NHS Highland Major Haemorrhage Protocol
(excluding Argyll & Bute)

Title: NHS Highland Major Haemorrhage Protocol (excluding Argyll & Bute)
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1. Introduction

This document represents the NHS Highland ‘generic’ major haemorrhage protocol. It will be the basis for any more specialised departmental major haemorrhage protocols.

1.1. Objective

- To allow rapid and appropriate response to major haemorrhage
- To ensure appropriate communication between clinical area and blood bank(s)
- To provide quick and effective delivery of blood components for patients with major haemorrhage

1.2. Target Population(s)

- Adults (age > 14; weight > 40 Kg), including obstetric patients
- Paediatric (see appendix 2)
- Hospitals covered: Raigmore, Belford and Caithness General Hospitals.

1.3. Definition of massive bleeding

Haemorrhagic SHOCK with ongoing major blood loss due to any underlying cause

e.g for adults

May be associated with

- blood loss > 150mls/min
- 50% blood volume loss in < 3 hours
- 4 units RBC in < 4 hours.

1.4. Trigger for Major Haemorrhage Protocol (MHP) activation

Experienced clinician determines that patient fulfils the above definition in para 1.3.

1.5. Responsibilities

It is imperative that everyone involved in major haemorrhage is aware of their roles and responsibilities.

Team Leader – determines patient management.
Communication Lead – allocated to communicating with laboratories/theatres, other staff required etc.
Resuscitation – ‘ABC’, Blood component administration etc.
Haemorrhage control – directly attempting to stem blood loss via local measures.
Sample taking/Transport – ensuring required samples reach lab’ rapidly, co-ordinating porter activity etc
Documentation – to ensure events during episode are documented, to ensure blood component administration recorded/ ‘traceability’ returns completed.
Activating Major Haemorrhage (MH) response

2.1 How to activate MH response

Raigmore Hospital

Week day 9-5: Telephone 4216 and state that a major haemorrhage is occurring. All other times: Bleep 5081 and state that a major haemorrhage is occurring to the responder.

Belford Hospital

Week day 9-5: Telephone 4315 and state that a major haemorrhage is occurring. All other times: Contact Belford switchboard and ask for on-call Biomedical scientist.

Caithness General Hospital

Week day 9-5: Telephone 266/267 and state that a major haemorrhage is occurring. All other times: Contact Caithness General switchboard and ask for on-call Biomedical scientist.

2.2 General response to bleeding patient

Control bleed; ensure venous access; avoid hypothermia - warm fluids using a blood warmer. Take appropriate blood tests and send urgently to appropriate laboratory.

2.2.a Immediate blood tests

FBC; Crossmatch (if no valid existing group and screen sample exists); Clotting screen (including Fibrinogen); Biochemistry (including Calcium); Blood gases (if appropriate)

2.2.b Information required by Blood Bank

i) Urgency of the situation!

ii) Patient details -
Minimum data set:
Conscious patient - name; DOB; gender; CHI number, T Number
Unconscious/ unidentified patient:
Raigmore = minimum of gender, ‘RUP’ Number, T-Number
Belford = minimum of gender, ‘A&E’ Number, T-Number
Caithness = minimum of gender, ‘EMW’ Number, T-Number

iii) Major haemorrhage location information

Key clinical contact – name, Phone number/Bleep number.
Number and nature of components required in the first instance
Patient diagnosis, location of patient and any likely relocation

Confirm which samples have been sent and how (air tube or porter).
2.3 Time frames

2.4 Blood Component Availability

Raigmore Hospital
- Immediate: O Neg blood
  - Uncross matched stock, A&E (4u) & Theatres Blood Refrigerators (2u)
  - Further such stock available from Blood Bank if needed
- Urgent (15-20 minutes*) – Group specific blood (ABO + RhD grouping)
- Further such stock available from Blood Bank if needed
- 30-40 minutes* – fully crossmatched blood
- Fresh Frozen Plasma/Cryoprecipitate – allow 20 minutes for thawing.
- Platelets – immediate.
- *=will be available much faster if valid pre-existing Group and Screen sample exists.

