The complete blood count (CBC)

The complete blood count (CBC) is often used as a broad screening test to determine an individual's general health status.

1. Evaluation of white blood cells, the five types include neutrophils, lymphocytes, monocytes, eosinophils, and basophils.

تعليق عليه **[DS21]:**

2. Evaluation of red blood cells: Hemoglobin measures the total amount of the oxygen-carrying protein in the blood, which generally reflects the number of red blood cells in the blood.

3. Hematocrit measures the percentage of a person's total blood volume that consists of red blood cells, a low hematocrit and low RBC indicate anemia some other causes:

Excessive loss of the blood for ex ,trauma, chronic bleeding like bleeding from digestive tract e.g ulcer polyps, colon cancer, ,heavy menstrual bleeding ,nutritional deficiencies such as iron ,folate or vit B12 deficiency, damage to the bone marrow ,aplastic anemia ,.leukemia, lymphoma ,multiple myeloma ,kidney disease ,erythropoietin production ,chronic inflammatory diseases ,thalassemia and ,hemolytic anemia caused by autoimmunity or defect in the red blood cell itself. While, high hematocrit indicate

 Dehydration . lung pulmonary disease congenital heart disease kidney tumor smoking and living at a high altitudes a compensation for decrease O2 in the air polycythemia vera

4. Red blood cell indices are calculations that provide information on the physical characteristics of the RBCs:

Mean corpuscular volume (MCV) is a measurement of the average size of a single red blood cell.

Mean corpuscular hemoglobin (MCH) is a calculation of the average amount of hemoglobin inside a single red blood cell.

Mean corpuscular hemoglobin concentration (MCHC) is a calculation of the average concentration of hemoglobin inside a single red blood cell.

Red cell distribution width (RDW) is a calculation of the variation in the size of RBCs. The CBC may also include reticulocyte count, which is a measurement of the absolute count or percentage of young red blood cells in blood.

Evaluation of platelets, cell fragments that are vital for normal blood clotting:

5. The platelet count is the number of platelets in a person's sample of blood.

Mean platelet volume (MPV) may be reported with a CBC. It is a calculation of the average size of platelets.

Platelet distribution width (PDW) may also be reported with a CBC. It reflects how uniform platelets are in size. Note The CBC is a very common test.

When the dentist is used complete blood picture? A CBC may be ordered when

1. A person has any number of signs and symptoms that may be related to disorders that affect blood cells.

2. When an individual has fatigue or weakness or has an infection, inflammation, bruising, or bleeding,

3. If someone is receiving treatment for a blood-related disorder, then a CBC may be performed frequently to determine if the treatment is effective.

4. Some therapies, such as chemotherapy, can affect bone marrow production of cells.

WBC White Blood Cell Count : **causes of a low count**

Known as leukopenia Bone marrow disorders or damage, Autoimmune conditions Severe infections (sepsis), Lymphoma or other cancer that spread to the bone marrow, Dietary deficiencies, Diseases of immune system (e.g., HIV/AIDS)

examples of causes of a high count

Known as leukocytosis Infection, most commonly bacterial or viral Inflammation Leukemia, myeloproliferative disorders Allergies, asthma Tissue death (trauma, burns, heart attack) Intense exercise or severe stress

Absolute neutrophil count, % neutrophils)

Known as **neutropenia** Severe, overwhelming infection (sepsis), Autoimmune disorders, Dietary deficiencies, Reaction to drugs, chemotherapy Immunodeficiency Myelodysplasia Bone marrow damage (e.g., chemotherapy, radiation therapy) Cancer that spreads to the bone marrow .

neutrophilia Acute bacterial infections, Inflammation, Trauma, heart attack, or burns, Stress, rigorous exercise Certain leukemias (e.g., chronic myeloid leukemia) Cushing syndrome

Absolute lymphocyte count, % lymphocytes

Known as **lymphocytopenia** Autoimmune disorders (e.g., lupus, rheumatoid arthritis) Infections (e.g., HIV, viral hepatitis, typhoid fever, influenza), Bone marrow damage (e.g., chemotherapy, radiation therapy) ,Corticosteroids.

Known as **lymphocytosis** Acute viral infections (e.g., chicken pox, cytomegalovirus (CMV), Epstein-Barr virus (EBV), herpes, rubella) Certain bacterial infections (e.g., pertussis (whooping cough), tuberculosis (TB)) Toxoplasmosis Chronic inflammatory disorder (e.g., ulcerative colitis) Lymphocytic leukemia, lymphoma Stress (acute).

