Blood and Components, Safe and Appropriate Use

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Topics to be covered

- Red blood cells
  - Compatibility procedures
  - Risks and adverse events
- Platelet
- Plasma (Fresh Frozen Plasma and cryoprecipitate)
- Autologous blood and cell salvage
Figure 2: Production of blood components and plasma derivatives

Test for:
- HIV
- Hepatitis B
- Hepatitis C
- HTLV
- Syphilis
- ABO + RhD
- Other phenotypes
- Red cell antibodies (CMV, HbsS, malaria)

Education
Recruitment
Selection
Donation

Process into blood components

Filter to remove leucocytes

Red cells
Pooled platelets
Fresh frozen plasma

Plasma (from non-UK source)

Fractionation

4°C 35 days
Confirm compatibility

22°C 5 days
(Pool)

-30°C 24 months
(Thaw)

Patient

Plasma derivatives, e.g. albumin, immunoglobulin
Red Blood cells (RBC)
RBC

- Indicated for treatment of anaemia

- In the UK, all RBC are leucodepleted

- Contains ~20 mL of plasma and SAGAM (saline, adenine, glucose and manitol)

- Stored up to 35 days at +2-6°C
RBC MUST be compatible with the recipient’s ABO (and usually RhD type)

<table>
<thead>
<tr>
<th>Patient’s ABO blood group</th>
<th>Patient’s plasma</th>
<th>RBC that are compatible</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>Anti - A, -B</td>
<td>O</td>
</tr>
<tr>
<td>A</td>
<td>Anti - B</td>
<td>A, O</td>
</tr>
<tr>
<td>B</td>
<td>Anti - A</td>
<td>B, O</td>
</tr>
<tr>
<td>AB</td>
<td>Neither</td>
<td>AB, O</td>
</tr>
</tbody>
</table>
Compatibility procedure

- Group & Screen (tests for patient’s ABO and RhD type and the presence of Anti A, - B or - AB in the plasma)

- Crossmatching (above testing + confirm compatibility with each of RBC units to be transfused)

- Electronic issue (computer crossmatch)
  - ABO and RhD typing confirmed on the 2\textsuperscript{nd} sample
  - No RBC allo antibodies
  - Patient’s ID is reliable
Right Blood, Right Patient, Right Time, Right Place

- Competency assessment
- Patient Identification and Consent
  Sample labelling

- *Wristband Identification*
  - The patient!
  - The Blood label
  - Prescription chart
  - Notes
Acute transfusion reaction due to ABO mismatch

\[ \text{Ab} + \text{Ag} + C' \rightarrow \text{haemolysis} \rightarrow \text{thromboplastic substances} \rightarrow \uparrow \text{coagulation} \rightarrow \text{DIC} \]

\[ \text{C3a} + \text{C5a} \rightarrow \text{mast cells} \rightarrow \text{inflammation} \]

\[ \downarrow \text{blood pressure} \rightarrow \text{SHOCK} \rightarrow \text{RENAL FAILURE} \]

- Histamine + other vasoactive amines
- Cytokine release
- Smooth muscle contraction
- Lung oedema
- Platelet aggregation
- Vascular permeability
Delayed Haemolytic transfusion reaction
- Due to red cell Ab’s
- Rh system/ Kell/ Fy\textsuperscript{a}/ Jk\textsuperscript{b} etc
- 7 to 10 days post transfusion
- Failure of haemoglobin to rise and Jaundice
- Positive Direct Antiglobulin Test (DAT)

Febrile non-haemolytic transfusion reactions
- During or soon after transfusion
  - Fever, rise in temp > 1°C, shakes/ rigors, ± ↑ pulse
- Unpleasant but not life threatening - must exclude ‘wrong blood’ or bacterial infection
Allergic Reactions

- **Urticarial Rash ± wheeze**
  - Often not severe
  - Hypersensitivity to a ‘random’ plasma protein

Anaphylaxis

- Severe, life-threatening reaction soon after transfusion started
  - Wheeze/ asthma, ↑ pulse, ↓ BP (shock)
  - Laryngeal oedema/ facial oedema
  - IgA deficiency
Other Immune risks

