

Surgical Bleeding and Transfusion

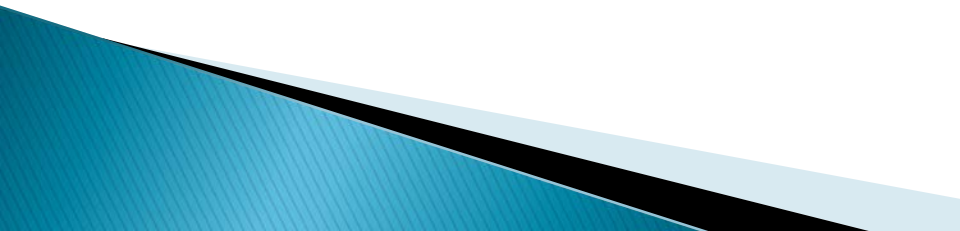
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What is haemostasis

- ▶ Hemostasis is the body's normal physiological response for the prevention and stopping of bleeding/hemorrhage



Why is haemostasis important?

- ▶ Haemostasis is the third highest priority (after securing airway and ensuring breathing) in resuscitation
 - ▶ Haemorrhagic shock accounts for 30–40% of all injury related death
 - ▶ Bleeding related causes account for 82% of all operating room deaths occurring after injuries
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Normal haemostasis

1st stage: blood vessels constriction.

- ▶ This is due to smooth muscle constriction and it is mediated by thromboxane A² and sympathetic innervation.
- ▶ It may be defective in diseased arteries stiffened by arteriosclerosis.
- ▶ Constriction is also aided by the tamponading effect of the contained (extravasated) blood.

Normal haemostasis

2nd stage: platelet adherence.

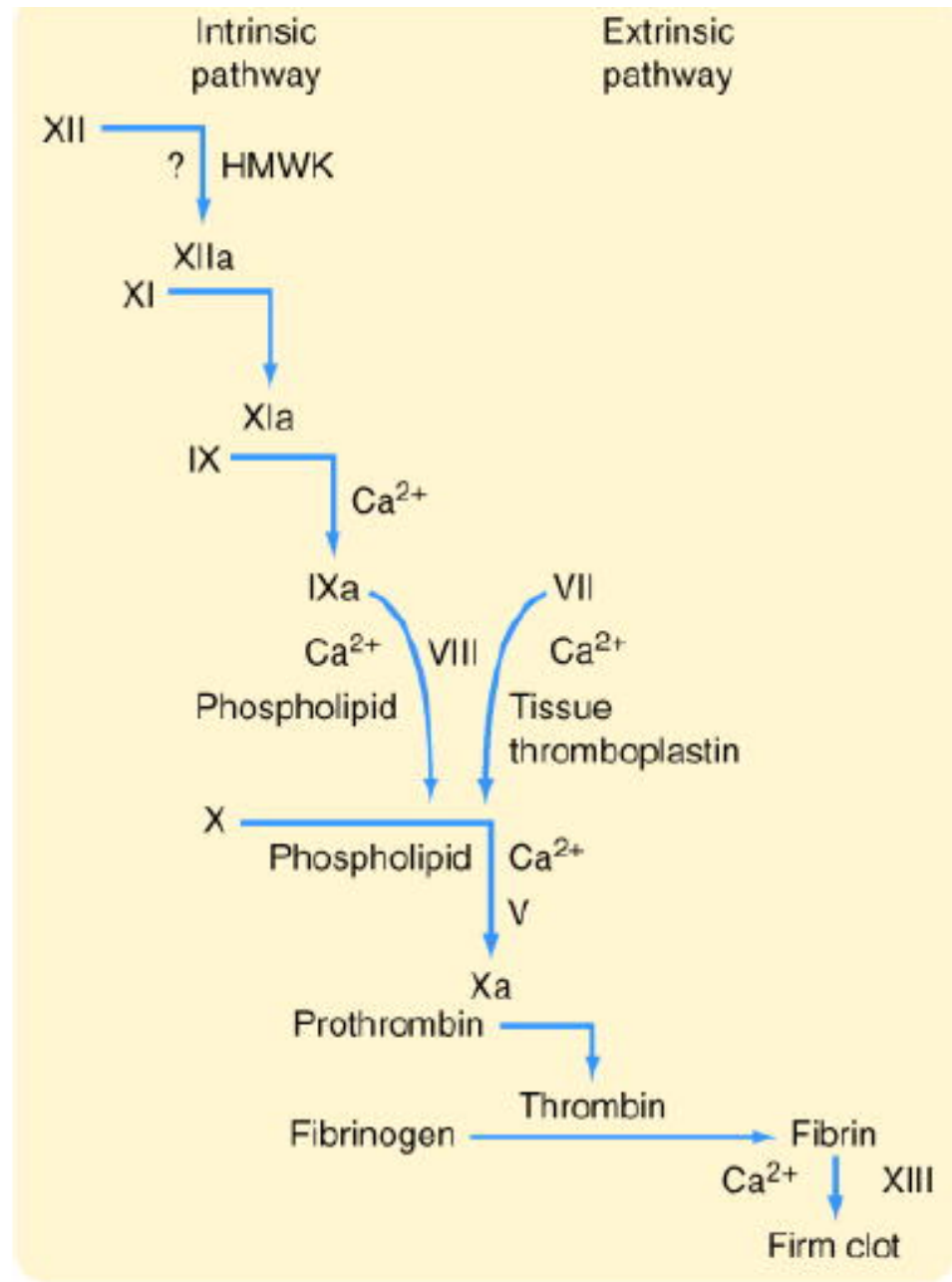
- ▶ Occurs when blood come in contact with the sub-endothelial tissue.
- ▶ Mediated by epinephrine, ADP, collagen and thrombin.

