Essentials of Coagulation & Hemostasis

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CLOT OR BLEED?
HOW DO WE MAKE A CLOT?

Normal blood vessel
HOW DO WE MAKE A CLOT?

Platelets

Injured blood vessel
THE WHOLE SCENARIO

1. VASOCONESTRUCTION
   Vascular hemostasis
2. PLATELET PLUG
   Primary hemostasis
3. FIBRIN CLOT
   Secondary hemostasis
4. FIBRINOLYSIS
   Anticoagulation
HOW DO WE MAKE A CLOT
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HOW DO WE MAKE A CLOT?

CASCADE COAGULATION

CELL-BASED COAGULATION
Clotting factors

Coagulation cascade
HOW DO WE MAKE A CLOT
HOW TO PREVENT CLOTTING?
HOW TO PREVENT CLOTTING?
COMMON PREANALYTICAL ERRORS:
1. Poor mixing of blue top tubes
2. Slow collection
3. Refrigerated blood tubes
4. Excessive duration of tourniquet application
5. Unfilled blue top tubes
LABORATORY TESTS

EVALUATION OF CLOTTING STATUS:

I. PLATELETS

II. COAGULATION TESTS
LABORATORY TESTS

PLATELETS

1. PLATELET COUNT
LABORATORY TESTS

PLATELETS

2. PLATELET AGGREGATION TESTS
LABORATORY TESTS

PLATELETS

3. PLATELET FUNCTION ANALYZER
COMMON COAGULATION TESTS:
COMMON COAGULATION TESTS:

- Partial Thromboplastin Time (PTT)
- Prothrombin Time (PT)
LABORATORY TESTS

COMMON COAGULATION TESTS:

Classical 1:1 mixing study

- PT and PTT before mixing
- Patient’s plasma
- Control plasma
### LABORATORY TESTS

**CAUSES OF ABNORMAL ROUTINE COAGULATION STUDIES**

<table>
<thead>
<tr>
<th>Isolated Prolonged aPTT</th>
<th>Isolated Prolonged PT</th>
<th>Prolonged aPTT and PT</th>
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<tbody>
<tr>
<td>LUPUS ANTICOAGULANT</td>
<td>WARFARIN USE, VITAMIN K DEFICIENCY</td>
<td>DIC, VITAMIN K DEFICIENCY</td>
</tr>
<tr>
<td>HEPARIN IN SAMPLE (AT CLINICALLY RELEVANT CONCENTRATIONS)</td>
<td>LIVER DISEASE</td>
<td>LIVER DISEASE</td>
</tr>
<tr>
<td>DEFICIENCY OF, OR INHIBITOR TO, FACTORS VIII, IX, XI</td>
<td>LUPUS ANTICOAGULANT</td>
<td>WARFARIN USE</td>
</tr>
<tr>
<td>DEFICIENCY OF, OR INHIBITOR TO, FACTOR XII PK OR HMWK</td>
<td>DEFICIENCY OF, OR INHIBITOR TO FACTOR VII</td>
<td>DEFICIENCY OF, OR INHIBITOR TO FIBRINOGEN, FACTORS II, V, X</td>
</tr>
<tr>
<td>TRAUMATIC VENIPUNCTURE</td>
<td>HYPO- OR DYSFIBRINOGENEMIA</td>
<td>LUPUS ANTICOAGULANT</td>
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<tr>
<td>SEVERE VON WILLEBRAND DISEASE</td>
<td></td>
<td>ANTICOAGULANTS</td>
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</table>
LABORATORY TESTS

COMMON COAGULATION TESTS:
LABORATORY TESTS

COMMON COAGULATION TESTS:
LABORATORY TESTS

COMMON COAGULATION TESTS:

D-DIMER
SPECIALIZED COAGULATION TESTS:

1. Anti Xa
2. Tests for LA
3. Assays for specific clotting factors
4. Euglobulin clot lysis time
5. TEG, ROTEM
6. ACT
DISORDERS OF HEMOSTASIS

BLEEDING DISORDERS

A. HEREDITARY

1. Von Willebrand Disease
   Type I
   Type II
   Type III

Ah Yes. I see your von Willebrand Factor is low!
DISORDERS OF HEMOSTASIS

BLEEDING DISORDERS

A. HEREDITARY

2. Hemophilia A

3. Hemophilia B
BLEEDING DISORDERS

A. HEREDITARY

4. Other Factor Deficiencies
   Factors XI and XIII

5. Platelet Disorders
   Bernard-Soulier Syndrome
   Glanzmann Thrombasthenia
   Gray Platelet Syndrome
DISORDERS OF HEMOSTASIS

BLEEDING DISORDERS

B. ACQUIRED

1. Disseminated Intravascular Coagulation-DIC
DISORDERS OF HEMOSTASIS

BLEEDING DISORDERS

B. ACQUIRED

2. Idiopathic Thrombocytopenic Purpura-ITP
DISORDERS OF HEMOSTASIS

BLEEDING DISORDERS

B. ACQUIRED

3. Deficiency of Vitamin K Dependent Factors
4. Liver Failure
DISORDERS OF HEMOSTASIS

THROMBOTIC DISORDERS

VIRCHOW’S TRIAD

- Altered Blood flow
- Endothelial Injury
- Hypercoagulability

THROMBOSIS
DISORDERS OF HEMOSTASIS

THROMBOTIC DISORDERS

Risk Factors for Thrombosis:

1. Atherosclerosis
2. Trauma
3. Obesity
4. Prolonged immobilization
5. Obesity
6. Varicose veins
7. Atrial Fibrillation
8. MI
9. Pregnancy
10. Smoking
DISORDERS OF HEMOSTASIS

THROMBOTIC DISORDERS

A. HEREDITARY

1. Factor V Leiden
THROMBOTIC DISORDERS

A. HEREDITARY

2. Antithrombin III Deficiency
DISORDERS OF HEMOSTASIS

THROMBOTIC DISORDERS

A. HEREDITARY

3. Protein C Deficiency
4. Protein S Deficiency
5. Factor II (Prothrombin) Gene Mutation
THROMBOTIC DISORDERS

B. ACQUIRED

1. Antiphospholipid Antibody Syndrome
References


Shaz, Hillyer, Reyes Gil (2019). *transfusion medicine and hemostasis: clinical laboratory aspects*. Elsevier Inc


Kristine Krafts MD (2011). *clot or bleed: a painless study guide for people who hate coag*

Medialab, Medtraining websites (*specific coagulation topics*), Amboss Chalk talk