Belford Hospital
- Immediate: O Neg blood
  - Uncross matched stock, A&E Blood Refrigerator (4u)

MAXIMUM DELAY DUE TO STAFF TRAVEL TIME = 20 MINS, THEN
- Immediately thereafter – further uncross-matched Group O
- Urgent (15-20 minutes*) – Group specific blood (ABO + RhD grouping)
- 30-40 minutes* – fully cross matched blood
  - If more than 8 units of red cells required then allow for delivery time from Raigmore.
- Please allow deliveries of blood components to reach the laboratory and do not try to intercept or re-direct.
- Fresh Frozen Plasma/Cryoprecipitate – allow 20 minutes for thawing.
- Platelets – not in stock, therefore approximately 2 hour delivery time.
- *=will be available much faster if valid pre-existing Group and Screen sample exists.

Caithness General Hospital
- Immediate: O Neg blood
  - Uncross matched stock, Laboratory Blood Refrigerator (4u)

MAXIMUM DELAY DUE TO STAFF TRAVEL TIME = 20 MINS, THEN
- Immediately thereafter – further uncross-matched Group O
- Urgent (15-20 minutes*) – Group specific blood (ABO + RhD grouping)
- 30-40 minutes* – fully cross matched blood
  - If more than 8 units of red cells required then allow for delivery time from Raigmore.
- Please allow deliveries of blood components to reach the laboratory and do not try to intercept or re-direct.
- Fresh Frozen Plasma/Cryoprecipitate – allow 20 minutes for thawing.
- Platelets – not in stock, therefore approximately 2 1/2 hours delivery time.
- *=will be available much faster if valid pre-existing Group and Screen sample exists.
3 Blood component support

3.1 Trauma

Trauma ‘shock’ pack
Where trauma and high potential for coagulopathy (with systolic BP < 90; poor response to initial fluid resuscitation; and probable ongoing active haemorrhage) and no results available:

Order – 4 RBC / 4 FFP in first instance

If bleeding persists and still no blood results – order 4 RBC / 4 FFP / 1 unit platelets / 2 pools of cryoprecipitate (if evidence of hypofibrinogenaemia)

Once results available, then tailor blood product support to maintain:

Hb > 8g/dL (target range 9 – 10)
PT & APTT – normalise – transfuse 4 units of FFP if APTT or PT ratio > 1.5 x normal
Fibrinogen ≥1.0g/L – transfuse 2 units of pooled cryo if < 1.0
Platelets > 75 x10⁹/L – transfuse 1 unit of platelets (2 units if < 30)

3.2 Massive haemorrhage, but no immediate risk for coagulopathy (as determined in 3.1 above)

Order – 4 RBC in first instance

If bleeding persists and still no blood results – order 4 RBC / 4 FFP / 1 unit platelets / 2 pools of cryoprecipitate (if evidence of hypofibrinogenaemia)

Once results available, then tailor blood product support to maintain:

Hb > 8g/dL (target range 9 – 10)
PT & APTT – normalise – transfuse 4 units of FFP if APTT / PT ratio > 1.5 x normal
Fibrinogen ≥1.0g/L – transfuse 2 pools of cryo if < 1.0
Platelets > 75 x10⁹/L – transfuse 1 unit of platelets (2 units if < 30)

3.3 Additional interventions

Cell salvage – should be used where appropriate, if local reliable availability

Near patient testing – should be used where appropriate, if local reliable availability (TEG/ROTEM etc)

The use of Tranexamic Acid should be considered in bleeding trauma patients*

Recombinant activated Factor VII (Novo 7) – although current EMEA recommendation is that Novo 7 is not for use outside licensed indication, consideration should be given to it’s use where treatment options are limited and patient is exsanguinating.
Use according to locally agreed protocols if available. (NB, not currently so in Highland)

Other pharmacological interventions using factor concentrates, anti-fibrinolytics and fibrin sealants should be considered where appropriate
* The use of Tranexamic Acid has recently been shown in the CRASH 2 Trial to safely reduce the risk of death in bleeding trauma patients. Tranexamic Acid should therefore be considered for use in bleeding trauma patients. Dose – 1g i.v. over 10 minutes, followed by infusion of 1g over 8 hours

3.4 Management of adverse complications

The following complications should be anticipated and managed appropriately in patients receiving multiple units of blood components

Hypothermia – monitor temperature, keep patient warm

Hyperkalaemia – monitor potassium, initiate local protocol for treatment of any hyperkalaemia (glucose + insulin + bicarbonate)

Acidosis – monitor patient closely, take corrective action

Hypocalcaemia – monitor calcium levels* – if ECG changes or clinical evidence of hypocalcaemia, give 10mls of 10% calcium chloride (for adults) by slow IV injection or IV infusion, and if necessary repeated until ECG is normal

* ionised calcium results generally available from blood gas analysers

3.5 Management of warfarin (Vitamin K antagonist) reversal

Vitamin K antagonists e.g. Warfarin will require immediate reversal with Four Factor Concentrate and Vitamin K in patients experiencing massive haemorrhage. Haematologist advice should be sought immediately.
4 De-activation of MH response

It is essential that Blood Bank is informed whenever the clinical emergency has ended, to minimise wastage of blood components. This is the responsibility of the Team leader.

