Blood transfusion and the Massive Haemorrhage Protocol

Key teaching points – cover as much as you can in the allotted time

1. How to activate the MHP
    - Ask students "*how would you activate the massive haemorrhage protocol*" – allow phase one/allied health to answer first as clinical years will know this
    - Explain process:
        - Call 2222 from any hospital phone – this will connect you to the emergency switchboard.
        - Tell them you have a "*massive haemorrhage in [location]*"
            - Type of emergency (massive haemorrhage) and location must be very specific as the operator is not clinical staff and will likely not know the hospital well.
            - E.g. ***"we have a massive haemorrhage in bed 1, bay 2, ward 15 (AMU), level 5, Balmoral Building, Leicester Royal Infirmary"*** – saying "*we have a massive haemorrhage in AMU bed 1*" is not enough.
        - Blood bank gets activated and they will call you back immediately
        - You must explicitly tell them ***"I am declaring a massive haemorrhage"***
        - Then specify the type (e.g. traumatic, obstetric) and provide any relevant details
        - They will tell you where to send your porter/runner to collect blood products from, and stay in constant contact
2. What gets delivered in MHP packs
    - Ask students "*where can you get blood from immediately while you wait*"
        - Emergency O negative blood is available from various locations:
            - LRI – Transfusion Lab, Level 2, Sandringham Building (2 units), Maternity unit (2 units), Central Operating Department (2 units), **ED Resus (4 units)**
            - Glenfield - Pathology (4 units), outside CICU (6 units)
            - Leicester General - Pathology (4 units), Maternity Unit (2 units)
    - Blood bank will start issuing O negative blood immediately in the first MHP pack
    - Once blood samples have been sent off, typed and cross-matched blood will be available within 20 minutes
    - Packs of blood products will be sent continuously every 15 minutes until you call blood bank and tell them ***"massive haemorrhage protocol stand down"***
    - Blood products are sent in packs, as below. If emergency blood is used first, give more blood to make up the equivalent of MHP 1, then start from MHP 2 onwards as normal
    - FFP/platelets/cryo are essential to avoiding dilutional coagulopathy

MHP 1

	Red cells
>50kg	4 units
31-50kg	3 units
10-30kg	2 units
<10kg	1 unit

MHP 2 trauma

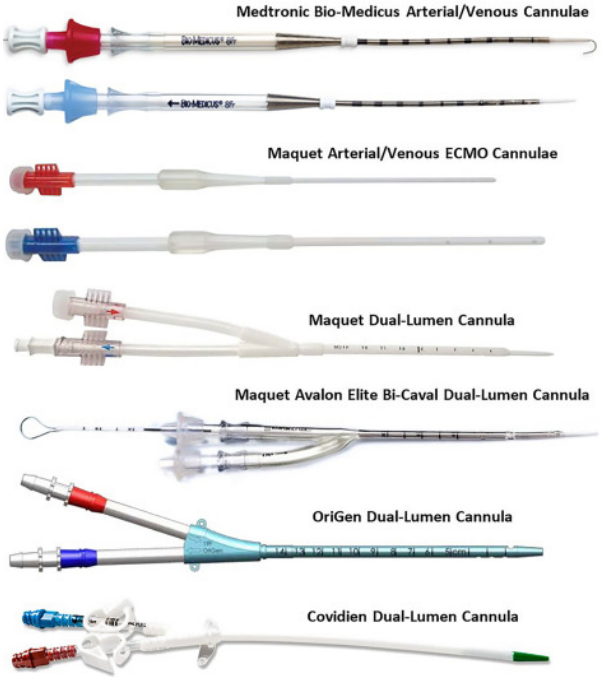
	Red cells	FFP	Plt
>50kg	4 units	3 units	1 ATD
31-50kg	3 units	2 units	1 ATD
10-30kg	2 units	2 units	1 ATD
<10kg	1 unit	1 unit	1 ATD

MHP 3 and all subsequent packs

	Red cells	FFP	Platelets	Cryo
>50kg	4 units	3 units	1 ATD	2 pools
31-50kg	3 units	2 units	1 ATD	5 paed units
10-30kg	2 units	2 units	1 ATD	2 paed units
<10kg	1 unit	1 unit	1 ATD	1 paed unit

