بنام خدا

MASSIVE TRANSFUSION

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- **Massive transfusion** is typically defined as the need to transfuse
- **more than one blood volume in a 24-hour** period (***greater than 70 mL/kg***)

  -**50% blood volume in 3 hours**, (35 mL/kg)

  -or a **transfusion rate of 10% of a blood volume every 10 minutes**

- It causes a number of physiologic derangements that can be detrimental in the patient with multiple injuries,
- Including: **coagulation defects**, **electrolyte and acid-base abnormalities**, and ***hypothermia***.

- ***Dilutional thrombocytopenia*** and ***clotting factor defciencies*** have been primarily implicated in the etiology of nonsurgical bleeding after massive blood transfusion.

TABLE 20-5 Complications of Massive Transfusion

Complication	Mechanism
Acidosis	Poor oxygen delivery, lactate accumulation
Alkalosis	Citrate metabolism to bicarbonate by the liver
Hypocalcemia	Citrate binding of calcium
Hyperglycemia	Dextrose preservative in packed red blood cells
Hypothermia	Transfusion of cold blood products
Hyperkalemia	Multifactorial

- Metabolic alkalosis and hypocalcemia result from sodium citrate and citric acid that is added to blood products in storage to prevent coagulation.

- Each unit of blood can generate a total of 23 mEq of bicarbonate as citrate is metabolized. This can result in a metabolic alkalosis if the kidneys are unable to excrete the excess bicarbonate

- Hypothermia can also result from the infusion of blood products. Blood products are stored at 4 C. Rapid infusion of cold blood can lead to lower core body temperatures. Given that this population is already predisposed to hypothermia, which can further worsen coagulopathy,

- the traditional complications of blood transfusion, specifically transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO) can occur with massive transfusion.
- the incidence of TRALI increases as the number of blood products given increases.

- There is also a **coagulopathy of trauma**.
- This coagulation abnormality may be precipitated by an alteration in protein C and tissue plasminogen activator (TPA)

- It is characterized by an elevation of PT and PTT prior to the administration of resuscitation fluids.
- The degree of coagulopathy predicts mortality, and this has been described in both adults and children.

- However, after losing two blood volumes, most adult patients have *platelet counts* less than $50\times10^9/L$,
- And many require correction of symptomatic thrombocytopenia before the platelet count decreases to that level.

- In otherwise healthy adults, the intraoperative loss of about 1.5 blood volumes requires replacement of coagulation factors with FFP.

- This is in contrast to trauma patients who **may benefit from FFP early** in the course of resuscitation

- The *ratio of fresh frozen plasma to PRBCs* may be an important determinant of outcome in trauma patients who receive massive transfusions.

- In vitro studies suggest that a *1: 1: 1* ratio of *RBC: FFP: PLT*, respectively, maintains *coagulation function* better than 3: 1: 1

- Demonstrated in adults that during massive transfusions, an *FFP/PRBC ratio* of *greater than or equal to 1: 1.5* decreased the number of transfusions and 1-day mortality more than did an FFP/PRBC ratio of less than 1: 1.5.

- This means that *those patients who received close to equal volumes of FFP and PRBCs had decreased 24-hour mortality rates* over those who received signifcantly more PRBCs than FFP,
- *Although patients receiving larger quantities of FFP had a higher incidence of ARDS*.

- The likely explanation for the reduction in mortality is *the early correction of coagulopathy and reduction in hemorrhage.*

- More recently, a prospective multicenter study (PROMMTT Study) demonstrated *that a higher ratio of plasma and platelets* *early in the resuscitation* of patients receiving *more than 3 units* of PRBCs decreased mortality

- *Monitoring the coagulation status is vital* in patients who require massive transfusions. *Hypothermia*, *acidosis*, and *hemodilution* with *hypofbrinogenemia* *further exacerbate any coagulopathy.*

- **Massive transfusions** *decrease fbrinogen*, *decrease platelets*, and *dilute coagulation factors.*

- *Intraoperative evaluation of the bleeding patient* can be assessed by *classic tests (PT, PTT, and platelet count*).

. However, the coagulation system, including clot formation and clot dissolution, can also be assessed by thromboelastography.

Thromboelastography is a **global measure of hemostasis**

- *Early diagnosis* of hemorrhage and *timely intervention* are key to minimizing patient morbidity and mortality

- *Cryoprecipitate* or *fibrinogen* concentrate should be considered if decreased fibrinogen is present or likely.

- *Tranexamic acid* is an antifibrinolytic that is used in trauma, cardiac surgery, and multiple surgical populations to decrease blood loss.

- It is a *lysine analogue* that binds to receptors on plasminogen and plasmin, which results in inhibition of plasmin-mediated fibrin degradation.

- A large randomized, double-blind, placebo-controlled trial randomized 20,060 women to receive either tranexamic acid or placebo at the time postpartum hemorrhage was diagnosed.

- The authors found a reduction in death due to bleeding in women with postpartum hemorrhage *if given within 3 hours*

- There was no difference between the two groups in terms of thromboembolic event or other side effects.


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