40.2D: Platelets and Coagulation Factors

Platelets and coagulation factors are instrumental in plugging damaged blood vessel walls and stopping blood loss.

Learning Objectives

• Describe the roles played by platelets and coagulation factors

Key Points

• Platelets (thrombocytes) are small, anucleated cell fragments that result from the disintegration of megakaryocytes.
• Under normal conditions, blood vessel walls produce chemical messengers that inhibit platelet activation, but, when injured, they expose collagen, releasing factors that attract platelets to the wound site.
• Activated platelets stick together to form a platelet plug, which activates coagulation factor proteins found in the blood to further enhance the response to injury by strengthening the plug with fibrin.
• Vitamin K is necessary for the proper function of many coagulation factors; a deficiency is detrimental to blood clotting.
• Platelets can become activated and form clots in situations with non-physiological flow caused by disease or artificial devices.

Key Terms

• collagen: Any of more than 28 types of glycoprotein that forms elongated fibers, usually found in the extracellular matrix of connective tissue.
• clot: a solidified mass of blood
- **stenosis**: an abnormal narrowing or stricture in a blood vessel or other tubular organ

### Platelets and Coagulation Factors

Blood must form clots to heal wounds and prevent excess blood loss. Small cell fragments called platelets (thrombocytes) are formed from the disintegration of larger cells called megakaryocytes. For each megakaryocyte, 2000–3000 platelets are formed with 150,000 to 400,000 platelets present in each cubic millimeter of blood. Each platelet is disc shaped and 2–4 μm in diameter. They contain many small vesicles, but do not contain a nucleus.

Figure 1: How platelets are made and how they work: (a) Platelets are formed from large cells called megakaryocytes. The megakaryocyte breaks up into thousands of fragments that become platelets. (b) Platelets are required for clotting of the blood. The platelets collect at a wound site in conjunction with other clotting factors, such as fibrinogen, to form a fibrin clot that prevents blood loss and allows the wound to heal.

The inner surface of blood vessels is lined with a thin layer of cells (endothelial cells) that under normal situations produce chemical messengers that inhibit platelet activation. When the endothelial layer is injured, collagen is exposed, releasing other factors to the bloodstream which attracts platelets to the wound site. When the platelets are activated, they clump together to form a platelet plug (fibrin clot), releasing their contents. The released contents of the platelets activate other platelets and also interact with other coagulation factors. Coagulation factors (clotting factors) are proteins in the blood plasma that respond in a complex cascade to convert fibrinogen, a water-soluble protein present in blood serum, into fibrin, a non-water soluble protein, which strengthens the platelet plug. Many of the clotting factors require vitamin K to function. Vitamin K deficiency can lead to problems with blood clotting. The plug or clot lasts for a number of days, stopping the loss of blood.

Outside of the body, platelets can also be activated by a negatively-charged surface, such as glass. Non-physiological flow conditions (especially high values of shear stress) caused by arterial stenosis or artificial devices (e.g. mechanical heart valves or blood pumps) can also lead to platelet activation.