3. What are the different blood products and what do they do
    - Ask students what blood products they know of and what they contain
    - The most important products are:
        - **Packed Red Cells** - red blood cells – replace blood volume and, importantly, can carry oxygen – this is why blood is far superior to fluids in haemorrhage
            - Must be ABO and rhesus D compatible – O negative is the universal donor
        - **Platelets** – platelets suspended in additive solution – aggregate and bind with fibrinogen in response to endothelial injury to form 'platelet plug' – first stage of haemostasis
            - Preferably ABO compatible but not essential – risk of reaction is very low. If using platelets suspended in plasma – must be ABO compatible or AB as with FFP below
            - Measured on MHP in adult therapeutic dose (ATD)
        - **Fresh Frozen Plasma (FFP)** – plasma containing all clotting factors and proteins – important for forming a stable thrombus from a 'platelet plug' via coagulation cascade
            - No cellular content - must still be ABO compatible as plasma proteins include antibodies (anti-A, and/or anti-B). Therefore for plasma, group AB is the universal donor (as it contains no anti-A or anti-B antibodies)
        - **Cryoprecipitate** – made from centrifuging thawed FFP – concentrated clotting components – mostly fibrinogen (also some vWF and fibronectin)
            - Fibrinogen – substrate to stable clot formation – fibrinogen is converted to fibrin (Ia) by thrombin (IIa)
            - ABO compatibility is preferred but not essential
            - May be issued in single units (from one donor) or as pooled units (1 pool = 5 units – highly concentrated cryo from multiple donors)
    - Other blood products not in the MHP, but useful to know about:
        - **Whole blood** – very rarely used – usually only if using autologous cell salvage for transfusion of patient's own blood
        - **Prothrombin complex concentrate (PCC)** – contains the vitamin-K dependent clotting factors only – used for Warfarin reversal
        - **Single factor concentrates** – specific clotting factor deficiencies
        - **Antithrombin III** – for anticoagulation
        - **Albumin** – colloid volume replacement
4. Prescribing and giving blood for rapid infusion
    - Blood should be prescribed on the UHL blood transfusion chart. This will be done by additional personnel while the blood is being given in an emergency. Stickers from the blood bags must be put into the chart
    - Blood products must all be scanned on BloodTrack (including MHP units) as this is a legal requirement – scan blood barcode and patient's barcode, confirm match
    - Blood for MHP is sent every 15 minutes so is being infused very rapidly
        - Patient must have at least 2 IV cannulas (usually more)
        - No other substances (e.g. fluids/drugs) can go through cannulas used for blood products

- Will have multiple running at once through different IV sites
- Rapid infusers are used – Belmont rapid infuser
    - Extremely powerful rapid transfusers – must be monitored at all times by a staff member assigned to transfusion – left unchecked it can deliver huge volumes and cause circulatory overload
    - Can connect many blood bags at once, usually 2 or 4 depending on the model. Can change empty blood bags while the others are still running, the machine doesn't need to stop
    - Will warm the blood
    - Flow rate generally starts at 50ml/min. In MHP is often set around 200ml/min (1 unit of packed red cells in ~ 2 minutes)
    - Max flow rate of the Belmont is 1000ml/min – human body contains ~5 litres of blood – can deliver entire blood volume in just 5 minutes
    - Only limit to flow rate is cannula size – must be grey (180ml/min) or orange (240ml/min). Larger volumes can be given by specialist ECMO cannulas which are usually inserted into the femoral vessels at the groin (flow rates up to 4,500 ml/min)



Massive haemorrhage – UHL protocol

University Hospitals of Leicester NHS
NHS Trust

- Give appropriate warmed IV crystalloid bolus
- Ensure senior staff is involved **NOW** (in children, also involve senior anaesthetist)
- **ABCDE** approach in appropriate environment
- Request / transfuse red cells if indicated, using O neg emergency blood if necessary
  NB: Inform Blood Bank if emergency blood is used to ensure the units are replaced

- Attempt to control the bleeding, e.g.
  - Direct pressure on wounds / nose if epistaxis
  - Pelvic binder for suspected unstable pelvic #
  - Limb tourniquet where indicated
- Consider giving tranexamic acid (see box 1)
- Reverse any anticoagulation

See INsite for 'Prothrombin complex concentrate' (B15/2018) and 'DOAC reversal in bleeding patients' (C13/2017) guidelines

- Arrange cell salvage where available (see box 2)
- Beware hypothermia - use fluid warming devices and forced-air warming blanket (e.g. 'Bair Hugger')
- Send off all necessary blood samples (see box 4)

Senior decision maker (e.g. trauma team leader) decides to declare massive haemorrhage (see box 3)?

