Platelets Function And Abnormalities

Platelets form the initial hemostatic plug whenever hemorrhage occurs. They also are the source of phospholipid, which is needed for the interaction of coagulation factors to form a fibrin clot. Platelets are produced in the bone marrow from megakaryocytes, under the influence of thrombopoietin. Platelet production begins with invagination of the megakaryocyte cell membrane and the formation of cytoplasmic channels and islands. The cytoplasmic islands produce platelets by fragmentation from the megakaryocyte.

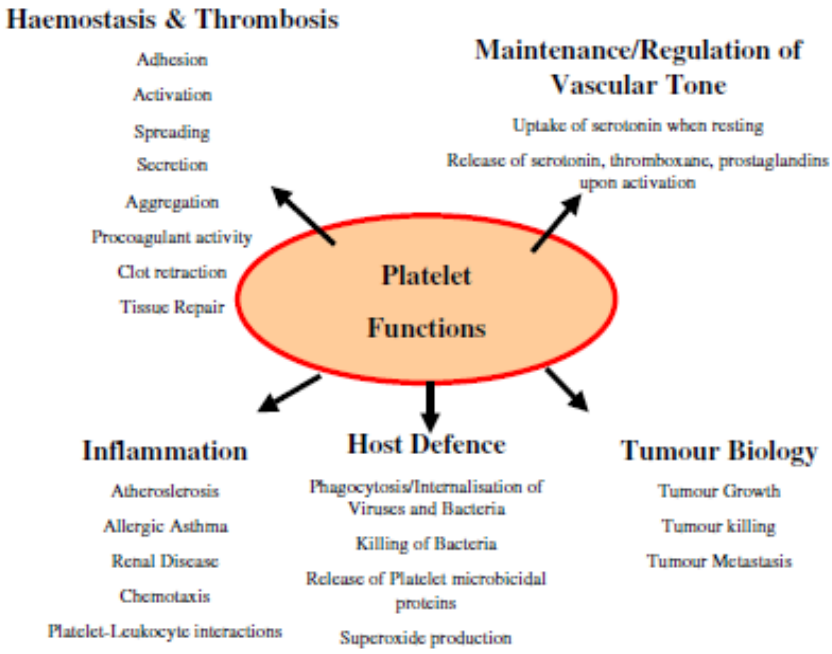


Figure 1 The multifunctional platelet. Platelets are involved in many pathophysiological processes, in addition to haemostasis and thrombosis, namely maintenance of vascular tone, inflammation, host defence and tumour biology.

Platelets are small cytoplasmic fragments of megakaryocytes. Megakaryocytes are derived from pluripotent stem cells in the bone marrow.

Platelet production requires presence of adequate megakaryocytes in the bone marrow (megakaryopoiesis) and normal formation and delivery of platelets to the circulation (thrombopoiesis).

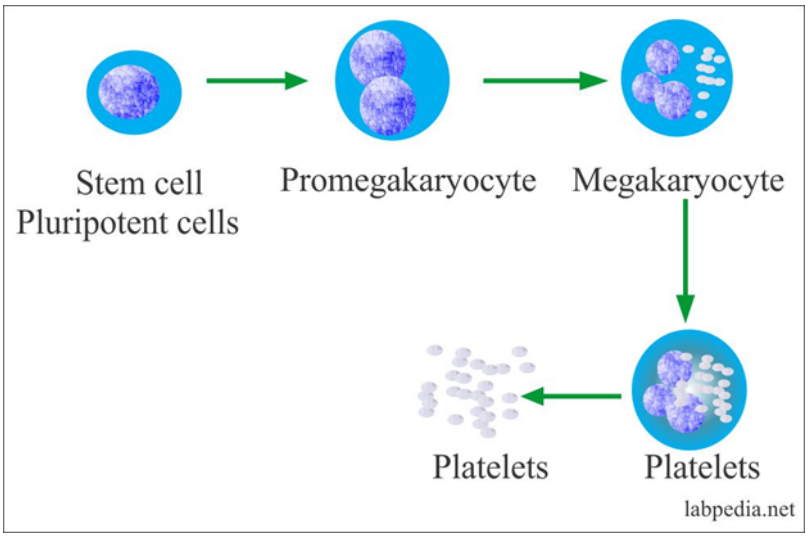
Megakaryopoiesis and thrombopoiesis are primarily mediated by thrombopoietin. This hormone is derived from hepatocytes, renal tubular epithelium and stromal bone marrow cells. Thrombopoietin is cleared by platelets and megakaryocytes. Erythropoietin plays a lesser role in platelet production.

