Current Trends in Internal Medicine
Dar A. Curr Trends Intern Med 9: 244.
www.doi.org/10.29011/2638-003X.100244
www.gavinpublishers.com



GAVIN PUBLISHERS

## Short Communication

# A Practical Approach to an Abnormal CBC

**Ajay Dar***

Medical Oncologist, Virginia Cancer Specialists Lansdowne, VA, USA

***Corresponding author:** Ajay Dar, Medical Oncologist, Virginia Cancer Specialists Lansdowne, VA, USA

**Citation:** Ajay Dar. (2025) A Practical Approach to an Abnormal CBC. Curr Trends Intern Med 9: 244. DOI: https://doi.org/10.29011/2638-003X.100244

**Received Date:** 04 June, 2025; **Accepted Date:** 11 June, 2025; **Published Date:** 20 June, 2025

As a hematology medical oncology physician, I am often consulted by primary care providers for abnormal CBC. I would like to explain my approach to these abnormalities. This will help primary care providers initiate the workup while the patient is waiting to be seen by hematology and hopefully decrease patient anxiety while waiting for the appointment.

Complete blood count or CBC is one of the most performed laboratory tests. The standard CBC measures RBC count, hemoglobin, red cell indices, platelet counts and white blood cell count. Most analyzers will also generate a WBC differential.

The three important parts of CBC are white cells, red cells, and platelets. These three cell lines can be increased, decreased or abnormal. I will try to summarize my approach. While evaluating the latest CBC it is important to try and obtain historical records of blood counts as they may be helpful in determining chronicity of the abnormalities seen.

**Red cells**

Red cells are assessed in the CBC on the basis of hemoglobin, hematocrit, MCV, MCHC, RDW and RBC count.

If the hemoglobin is less than the reference range, it is called anemia. It is important to confirm that the demographics of the patient are entered correctly as the normal range will vary depending upon the age and the sex of the patient. Hemoglobin levels are lower in females of menstruating age as compared to males. Even after correction of iron stores this difference persists probably because of testosterone stimulation of the bone marrow. Hemoglobin is 12% lower hemoglobin in women as compared to age and race matched males. This difference is not seen in prepubertal patients [1].

The next parameter to look at is the MCV or Mean corpuscular volume. MCV is a measure of the size of red cells. If less than 80 Fl the cells are smaller than normal and are called microcytic. If MCV is greater than 100 Fl it is macrocytic anemia. And if it is between 80-100 it is normocytic anemia. Iron deficiency is the most common cause of microcytic anemia and checking ferritin should be the next step. If iron deficiency is confirmed the causes of iron deficiency will need to be determined. Ferritin may be elevated in patients with chronic or acute inflammation however ferritin greater than 100 ng/mL excludes iron deficiency anemia regardless of any underlying disease status. Other causes that can cause microcytic anemia include thalassemia. CBC characteristic of thalassemia is a low MCV but with a normal red cell dispersion width (RDW). Hemoglobin electrophoresis is the test that would confirm the diagnosis except in alpha thalassemia where this may be unremarkable. Iron stores should be repleted before starting the work up to confirm thalassemia as patients with concomitant iron deficiency and beta thalassemia trait the increase in Hb A2 (indicating beta thalassemia ) may not be seen [3]. If alpha thalassemia is suspected specific genetic test will need to be done. RDW is increased with iron deficiency as the bone marrow is making cells that are variable in size however in thalassemia all the cells are uniform in size and hence RDW is within normal limits. Increase in RDW may be the first sign in iron deficiency even before microcytosis develops. Patients with chronic inflammatory disorders will also have a microcytic anemia.

If the MCV is greater than 100 Fl but especially if greater than 120fl it is macrocytic anemia. In patients with history of alcohol abuse macrocytosis is seen on CBC. Chronic liver disease may also be associated with macrocytosis. Less common causes include folic acid and vitamin B12 deficiency. If B12 deficiency is confirmed and the patient is not vegan, consider referral to gastroenterology to determine causes for B12 malabsorption. Thyroid disorders can lead to macrocytosis also and should be excluded. Medications that affect nuclear division like chemotherapeutic agents will cause macrocytosis. Patients with severe hemolysis that have increased reticulocyte count can also show macrocytosis as reticulocytes have a larger volume than mature red cells. MCV of reticulocytes ranges between 120-140 fl.