Normal haemostasis

3rd stage: production of fibrin clot

- ▶ Mediated by clotting factors through the *intrinsic* and the *extrinsic* pathways.

The Clotting Cascade



Normal haemostasis

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

Mediated by

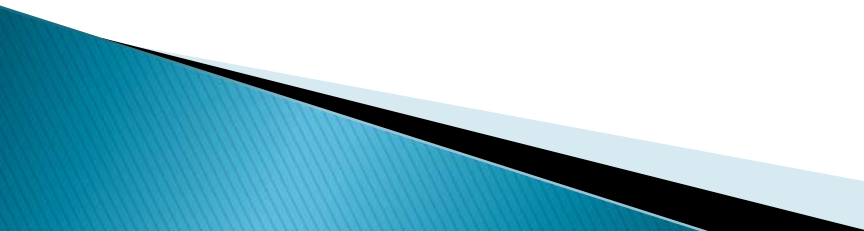
- ▶ plasminogen
- ▶ AT-III (inhibits IXa, Xa, and thrombin).
- ▶ Heparin binds to AT-III for its anti-clotting activities.
- ▶ Protein-C, a fibrinolytic agent inhibits factors V and VIII.

Preoperative Screening for Bleeding Risk

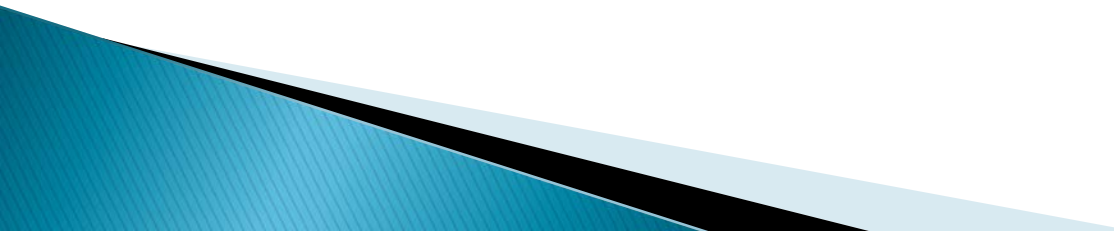
▶ Take a good history

1. Personal history of abnormal bleeding (see next slide)
2. Family history of bleeding
3. History of drug use

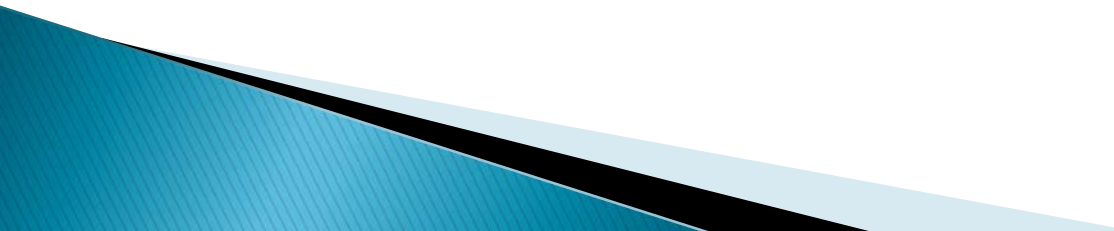
Personal History of:

- ▶ Prolonged bleeding after biting the lip
 - ▶ Prolonged bleeding after circumcision
 - ▶ Bruises without apparent injury
 - ▶ Prolonged bleeding after dental extraction
 - ▶ Recurrent painful joint swellings
 - ▶ Excessive menstrual bleeding
 - ▶ Medications e.g. aspirin
- 

Examination

- ▶ Skin for
 - Petechiae: Platelet disorder
 - Ecchymosis: Coagulation disorder
 - ▶ Mucous membranes including the conjunctiva for evidence of bleeding.
 - ▶ Joints for painful swelling (Haemarthrosis)
 - ▶ Splenomegaly
 - ▶ Hepatomegaly
- 

Preoperative laboratory screening tests for asymptomatic patient

- ▶ Platelet count
 - ▶ Prothrombin time (PT) –Extrinsic pathway
 - ▶ Activated Partial Thromboplastin Time (APPT)– Intrinsic and common paths.
 - ▶ Bleeding Time – Prolonged in drugs like (ASA, NSAIDs, steroids) and platelet disorder.
 - ▶ Thrombin Time – Prolonged in low or abnormal fibrinogen, heparin therapy.
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Causes of excessive surgical bleeding

Congenital bleeding disorders

- ▶ Hemophilia A (Factor VIII)
- ▶ von Willebrand's disease (v W's factor, platelet adhesion)
- ▶ Hemophilia B (Factor IX = Christmas disease, less common than A)
- ▶ Factor XI deficiency (commonest among Ashkenazi Jews)
- ▶ Congenital platelet dysfunction (uncommon)

Acquired

Thrombocytopenia /Thrombocytopathy

- ▶ Decreased platelet production (e.g. aplastic anemia)
- ▶ Increased destruction (e.g. idiopathic thrombocytopenia purpura [ITP] or DIC)
- ▶ Splenomegaly (splenic pooling)
- ▶ Combination of these disorders, as in alcoholic liver failure
- ▶ Platelet dysfunction (ASA – N.B. irreversible for life of platelets; NSAIDs)
- ▶ Uremia → platelet dysfunction