Platelet alpha granules store proteins involved in hemostasis and vessel repair.

Dense granules in platelets contain Ca2+, Mg2+, ADP, ATP and serotonin which are also secreted with appropriate stimuli.

The main function of platelets is in primary hemostasis. They are involved in formation of the hemostatic plug (clot.(

In addition to vascular damage repair and formation of hemostatic plugs, platelets participate in inflammation and wound healing.



Abnormalities:

When platelets do not function properly, people are at risk of excessive bleeding due to injuries or even spontaneous bleeding. Platelet dysfunction may be

- Inherited
- Acquired

Inherited platelet disorders

Von Willebrand disease is the most common inherited platelet-related disorder. There are a number of other rare inherited disorders that affect platelets, including Glanzmann disease, Wiskott-Aldrich syndrome, Chédiak-Higashi syndrome, and Bernard-Soulier syndrome.

Acquired platelet disorders

- Drugs
- Diseases

Diagnosis

- Blood tests to measure platelet count and clotting
- Special tests to measure platelet function and bleeding

Platelets Count (Thrombocyte count)

Sample

1. This can be done on EDTA blood.
    1. This is stable for 5 hours at 23 °C and 24 hours at 4 °C.
2. Can take capillary blood and make a direct dilution, this sample is stable for 3 hours.
3. Fetal blood is collected from the umbilical area percutaneous.
4. The platelets can be assessed on the DLC slide.

Indication

1. To diagnose the cause of petechial hemorrhage in the skin.
2. To find the cause of spontaneous bleeding.
3. In women with heavy menses.
4. This is advised in a patient on chemotherapy.
5. This is advised in case of bone marrow failure.
6. Platelets count is of value in thrombocytopenia seen in:
    1. Uremia.
    2. Liver diseases.
    3. malignancies.

NORMAL

Source 1

- To convert into SI unit x 10^6 = x 10^9/L

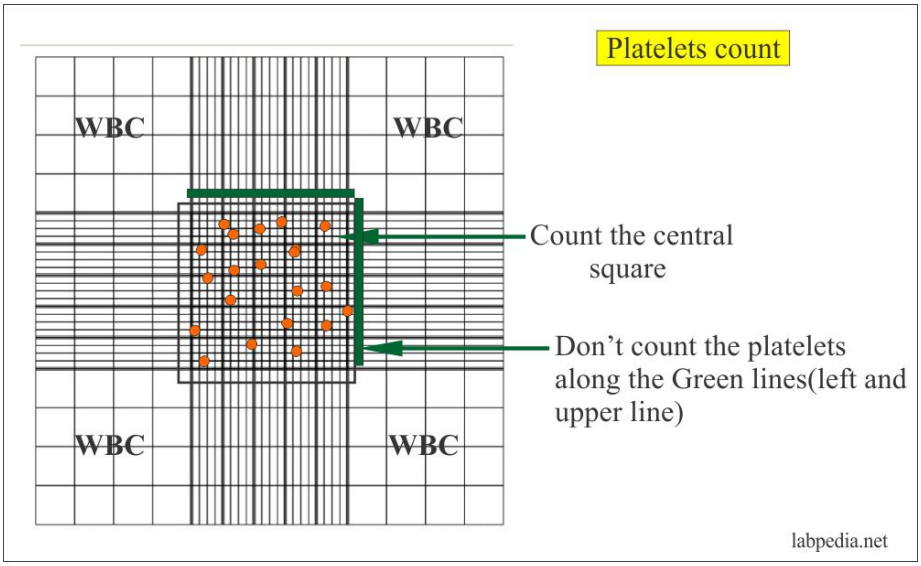
Age	**cmm** (mm^3)	**x 10^9/L (SI unit)**
Adult/elderly	150,000 to 400,000	150 to 400
Premature infants	100,000 to 300,000	100 to 300
Newborn	150,000 to 300,000	150 to 300
Infants	200,000 to 475,000	200 to 475
Children	150,000 to 400,000	150 to 400