5 Audit

Activation of the major haemorrhage response should be audited by the local Hospital Transfusion Committee so that defects in the process can be identified, rectified, and lessons learned fed back to all staff involved in the major haemorrhage response.
Appendix 1: Flow Sheet for Adults.

**Transfusion Management of Major Haemorrhage (Adult)**

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

**Haemostatic Drugs**
- For trauma patients: Tranexamic acid 1g bolus followed by 1g over 8 hrs
- For Warfarin patients: Vit K and Prothrombin complex concentrate
- Other haemostatic agents: discuss with Consultant Haematologist

**Cell salvage if available and appropriate**
- Consider ratios of other components: 1 unit of red cells = 250 ml salvaged blood

**Stop the Bleeding**

**Activate Massive Haemorrhage Pathway**

**Call for help**
- Allocate team roles:
  - Team Leader
  - Communication Lead
  - Resuscitation
  - Haemorrhage control
  - Sample taking
  - Transport
  - Documentation

**RESUSCITATE**
- Airway
- Breathing
- Circulation

**Continuous cardiac monitoring**

**Prevent Hypothermia**
- Use fluid warming device
- Use forced air warming blanket
- Consider 10 ml Calcium chloride 10% over 10 mins

**Aims for therapy**
- Aim for:
  - Hb: > 90 g/dl
  - Platelets: > 75 x 10^9/L
  - PT ratio: < 1.5
  - APTT ratio: < 1.5
  - Fibriogen: > 1g/L
  - Ca²⁺: > 1 mmol/L
  - pH: > 7.35 (on ABG)
- Monitor for hyperkalaemia
- 2 packs cryoprecipitate if fibriogen < 1g/L (or < 2g/L in obstetric haemorrhage) or as guided by TEG / ROTEM

**Take bloods and send to lab.**
- FBC, PT, APTT, Fibriogen, U+E, Ca²⁺, NPT: ABG, TEG / ROTEM if available

**Order MHP 1**
- Red cells: 4 units
- FFP: 4 units
- Platelets: 1 adult dose
- *Emergency O blood, group specific blood, XM blood depending on availability.
- **Travel delay for Belford/Cathness

**Give MHP 1**

**Reassess**
- Suspected continuing haemorrhage requiring further transfusion
- Take bloods and send to lab.
- FBC, PT, APTT, Fibriogen, U+E, Ca²⁺, NPT: ABG, TEG / ROTEM if available

**Order MHP 2**
- Red cells: 4 units
- FFP: 4 units
- Platelets: 1 adult dose
- *Request Cryoprecipitate 2 packs if fibriogen < 1g/L (or < 2g/L in obstetric haemorrhage) or as guided by TEG / ROTEM

**Give MHP 2**

**Once MHP 2 administered, repeat bloods:**
- FBC, PT, APTT, Fibriogen, U+E, NPT: ABG
- To inform further blood component requesting

**STAND DOWN**
- Inform lab, return unused components
- Complete documentation

**Thromboprophylaxis should be considered when patient stable**

**ABG: Arterial Blood Gas**
**APTT: Activated partial thromboplastin time**
**MHP: Major Haemorrhage Pack**
**NPT: Near Patient Testing**
**TEG/ROTEM: Thromboelastography**
**XM: Crossmatch**

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Transfusion Management of Major Haemorrhage in Children

STOP THE BLEEDING

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

Haemostatic Drugs
For trauma patients: Tranexamic acid 15mg/kg bolus followed by 2mg/kg per hour.
For 'Warfarin' patients: Vit K and Prothrombin complex concentrate
Other haemostatic agents: discuss with Consultant

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

Actived Massive Haemorrhage Pathway

Call for help
Allocate team roles:
Team Leader
Communication Lead
Resuscitation
Haemorrhage control
Sample taking
Transport
Documentation

RESUSCITATE
Airway
Breathing
Circulation

RESUSCITATE

Continuous cardiac monitoring

Prevent Hypothermia
Use fluid warming device
Use forced air warming blanket

Further cryoprecipitate
[10ml/kg] if fibrinogen < 1g/l
or as guided by TEG / ROTEM

Aims for therapy
Hb: 8 - 10g/dl
Platelets: > 75 x 10^9/l
PT ratio: < 1.5
APTT ratio: < 1.5
Fibrinogen: > 1g/l
Ca²⁺: > 1 mmol/l
Temp: > 36°C
pH: > 7.35 (on ABG)

Monitor for hyperkalaemia

STAND DOWN
Inform lab,
Return unused components,
Complete documentation.