PTP (Post Transfusion Purpura) - rare
- 7-10 days after transfusion (blood or platelets)
- HPA 1 negative patients forms antibodies after transfusion or pregnancy
- After further transfusion, destruction of own platelets

Transfusion Associated Graft-Versus-Host Disease
- Rare, but always fatal
- Mediated through viable lymphocytes in Donor’s blood transfused to an immunocompromised host
# Infective risks of Blood Transfusion

<table>
<thead>
<tr>
<th>Infection</th>
<th>Testing started</th>
<th>Risk of infection per unit of blood 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>1975</td>
<td>1 in 850,000</td>
</tr>
<tr>
<td>HIV</td>
<td>1985</td>
<td>1 in 6 million</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>1991 &amp; 1998</td>
<td>1 in 51 million</td>
</tr>
<tr>
<td>(Anti HCV and NAT testing)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Haemovigilance

- Serious Acute Reactions and Events
  - Mandatory reporting to MHRA (Medicines and Healthcare products Regulatory Agency) under Blood safety and quality regulations

- Reporting to Serious Hazards of Transfusion (SHOT)
Maximum Surgical Blood Order Schedule (MSBOS)

- developed using **local audit** of crossmatched to transfused ratios per procedure
- allows more efficient use of blood stocks and reduces wastage

<table>
<thead>
<tr>
<th>Procedure</th>
<th>no of units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caesarian</td>
<td>G&amp;S</td>
</tr>
<tr>
<td>Myomectomy</td>
<td>2</td>
</tr>
<tr>
<td>Hip replacement</td>
<td>G&amp;S</td>
</tr>
<tr>
<td>Hip revision</td>
<td>2</td>
</tr>
<tr>
<td>Knee bilateral</td>
<td>2</td>
</tr>
<tr>
<td>Anterior Resection</td>
<td>3</td>
</tr>
<tr>
<td>Appendicectomy</td>
<td>G&amp;S</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>G&amp;S</td>
</tr>
<tr>
<td>Fem-pop bypass</td>
<td>2</td>
</tr>
</tbody>
</table>

An example MSBOS
Pre-operative assessment - anaemia

- Pre-op haemoglobin <120 g/L increases likelihood of transfusion three fold

- Iron deficiency major public health issue
  - estimated prevalence of anaemia 4.1% in men and 10.8% in women in UK

- Patients must be assessed at least 4 weeks prior to surgery to allow time to address anaemia.

- If confirmed to be iron deficient treat with oral iron or if non responsive or intolerant intravenous iron

- Look for cause of iron deficiency
Platelets
Platelets

- Can be either from
  - Buffy coat from whole blood donation
  - 4 pools = 1 dose
  - Single donor Apheresis

- All leucodepleted

- Stored at 22°C with gentle agitation for up to 7 days
Platelet: Clinical Indication - 1

- Lack of evidence base for guidelines

- Bone marrow failure
  - To prevent spontaneous bleeding when platelet count <10 × 10^9/litre
  - or <20 × 10^9/litre if there is an additional risk, e.g. sepsis

- Prophylaxis for surgery
  - Minor procedures 50x10^9/l;
  - More major surgery 80x10^9/l; CNS or eye surgery 100x10^9/l
  - Epidural - BCSH ITP guidelines 80x10^9/l
Platelet: Clinical Indications - 2

- **Cardiopulmonary bypass**
  - Platelets should be readily available
  - Use platelets only if bleeding

- **Abnormal Platelet Function; antiplatelet drugs**

- **Neonatal alloimmune thrombocytopenia**
  - high risk intracranial haemorrhage
  - HPA 1a neg, 5b neg platelets for emergency use
Plasma
Fresh frozen plasma (FFP) - UK specification

- From whole blood donations (or apheresis), separated & frozen to -30°C within a few hours of collection
- Leucocyte depleted by filtration
- Source of clotting factors
- Specification: 75% of units to contain 0.7iu/ml factor VIII
- Shelf life 24 months at -30°C
- Post-thaw shelf life 4 hours at room temp OR 24 hours at 4°C
Methylene Blue FFP and Solvent Detergent FFP

- **Methylene Blue**
  - Photodynamic process-oxygen radicals
    - MB + white light
  - Single units
  - Sourced from US
  - For Children born after 1.01.1996

