	**Group:** Women's and Children's Clinical Governance Group **Date:**
Date of Upload	23/09/2024
Review Date	November 2028
Contact for Review	Dr Ian Lewins