Another term which is often used when MCV is high is megaloblastic anemia. Megaloblastic anemia is a type of macrocytic anemia but

the difference is that megaloblastic anemia is from conditions that affect the bone marrow. B12 and folic acid deficiency leads to megaloblastic anemia and bone marrow biopsy shows large proerythroid cells in the bone marrow and hyper segmented neutrophils in peripheral blood. Other causes of macrocytosis like alcohol and thyroid dysfunction lead to enlarged red cells but no changes in the white cells or in the bone marrow.

In most patients with anemia MCV is within normal limits. This can be seen with any of the nutritional deficiencies in the early stage. Acute blood loss will be also associated with red cells that are normal in size. In patients with chronic blood loss, however, iron deficiency may lead to microcytosis . Anemia of chronic kidney disease from decreased erythropoietin levels are also normocytic. Other less common causes include primary bone marrow pathologies, anemia of chronic disease and hemolytic anemia. However patients with hemolysis produce excessive numbers of reticulocytes the MCV may be increased as stated above.

If the hemoglobin is higher than the reference range, it is called polycythemia. Erythrocytosis can be used interchangeably but refers to increase in red cell count. Common causes include patients that are on diuretics or are dehydrated so that there is a relative increase in red cells. However, in otherwise healthy patients increased red cells can be seen both as a primary phenomenon from bone marrow overactivity / myeloproliferative disorder and secondary to extra medullary causes. Make sure to check the normal range is correct for that patient's age and sex. The next step is to check erythropoietin levels. If erythropoietin levels are decreased, then primary polycythemia including polycythemia vera is more likely. Increase in white cells and/or increase in platelets may also be seen with primary myeloproliferative disorders. If erythropoietin levels are increased conditions associated with chronic or intermittent hypoxia like sleep apnea should be considered especially when a patient is newly diagnosed or is noncompliant with treatment. Smoking is another common cause of secondary polycythemia. Patients with underlying cardiopulmonary disease with episodic or persistent hypoxia may lead to secondary erythrocytosis. Rarely tumors or cysts like renal cysts or renal cell cancer can produce erythropoietin and lead to polycythemia. Patients taking supplemental medications including testosterone replacements may also have secondary polycythemia. Use of exogenous erythropoietin like medications, especially in athletes, should be considered.

Less common abnormalities in the CBC are also important to look for. An increase in MCHC occurs with spherocytosis. Looking at the peripheral smear in patients with elevated MCHC is important. Less commonly MCHC may be increased with hemolyzed samples. MCHC is calculated by using hemoglobin and the red cell count. In patients with hemolysis hemoglobin may be present in the plasma but the red cell count is decreased so the ratio becomes abnormal. Cold agglutinins may cause an elevation in MCHC. If MCHC is found to be increased warming the blood to 37 degrees and then rechecking a CBC to rule out cold agglutinins. Evaluation of the peripheral smear should be done to rule out hereditary spherocytosis.

Let us now turn our attention to the white cells. If white cells are increased, it is called leukocytosis. Look at the machine read differential to see which cell lines are increased (3). Most commonly is an increase in neutrophils. Increase in neutrophils could be secondary to underlying infection, stress, pain, or any inflammatory disorder. Do not forget to check urinalysis especially in female patient since asymptomatic UTIs can cause increased white cells. Medications like steroids can be associated with increased white cell count. Chronic myeloid leukemia is a less common condition but if no other underlying cause for polymorphonuclear leukocytosis is found checking for the BCR-ABL mutation should be the next step. If the lymphocyte count is high chronic lymphocytic leukemia or other lymphoproliferative disorders will need to be ruled out. Check peripheral blood flow cytometry to confirm. Increasing eosinophil count can be seen with allergy, parasitic infections and much less common with myeloproliferative disorders or Hodgkin's lymphoma. Increased monocytes and basophils are less common but could be associated with myeloproliferative disorders or bone marrow recovery after chemotherapy induced suppression.

Low neutrophil count is often seen with patients on chemotherapy. If the count is less than 500/microliter risk of infection is significantly increased. Sometimes viral infections can lead to low neutrophil count. Medications including chemotherapy can lower lymphocyte count increasing the risk of infection. HIV can be associated with low lymphocyte count. Cyclical neutropenia is a rare condition, but patients often give history of cyclical severe infections associated with a low white count. Chronic neutropenia can be seen in patients of African ancestry and has been associated with Duffy Null blood group phenotype. These patients will have a history of neutropenia and for a long duration without any history of repeated infections.

