Surgical Bleeding and Haemostasis

Normal haemostasis

Haemostasis is the physiological cessation of bleeding.

1st stage: blood vessels constriction.

- This is due to smooth muscle constriction and it is mediated by thromboxane A_2 and sympathetic innervation.
- It may be defective in diseased arteries stiffened by arteriosclerosis.
- Constriction is also aided by the tamponading effect of the contained (extravassated) blood.

2nd stage: platelet adherence.

This occurs when blood comes in contact with the sub-endothelial tissue. It is mediated by epinephrine, ADP, collagen and thrombin.

3rd stage: production of fibrin clot

This is mediated by clotting factors through the intrinsic and the extrinsic pathways.

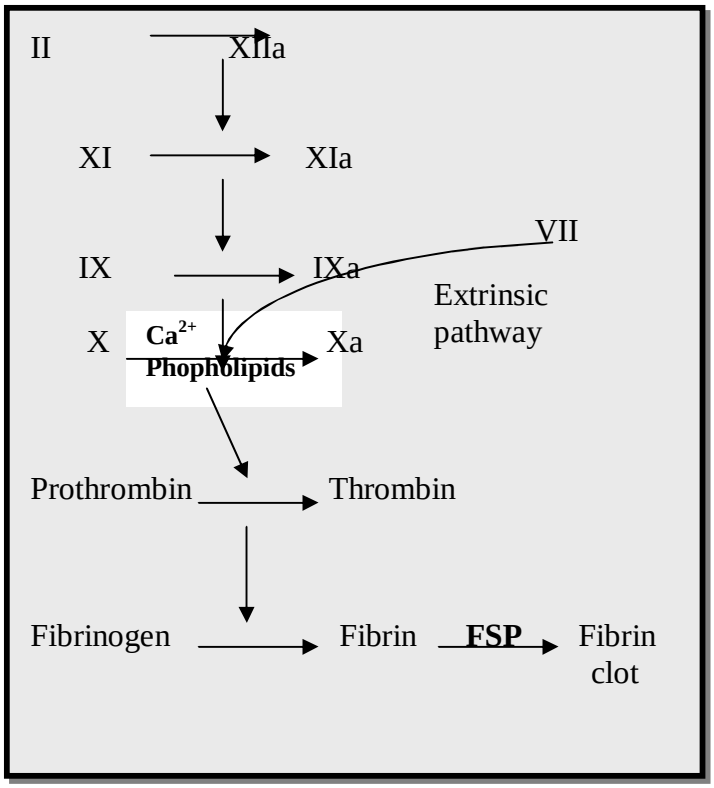

Figure I: The Clotting Cascade.

4th stage: prevention of excessive coagulation. (Fibrinolysis)

This is mediated by plasminogen; AT-III (inhibits IXa, Xa, and thrombin). Heparin binds to AT-III for its anti-clotting activities. Protein-C, a fibrinolytic agent inhibits factors V and VIII.

Surgical bleeding

Bleeding occurs at every surgery, but this can become excessive whenever there are disorders of bleeding. These may be congenital or acquired.

Congenital

1. Haemophiliacs
2. Von-Willebrand's disease.

Haemophiliacs are of two types: A and B.

- They are sex-linked
- Incidence is 1 in 25,000 births
- Low levels of factor VIII (A) or IX (B)
- PTT is raised while bleeding time and PT is normal.

The most common problem of haemophiliacs is haemathrosis which when oft repeated may lead to severe disability.
It is advisable not to operate on these patients, but when this is necessary, high levels of the deficient factor must be infused.

Von-Willebrand's disease

- Lack of Von-Willebrand's factor
- Commonest congenital disorder of coagulation.
- Clinically there is both coagulopathy and platelet dysfunction.

Acquired disorders.

This may be due to disorders of coagulation or platelets dysfunction.

