

A 16-year old student cuts their leg while playing sports. The wound bleeds heavily at first, but after a few minutes the bleeding slows and eventually stops. Later, the area around the cut becomes slightly red and warm. The blood and blood vessels are connected through a continuous, closed circuit where vessels act as transport pipes (arteries, veins, capillaries) that carry blood to all parts of the body (tissues and organs), and in this paper I will discuss about the roles of different components of blood in responding to this injury (Opneja 2019).

The student will have a heavy bleeding at first if the skin becomes damaged and also if the capillaries or arteries get cut then blood will flow at high pressure. Blood flows heavily after a cut in the leg primarily because it is vascularized area, containing large, high-pressure arteries and veins close to the surface, particularly in the thighs and calves (Derbel 2023).

There are many other reasons why the student could have a heavy bleeding after a cut in the leg, for example Chronic Venous Insufficiency (CVI) is a primary cause. When leg veins cannot efficiently return blood to the heart, pressure builds up in the lower legs, causing veins to become engorged and skin to become thin and fragile. A small cut can rupture these high-pressure, fragile veins, leading to significant bleeding (Youn 2018).

In varicose veins, swollen, enlarged veins are highly prone to rupture when injured, or even spontaneously, causing severe bleeding that can be fatal if not treated immediately (Serra 2018).

Hemophilia and Von Willebrand Disease are also examples of diseases which can cause heavy bleeding. Hemophilia is a genetic disorder characterized by a lack of sufficient clotting proteins in the blood, which leads to prolonged bleeding after a cut. The coagulation cascade is the body's built-in repair system that turns liquid blood into a solid gel (clot) to stop bleeding after a vessel is damaged (Kizilocak 2019).

Von Willebrand Disease which is also an example of diseases which can cause heavy bleeding is the most common inherited bleeding disorder, affecting

the 'glue' that helps platelets stick together, resulting in heavier than normal bleeding from injuries (Seidizadeh 2024).

The body stops bleeding and forms a blood clot through a three-step process called hemostasis. The three-step processes are vascular spasm, platelet plug formation, and blood clotting. In vascular spasm upon injury, smooth muscle in the blood vessel wall immediately contracts. This reduces the vessel diameter to lower blood flow to the damaged area (Sierra 2022). Platelet plug formation is the second step of hemostasis, in this platelets in the blood adhere to the exposed collagen of the damaged vessel and become activated. They change shape and release chemicals to attract more platelets, forming a temporary plug that acts as a plug to immediately restrict bleeding. Blood clotting is the final step of hemostasis to stop bleeding. It stops bleeding by transforming blood from a liquid to a gel-like plug at the injury site, creating a barrier to prevent blood loss and seal wounds from infection.

Fibrinogen is a soluble protein produced by the liver that acts as a vital component in blood formation. One of the roles of fibrinogen is wound healing and inflammation in this fibrinogen functions as an acute-phase protein, increasing in concentration during inflammation or tissue injury to aid in tissue repair. The inflammatory immune response is a rapid, localized, or systemic defense mechanism triggered by tissue injury, infection, or irritation. After inflammation, a body has an increased blood flow and chemical releases that cause heat, redness, swelling, and pain. When a wound becomes warm and red, the small blood vessels (arteries and capillaries) in the area undergo vasodilation, meaning they widen or expand.

In widening (vasodilation) the blood vessels dilate to significantly increase blood flow to the injured area. This influx of warm blood from the body's core makes the skin feel hot and look red.

There are many components of blood for example, plasma, red blood cells, white blood cells, and platelets. The first one is plasma and one of the roles of plasma is providing a temporary scaffold, the plasma proteins, specifically fibrin, form a provisional matrix that acts as a physical scaffold, allowing new cells (such as fibroblasts and keratinocytes) to migrate into the wound site to repair the damaged skin and tissue (Reinke 2012).

Fibroblast is a type of cell that acts as a “builder” in the body, creating connective tissue that holds organs and skin together.

Keratinocytes are the main type of cell found in the epidermis.

One of the roles of red blood cells is amplifying clotting, the RBCs amplify the activation of platelets, leading to faster clotting. They release substances such as ADP and thromboxane A2 and provide a surface (phosphatidylserine) that helps generate thrombin, which stabilizes the clot.

ADP (adenosin diphosphate) is a molecule found in all living cells that acts like a “dead” or used battery.

Thromboxane A2 (TXA2) is a short-lived substance produced by activated platelets that acts as a powerful helper in blood clotting.

The main function of some specific white blood cells called phagocytes (such as neutrophils and macrophages) is to engulf and digest pathogens including bacteria and viruses in a process known as phagocytosis. White blood cells or leukocytes are the active, primary cellular component of our immune system. There are also other roles of white blood cells (WBCs) for example, preventing infection, the WBCs identify pathogens like bacteria and viruses by presenting antibodies (Silva 2012).

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