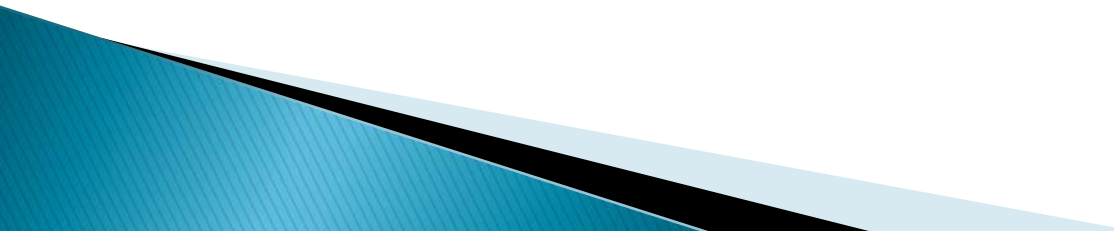
Acquired bleeding disorders

Liver diseases

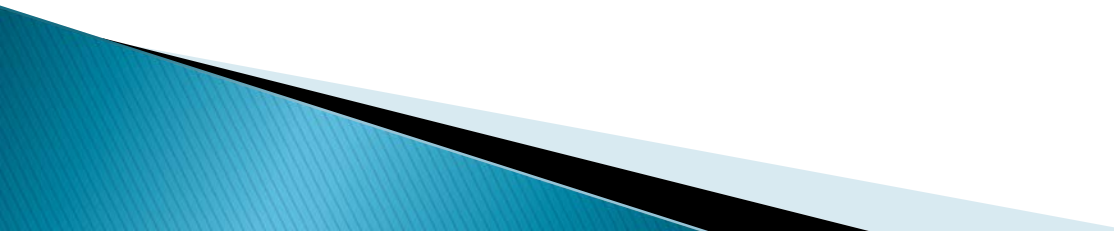
(Decreased levels of prothrombin and Factors V, VII, and X → prolonged PT and PTT.

1. Alcohol ingestion → acute thrombocytopenia
2. Hypersplenism → thrombocytopenia
3. Obstructive jaundice → factor deficiencies (Rx = Vitamin K)
4. Cirrhosis → factor deficiencies (not amenable to Vitamin K)
5. Anticoagulant Therapy – Warfarin

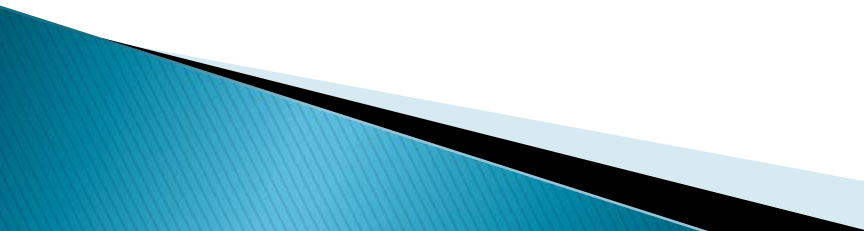
Local Hemostasis

- ▶ Classified as
 - 1 Mechanical
 - 2 Thermal
 - 3 Chemical
 - ▶ Goal: prevent the flow of blood from incised or transected blood vessels
 - ▶ Surgical bleeding is usually caused by ineffective local hemostasis
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Mechanical Procedures

- ▶ Firm dressing (Limbs and scalp)
 - ▶ Digital pressure
 - ▶ Packing with gauze
 - ▶ Hemostat
 - ▶ Sutures
 - ▶ Tourniquet
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Tourniquet: Guidelines for use

- ▶ Controversial
 - ▶ Can be dangerous!
 - ▶ Use only when bleeding is
 - life-threatening,
 - conventional measures have failed
 - ▶ Use for the shortest time possible
 - ▶ Deflate for 10 minutes every 2 hours
 - ▶ Use wide cuffs to allow for lower occlusion pressure
 - ▶ Record the time when applied
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Thermal agents

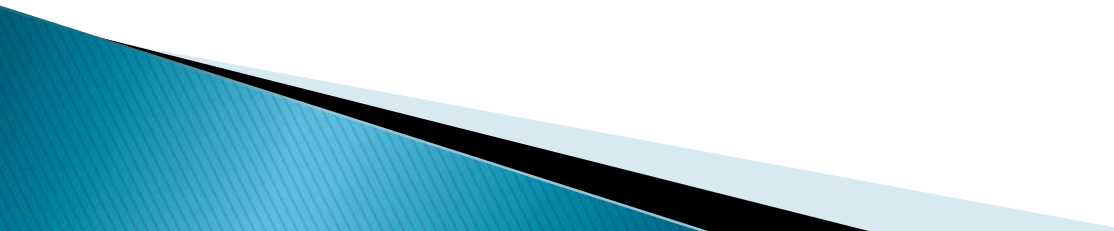
- ▶ Electrocautery or diathermy
- ▶ Hypothermia – vasoconstriction
- ▶ Cryosurgery (–20 to –180 degree Celsius)
dehydrate and denature of fatty tissue