- **Solvent detergent**
  - SD dissolves lipid coated viruses
  - Needs POOLING of 500-1000 donations
  - Non UK plasma
  - Plasma exchange for TTP
  - Commercially from Octapharma- ‘Octaplas’
Guidelines for FFP use

- Acute DIC with bleeding
  - Surgical bleeding
  - Massive haemorrhage
  - Liver disease – bleeding, procedures

- Dose FFP 10 – 15 ml/kg
  - Monitor coagulation

- FFP should not be used to reverse warfarin- use PCC

- Increase use of FFP to manage major bleeding episodes, particularly trauma; evidence is lacking
Cryoprecipitate

- Cryoglobulin fraction of plasma obtained by thawing FFP at 4°C
- Contains FVIII, vWF, fibrinogen
- Stored at -30°C; Post thaw shelf life 4hrs at room temp
- Current clinical use – replacement fibrinogen
  - In UK, fibrinogen concentrate does not have a license for use in massive haemorrhage
Autologous blood and cell savage
Use of Autologous blood

- **Pre-operative Autologous Donation**
  - no longer routinely recommended or available UK
  - no evidence that patients receive any less donor blood
  - It is only used in rare cases of unusual antibody formation, or if patients have rare blood group that we cannot provide blood for

- **Acute Normovolaemic Haemodilution (ANH)**
  - A meta-analysis showed only modest benefits
  - Technique not currently encouraged
Use of Intra-operative Cell Salvage reduces demand on donor red cells and is a cost effective

Need resources to set up and maintain an ICS service in a safe, appropriate and cost effective manner:

- clinical lead
- member of theatre management team responsible for ensuring overall management
- training and competency
- documentation and audit

www.bloodsavers.com
Example of blood component use for Management of major haemorrhage at the Royal London Hospital
SENIOR MEMBER OF TRAUMA TEAM LEADER MUST DECLARE **CODE RED** if:

- Systolic BP < 90
- Poor response to initial fluid resuscitation
- Suspected active haemorrhage

**Take baseline blood samples prior to transfusion for:**

- FBC, G&S, clotting screen and fibrinogen, Near patient testing – ABG, FBC and ROTEM

**Nominate a member of team to call blood bank on 61108 to activate **CODE RED**

State “patient unique identifier & CODE RED TRAUMA”

Request:

-EITHER “CODE RED PACK A” (contains: 6 units RBC, 4 units FFP) OR

“CODE RED PACK B” (contains: 6 units RBC, 4 units FFP, 1 unit platelets, 2 pools cryoprecipitate)

- Send porter to lab to collect pack immediately
- Take Immediate Blood Transfusion (red cells) from RESUS fridge

- Use O NEG units in females or O POS units in males
- Use group specific blood as soon as available
- Check Ca++ levels after 6 units of RBC
Check if bolus dose of Tranexamic acid (TxA) has been given by HEMS team prior to arrival in ED

Give bolus of 1g IV TxA over 10min (within 3 hrs of massive haemorrhage) followed by IV infusion of 1g over 8 hrs

**IF BLEEDING CONTINUES:**

Continue requesting one “CODE RED PACK B” until bleeding stops

Use near patient testing to determine if Ca++ therapy is required (CaCl₂ 10 mls 10% IV)

If bleeding persists after 2 x “CODE RED PACK B” Transfusion
Lab must contact the on call haemophilia SpR on bleep 1155 or via switchboard out of hours

If bleeding is controlled REPEAT FBC AND CLOTTING SCREEN and administer:

- Platelets: if count <100x10⁹/l
- Cryoprecipitate: if Fibrinogen <1.5g/l
- FFP: to maintain PT/APTT ratio <1.2x normal
- Keep Temp >36°C and Ca+ >1.0
References

- Local policies based on national guidance
- British Committee for standards in haematology
  - www.bcshguidelines.com
- The Association of Anaesthetists of Great Britain and Ireland
  - www.aagbi.org
- Handbook of transfusion medicine
  - www.transfusionguidelines.org.uk
  - Hospital Transfusion Policy
  - Investigation of Transfusion reactions
  - Clinical use of Red Cells, Platelets and plasma
  - Massive haemorrhage