N → Protocol not applicable; revisit later if indicated

Y

Nominate a 'Blood Bank coordinator' for the duration of the incident (**NB**: Inform laboratory if this changes)

- Coordinator to dial **2222** and say 'Massive haemorrhage in [state exact location, e.g. ED Emergency Room Bay 8]' (switchboard will fast bleep blood transfusion laboratory)
- When Blood Bank staff call back, coordinator should say '**Massive haemorrhage DECLARED**' and state all relevant **details**
- Blood bank will advise where to send porter

Details should include

- Coordinator's own name
- Name of senior clinician responsible for patient
- Incident location (e.g. 'ED Emergency Room Bay 8')
- Extension number (in the ER, state extension in Bay)
- Type of haemorrhage (i.e. trauma, obstetric or other)
- Patient's details (if already known, or say 'unknown')

Inform your consultant **NOW** if not yet involved

Blood transfusion staff prepares and issues packs of blood components (**MHP**; massive haemorrhage pack – see next page for details) every 15min

Bleeding controlled? Y → (to Blood Bank)

N

Administer **MHP** (all or partially, as per senior clinical judgment)

- Follow through bleeding control measures (see box 5)
- Repeat laboratory test bundle (see box 4)
- Make any necessary goal-directed corrections (see box 6)
- Actively look for hyperkalaemia if >6units of red cells transfused
- Consider 1g calcium chloride (e.g. 10mL of 10%) after every MHP

Involve haematology on-call doctor

Blood Bank to call coordinator 15min after each **MHP** released

N Bleeding controlled? Y

- Coordinator calls Blood Bank, stating '**Massive haemorrhage protocol STAND DOWN**'
- Return all unused components within 2 hours
- Complete goal-directed adjustments (see box 6)

Blood Bank

Site	Extn	Bleep
LRI	6605	4703
GGH	3577	2588
LGH	4564	3383

① Giving tranexamic acid

In adults, give

- 1G (i.e. 10mL) neat as slow bolus over 10min, **followed by**
- 1G (10mL) in 0.9% NaCl 90mL over 8h (i.e. set infusion pump to deliver 12.5mL/h)

In children, give

- 15mg/kg bolus (max 1G), **followed by**
- 2mg/kg/h for 8h in a suitable volume of 0.9% NaCl

NB: In trauma, use caution if >3h from injury

② Cell salvage

Cell salvage machines are available from

LRI
- Equipment room near Theatre 6 (Balmoral Building)
- Obstetric theatre (Kensington building)

GGH
Cardiac theatres and orthopaedic theatres

LGH
Main theatres and obstetric theatres

NB: For every 1L of salvaged red cells ensure replacement of other blood components as followed:

- FFP 3 units
- Platelets 1 Adult therapeutic dose (ATD)
- Cryoprecipitate 2 pools (after 2L)

③ When to declare

Typical scenarios include (but are not limited to)

- Clinically obvious severe traumatic bleeding or collapse
- Haemorrhagic shock (e.g. systolic BP <70 initially or <90 after fluid bolus)
- ≥4 units (in children: ≥20mL/kg) red cells transfused within an hour **AND** similar further needs anticipated
- Bleeding rate 150mL/min
- 50% total blood volume loss in 3h

④ Laboratory test bundle

- Laboratory tests
  - FBC, U&Es, ionized Calcium, INR, APTT and fibrinogen
  - LFT and G&S **initially**
- Venous blood gas – machines available in

LRI	ED	AMU	ITU
GGH		CDU	CICU
LGH			ITU

- Additional *(depending on local availability)*
  - FBC or Hb (HemoCue)
  - Thromboelastography (TEG)