Chemical agents

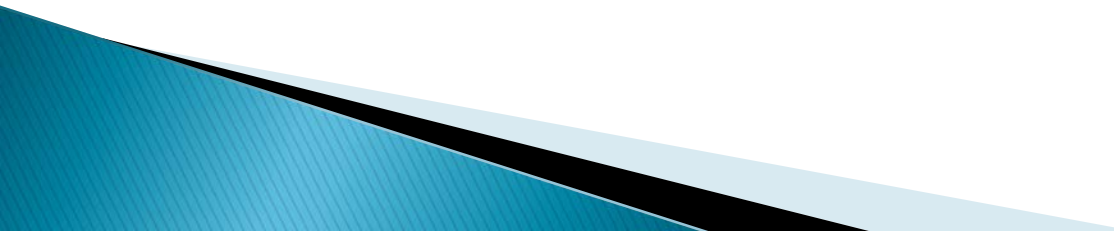
- ▶ Gelatin foam (Gelfoam)– Causes platelet release reaction
- ▶ Oxidized regenerated cellulose (Surgicel)
- ▶ Fibrin glue– two components e.g. Fibrinogen + factor XIII, must be mixed together
- ▶ Collagen (Instat)– Causes platelet release reaction

Surgical bleeding

Three types, Based on when it occurs

- ▶ Primary Haemorrhage occurs right on the operating table
 - ▶ Reactionary haemorrhage occurs within 24 hours
 - ▶ Secondary haemorrhage occurs usually between 7 and 14 days. Usually as a result of blood vessel necrosis from infections
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Primary haemorrhage

- ▶ **Intraoperative diffuse bleeding**
 1. Platelet deficiency after massive transfusion
 2. Hypothermia-induced coagulopathy
 3. DIC
 4. Elevated level of circulating anticoagulants
 - ▶ **Large vessel bleeding**
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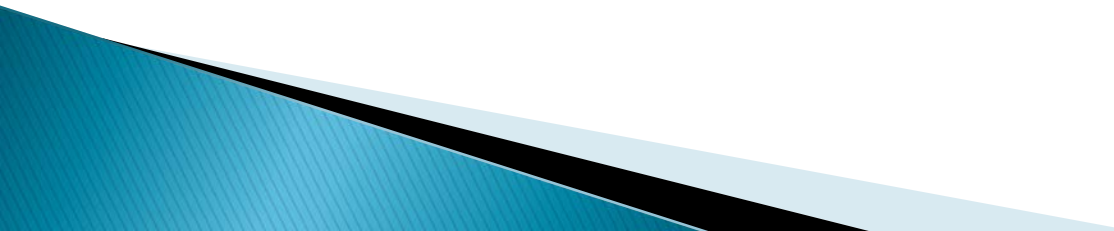
Reactionary haemorrhage

- ▶ Occurs within 24 hours of surgery
 1. An unligated vessel: Blood clot may have slipped due to post-op normalization of BP
 2. Slipped ligature: Slip occurs when BP rises post-op.
 3. Hematologic problem developing as a result of the operation e.g. DIC

Managing post-op bleeding

1. **If unstable, reoperate immediately to stop bleeding**
2. **If stable**
 - Reassess history and medications given
 - Stop transfusion; send sample to blood bank
 - Check body temperature if low, warm patient
 - Check PT, PTT and platelet function

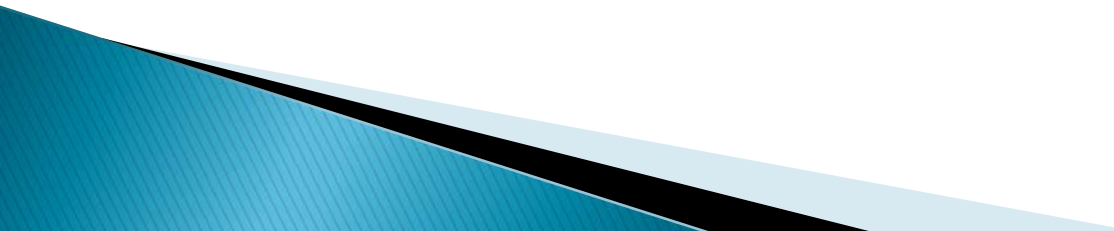
Indications for blood transfusion

- ▶ To increase oxygen carrying capacity
 - ▶ Volume replacement
 - ▶ Replacement of clotting factors
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Banked Whole Blood

