

Massive transfusion

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Definition

- Massive transfusion, defined as the replacement by homologous transfusion of more than 50 percent of a patient's blood volume in 12 to 24 hours
- Total volume ??

Alternate definitions

OR

the replacement of 10 units of blood over the course of a few hours.

Or

Pump in a rate of 150 ml or more min^{-1}

Clinical scenario

a. Haemorrhagic shock

- Obstetric patients
- Severe trauma

b. Exchange transfusion

c. Cardiopulmonary bypass

Priorities

- **Correct volume deficit**
- **Achieve haemostasis**
- **Consider component therapy**

● Why should we be worried about massive transfusions ??

● Associated complications

● Anesthesiologists - maximum user of blood

Complications

- Acidosis
- Hyperkalaemia
- Citrate toxicity and hypocalcaemia
- Depletion of fibrinogen and coagulation factors
- Depletion of platelets
- Disseminated intravascular coagulation (DIC)
- Hypothermia
- Reduced 2,3 diphosphoglycerate (2,3 DPG)
- Microaggregates

Complications of massive transfusion

- discussed in **three** categories:

- Hypothermia

- Metabolic

- Haemostatic

Acidosis

- During blood storage, red cell metabolism generates acids. At the end of 21 days, the pH may be as low as 6.9, still
- If acidosis is present in a patient receiving a large volume transfusion,
- more likely to be result of inadequate treatment of hypovolemia than due to the effects of transfusion.

Treatment

- Usually body naturally excretes acids
- No need to administer soda bicarb

Hyperkalemia

- The storage of blood will result in a small increase in extracellular potassium
- release from red cells increases during storage, and after irradiation.
- Levels of up to 80 mmol/L- found
- More significant in neonatal exchange transfusions
- use blood less than 7 days old.

Citrate toxicity and hypocalcaemia

- Large amounts of citrate binds with calcium to reduce ionized calcium
- More than 125 ml/min
- or liver transplanted, liver diseased patients

in combination with hypothermia and
acidosis hypocalcemia $\downarrow\downarrow$ cardiac output,
bradycardia, and other dysrhythmias



“bloody vicious cycle,”

- hypothermia, coagulopathy, and acidosis
- 50% of massively transfused patients develop an INR >2.0
- 33% have thrombocytopenia
- Disseminated intravascular coagulation (DIC) occurs in 5-30% of massively transfused trauma patients.

Calcium

- Following transfusion, the anticoagulant citrate is usually rapidly metabolized to bicarbonate -- acidosis taken care of ??
- No routine calcium
- Check for arterial ionized calcium and replace
- Use red cells to decrease incidence

Depletion of fibrinogen and coagulation factors

- Blood loses coagulation factors during storage, particularly Factors V and VIII, unless stored at -25°C or colder
- Red cell concentrates & IV fluids dilute coagulation factors

PT and aPTT

- prolongation of the prothrombin time
- Use FFP – 15 ml/kg
- If the APTT is also prolonged, heat-treated Factor VIII/fibrinogen is recommended in addition to the fresh frozen plasma.

Or

- 10 -15 units of cryoprecipitate
- Cryoprecipitate contains factor VIII, the vWF, fibrinogen, fibronectin, and factor XIII.

Depletion of platelets

- Platelet function is rapidly lost during storage of blood and there is virtually no platelet function after 48 hours.
- **Massive transfusion syndrome**
 - hemorrhagic reaction to massive transfusions of platelet-poor stored blood.
 - Other clotting factors don't contribute to the condition.
 - Platelet concentrates may be given to correct the deficiency.

- Platelet concentrates should only be given when:
- Patient shows clinical signs of microvascular bleeding: i.e.
- bleeding and oozing from mucous membranes, wounds, raw surfaces and catheter sites
- Patient's platelet count falls below 50000

- Platelet transfusion should be considered in cases where the platelet
- count falls below 20 000 even without symptoms
- **No prophylactic use of platelets**

Disseminated intravascular coagulation

- Disseminated intravascular coagulation (DIC) is the abnormal activation of coagulation and fibrinolytic systems, resulting in consumption of coagulation factors and platelets
- Cause – massive transfusion or underlying disease
- Correct the cause

Clinical scenario

- If the patient is actively bleeding, transfuse to keep the platelet count $>50,000$, INR $\leq 1.5-2.0$ and fibrinogen $>1.0\text{g/L}$.
- (Head injury patients should have a platelet count $>1,00,000$).
- Component therapy (RBC, platelets, FFP, and cryo) should not be administered in a fixed ratio to the number of red cells transfused

