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| Clinical Guideline for:**Management of Adult Massive Haemorrhage**  |

**Summary**

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| *These guidelines outline the process to be followed in the event of massive haemorrhage.* |

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# 1. INTRODUCTION

* The urgent provision of blood for life threatening haemorrhages requires a rapid, focused approach as excessive blood loss can jeopardise the survival of patients. Early recognition of major blood loss and immediate effective interventions are vital to avoid hypovolaemic shock and its consequences.
* One such action is the rapid provision of blood and blood components. Effective communication between all personnel involved in the provision and transportation of blood is vital.
* Between October 2006 to September 2010, the National Patient Safety Agency (NPSA) received reports of 11 deaths and 83 incidents in which a patient was harmed as a result of delays in the provision of blood in an acute situation.
* The following recommendations were made by the NPSA report:
	+ The Patient Blood Management Group reviews the local protocols and practices for requesting and obtaining blood in an emergency (including out of hours), ensuring that they include all the actions required by clinical teams, laboratories and support services, e.g. portering and transport staff/drivers and any specific actions pertinent to sites without an on-site transfusion laboratory.
	+ Local protocols enable the release of blood and blood components without the initial approval of a haematologist although they should be advised of the situation at the earliest opportunity.
	+ Staff (clinical, laboratory and support staff) know where to find the massive haemorrhage protocol in all relevant clinical and laboratory areas and are familiar with it, supported by training and regular drills.
	+ The blood transfusion laboratory staff are informed of patients with a massive haemorrhage at the earliest opportunity.
	+ Clinical teams dealing with patients with massive haemorrhage nominate a specific member of the team to co-ordinate communication with the laboratory staff and support services for the duration of the incident.
	+ There is a clear and well understood trigger phrase to activate the massive haemorrhage protocol, for example *“I want to trigger the massive haemorrhage protocol [*and state location e.g. *delivery suite]”* and all subsequent communications between clinical areas and laboratory staff should be preceded by the use of a locally agreed trigger phrase such as *“This call relates to the massive haemorrhage protocol [and location]”.*
	+ All incidents where there are delays or problems in the provision of blood in an emergency are reported and investigated locally, and reported to the NPSA and the Serious Hazards of Transfusion (SHOT) scheme (www.shotuk.org).
	+ Each event triggering the massive haemorrhage protocol is recorded and significant cases are reviewed by the Patient Blood Management Group to ensure local protocols are applied appropriately and effectively and that any learning points can be used to improve the system.

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# 2. PURPOSE

* To identify adult patients suffering a massive haemorrhage
* To provide effective and appropriate blood and blood components in a timely manner
* To ensure that staff involved understand the protocols to be followed in the event of massive haemorrhage

# 3. DEFINITIONS

* Replacement of one blood volume, or the transfusion of 10 units or more within a 24 hour period.
* Replacement of 50% blood volume loss within 3 hours or less
* On-going transfusion requirement in an adult of more than of 150 ml/min
* **Bleeding leading to a heart rate of greater than 100 and / or a systolic blood pressure considered to have dropped significantly from patient’s base line.**
* Guidance on blood volume estimation can be found in Appendix 2: Blood Volume estimation.

# 4. DUTIES AND RESPONSIBILITIES OF STAFF

* **Medical staff** are responsible for assessing the clinical condition of the patient and activating the guideline if appropriate
* **Medical staff** are responsible for consultation with senior surgical, anaesthetic/intensive care and consultant haematologist, as appropriate
* **Clinical staff** are responsible for ensuring swift and accurate communication of the activation of the guideline via the appropriate channels
* **Clinical staff** are responsible for ensuring appropriate blood samples are collected for diagnostic testing and delivered to the laboratory for testing
* **Laboratory staff** are responsible for the provision of blood and blood components without the approval of a Haematologist. Blood transfusion staff are responsible for ensuring that diagnostic blood samples (for haematology and chemistry) are distributed to the relevant laboratories for urgent processing once received in the laboratory
* **Clinical staff** are responsible for coordinating the collection of blood and blood components and ensuring that have relevant training and competency to access the blood fridges
* **Clinical staff** are responsible for communicating the cessation of the massive haemorrhage to laboratory staff
* **Clinical staff** are responsible for ensuring that all blood components transfused can be traced to the patient via the electronic blood tracking system or compatibility tags returned to the transfusion laboratory appropriately completed