- ▶ Shelf life 35–45 days
- ▶ poor source of platelets
- ▶ Factors II, VII, IX, X are stable
- ▶ Within 3 weeks: pH decreases but lactic acid, K^+ and ammonia goes up

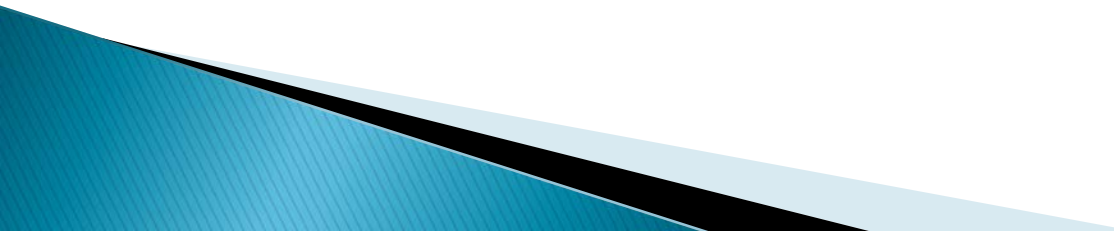
Fresh Whole Blood

- ▶ Administered within 24hr of its donation
 - ▶ Rarely indicated except in patients like SS diseased patients
 - ▶ Not commonly available
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Packed Red Cells

- ▶ Product of choice for most
- ▶ Na, K⁺, NH₄, citrate
- ▶ provides oxygen carrying capacity
- ▶ Give leukocyte reduced RBC in patients with previous history of febrile reaction

Autologous blood

- ▶ Pre-deposited by patient: Within 40 days of surgery every 4–7 days
 - ▶ Up to 5–6 units may be donated
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Fresh Frozen Plasma

- ▶ Provides factors V, VIII
- ▶ Indicated in multiple coagulation factor deficiency states such as:
 - ▶ Liver disease
 - ▶ DIC
 - ▶ Dilutional coagulopathy

Platelet Concentrates

- ▶ Indications
 - Thrombocytopenia due to massive transfusion or inadequate production
 - Qualitative platelet disorders
- ▶ For surgery: elevate level to 50,000–100,000

Massive transfusion

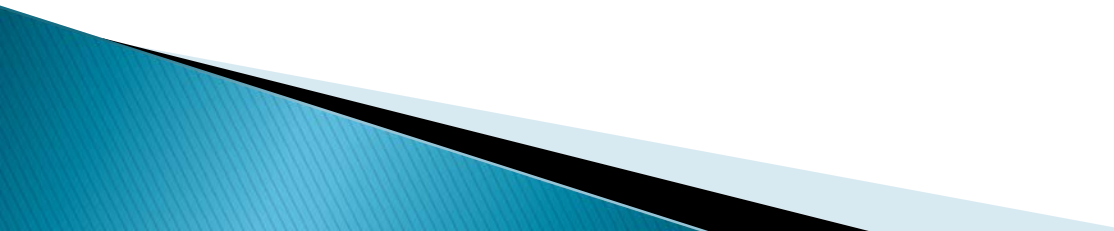
Various definitions!

- ▶ Single transfusion > 2,500 ml.
- ▶ > 50% blood volume in 3 hours
- ▶ > 5,000 ml (Blood Volume) over 24h

Problems

- DIC
- dilutional thrombocytopenia
- deficiency of factors V, VIII, XI
- hypothermia,
- decreased oxygen delivery

Complications of Transfusion

- ▶ Hemolytic reactions
 - ▶ Febrile, allergic reactions
 - ▶ Bacterial sepsis
 - ▶ Embolism, Thrombophlebitis
 - ▶ Over transfusion
 - ▶ Transmission of Diseases– viral hepatitis, HIV
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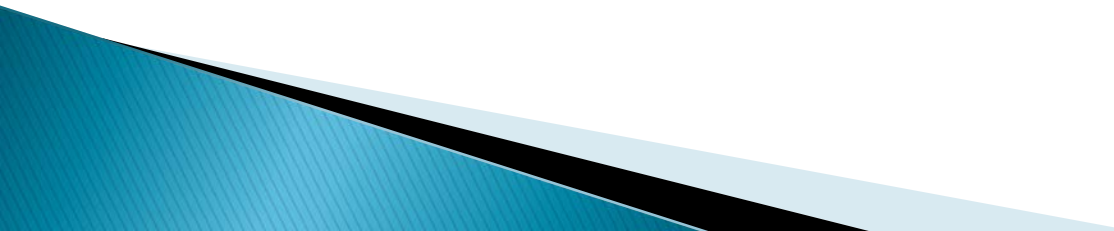
Hemolytic Reactions