Next, we move our attention to the platelets. Platelets are cells that help us prevent bleeding. The normal count is between 150-450,000 but spontaneous bleeding will not occur at platelet counts greater than 20,000 especially if they are normally functioning. Low platelet counts are seen with certain infections. The most common cause is idiopathic thrombocytopenic purpura. There is no specific test for this condition though occasionally autoantibodies can be found. This is a diagnosis of exclusion. Liver disease, especially if associated with an enlarged spleen can lead to low platelets. Gestational thrombocytopenia is characteristic of pregnancy but is not associated with bleeding. But may be associated with some anxiety especially late in the pregnancy when an epidural analgesia is being planned. Autoimmune disorders including lupus may be associated with low platelets and need to be ruled out. In patients with low platelets evaluation of peripheral smear is important

because of a condition called pseudo thrombocytopenia leading to platelet clumps or platelet satellitosis [2]. This is an artifact of using EDTA as anticoagulant. So, collecting the blood in tubes that have a different anticoagulant may help clarify the issue apart from looking at the peripheral smear. This condition is not associated with increased risk of bleeding as the platelet count is normal in vivo and does not require any treatment. Patients with thrombocytopenia do require an examination of the peripheral smear especially those that are ill or hospitalized to rule out thrombotic thrombocytopenic purpura/hemolytic uremic syndrome where schistocytes will be seen on the peripheral smear. Patients with low platelets may also have disseminated intravascular coagulation or DIC. DIC will often lead to coagulation abnormalities unlike TTP/HUS.

Mean platelet volume (MPV) is the average size of platelets. In patients with low platelets were MPV is high it indicates that platelets are being destroyed and the bone marrow is compensating by producing young platelets as seen in ITP. Extremely elevated MPV with a low platelet counts can be seen with Bernard-Soulier disease and May-Hegglin abnormality.

Platelets are increased in iron deficiency. So make sure to check ferritin/iron levels in patients with high platelets. In patients who have had splenectomy platelets can run high. If no cause of elevated platelets is found, then primary thrombocytosis due to myeloproliferative disorder is a possibility and will require specific testing to be done.

**Indications for manual differential.**

Despite the improvement in technology and CBC counters manual evaluation of peripheral smear still has a role especially (1)

#1 confirm abnormality seen on CBC.

#2 patient with pancytopenia

#3 unexplained low platelets to rule out platelet clumping or satellitism or TTP.

**Glossary**

**Acanthocytosis** irregularly spiculated red cells. These are found in liver disease. Characteristic of rare condition called abetalipoproteinemia.

**Anisocytosis** variation in red cell size

**Basophilic** stippling. Seen classically with lead poisoning.

**Blast cells.** Immature white cells could be indicative of myelofibrosis or acute leukemia.

**Burr cells.** Irregularly shaped red cells. Seen in patients with uremia.

**CBC** complete blood count. Also referred to as full blood count or FBC

**Dohle bodies.** Blue staining area in the cytoplasm seen in severe infections.

**Elliptocytes** oval-shaped red cells. Characteristic of hereditary elliptocytosis

**Hb** hemoglobin

**HCT** hematocrit

**Howell-Jolly bodies** nucleus fragments and red cells. In patients after splenectomy

**Hyper segmented neutrophils**. Increased neutrophilic segments. Seen with B12 deficiency.

**MCV** mean corpuscular volume.

**MCH** mean corpuscular hemoglobin.

**MCHC** mean corpuscular hemoglobin concentration.

**ITP** idiopathic thrombocytopenic purpura

**Poikilocytosis** variation in red cell shape. Seen in iron deficiency.

**RBC** red blood cell count

**RDW** Red cell dispersion width

**Schistocytes** Red cell fragments. Characteristic of micro angiopathic hemolysis

**Spherocytes**. Round red cells with loss of central pallor. Seen with active hemolysis and hereditary spherocytosis

**Target cells** diagnostic of thalassemia and other hemoglobinopathies

**WBC** white blood cell count. Also referred to as TLC or total leukocyte count

**References**

1. Erhabor O, Muhammad HA, Muhammad K, Onwuchekwa C, Egenti NB (2021) Interpretation of Full Blood CountParamets in health and disease. Haematol Int J, 5 :00180

2. Tan GC, Stalling M, Dennis G, Nunez M, Kahwash SB (2016) Pseudothrombocytopenia due to Platelet clumping : A case report and brief review of literature. Case Rep Heamtol, 2016:3036476.

3. Tefferi A, Hanson CA, Inwards DJ (2005) How to interpret and pursue an Abnormal Complete Blood Cell Count in Adults. Mato Clin Proce, 80: 923-936.