Thromboprophylaxis should be considered when patient is stable

ABS – Arterial Blood Gas
FFP – Fresh Frozen plasma
PT – Prothrombin Time
APTT – Activated partial thromboplastin time
MHP – Major Haemorrhage Pack
NPT – Near Patient Testing
XM – Crossmatch

V1 2011

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Table 1 – Major Haemorrhage pack 1 (MHP 1) order these volumes, which are also the maximum volumes to be administered from this pack in each weight category. Calculate volumes to be administered as detailed in the flow chart, but do not exceed these maximums (see example below)

<table>
<thead>
<tr>
<th>Weight</th>
<th>Red cells * group O, group specific, crossmatched depending on availability</th>
<th>FFP</th>
<th>Platelets</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5kg</td>
<td>2 Paediatric units (80-100ml)</td>
<td>2 'neonatal' units of Methylene Blue (MB) treated FFP (100ml)</td>
<td>1 Paediatric pack of platelets (50ml)</td>
</tr>
<tr>
<td>5-10kg</td>
<td>1 Adult unit (250ml)</td>
<td>1 Paediatric unit MB treated FFP (225ml)</td>
<td>2 Paediatric packs of platelets (100ml)</td>
</tr>
<tr>
<td>10-20kg</td>
<td>2 Adult units (500ml)</td>
<td>2 Paediatric units MB treated FFP (450ml)</td>
<td>1 Adult apheresis pack (200ml)</td>
</tr>
<tr>
<td>&gt;20kg</td>
<td>4 Adult units (1000ml)</td>
<td>4 Paediatric units MB treated FFP (800ml)</td>
<td>1 Adult apheresis pack (200ml)</td>
</tr>
</tbody>
</table>

Table 2 – Major Haemorrhage pack 2 (MHP 2) order these volumes, which are also the maximum volumes to be administered from this pack in each weight category. Calculate volumes to be administered as detailed in the flow chart, but do not exceed these maximums (see example below)

<table>
<thead>
<tr>
<th>Weight</th>
<th>Red cells</th>
<th>FFP</th>
<th>Cryoprecipitate - Request if fibrinogen &lt;1g/l or according to TEG / ROTEM</th>
<th>Platelets</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5kg</td>
<td>2 Paediatric units (80-100ml)</td>
<td>2 'neonatal' units of Methylene Blue (MB) treated FFP (100ml)</td>
<td>1 single donor unit MB treated (40ml)</td>
<td>1 Paediatric pack of platelets (50ml)</td>
</tr>
<tr>
<td>5-10kg</td>
<td>1 Adult unit (250ml)</td>
<td>1 Paediatric unit MB treated FFP (225ml)</td>
<td>2 single donors units (80ml)</td>
<td>2 Paediatric packs of platelets (100ml)</td>
</tr>
<tr>
<td>10-20kg</td>
<td>2 Adult units (500ml)</td>
<td>2 Paediatric units MB treated FFP (450ml)</td>
<td>1 pool (5 units) (200ml)</td>
<td>1 Adult apheresis pack (200ml)</td>
</tr>
<tr>
<td>&gt;20kg</td>
<td>4 Adult units (1000ml)</td>
<td>4 Paediatric units MB treated FFP (900ml)</td>
<td>2 pools (10 units) (400ml)</td>
<td>1 Adult apheresis pack (200ml)</td>
</tr>
</tbody>
</table>

An example:

In a 5kg child, you may administer up to 200 mls RBC (40ml/kg) and 50mls platelets (10ml/kg), however, in a 30kg child do not administer more than 4 adult units of RBC (33ml/kg) or 1 ATD of platelets (6ml/kg).
## Appendix 3 - Summary of recent guidance for management of major haemorrhage.