- **Thrombocytopenia** when The count is less than 100,000 /cmm
  Thrombocytosis when the count is more than 400,000 /cmm.
  Thrombocythemia when the count is above one million /cmm.

Method To Count Platelets

1. By automated hematology analyzers.
2. Direct smear also gives information about the size, shape, and clumping of platelets.
3. Direct count from the peripheral blood smears.
    1. Count platelets on oil objective in 10 fields and multiply with 2000, will give a rough idea about the count.
        1. Platelets in 10 field X 2000 = total platelets.
4. **The manual method of platelet count:**
    1. Take 20 µL of blood.
    2. Add 1.8 mL of 1% ammonium oxalate.
        1. Ammonium oxalate will lyse the RBCs and WBCs and Platelets will remain intact.
    3. Leave for 15 minutes for complete lysis of RBCs.
    4. Mount the Neubauer chamber.

5. Leave the chamber for 15 minutes in the high humidity.
6. Count the central large square.



Neubauer Chamber for Counting the Platelets

7. The average number of platelets counted in 1 mm² = X
8. The dilution of the blood is 1:100.
9. The depth of the chamber is 0.1 mm.

$$\text{Formula} = \frac{\text{average number of platlets x 100 x 1 mm}^2}{\text{0.1 mm}} \text{ x10}^6 = \text{Platelets x10}^9/\text{L}$$

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Calculation of the platelets formula

10. Note: Can use the constant factor of 1000.
11. To minimize the error to count platelets manually:
    1. Avoid the platelets clumping.
    2. Avoid the microclot formation.
    3. Run the test in duplicate and then get the average of the two results.
    4. If taking blood from the finger then don't squeeze the finger.

What Are The Mechanism Leading To Thrombocytopenia:

1. This may be due to decreased production of the bone marrow. This may be due :
    1. Bone marrow failure.
    2. Infiltration of the bone marrow by tumors or fibrosis.
2. Destruction or sequestration of the platelets by hypersplenism.
3. Antibodies destroying the platelets.

4. destruction of the platelets by infection or drugs.
5. Increased utilization of disseminated intravascular coagulopathy.
6. In severe hemorrhage which leads to loss of platelets.
7. A large blood transfusion leads to a dilutional effect.

Causes Of Thrombocytopenia Or Decreased Platelets:

1. Idiopathic thrombocytopenia ITP.
2. Hypersplenism.
3. Anemias like pernicious, aplastic, and hemolytic.
4. After a massive blood transfusion
5. An infection like viral, and bacterial,
6. Chemotherapy treatment.
7. HIV infection.
8. Leukemias, carcinoma, and myelofibrosis. This is due to the infiltration of the bone marrow.
9. D I C.
10. Toxemia of pregnancy, eclampsia.
11. Antiplatelets antibody.
12. Renal failure.
13. Inherited diseases like Wiskott-Aldrich syndrome.
14. An autoimmune disease like systemic lupus erythematosus

Thrombocytosis Or Increased Platelets:

1. malignant tumors like leukemia, and lymphoma,
2. Polycythemia vera.
3. Splenectomy.
4. Iron deficiency anemia.
5. Autoimmune diseases like Rheumatoid arthritis, and SLE.
6. Hodgkin's lymphoma
7. Chronic pancreatitis, and inflammatory bowel disease.
8. Tuberculosis.

Critical Value

- The patient may develop spontaneous bleeding when the count is **< 20,000 /cmm**.
- Platelets counts > 50,000 /cmm usually show no bleeding.