Disseminated Intravascular Coagulation (DIC)

Definition

Disseminated intravascular coagulation (DIC) is a serious condition in which coagulation and fibrinolysis are unusually triggered, resulting in continuous clotting, bleeding and/or thrombosis (Leung, 2023). DIC, also known as consumption coagulopathy and defibrination syndrome, can be an acute, life-threatening emergency or a chronic condition.

Causes (Costello & Nehring, 2023; Leung, 2023)

DIC typically develops as an acute complication in patients with life-threatening illnesses that cause a systemic inflammatory response or the release of procoagulants into the bloodstream. Common causes of DIC include:

- Sepsis – gram negative and gram positive (bacterial, fungal, viral, and parasitic)
- Cancer/malignancy – acute promyelocytic leukemia, mucinous tumors (i.e., pancreatic, gastric, ovarian), and brain tumors
- Trauma – particularly to the central nervous system
- Obstetric complications – amniotic fluid embolism, abruptio placentae, HELLP syndrome, eclampsia, severe preeclampsia, acute fatty liver of pregnancy
- Intravascular hemolysis – due to acute hemolytic transfusion reaction secondary to ABO incompatible transfusion

Other less common causes include:

- Heat stroke
- Crush injuries
- Amphetamine overdose
- Fat embolism
- Vascular abnormalities (i.e., aortic aneurysm)
- Rattlesnake or viper bite
- Heredity homozygous protein C deficiency (purpura fulminans)
- Acute solid organ transplant rejection
- Catastrophic antiphospholipid syndrome (CAPS)
- Specific types of heparin-induced thrombocytopenia (HIT) and syndromes such as COVID-19 vaccine-induced immune thrombotic thrombocytopenia

Pathophysiology (Costello & Nehring, 2023)

The pathophysiology behind DIC involves a complex imbalance between coagulation and bleeding. When the body is exposed to trauma, cancer treatments, bacterial endotoxins, or cytokines, tissue factor (TF) activates coagulation factor VII into VIIa in the coagulation pathway. Thrombin and fibrin are formed in the extrinsic pathway creating clots in the circulation, resulting in a constant feedback loop of coagulation stimulation, inhibition, and consumption. In other words, clotting factors are consumed and synthesis of new platelets in the bone marrow cannot keep up with demand, leading to excessive bleeding.

DIC typically progresses through two stages: overactive clotting followed by bleeding (National Heart, Lung, and Blood Institute, 2022).

- Stage 1: excessive clotting leads to blood clots in the vasculature. Blood clots decrease or block blood flow which can damage organs.
- Stage 2: uncontrolled clotting uses up platelets and clotting factors, leading to bleeding.

Acute (decompensated) DIC occurs when blood is exposed to significant amounts of tissue factor (or other procoagulant substances) over a short timeframe, with an excessive generation of thrombin. This results in rapid consumption of coagulation factors that outpace their production. Fibrin degradation products (FDPs) interfere with fibrin clot formation and platelet aggregation.

Chronic (compensated) DIC develops when blood is continuously or intermittently exposed to smaller amounts of tissue factor. Coagulation factors and platelets are consumed, but new synthesis can compensate, and the liver can clear FDPs. Clotting times may be normal, and thrombocytopenia mild or absent. Many patients are asymptomatic with abnormal lab tests showing increased thrombin production and fibrinolysis. Chronic DIC is seen in patients with advanced malignancy.

Physical Examination Findings (Costello & Nehring, 2023)

Consider DIC if your patient exhibits generalized oozing or unexplained thrombosis.

- Bleeding from a variety of areas such as nose, gums, mouth, sites of trauma or surgery, wound sites, the vagina, the rectum, or through devices such as urinary catheters and intravenous lines
- Kidney failure, hematuria, oliguria, and anuria
- Acute lung injury, dyspnea, and hemoptysis secondary to pulmonary hemorrhage or pulmonary embolism
- Neurologic dysfunction, coma, delirium, and transient focal neurologic symptoms or mental status changes secondary to thrombi or hemorrhage in the brain
- Chest pain if coronary artery occlusion occurs
- Skin lesions, ecchymosis, hematoma, necrosis, gangrene, purpura, petechiae, and cyanosis
- Liver dysfunction, jaundice
- Adrenal failure from adrenal hemorrhage or infarction
- Purpura fulminans – a rare, life-threatening condition with tissue thrombosis and hemorrhagic skin necrosis

Laboratory Tests (Leung, 2023)

Diagnosis of DIC must be made using a combination of history, physical exam, and laboratory findings. Lab tests are outlined in the table below. Note that no single laboratory test can confirm or exclude a diagnosis of DIC. However, evidence of fibrinolysis (i.e., increased D-dimer), thrombocytopenia (low platelets), and coagulation factor consumption (i.e., increased PT, aPTT, low fibrinogen) support the diagnosis of acute DIC.

Lab Test	Acute (decompensated) DIC	Chronic (compensated) DIC
Platelet count	Decreased	Variable
Prothrombin time (PT)	Prolonged	Normal
Activated partial thromboplastin time (aPTT)	Prolonged	Normal
International normalized ratio (INR)	Prolonged	Normal
Thrombin time	Prolonged	Normal to slightly prolonged

Plasma fibrinogen	Decreased	Normal to elevated
Plasma factor V	Decreased	Normal
Plasma factor VIII	Decreased	Normal
Fibrin degradation products	Increased	Increased
D-dimer	Increased	Increased

Management (Costello & Nehring, 2023)

Patient management is focused on treating the underlying cause of DIC. For example, administer antibiotics for sepsis or surgical intervention for trauma.

- Platelet transfusion should be provided only in patients with active bleeding or at high risk of bleeding. These include:
  - Patients with serious bleeding or for emergency surgery and a platelet count less than 50,000/microL
  - Patients with a platelet count less than 10,000/microL due to increased risk of spontaneous bleeding
- Fresh frozen plasma (FFP) or cryoprecipitate may be transfused to supplement coagulation factors in patients with:
  - Significantly prolonged prothrombin time (PT) or activated partial thromboplastin time (aPTT)
  - Fibrinogen level less than 50 mg/dL and serious bleeding
- Supportive measures based on the patient's individualized needs, such as:
  - Hemodynamic and/or ventilatory support
  - Hydration for acute hemolytic transfusion reaction
  - Red blood cell transfusion for severe bleeding
- ***Antifibrinolytic agents are contraindicated*** in DIC patients as they may increase the risk of thrombotic complications. These include:
  - Tranexamic acid (TXA)
  - Epsilon-aminocaproic acid (EACA)
  - Aprotinin

References

Costello, R.A. & Nehring, S.M. (2023, January 20). Disseminated Intravascular Coagulation. StatePearls. https://www.ncbi.nlm.nih.gov/books/NBK441834/

Leung, L.K. (2023, July 18). Evaluation and management of disseminated intravascular coagulation (DIC) in adults. *UpToDate*. https://www.uptodate.com/contents/evaluation-and-management-of-disseminated-intravascular-coagulation-dic-in-adults

National Heart, Lung, and Blood Institute (2022, March 24). Disseminated Intravascular Coagulation. National Institute of Health. https://www.nhlbi.nih.gov/health/disseminated-intravascular-coagulation