⑤ Bleeding control measures

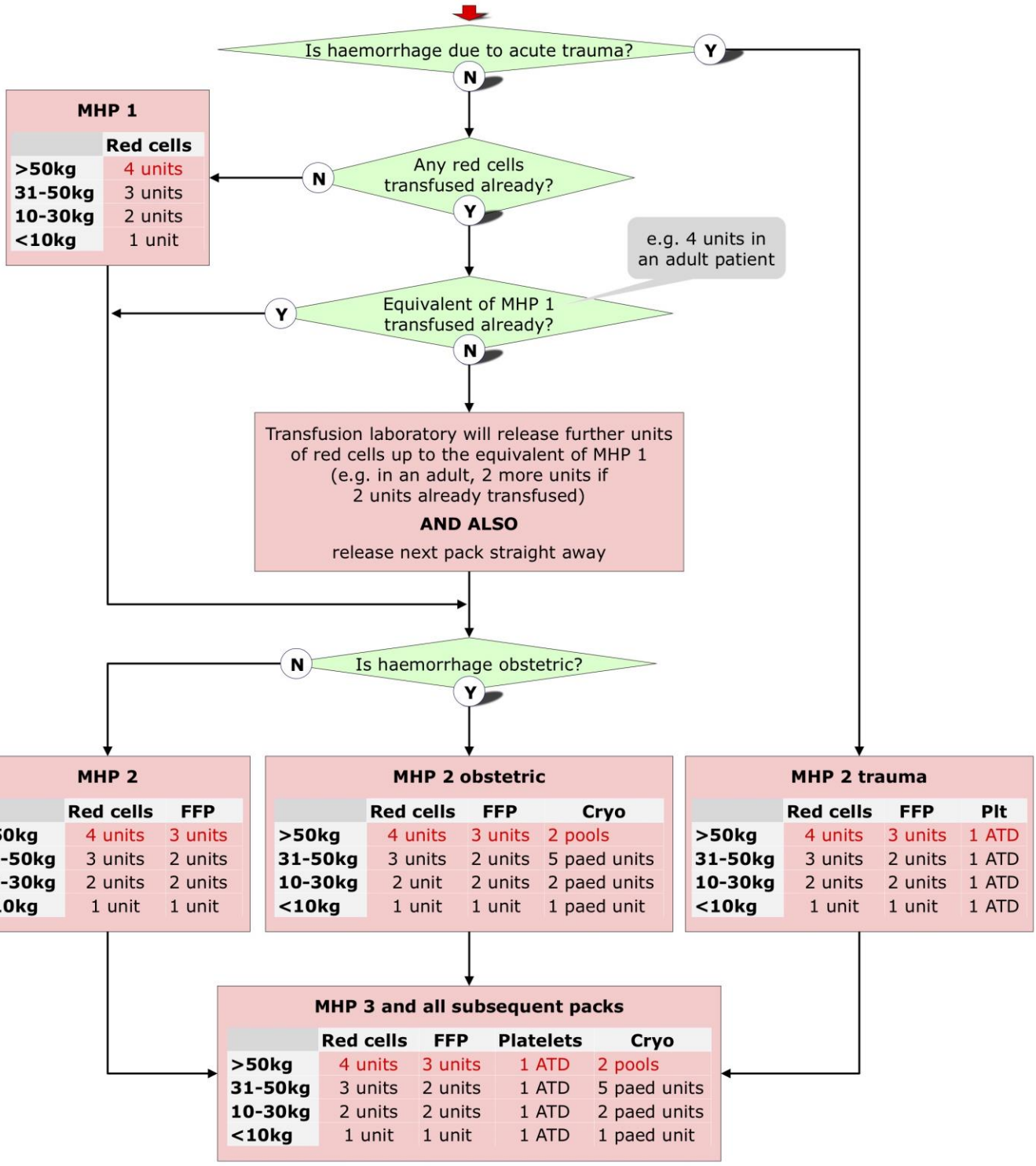
- **For postpartum haemorrhage**
  See guideline C38/2011 on PAGL
- **For antepartum haemorrhage**
  See guideline C39/2011 on PAGL
- **For massive gynaecological haemorrhage**
  See guideline C80/2007 on PAGL
- **For acute upper GI bleeding**
  See guideline C33/2002 on PAGL
- Consider interventional radiologist advice (e.g. for arterial embolization in pelvic fractures)
- Consider 'damage control surgery'
- Haematology duty doctor can advise on use of
  - Prothrombin Complex Concentrate (PCC)
  - Idarucizumab (Praxbind) – see C13/2017
  - Recombinant activated Factor VII (rFVIIa) – see Blood transfusion policy - Appendix 8

⑥ Goal-directed corrections

***NB**: In children, involve anaesthetist ASAP to advise on appropriate dosing*

- **If fibrinogen <1.5 (<2.0 in obstetrics)**
  Give Cryoprecipitate 2 adult pools
- **If ionized Calcium <1.1**
  Give Calcium Chloride 10% 10mL IV over 3min
- **If platelets <80**
  Give 1 adult therapeutic dose (ATD) of platelets; give 2 ATD if platelets <30
- **If TEG trace abnormal**
  Give appropriate products as guided by TEG treatment algorithm
- **If INR or APTT >1.5 (NB: use these only in those areas where no TEG available)**
  Give FFP 4 units

Massive haemorrhage pack (MHP) release sequence



Notes to clinicians

- If cross-matched blood not yet available, red cells will be provided as
  - O negative (women aged <50 and children) or O positive (men); available immediately (**NB**: In this situation, the clinical urgency will outweigh any concerns about the untested possible presence of atypical red cell antibodies)
  - Group specific (available within 20min)
- Cryoprecipitate and FFP will require defrosting – this takes about 20min
- In children, transfusion of **5mL/kg** red cells will typically raise Hb by **10g/L**