MAKUP: Outline the complications of massive blood transfusion

General: Transfusion of a volume of stored blood greater than the recipient’s blood volume in less than 24 hours

Complications

**Citrate toxicity** / ↓Ca²⁺
- Citrate chelates Ca²⁺
- Signs / Symptoms related to ↓Ca²⁺: involuntary mm tremor; ↓HR; widened ST segment; prolonged QT
- Treatment: if ECG changes → CaCl₂

**Hyperkalaemia**
- RBC in storage lose cell integrity, ↓ function Na⁺/K⁺ATPase → ↑ extracellular K⁺
  - Up to 30 mmol/L at 28 days
- Na⁺/K⁺ATPase function regained after transfusion → K⁺ diffuses into RBC → not a clinically significant problem
  - May be if Pt already hyperkalaemic / acidotic

**Acidosis**
- pH blood at 2 weeks storage → 6.5-6.8
  - May exacerbate existing acidosis in Pt
- Citrate metabolised in liver on transfusion → HCO₃⁻
- Lactate (Emden-Meyerhoff glycolytic pathway) → metabolised to pyruvate in Cori cycle

**Hypothermia**
- Blood stored at 4°C
- If transfused rapidly → ↓ T°C of patient
  - Each unit transfused at 4°C → ↓ Core temp by 1°C
- <28°C → VF; left shift OHDC (Bohr effect); aggravation ↑K⁺ / citrate toxicity

**2,3-DPG deficiency**
- During storage, 2,3 DPG depleted (almost zero at 4 weeks)
  - Left shift OHDC → ↓O₂ delivery to tissues
- Rapidly replenished by 24 hours post-transfusion
- CPD-adenine preservative minimises this

**Dilutional Coagulopathy**
- Stored blood has low levels Factor V, VIII, XI
- Dilution of Pt coagulation factors occurs if total body blood vol replaced >2 in 24 hours
- Platelets in stored blood dysfunctional at 48 hours storage
  - Also dilution of Pts platelets

**TRALI (transfusion related acute lung injury)**
- Acute onset of non-cardiogenic pulmonary oedema within 6 hours of transfusion
  - Incidence 1:5000 (US), mortality 9% → 1° transfusion related death in US
- Typically associated with FFP, can occur in RBC 2° residual plasma in unit
- May be immune-mediated

By Amanda Diaz
Antibodies against HLA (human lymphocyte antigen) or HNA (human neutrophil antigen) → sensitisation from previous transfusion / transplant
- Multiparous women → develop antibodies after exposure to fetal blood

“2 hit hypothesis”
- 1\textsuperscript{st} hit: existing pulmonary pathology → localisation of neutrophils in pulmonary vasculature
- 2\textsuperscript{nd} hit: Antigen laden blood transfused → attach to neutrophils → degranulation → release of vasoactive substances

Non-immune mediated hypothesis
- Accumulation of bioactive lipids in stored components with neutrophil priming capabilities

**Microaggregates**
- Clumps of fibrin, platelets, leukocytes formed in stored blood
  - When transfused → lodged in microvasculature of lung → release lysosomes → ARDS

**Volume overload**
**Haemosiderosis**
**Blood-borne infection**
**DIC**
\(\downarrow\text{Mg}^{2+}\)