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Platelets in Health and Disease

In the bloodstream, three main types of blood cells exist: red blood cells (RBCs), white blood cells (WBCs), and platelets. While red blood cells serve as oxygen carriers, white blood cells defend against various pathogens, and platelets play a crucial role in preventing excessive bleeding. All three types of blood cells are produced in the bone marrow, with platelets originating from specialized cells called megakaryocytes. It takes approximately five days for platelets to form from these cells, resulting in about 1000 crore platelets produced and destroyed daily in a healthy individual, maintaining a constant platelet count between one and a half to four lakh per milliliter of blood. Platelets after entering the blood stream from bone marrow, survive for seven to ten days before getting destroyed within spleen.

Platelets have a complex structure, being tiny, two-micron-sized plate-shaped cells enveloped by a cushiony layer called the glycocalyx on the outside and containing a network of small tubes internally. Even the slightest damage to blood vessels can cause bleeding, but platelets act promptly to seal the holes in the vessels. They form a solid clot with various blood factors which are mostly produced from liver.

Despite their crucial role in preventing excessive bleeding, they are responsible for creating clots within blood vessels. Blood clots can also be harmful under certain circumstances, when they cause blockages in critical organs like the brain or heart, potentially resulting in a stroke or cardiac arrest. To mitigate such risks, antiplatelet agents, including drugs like aspirin and clopidogrel, are administered to prevent platelets from becoming too active.

In some cases, individuals may have abnormally low platelet counts, which can cause bleeding in various parts of the body, such as the nose, mouth, or skin. Severe cases may even lead to bleeding in the brain or internal organs, posing life-threatening consequences. Increasing the platelet count becomes crucial in these situations, and platelet transfusions can serve as a supplemental treatment. However, the primary focus should be on addressing the underlying cause of low platelet count, as treating the underlying condition can lead to a natural increase in platelet count.

Low platelet counts can stem from various factors, including reduced platelet production in the bone marrow or accelerated destruction of platelets. Conditions like blood cancer can invade the bone marrow and disrupt the production of healthy cells, including those responsible for platelets. Additionally, diseases like aplastic anemia and myelodysplastic syndromes can halt the process of blood cell formation in the bone marrow, leading to a condition known as bone marrow failure syndromes. Dengue fever can also impair platelet development.

In the condition known as Immune Thrombocytopenia (ITP), the body produces antibodies that attack and destroy platelets. Platelet transfusions do not offer any benefit for these patients since the antibodies also target and destroy the transfused platelets. However, the disease can be effectively treated by administering drugs like steroids, which help prevent the development of these antibodies.

In patients with Thrombotic Thrombocytopenic Purpura (TTP), blood clots form in small blood vessels throughout the body, leading to a depletion of platelets. This causes bleeding due to the lack of platelets and organ failure due to blocks within blood vessels. A life-saving treatment for TTP patients is Plasma Exchange, which removes and replaces the patient's plasma with donor plasma. Without timely diagnosis and Plasma Exchange, over 90% of patients face a fatal outcome. However, with proper treatment, 90% patients get completely cured of TTP.

Increased platelet count can also pose problems. Conditions like Essential Thrombocythemia arise when the bone marrow produces excessive platelets without any apparent stimulus. This condition increases the risk of blood clots forming in the blood vessels, necessitating medications that reduce platelet production and prevent them from functioning properly.

Both platelet deficiency and excess can lead to serious health issues, highlighting the importance of identifying the underlying cause and providing appropriate treatment. Administering treatment without a clear understanding of the cause can be ineffective or even dangerous. Therefore, when encountering bleeding in any part of the body, conducting a blood test to assess the platelet count and determining the appropriate treatment becomes crucial.

Platelet transfusion is a critical life-saving intervention for patients with platelet deficiency. Two methods for collecting platelets are Single Donor Platelet (SDP) and Random Donor Platelet (RDP). SDP involves collecting the donor's blood, isolating the platelets, and returning the rest of the blood to the donor. RDP is derived from whole blood. Individuals can donate whole blood once every three to six months and SDP once a week. Regular blood or platelet donation offers the gratification of saving lives without any harm to oneself.

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