Absolute monocyte count, % monocytes

Repeated **low** counts can indicate: Bone marrow damage or failure Hairy cell leukemia Aplastic anemia.

High count can indicate: chronic infections (e.g., tuberculosis, fungal infection) Infection within the heart (bacterial endocarditis) ,Collagen vascular diseases (e.g., lupus, scleroderma, rheumatoid arthritis, vasculitis) ,Monocytic or myelomonocytic leukemia (acute or chronic) .

Absolute eosinophil count, % eosinophils

Numbers are normally **low** in the blood. One or an occasional low number is usually not medically significant

High count in Asthma, allergies such as high fever Drug reactions Parasitic infections Inflammatory disorders (celiac disease, inflammatory bowel disease) Some cancers, leukemias or lymphomas Addison disease

Absolute basophil count, % basophils

As with eosinophils, numbers are normally **low** in the blood; usually not medically significant.

Rare allergic reactions (hives, food allergy) Inflammation (rheumatoid arthritis, ulcerative colitis).

Test Full Name examples of causes of low Result

RBC Red Blood Cell Count

Known as anemia Acute or chronic bleeding RBC destruction (e.g., hemolytic anemia, etc.) Nutritional deficiency (e.g., iron deficiency, vitamin B12 or folate deficiency) Bone marrow disorders or damage chronic inflammatory disease chronic kidney disease.

Examples of causes of high result

Known as **polycythemia** ,Dehydration, Lung (pulmonary) disease, Kidney or other tumor that produces excess erythropoietin ,Smoking ,Living at high altitude Genetic causes (altered oxygen sensing, abnormality in hemoglobin oxygen release) Polycythemia vera—a rare disease

Usually mirrors RBC results; most common cause is dehydration RBC indices **MCV Mean Corpuscular Volume** Indicates RBCs **are smaller** than normal (microcytic); caused by iron deficiency anemia or thalassemias, for example.

Indicates RBCs are **larger** than normal (macrocytic), for example in anemia caused by vitamin B12 or folate deficiency, myelodysplasia, liver disease, hypothyroidism

MCH Mean Corpuscular Hemoglobin

Mirrors MCV results; small red cells would have a lower value

MCHC Mean Corpuscular Hemoglobin Concentration

May be low when MCV is low; decreased MCHC values (hypochromia) are seen in conditions such as iron deficiency anemia and thalassemia.

Mirrors **MCV results**; macrocytic RBCs are large so tend to have a higher MCH.

Increased MCHC values (hyperchromia) are seen in conditions where the hemoglobin is more concentrated inside the red cells, such as autoimmune hemolytic anemia, in burn patients, and hereditary spherocytosis, a rare congenital disorder.

Distribution Width

uniformity in size of RBCs. and large RBCs; young RBCs tend to be larger. For example, in iron deficiency anemia or pernicious anemia, there is high variation in RBC size (along with variation in shape – poikilocytosis), causing an increase in the RDW.

Reticulocytes (absolute count or %)

In the setting of anemia, a low reticulocyte count indicates a condition is affecting the production of red blood cells, such as bone marrow disorder or damage, or a nutritional deficiency (iron, B12 or folate).

In the setting of anemia, a high reticulocyte count generally indicates peripheral cause, such as bleeding or hemolysis, or response to treatment (e.g., iron supplementation for iron deficiency anemia).

Plt Platelet Count : Known as thrombocytopenia: Viral infection (mononucleosis, measles, hepatitis) Platelet autoantibody Drugs (acetaminophen, quinidine, sulfa drugs) ,Cirrhosis Autoimmune disorders Sepsis Leukemia, lymphoma

Myelodysplasia Chemo or radiation therapy Known as thrombocytosis: Cancer (lung, gastrointestinal, breast, ovarian, lymphoma) Rheumatoid arthritis, inflammatory bowel disease, lupus Iron deficiency anemia, Hemolytic anemia Myeloproliferative disorder (e.g., essential thrombocythemia)

MPV (Not always reported) Mean Platelet Volume Indicates average size of platelets is small; older platelets are generally smaller than younger ones and a low MPV may mean that a condition is affecting Indicates a high number of larger, younger platelets in the blood; this may be due to the bone marrow producing and releasing platelets rapidly into circulation.

the production of platelets by the bone marrow.

PDW (Not always reported) Platelet Distribution Width

Indicates uniformity in size of platelets

Indicates increased variation in the size of the platelets, which may mean that a condition is present that is affecting platelets

Recent blood transfusions affect the results of the CBC. Normal CBC values for babies and children are different from adults. The laboratory will supply the reference ranges for various age groups, and a health practitioner will take these into consideration when interpreting data.