# 5. PROTOCOL FOR DEALING WITH A MASSIVE HAEMORRHAGE

* A team approach is vital. Early consultation with senior surgical, anaesthetic/ intensive care and haematology colleagues is essential.
* A clear phrase to activate the massive haemorrhage protocol should be used (e.g.” I want to trigger the massive haemorrhage protocol in *state site and patient details*”*)*. A specific member of the team should be nominated to co-ordinate communication with the laboratory services and support services for the duration of the incident
* Appropriate surgical / radiological expertise for the area of bleeding is vital. In the more difficult cases, confidence to pack visceral cavities, cross clamp and tie off major vessels may be required. Radiological embolisation and / or stenting has an established role.
* An intensive care bed is likely to be required. Early warning of this to ICU is advisable.
* The hospital transfusion laboratory must be informed of a massive transfusion situation at the earliest possible opportunity**– Dial 2222. State “I want to activate the Adult Massive Haemorrhage Protocol” and give your extension number for transfusion to call.**
* Transfusion laboratory staff must call the given extension and establish the identity of the named individual in the clinical team responsible for all communication.
* An individual within the clinical team should be identified as the “runner”. This person is responsible for taking blood samples to the transfusion laboratory and for collection of blood components/products.

## 5.1 **Specific aims**

* Adequate ventilation and oxygenation
* Control the source of the haemorrhage
* Resuscitation to maintain adequate tissue perfusion and oxygenation
* Start blood component therapy
* Keep the patient normothermic
* Anticipate a coagulopathy

## **5.2 Adequate ventilation and oxygenation**

* Establish a patent airway and give 100% oxygen

## **5.3** **Control the source of haemorrhage and set up intravenous access**

* Control obvious bleeding points (pressure, tourniquets, haemostatic dressings) Transfer the patient to an area where definitive intervention for diagnosis and treatment can occur.
* Establish intravenous access with at least two short bore cannulae, ideally 14 G or larger.
* If venous access is difficult the use of an intraosseous needle should be considered. Suitable needles are located in the Emergency Department, Wonford main theatres and Bramble ward (EZ-IO device)
* If the source of haemorrhage is below the diaphragm at least one line must be in the upper limb or neck.
* Patients with upper thoracic and neck injuries should have large bore access in the lower extremities.
* In patients with multiple injuries one access site should be above and one below the diaphragm.

## **5.4** **Resuscitation**

* The blood pressure is adequate if the patient is conscious, talking, and has a palpable peripheral (e.g. radial) pulse.
* In cases of major trauma, resuscitation should be with blood products rather than crystalloid wherever possible
* For major haemorrhage due to causes other than trauma, initial resuscitation should be with a warmed crystalloid. Hartmann’s solution, a balanced salt solution should be used to avoid the hyperchloraemic metabolic acidosis seen in patients resuscitated with large volumes of normal saline.
* Red cell transfusion will be required when 30–40% of blood volume is lost. 30% blood volume loss (Class III shock) causes cardiovascular collapse; the loss of over 40% of blood volume (Class IV shock) is immediately life-threatening (see Appendix 1: Assessing degree of blood loss).
* Blood loss is usually underestimated, and it must be remembered that haemoglobin and haematocrit values do not fall for several hours after acute haemorrhage.
* For bleeding patients, blood transfusion is rarely indicated when the haemoglobin concentration is >100 g/L but is almost always indicated when it is <60 g/L. Determination of whether intermediate haemoglobin concentrations justify red cell transfusion should be based on the patient’s risk factors, such as pre-existing cardiorespiratory disease. The rate of blood loss should also be considered.
* Blood cell salvage should be used to reduce the requirement for allogeneic blood. 250ml washed salvaged red cells can be considered to be equivalent to 1 unit of packed red cells. Bacterial contamination of the wound is a relative contraindication.