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1. Coagulation disorders.

a) Drugs: this is one of the commonest causes of acquired disorders.

i. **Warfarin** (Vit.K antagonist) inhibits the hepatic synthesis of factors II, VII, IX and X
ii. **Heparin** combines with AT-III to inhibit thrombin, IXa, Xa, XIa, and XIIa.
iii. **Dextran** interferes with the formation of fibrin clot.

b) Hepatic insufficiency. The liver synthesises vit. k dependent factors, proteins C and S as well as being the main production site for factor V. It is also the site of clearance of activated factors from the circulation.

c) Uraemia by causing malabsorption may lead to coagulation defect. There may also be an increased loss of clotting factors through the urine. There may be associated platelet defect.

d) Collagen disorders e.g. SLE: the presence of immunoglobins found in these diseases may interfere with clotting.

Levels of clotting factors above 30% are usually not associated with bleeding disorders, but when this falls below 10%, it becomes dangerous and spontaneous bleeding may occur.

2. Platelet dysfunctions

a) Drugs e.g. Aspirin which interferes with the synthesis of arachidonic acid. Drugs which cause bone marrow depression may also cause bleeding disorders as a result of thrombocytopenia.

b) Accelerated destruction of platelets e.g. Tropical splenomegally syndrome and idiopathic thrombocytopenic purpura.

c) Disseminated intravascular coagulopathy [DIC] coagulation and fibrinolysis are triggered by circulating thrombogenic materials e.g. tissue embolism like amniotic fluid and fat, bacterial endotoxin, malignant cells and following crush injury. A consumptive form of coagulopathy develops, causing a fall in the serum level of clotting factors. This also leads to accumulation of fibrin degradation products (FDP), which worsens the situation. The treatment of this condition is very difficult.

Preparation of patients with bleeding disorders for surgery.

1) History taking: Is there a past history of

- Spontaneous bleeding from any of the orifices or excessive post-op bleeding (after circumcision) or after dental extraction.
- Purpura or petechiae
- Recurrent joint pain or swelling
- Family history of bleeding disorders
- Drug

2) Examination.

- Skin examination for purpura, petechiae or ecchymosis.
- Mucous membranes including the conjunctiva examination for evidence of bleeding.
- Joints examination for painful swelling (haemathrosis).

3) ***Investigations.***

I. *Bleeding time:* This is done by pricking the earlobes and it is usually < 4 minutes. It is prolonged in platelets and capillary defects.
II. *Clotting time:* this should be carried out on venous blood and it may be as long as 15 minutes. It is prolonged in patients on anticoagulants and in haemophiliacs.
III. *Prothrombin time.* In this test, oxalate is added to the blood, this precipitates calcium. Calcium is then added at the same time with thromboplastin. This eliminates the entire first stage of the clotting cascade (i.e. the steps involving factors VIII, IX, XI, or XII. But it is prolonged when there is insufficiency of prothrombin, factors V and VII or in the presence of anticoagulants. Normal value is about 11-17 secs, but it is more commonly reported as a ratio of the value for a normal subject (control) which is determined at the same time.
IV. *Partial thromboplastin time:* Detects factors II, V, VIII, IX, XII defects. Used to monitor heparin Rx.
V. *Thromboplastin generation test*: Useful in differentiating between the different types of haemophilia
VI. *Platelet count.*
VII. *Clot retraction:* This is a measure of platelet function.

4) Management (Principle)

I. Identify the missing factor (diagnosis)
II. Determine whether the deficiency is sufficiently severe to cause surgical bleeding
III. Replace the factor.
IV. Avoid unnecessary surgery

Bleeding disorders developing during surgery.

1) Incompatible blood transfusion: this will cause hypotension and severe oozing from the operative field. The transfusion must be stopped and osmotic diuresis stimulated by giving mannitol. Steroid is also given.
2) Massive blood transfusion
3) Extracorporeal circulation
4) Hypothermia
5) Amniotic fluid embolism
6) Pulmonary surgery
7) DIC