- ▶ Incompatibility of blood groups
- ▶ intravascular destruction of RBC
- ▶ hemoglobinemia, hemoglobinuria

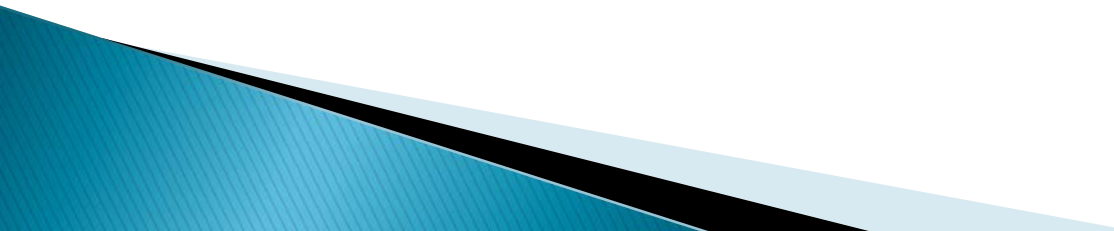
Clinical features

- sensation of heat and pain, chills, fever, respiratory distress, hypotension, tachycardia and abnormal bleeding in anesthetized patients

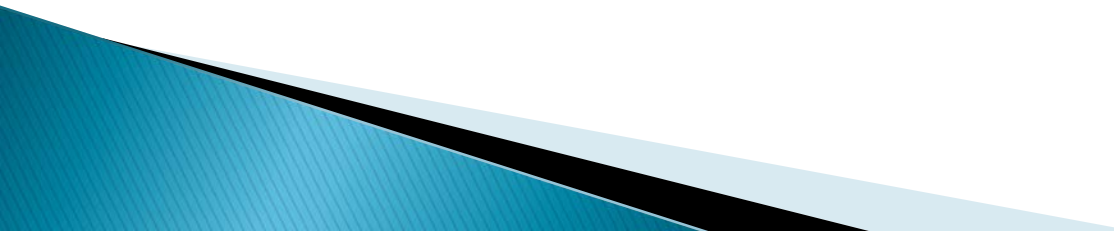
Hemolytic Reaction: Treatment

- ▶ If suspected, Stop transfusion immediately
 - ▶ Send samples to blood bank
 - ▶ Diuresis, alkalinize urine
 - ▶ Restrict fluid intake and K^+ if ARF develops
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Disseminated Intravascular Coagulopathy (DIC)

- ▶ Hypercoagulation
 - ▶ Clotting factors are consumed → promotes clotting dysfunction
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Pathophysiology of DIC

- ▶ Uncontrolled acceleration of clotting cascade
 - ▶ Small vessel occlusion
 - ▶ Organ necrosis
 - ▶ Depletion of clotting factors
 - ▶ Activation of fibrinolysis
 - ▶ Ultimately severe systematic hemorrhage
- 

DIC

precipitating causes

- ▶ Shock ,
- ▶ Massive transfusion
- ▶ Sepsis,
- ▶ Transfusion reactions,
- ▶ Disseminated cancer,
- ▶ Tissue ischemia,
- ▶ Drug reactions,
- ▶ Dead fetus
- ▶ Amniotic fluid embolism