Clinical goals are:

* a falling heart rate ( <100 beats per min)
* restoration of blood pressure ( >100 mmHg systolic)
* an adequate central venous pressure ( > 5 mmHg)
* satisfactory urine output (>30 mls/hour or 0.5 mg/kg/hr)
* a falling serum lactate on blood gas analysis

## **5.5** **Investigations**

Send samples as soon as possible for (a runner should be identified within the clinical team to take the samples to the transfusion laboratory):

* blood grouping, antibody screening and crossmatching
* haemoglobin and platelet count
* coagulation screening (INR, APTR),
* fibrinogen estimation (Clauss fibrinogen)
* biochemistry investigations (U&E)
* Arterial blood gas estimation (including serum lactate)
* Rotational thromboelastometry should be considered. There is a ROTEM analyser located in ICU.
* Repeat FBC and coagulation screen after every 4 units transfused or every hour, whichever is sooner.

## **5.6** **Blood component therapy**

* Use group O un-crossmatched red cells if the blood group is unknown in an extreme emergency. Premenopausal females (female <50 years of age) should be given O Rh(D)negative red cells in order to avoid sensitization and the risk of haemolytic disease of the newborn in subsequent pregnancy. Males <18 years of age should also be given O RhD negative until the blood group is known.
* A list of the areas where group O blood is held can be found on the transfusion web site Group O blood is available in the following areas:
	+ Haemobank fridge in the Transfusion Laboratory
	+ Haemobank fridge in Main Theatres
	+ Haemobank fridge in Labour ward (also has neonatal emergency blood)
* It is acceptable to give O Rh (D) positive cells to males (>18years) and postmenopausal females (>50 years) of unknown blood group.
* Group-specific red cells should be given at the earliest possible opportunity as group O blood is a scarce resource.
* A blood tracking pick-up slip is **NOT** required to collect emergency blood from the blood fridges

## **5.7 Initial Massive Haemorrhage “pack”**

* On activation of the guideline the initial components issued by the laboratory will consist of 4 units of compatible red cells and 2 units of FFP
* A unit of platelets may be requested at this time if clinically indicated
* Generally red cells will be ready for collection before FFP due to thawing time of FFP
* Further blood components should be requested from the laboratory as indicated by the condition of the patient and/or blood test results

## **5.8** **Fresh Frozen Plasma (FFP)**

* FFP at a dose of 15 ml/kg should be considered after the loss of one blood volume (calculated at 70 ml/kg) and definitely given before 1.5 blood volumes have been lost.
* Further administration of FFP should be guided by coagulation tests, but aimed at maintaining the INR/APTR at < 1.5.
* Early use of FFP may avoid the need for cryoprecipitate but if fibrinogen levels are low (at or below 1.5 g/l) cryoprecipitate should be given. 5 units of FFP contain the same quantity of fibrinogen as 2 pooled units of cryoprecipitate.
* FFP takes approximately 20 minutes to thaw; infusion should be completed within 4 hours of thawing.

## **5.9** **Cryoprecipitate/Fibrinogen Concentrate**

* If fibrinogen levels remain critically low (<1.5 g/l or <2g/l for obstetrics patients) on a laboratory or ROTEM sample, 2 packs of pooled cryoprecipitate should be given. This will typically raise the plasma fibrinogen by about 1 g/l.
* Cryoprecipitate is a frozen product taking approximately 20 minutes to thaw.
* Alternatively, fibrinogen concentrate which does not need to be thawed may be used. Fibrinogen Concentrate can be issued if fibrinogen levels are <1.5 g/l, or <2 g/l for obstetric patients or on basis of ROTEM analysis. ***This is an unlicensed indication in the UK and must be given on a named patient basis on advice from a senior clinician.***  ***There is a lack of clinical trials to define safe and effective use.***
* Fibrinogen Concentrate is given at a fixed dose of 4g and the laboratory holds 6 grams. Further doses may be ordered from neighbouring hospitals but will incur a delay in provision.
* The use of prothrombin complex concentrate (PCC) is not recommended

