Lecture- 1

HAEMORRHAGE

د.وليد نصار الجفال

Objectives:

To understand:

1. Definition of hemorrhage.
2. Pathophysiology of hemorrhage.
3. Types of hemorrhage.
4. Classification and Management of hemorrhage.
5. Damage control surgery.

It is the loss of blood or blood escape from the circulatory system.

It must be recognised and managed aggressively to reduce the severity and duration of shock and avoid death and/or multiple organ failure.

Haemorrhage is treated by arresting the bleeding, and not by fluid resuscitation or blood transfusion, but resuscitation is necessary as supportive measures to maintain organ perfusion.

Recovery of blood volume after haemorrhage begins immediately by withdrawal of fluid from the tissues to the circulation (there is haemodilution) while red cell recovery takes some 5-6 weeks.

Pathophysiology

Haemorrhage leads to a state of hypovolaemic shock.

The pathophysiological effect of haemorrhage results in acidosis, coagulopathy and hypothermia.

- **Acidosis:** results from cellular anaerobic metabolism and lactic acidosis due to tissue hypoperfusion.
- **Coagulopathy**: Occurs because acidosis leads to decreased function of the coagulation proteases, resulting in coagulopathy and further haemorrhage. This is exacerbated by ischaemia of the endothelial cells activating anti-coagulant pathways.
- **Hypothermia:** Underperfused muscle is unable to generate heat and hypothermia ensues.

Coagulation functions poorly at low temperatures and there is further haemorrhage, further hypoperfusion and worsening acidosis and hypothermia.

These three factors result in a downward spiral leading to physiological exhaustion and death.

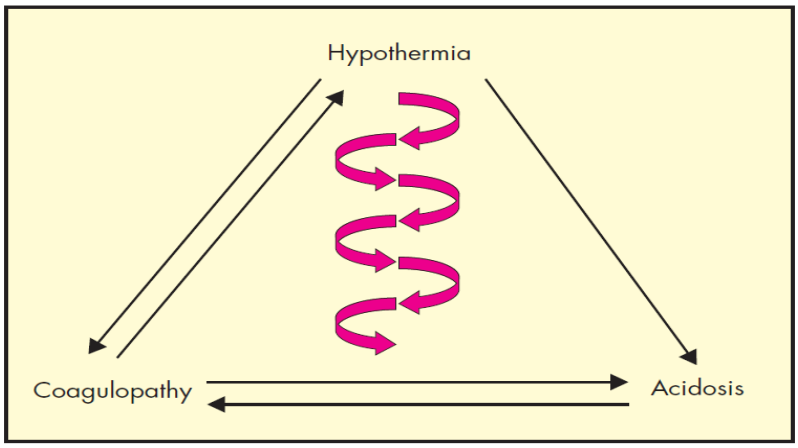

Figure : Physiological exhaustion: the triad of death.

Definitions

Revealed and concealed haemorrhage:

- Revealed haemorrhage is obvious external haemorrhage where blood leaks either through a natural opening such as the vagina, mouth, nose, ear or anus, or through a break in the skin.
- Concealed haemorrhage is contained within the body cavity and must be suspected, actively investigated and controlled. In trauma, haemorrhage may be concealed within the chest, abdomen, pelvis or retroperitoneum or in the limbs, with contained vascular injury or associated with long-bone fractures. Examples of non-traumatic concealed haemorrhage include occult gastrointestinal bleeding or ruptured aortic aneurysm.

Primary, reactionary and secondary haemorrhage

- Primary haemorrhage is haemorrhage occurring immediately as a result of an injury (or surgery).
- Reactionary haemorrhage is delayed haemorrhage within 24 hours (usually 4-6 hours) and is usually caused by dislodgement of clot by resuscitation, normalisation of blood pressure and vasodilatation. Reactionary haemorrhage may also result from technical failure such as slippage of a ligature.
- Secondary haemorrhage is caused by sloughing of the wall of a vessel. It usually occurs 7–14 days after injury and is precipitated by factors such as infection, pressure necrosis (such as from a drain) or malignancy.

Surgical and non-surgical haemorrhage

- Surgical haemorrhage(Traumatic): is the result of a direct injury and is amenable to surgical control (or other techniques such as angioembolisation).
- Non-surgical haemorrhage(Medical): is the general ooze from all raw surfaces due to coagulopathy; it cannot be stopped by surgical means (except packing) but requires correction of the coagulation abnormalities

Arterial, Venous and Capillary haemorrhage:

- **Arterial:** is bright red blood, spurting as a jet which rises and falls in times with the pulse. It may become watery when large quantities of fluids other than blood are given in protracted bleeding.
- **Venous:** is darker red, steady and copious flow. The colour darkens still further from excessive oxygen desaturation when blood loss is severe, or in respiratory depression or obstruction.
- **Capillary:** is bright red, often rapid ooze. If continuing for many hours, blood loss may become serious, as in haemophilia.

Degree and classification

Assessment and management of blood loss must be related to the pre-existing blood volume, where the adult human has approximately 5 litres of blood (70 ml/Kg children and adults, 80 ml/ kg neonates).