DIC

- ▶ **DIC is a clinical diagnosis**
- ▶ **Management: Rx underlying causes**

BONUS SLIDE

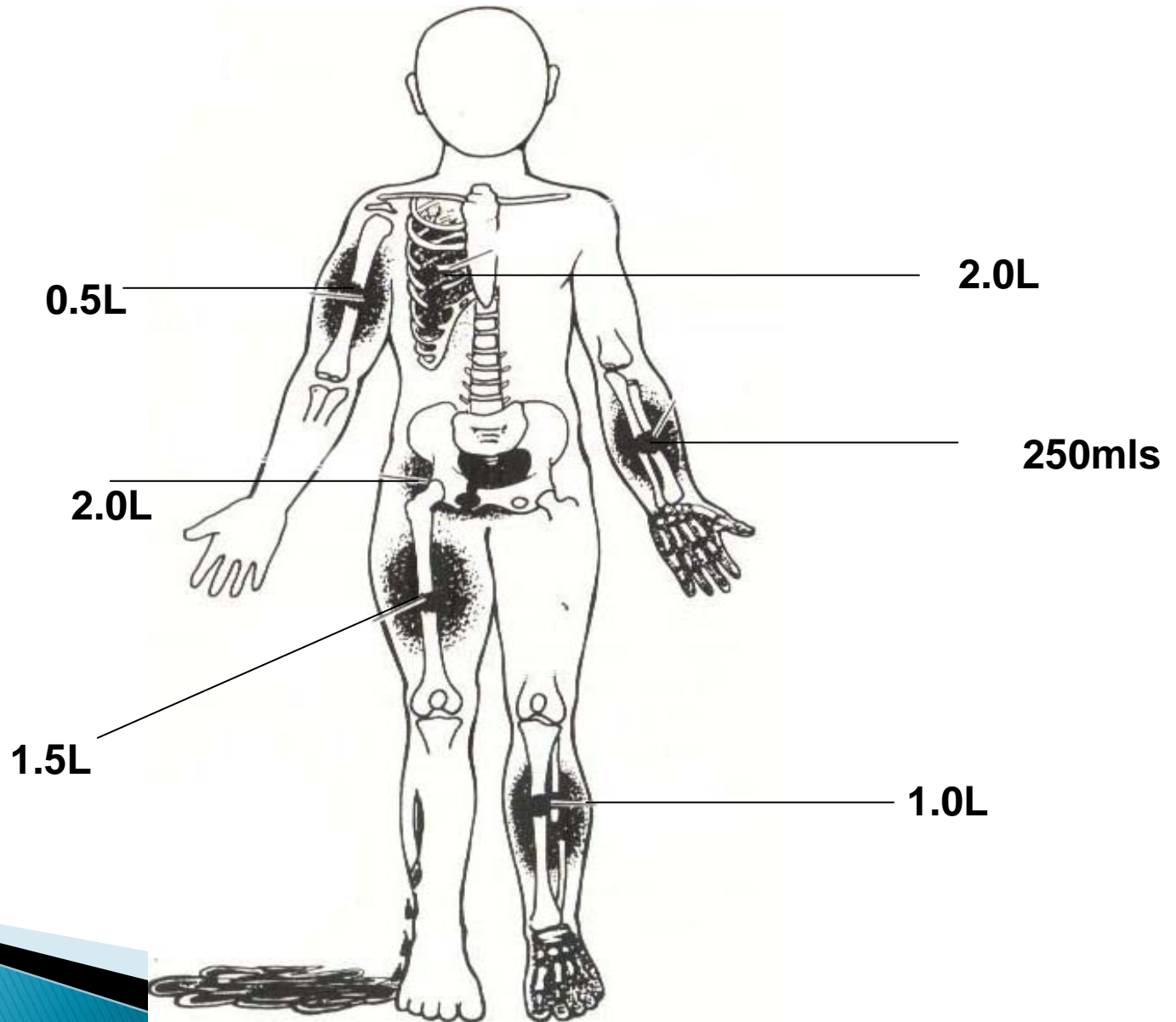
Common sites for massive blood loss in trauma

- Five common sites of blood loss in trauma and potential volume of blood that may be lost
- Rapidly search these regions in acute trauma

SITE	POTENTIAL VOLUME LOST
External	Exsanguinations possible
Chest	Greater than 1.5 L per hemithorax
Peritoneal cavity	Exsanguinations possible
Pelvis and retroperitoneum	Exsanguinations possible
Long bone fractures	Tibia/humerus, 750 mL; femur, 1,500 mL

BONUS SLIDE

Losses from Fractures



Thank You