Cool weather



Hypothermia

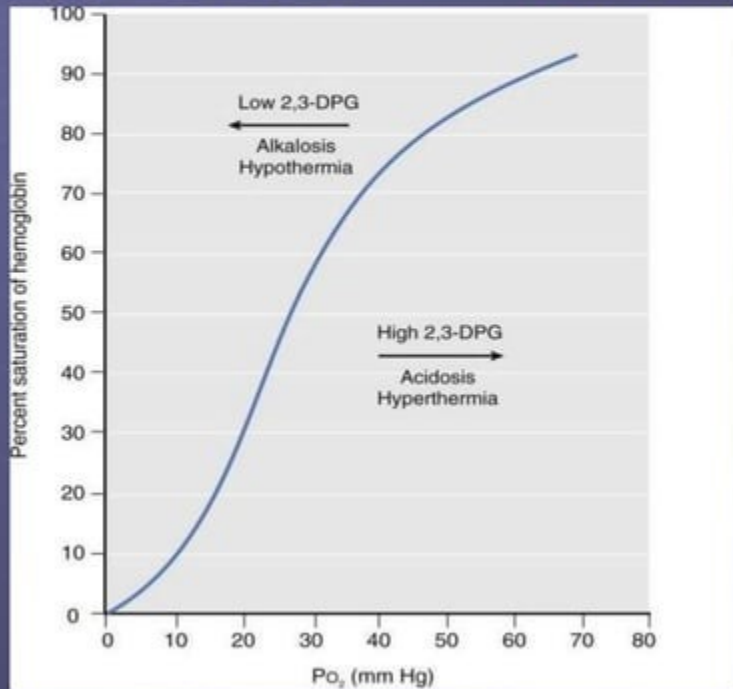
- The rapid administration of blood or fluids directly from refrigerator can result in a significant reduction in body temperature.
- Elevating the room temperature
- Surface warming the patient with heating blankets, heating lamps
- Using heated and humidified inspired gases for ventilators
- Using blood and fluid warmers for all fluids administered

Reduced 2,3 diphosphoglycerate (2,3 DPG)

- Release of oxygen ??
- Modern anticoagulant solutions ??
- Normally
- **Citrate phosphate dextrose adenine (CPDA-1) is an anticoagulant preservative in which blood is stored at 1°C to 6°C.**

- The shelf life - extended to 42 days when AS-1 (Adsol), AS-3 (Nutricel), or AS-5 (Optisol)
- Adsol contains adenine, glucose, mannitol, and sodium chloride;
- Nutricel contains glucose, adenine, citrate, phosphate, and sodium chloride.
- Optisol contains only dextrose, adenine, sodium chloride, and mannitol.

Decreased 2,3 DPG, hypothermia-- our aim



Microaggregates

- White cells and platelets can aggregate together in stored whole blood, forming microaggregates.
- Massive transfusion -- these microaggregates embolize to the lung and their presence has been implicated in the development of ARDS

- Filters are available to remove microaggregates use ??
- use buffy coat-depleted packed red cells

LRRBC

- Leukoreduced Blood and components are indicated:
- For patients who have experienced two or more non-hemolytic febrile transfusion reactions;
As a method of preventing transfusion transmitted CMV
- Appropriate filters are used to get LRRBCs

Investigations

- Hb, PCV, CVP, blood urea, sugar, electrolytes
- Temperature, ABG, ECG,
- PT, aPTT, platelet count
- XRay chest , cultures
- Urine for Hb