## **5.10** **Platelets**

* Platelets should be administered to maintain a platelet count of > 75 x109 /l. Patients who have sustained major trauma or who have an intracranial injury should have a target platelet count of 100x109/l.
* A platelet count of 50x109/lor less can be anticipated when approximately 2 blood volumes have been replaced: however, individual variation is great. Anticipation of platelet requirements should allow for ‘blue light’ delivery time from Bristol (at least 1 hour).
* When platelet function is abnormal (e.g. patients who are taking aspirin, clopidogrel or dual antiplatelet therapy empirical platelet transfusion may be required.
* One adult therapeutic dose (1 ATD = 4 pooled units) should increase the platelet count by approximately 30 x 109/l. It should be given through a fresh giving set – if a giving set that has previously been used for red cells is used it may reduce the effective transfused platelet dose.
* The laboratory keeps a single unit of platelets available for emergency use. Additional platelets will need to be ordered from the NHSBT. Delivery time will be greater than 1 hour.

## **5.11 Antifibrinolytic agents**

* Use tranexamic acid where: bleeding is secondary to blunt trauma or where near patient testing (TEG/ROTEM) suggest accelerated thrombolysis; in other cases of massive haemorrhage tranexamic acid can still be used, although the evidence base is less strong

## **5.12** **Maintain normothermia**

Core temperature should be measured. Hypothermia is an important contributor to continued bleeding and adverse patient outcomes because it causes:

* *Platelet dysfunction*
* *Alteration of coagulation enzyme kinetics*
* *Enhanced fibrinolysis*
* *Increased affinity of haemoglobin for O2*
* *Increased release of red cell potassium*
* *Decreased breakdown of lactate*
* Counter current fluid warmers *(Level 1/ Belmont)* should be used in patients requiring massive transfusion
* Forced air warming blanketsor thermal blankets should be used wherever possible to keep the patient warm

## **5.13** **Anticipate a coagulopathy**

* Despite immediate appropriate intervention a severe coagulopathy may occur. This is manifested by the onset of microvascular bleeding in the operative field and oozing from venupuncture sites.
* At particular risk are:
	+ - Patients with prolonged hypoxia or hypovolaemia
		- Patients with cerebral or extensive muscle damage
		- Patients who become hypothermic.
* Obstetric haemorrhage is frequently associated with DIC
* Prolongation of the INR and APTR (>1.8) beyond that expected by dilution, accompanied by significant thrombocytopenia (platelet count < of 50x109/l and low fibrinogen (<0.80 g/l) are consistent with disseminated intravascular coagulation (DIC). Measurement of fibrinogen degradation products or D-dimers may be useful in making the diagnosis.
* Treatment consists of platelets (1 ATD), FFP (15 ml/kg) and cryoprecipitate (2 packs), given as soon as possible. Cryoprecipitate is a frozen product which takes about 30 minutes to thaw.
* Fibrinogen concentrate (4g) which does not need to be thawed may be used as an alternative to cryoprecipitate. Fibrinogen Concentrate can be issued if fibrinogen levels are <1.5 g/l, or <2 g/l for obstetric patients, or on basis of ROTEM analysis. ***This is an unlicensed indication in the UK and must be given on a named patient basis on the advice of a senior clinician. There is a lack of clinical trials to define safe and effective use****.*

## **5.14 Specific clinical situations**

### **5.14.1 Obstetrics**

* Post-partum haemorrhage is the commonest reason for massive haemorrhage in the RD & E hospital. Management of obstetric haemorrhage should follow the above guidelines but particular emphasis should be placed on early measurement of fibrinogen levels. Fibrinogen levels increase during pregnancy and are around 6 – 8 g/l at delivery. A fibrinogen level of 2 – 3 g/l, which would be reassuring in a non-pregnant individual represents significant blood loss in a PPH. Fibrinogen supplementation should be administered when fibrinogen levels are < 2 g/l and there is ongoing bleeding.
* Severe PPH increases the risk of post-partum VTE. Thromboprophylaxis should be administered as soon as possible once PPH has ceased.