Estimation of the amount of blood that has been lost is difficult and inaccurate and is usually an underestimation of the actual value. However rough estimation can be obtained by:

- Blood clot which has a size of a clenched fist is roughly equal to 500 ml.
- Swelling in closed fracture; moderate swelling in closed fracture of the tibia equals 500-1500 ml blood loss. Moderate swelling in a fractured shaft of femur equals 500-2000 ml blood loss.
- Weighing of swab; in the operating theatre, the blood loss can be measured by weighing the swabs and subtracting the dry weight, the resulting total obtained (1 gm = 1 ml) is added to the volume of blood collected in the suction or drainage bottles.

The haemoglobin level is a poor indicator of the degree of haemorrhage as it represents a concentration and not an absolute amount. In the early stages of rapid haemorrhage, the haemoglobin concentration is unchanged (as whole blood is lost). Later, as fluid shifts from the intracellular and interstitial spaces into the vascular compartment, the haemoglobin and haematocrit levels will fall.

Traditionally and by the American College of Surgeons' Advanced Trauma Life Support (ATLS), the degree of haemorrhage can be classified into classes 1–4 based on the estimated blood loss required to produce certain physiological compensatory changes:

- **Class I Hemorrhage** involves up to 15% of blood volume. There is typically no change in vital signs and fluid resuscitation is not usually necessary.
- **Class II Hemorrhage** involves 15-30% of total blood volume. A patient is often tachycardic with a narrowing of the difference between the systolic and diastolic blood pressures. The body attempts to compensate with peripheral vasoconstriction. Skin may start to look pale and be cool to the touch. The patient may exhibit slight changes in behavior. Volume resuscitation with crystalloids (Saline solution or Lactated Ringer's solution) is all that is typically required. Blood transfusion is not typically required.
- **Class III Hemorrhage** involves loss of 30-40% of circulating blood volume. The patient's blood pressure drops, the heart rate increases, peripheral hypoperfusion (shock), such as capillary refill worsens, and the mental status worsens. Fluid resuscitation with crystalloid and blood transfusion are usually necessary.
- **Class IV Hemorrhage** involves loss of >40% of circulating blood volume. The limit of the body's compensation is reached and aggressive resuscitation is required to prevent death.

This classification, although conceptually useful there is variation across ages (the young compensate well, the old very poorly), between individuals (athletes vs. the obese) and because of confounding factors (e.g. concomitant medications, pain).

Management

Identify haemorrhage

- External haemorrhage may be obvious but the diagnosis of concealed haemorrhage may be more difficult.
- Any shock should be assumed to be hypovolaemic until proved otherwise and,
- similarly, hypovolaemia should be assumed to be due to haemorrhage until this has been excluded.

Immediate resuscitative manoeuvres

-Direct pressure should be placed over the site of external haemorrhage.
-Airway and breathing should be assessed and controlled as necessary.
- Large-bore intravenous access should be instituted and blood drawn for cross-matching .
-Emergency blood should be requested if the degree of shock and on-going haemorrhage warrants this.

Identify the site of haemorrhage

Once haemorrhage has been considered, the site of haemorrhage must be rapidly identified. Note that this is not to definitively identify the exact location but rather to define the next step in haemorrhage control (operation, angioembolisation, endoscopic control).
Clues may be in the history (previous episodes; known aneurysm; non-steroidal therapy for gastrointestinal bleeding) or

examination (nature of blood: fresh, melaena; abdominal tenderness; etc.). For shocked trauma patients the external signs of injury may suggest internal haemorrhage, but cavitary haemorrhage must be excluded with rapid investigations (chest and pelvic radiography, abdominal ultrasound or diagnostic peritoneal aspiration).
Investigations for blood loss must be appropriate to the patient's physiological condition. Rapid bedside tests are more appropriate for profound shock and exsanguinating haemorrhage than investigations such as computerised tomography, which takes a long time and for which patient monitoring and treatment
are difficult. Patients who are not actively bleeding can have a more methodical, definitive work-up.

Haemorrhage control:
Minimise blood loss by: pressure and packing, position and rest and operation, angioembolisation or endoscopic control.

- ❖ Pressure and packing:
  - examples of pressure used to control haemorrhage:
    - Pressure dressing from anything handy which is soft and clean(used as 1st - aid treatment)
    - Digital pressure (the use of forefinger and thumb)
    - Bouble balloon in the oesophagus and stomach to control bleeding from esophageal varices.
  - examples of packing to control haemorrhage:
    - Rolls of wide gauze.
- ❖ Position and rest:
  - examples :
    - Elevation of limbs (e.g. in ruptured varicose vein).
    - Gravity is used in certain operations,as thyroidectomy where the patient tilted feet downwards(reverse-Trendelenburg position) or in stripping of varicose veins when a head-down tilt is used (Trendelenburg position).
- ❖ Operation, angioembolisation and endoscopic control:
  The bleeding, shocked patient must be moved rapidly to a place of haemorrhage control. This will usually be in the operating room but may be in other areas of the hospital such as the angiography or endoscopy suites.

Once haemorrhage is controlled, patients should be aggressively resuscitated and warmed and coagulopathy corrected.

'Damage control surgery'

It is the concept of tailoring the operation to match the patient's physiology and staged procedures to prevent physiological exhaustion. In which surgery is limited to the minimum necessary to stop bleeding and control sepsis and more definitive repairs can be delayed until the patient is physiologically capable of sustaining the procedure. It is a term borrowed from the military whereby the continued functioning of a damaged ship is ensured above conducting complete repairs, which would prevent a rapid return to battle.

Summary box
Damage control surgery
■ **Arrest haemorrhage**
■ **Control sepsis**
■ **Protect from further injury**
■ ***Nothing else***