**Disseminated Intravascular Coagulation (DIC)**

**Clinical Cases Applicability:** Postpartum hemorrhage, HELLP Syndrome, Placental abruption, Fetal demise, Amniotic fluid embolism

**Learning Objectives:**
1) Understand the basic principles of normal hemostasis
2) Understand which clotting factors are measured in commonly ordered coagulation labs 3) Understand the pathophysiology of DIC

**Clinical Presentation:** Bleeding, hypotension out of proportion to bleeding, and coagulopathy

**How does a clot form? (See figure 1)**
Tissue factor at the wound site + VIIa → activates X and IX to generate small amounts of thrombin → activates factors V, VIII, XI and platelets, which leads to amplification of thrombin How does a clot stop forming?
1) Antithrombin inhibits thrombin 2) Activated protein C block activation of factors V and VIII 3) Tissue factor pathway inhibitor blocks activation of factor VII

**How is a clot removed (fibrinolytic system)?**
Fibrin & tissue plasminogen activator bind plasminogen → plasmin → cleaves fibrin → releases FDP (fibrin degradation products)

**What clotting factors are measured when you order aPTT? PT?**
- aPTT: “Intrinsic” pathway; all coagulation factors except VII and tissue factor
- PT: “Extrinsic” pathway; tissue factor, VII, V, X, II (prothrombin), fibrinogen
- factor VII, IX, X, II, protein C&S are vitamin K dependent → altered by warfarin

**What happens in DIC? See figure 2**

**Coagulation and fibrinolysis become abnormally activated within the vasculature**
Endothelial damage → activation of coagulation cascade → extensive thrombi in microvasculature and larger vessels→consumption of factors, platelets and anticoagulant factors (S, C, antithrombin) → consumption greater than production “consumptive coagulopathy”→fibrinolysis→large amount of FDP interferes with fibrin clot formation and platelet aggregation→tissue/organ damage from reduced perfusion, thrombosis and/or bleeding

**Pathophysiology in pregnancy:**
Decidual cells lining the vascular bed of the placenta strongly express tissue factor (similar to endothelial cells); TF released at sites of decidual trauma→coagulation cascade activation
- Abruptio, fetal demise: Release of procoagulants due to significant injury/necrosis of fetoplacental tissue
- AFE: Amniotic fluid rich in procoagulants and anticoagulants
- Preeclampsia, HELLP: Contribute to endothelial cell damage
- Hemorrhage leading to shock: severe tissue hypoxia proposed to result in release of TF from damaged cells

**What are laboratory findings that are consistent with DIC?**
↓ Platelets, hemolytic changes in peripheral blood smear (anemia & schistocytes), ↓ fibrinogen (normal fibrinogen levels range from 373 - 619 mg/dL in 3rd trimester), ↑ D-dimer (FDP), and ↑ PT and aPTT.

**How do you treat DIC?**
Focused on correcting the underlying cause, maintenance of maternal volume status, and replacement of blood products: platelets, fresh frozen plasma (contains all coagulation factors), cryoprecipitate (smaller volume than FFP, rich in von Willebrand factor, VIII, XIII, fibrinogen)
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Figure 1

- Protein S
- Protein C
- Activated Protein C
- Tissue factor + VIIa
- PT (Extrinsic)
- IXa
- VIIIa
- Xa
- Va
- IIa (Thrombin)
- PTT (intrinsic)
- Fibrinogen
- Fibrin
- Plasmin
- Plasminogen
- TPA
- TF pathway inhibitor

Figure 2

- Underlying condition
  - Activation of intravascular coagulation
  - Platelet consumption ↓ PLT
  - Coagulation factor consumption ↑ PT, aPTT
  - Fibrin deposition ↓ fibrinogen
  - Fibrinolysis ↑ PFP
  - Impaired coagulation
  - Bleeding
- Endothelial damage
  - Intravascular microthrombi
    - Microangiopathic hemolytic anemia
    - ↓ hemoglobin
  - Thrombosis
- Organ ischemia

Sources:
- Leung, LLK. Clinical features, diagnosis, and treatment of disseminated intravascular coagulation in adults. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (2016)
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