### **5.14.2** **Patients on anticoagulants or antiplatelet agents**

* These are often complex situations, contact the on- call haematologist.
* For reversal of anticoagulation in patients on warfarin or heparin, please refer to the linked policy [Reversal of anti-coagulation Policy](https://hub.exe.nhs.uk/_resources/assets/attachment/full/0/6844.pdf)
* For reversal of anticoagulation in patients on Novel Anticoagulants, please refer to the Summary of Product Characteristics (SPC) for each individual drug
* For patients on antiplatelet drugs, platelet function will be abnormal though platelet count may well be normal. In these patients e.g. patients who are taking aspirin, clopidogrel or dual antiplatelet therapy, empirical platelet transfusion may be required.

### **5.14.3** **Trauma Code Red (for ED staff only)**

* ED may call a Trauma Code Red if a patient with likely haemorrhagic shock, due to trauma, is expected, or has arrived, in the department in accordance with the ED Trauma Code Red flow chart.
* ED staff must bleep 227 and inform the laboratory staff that a Trauma Code Red is required.
* 4 units of group A FFP will be immediately thawed.
* Two emergency O RhD Negative red cells and 4 emergency A FFP will be supplied in blood boxes for collection from the laboratory.
* The blood boxes are only valid for a maximum of 4 hours; the time before which the blood/FFP must be transfused or returned to the laboratory will be clearly stated on the luggage tag attached to the box. The blood box is sealed and this seal must only be broken if the blood is to be transfused, blood returned to the laboratory in a box with a broken seal will be discarded and a re-charge for wastage will be issued.
* To ensure legal traceability of blood components the BloodTrack Tx system **must** be used for administration of red cells and FFP.

## **5.15 Administration of blood components**

Ideally all blood components, including uncrossmatched group O units, should be administered using the electronic blood tracking Tx system, in accordance with the [Transfusion Policy](http://qps-prd-app02/QPulseDocumentService/TRANSFUSIONPOLICY), to ensure patient safety.

In the unlikely event that the Tx system is not used to administer the units during a massive haemorrhage, the blood component units **must** be assigned to the patient using the Tx system retrospectively to ensure full traceability of all blood components transfused.

# 6. AFTER THE EVENT IS OVER

Once the event is complete i.e. once haemostasis is achieved with a normotensive patient, or once aggressive treatment has been stopped, or in the event of the patient dying, **inform the laboratory with the phrase ‘The massive haemorrhage protocol for (patient name and ID) is no longer active’** – this may prevent further blood products from being wasted/transported.

# 7. AUDIT

Audit of major haemorrhage is essential to assess adverse events, timeliness of blood product support, patient outcome and component wastage. The Transfusion Doctor will review the significant massive haemorrhage cases after the event and complete the attached audit form; significant massive haemorrhage events (greater than 4 units of blood and 4 FFP transfused) will be reviewed at the subsequent Hospital Transfusion Team meeting and/or Patient Blood Management Meeting.

# 8. REFERENCES

Hunt BJ, Allard S et al. A practical guideline for the haematological management of major haemorrhage. *Br J Haematol* 2015;**170:**788-803

CRASH-2 www.thelancet.com **Published online June 15, 2010 DOI:10.1016/S0140-6736(10)60835-5**

**NPSA Rapid Response Report October 2010**

# 9. ASSOCIATED TRUST POLICIES

[Transfusion Policy](http://qps-prd-app02/QPulseDocumentService/TRANSFUSIONPOLICY)

[Reversal of anti-coagulation Policy](http://ian.exe.nhs.uk/EasySiteWeb/GatewayLink.aspx?alId=201488)

# 10. PUBLICATION DETAILS

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| **Date written** | *21/03/13* |
| **Date revised** | *January 2018* |
| **Approving body and date approved** | *Patient Blood Management Group, 19/05/2016**Clinical Audit and Guideline Group, 01/07/2016* |
| **Version** | *6.0* |
| **Replaces version number** | *5.0* |
| **Review date** | *11/01/2020 (3-6 months prior to expiry date)* |
| **Expiry date** | *11/01/2020* |
| **Date document becomes live** | *11/01/2018* |

# Appendix 1: Assessing degree of blood loss



# Appendix 2: Blood Volume estimation

Adult 70 ml/kg

Child 80 ml/kg

Neonate 90 ml/kg