

Transfusion Medicine

2009A7: Outline the coagulation changes occurring from liver rupture requiring massive transfusion and how to minimise them.

Massive transfusion is defined as > 1 blood volume (~ 10 units) transfused in 24 hours, or > 150mL/min blood loss.

Coagulation changes:

1. Secondary to injury
 - a. Release of tissues factor (TF) → complex with factor VIIa → coagulation cascade → thrombin formation
 - b. Fibrinolysis: in presence of massive bleed, plasminogen → plasmin causing breakdown of fibrin at site of injury, and then widespread afterwards.
 - c. Consumption coagulopathy: widespread haemostasis consuming factors and fibrinogen
 - d. Hypothermia: ↓ platelet and clotting factor function < 35°C
 - e. Hypovolaemia: haemorrhagic shock → hypoperfusion → anaerobic metabolism and lactic acid formation → impaired coagulation
2. Secondary to transfusion
 - a. Hypothermia
 - b. Dilutional anaemia: initial infusion of crystalloid
 - c. Dilutional thrombocytopenia and coagulopathy: RBC volume infusion deplete of platelets and clotting factors
 - d. Hypocalcaemia: storage lesion of blood and citrate toxicity (metabolised in liver), unlikely to cause coagulopathy, but results in myocardial depression → impaired perfusion → lactic acidosis
3. Biochemical results:
 - a. Coags: ↑APTT/PT, ↑INR, ↓ fibrinogen, ↑D-dimer
 - b. FBC: ↓Hb, ↓ plts
 - c. EUC/CMP: ↑ K, ↓ Ca
 - d. Abnormal TEG

Minimise:

1. Blood products: activate MTP → aim Hb >80, platelets > 50, fibrinogen > 1.0g/L
 - a. Research suggests 1:1:1:1 ratio of PC:plts:FFP:cryo
 - b. Activated factor VII 80mg/kg
 - c. Tranexamic acid 1g IV over 10min, then 1g over 8 hours
2. Anaesthetic:
 - a. Normothermia: air warmer, fluid warmer, warm wash, warm theatre
 - b. Correction of anaemia – Hb > 80g/L and Hct > 0.3 → allow platelet streaming and adhesion to endothelium.
 - c. Acid base correction – pH > 7.3 with bicarbonate
 - d. Normal electrolytes - Ionised Ca > 0.9mmol/L, IV Ca gluconate
 - e. Cell saver

3. Surgical: control bleeding to minimise further transfusion
 - a. Site control by compression, ligation
 - b. Interventional radiology

2010A4: Describe the pathophysiological changes associated with a haemoglobin of 75 g/L. Outline the patient factors that would indicate the need for a perioperative red blood cell transfusion in a patient with a haemoglobin of 75 g/L.

Pathophysiological changes of anaemia (Hb < 120g/dL)

1. O₂ delivery: reduction of global O₂ flux by half → ↓O₂ delivery → tissue hypoxia
2. Systemic Compensation:
 - a. CVS:
 - i. Systemic: initially, ↑ in SV when later ↑HR with more severe anaemia
 1. ↑ cardiac output - ↑HR, ↑ contractility (SNS activation), vasoconstriction
 2. ↓ viscosity of blood → ↓ afterload, ↑ preload
 - ii. Local: autoregulation to ↓ resistance and ↑ flow
 1. Neural
 2. Hormonal
 3. Metabolic
 4. Myogenic
 5. ↑O₂ extraction (cannot further increase in CNS, myocardium)
 - b. Respiratory:
 - i. Hypoxia → ↑2,3 DPG, acidosis → Shift O₂ curve right
 - c. Renal: ↑ EPO

Patient Indications for transfusion: generally transfuse < 70g/L, avoid if >100g/L. TRICC trial (NEJM 1999) showed no difference in mortality between liberal (<100g/dL) and restrictive. This suggests that an absolute Hb concentration is not a good indication. The key determinant is impaired O₂ delivery to tissues.

1. Evidence of tissues hypoxia:
 - a. Rising Lactic acidosis
 - b. ↓ SvO₂
2. ↑ further blood loss expected:
 - a. Ongoing bleeding (trauma, post-operative)
3. ↑ O₂ / perfusion requirements:
 - a. Ischaemic heart disease, Cerebrovascular disease
 - b. Sepsis, burns, trauma
4. ↓ Compensatory ability
 - a. Duration: acute blood loss decompensates > chronic
 - b. Cardiac: CCF, bradyarrhythmias
 - c. Respiratory:
 - i. lung disease causing hypoxaemia
 - d. Haematological: ↓ ability for erythropoiesis
 - i. Fe deficiency

- ii. Bone marrow dysfunction
 - iii. Renal failure
- 5. Environmental:
 - a. Availability of blood
 - b. Availability of other measures:
 - i. Surgical treatment
 - ii. Cell saver
 - iii. Colloids
- 6. Consider risks of transfusion
 - a. Appropriate and safe cross matching available
 - b. Immunocompromised, cancer