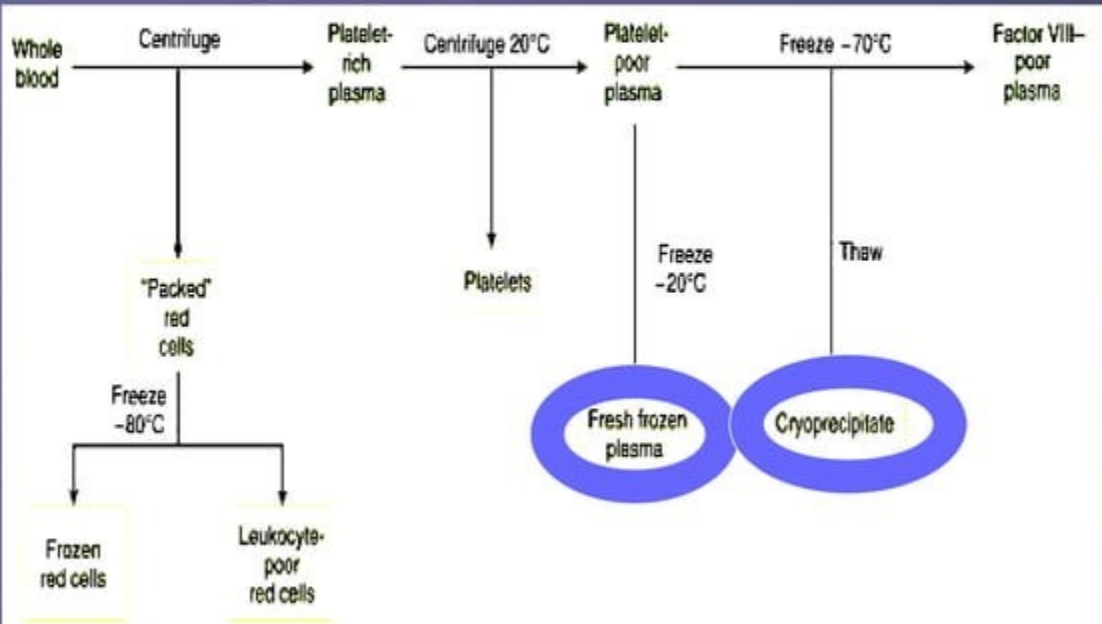
Treat the cause



Remember in massive transfusions

- It is often the underlying cause and consequences of major haemorrhage that result in complications rather than the transfusion itself.

Blood components



FFP

- FFP contains all coagulation factors in normal amounts
- NO red cells, leukocytes and platelets.
- It is not a concentrate of clotting factors. One unit is approximately 225 ml
- must be ABO compatible with the recipient's red cells,
- Rh need not be considered.

Something more about FFP – indications

- liver disease,
- anticoagulation with warfarin
- massive transfusion with red cells and crystalloid/colloid solutions
- One ml of FFP per 2.2 pounds of patient weight will raise most clotting factors by approximately 1%.

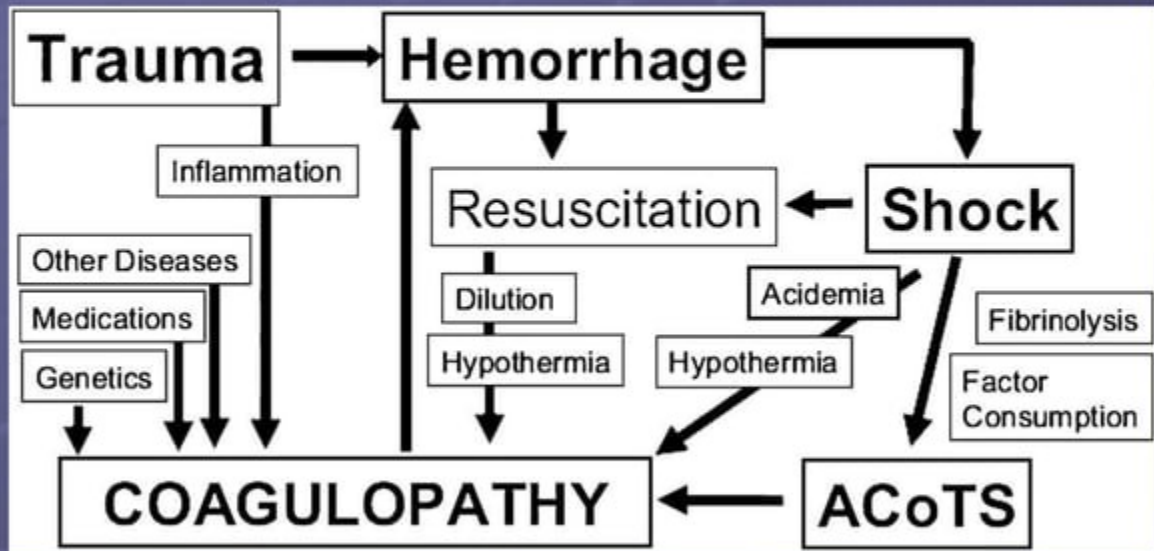
Cryoprecipitate

- Cryoprecipitate (Cryo) is a low purity concentrate of three hemostatic proteins prepared from donated whole Blood.
- A single bag of Cryo contains an average of 100 units of factor VIII and von Willebrand factor and 150 to 250 mg of fibrinogen with some factor XIII and fibronectin.
- No compatibility testing is required and ABO-Rh type is not relevant

Cryo

- Cryo can be suspended in 10 ml of saline per bag
- ten bags should provide enough fibrinogen to raise the fibrinogen 60 to 70 mg/dl in a 155 pound adult

Massive transfusion



Summary

- Definition
- Indications
- Complications
- Treat the cause
- **Priorities**

Complications

- A acidosis , aggregates
- B – blood overload
- C – calcium , citrate , cool ,
- D - DIC, DPG
- E – electrolytes – potassium ,magnesium
- F – fibrinogen and platelets
- Acute hemolytic and non hemolytic transfusion reactions, sepsis, TRALI,TACO

Salaam namasthe – thank you
all