PCC = Prothrombin complex concentrate (e.g Beriplex).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Scottish MH 2010</th>
<th>Assoc. of Anaesthetists 2010*</th>
<th>Euro trauma guide 2010 **</th>
<th>BCSH Guidelines 2006***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hb (g/dL)</strong></td>
<td>Trigger 8, Target 9 - 10</td>
<td>Not stated</td>
<td>Target 7 - 9</td>
<td>Maintain &gt; 8</td>
</tr>
<tr>
<td><strong>Platelets (x 10^9/L)</strong></td>
<td>Maintain &gt; 75</td>
<td>Minimum target 75</td>
<td>Recommend &gt; 50, but &quot;suggest&quot; &gt; 100 in severe trauma</td>
<td>Maintain &gt; 75 (possibly 100)</td>
</tr>
<tr>
<td><strong>Fibrinogen (g/L)</strong></td>
<td>Maintain &gt; 1.0</td>
<td>Emerging evidence &gt; 1.5</td>
<td>Treat &lt; 1.5 to 2.0</td>
<td>Maintain &gt; 1.0</td>
</tr>
<tr>
<td><strong>PT/ aPTT</strong></td>
<td>Aim to normalise. Treat &gt; 1.5 x normal</td>
<td>Maintain &lt; 1.5 normal</td>
<td>Not stated – measure INR/PT/APTT/TEG</td>
<td>Maintain &lt; 1.5 mean control</td>
</tr>
<tr>
<td><strong>Replacement ratios</strong></td>
<td>6 rbc:4 FFP:1 Platelet pool – trauma + coagulopathy</td>
<td>1:1:1 – reserved for most severely traumatised patients (in reality ~4rbc:4 FFP:1 platelet pool)</td>
<td>Not stated Formula replacement not recommended Possible where no rapid turnaround in coag tests.</td>
<td></td>
</tr>
<tr>
<td><strong>RBC</strong></td>
<td>O Neg then Group specific</td>
<td>O Neg then Group specific</td>
<td>Not stated</td>
<td>O Neg then Group specific as soon as possible</td>
</tr>
<tr>
<td><strong>FFP</strong></td>
<td>4 units = 15mls/kg for average adult Pre-thawed – no recommendation</td>
<td>15mls/kg, but higher if established coagulopathy Pre thawed if poss.</td>
<td>Early intervention 10-15mls/kg Further dose depends on coag. results</td>
<td>12-15 mls/kg (or 4 units)</td>
</tr>
<tr>
<td><strong>Platelets</strong></td>
<td>1 unit (adult equivalent dose)</td>
<td>Maintain &gt; 75 (1:1:1 severe trauma)</td>
<td>Initial 1 or 2 platelet pools or one apheresis unit</td>
<td>Not stated</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Warfarin reversal</strong></td>
<td>Prothrombin complex concentrate + Vit K (no dosing)</td>
<td>Prothrombin complex concentrate + Vit K (dosing recommended)</td>
<td>Prothrombin complex concentrate</td>
<td>Prothrombin complex concentrate (refers to BCSH guideline on oral anticoag)</td>
</tr>
<tr>
<td><strong>Thrombo - elastography</strong></td>
<td>Recommends if available / reliable</td>
<td>Recommends if available, suggests TEG blood replacement protocol</td>
<td>Recommends</td>
<td>Not stated</td>
</tr>
<tr>
<td><strong>Cell Salvage</strong></td>
<td>Recommends if available / reliable</td>
<td>Recommends</td>
<td>Recommends</td>
<td>Recommends if routinely available</td>
</tr>
<tr>
<td><strong>Thrombo- prophylaxis</strong></td>
<td>Not stated</td>
<td>Post MH event</td>
<td>Post - PCC</td>
<td>Not stated</td>
</tr>
<tr>
<td><strong>Novo 7</strong></td>
<td>Restricted recommendation</td>
<td>Requires local protocol</td>
<td>Restricted recommendation</td>
<td>Consider use, after other interventions. Need local protocol</td>
</tr>
<tr>
<td><strong>Tranexamic acid</strong></td>
<td>Recommends</td>
<td>Recommends</td>
<td>Recommends</td>
<td>Insufficient evidence to support or refute</td>
</tr>
</tbody>
</table>
Note:

* The Association of Anaesthetists – Blood Transfusion and the Anaesthetist – Management of massive haemorrhage (this is a draft document, currently out for consultation)

** Management of bleeding following major trauma: an updated European guideline Rossaint R. et al Critical Care 2010, 14: R52


END