There are many types of anemia, including :

1- Iron deficiency anemia

Anemia that is due to low iron levels is called iron deficiency anemia.

1- Young women are likely to have low grade iron deficiency anemia because of the loss of blood each month through normal menstruation .This is generally without any major symptoms as the blood loss is relatively small and temporary

2- Another common reason for iron deficiency anemia can be due to recurring or small ongoing bleeding, for instance from colon cancer or from stomach ulcers. even very common over-the-counter drugs such as aspirin and ibuprofen.

3- In infants and young children, iron deficiency anemia is most often due to a diet lacking iron.

2- Pernicious Anemia

Pernicious anemia is a condition in which the body can't make enough healthy red blood cells because it doesn't have enough vitamin B12.

This typically causes of macrocytic (large blood cell volume) anemia.

Vitamin B12, along with folate, is involved in making the heme molecule that is an integral part of hemoglobin.

Folate deficiency can be the cause of anemia as well. However, other conditions and factors can also cause vitamin B12 deficiency.

Causes:

1- A lack of intrinsic factor is a common cause of pernicious anemia as the body can't absorb enough vitamin B12.

2- Some pernicious anemia occurs because the body's small intestine can't properly absorb vitamin B12 which may be due to the wrong bacteria in the small intestines;

3- Certain diseases that interfere with vitamin B12 absorption

4- Surgical removal of part of the small intestine , 5- Tapeworm infection .

6 - Strict vegetarians are at risk if they do not take adequate vitamin supplement.

7- Under-consumption of green, leafy vegetables , 8- Long-term alcoholics.

Signs and symptoms Apart from the symptoms of anemia (fatigue, dizziness, etc.), the vitamin B12 deficiency may also have some serious symptoms like Nerve damage, Neurological problems such as confusion, dementia, depression, and memory loss. Symptoms in the digestive tract include nausea and vomiting, heartburn, abdominal bloating and gas, constipation or diarrhea, loss of appetite, and weight loss .An enlarged liver, A smooth, beefy red tongue. Infants who have

vitamin B12 deficiency may have poor reflexes or unusual movements, such as face tremors.

3- Aplastic Anemia; is a blood disorder in which the body's bone marrow doesn't make enough new blood cells. **Causes** Damage to the bone marrow's stem cells causes aplastic anemia. In more than half of people who have aplastic anemia, the cause of the disorder is unknown.

1- A number of acquired diseases, conditions, and factors can cause aplastic anemia including: Toxins, such as arsenic, and benzene, Radiation and chemotherapy, Medicines such as chloramphenicol, Infectious diseases such as hepatitis, Epstein-Barr virus, cytomegalovirus, parvovirus B19, and HIV Autoimmune disorders such as lupus and rheumatoid arthritis
2- Inherited conditions, such as Fanconi anemia, dyskeratosis congenital.

Signs and symptoms The most common symptoms of **aplastic anemia** are Fatigue, Shortness of breath , Dizziness , Headache, Coldness in hands or feet, Pale skin, gums and nail beds, Chest pain . **Treatment** of aplastic anemia includes blood transfusions, blood and marrow stem cell transplants, and medication. In some cases, a cure may be possible. Removing a known cause of aplastic anemia, such as exposure to a toxin, may also cure the condition.

4-Hemolytic Anemia is a condition in which red blood cells are destroyed and removed from the blood stream before their normal lifespan is up. There are many types of hemolytic anemia's – some of which are inherited and others that are acquired.

1- Inherited hemolytic anemia's include: Sickle cell anemia, Thalassaemias, Hereditary spherocytosis, Glucose-6-phosphate dehydrogenase (G6PD) deficiency, Pyruvate kinase deficiency

2- Acquired hemolytic anemia include: Autoimmune hemolytic anemia, Drug-induced hemolytic anemia Mechanical hemolytic anemia, certain infections.

5-Thalassaemia :are inherited blood disorders which cause the body to make fewer healthy red blood cells and less hemoglobin. The two major types of

thalassaemia are: alpha- and beta thalassaemia. •The most severe form of alpha thalassaemia is known as alpha thalassaemia major or hydrops fetalis • the severe form of beta thalassaemia is known as thalassaemia major or Cooley's anemia. Thalassaemias affect both males and females. Severe forms are usually diagnosed in early childhood and are lifelong conditions. Genes control how the body makes hemoglobin protein chains. When these genes are missing or altered, thalassaemias occur. People who get abnormal hemoglobin genes from one parent but normal genes from the other are carriers. Carriers often have no signs of illness other than mild anemia. However, they can pass the abnormal genes on to their children. People with beta thalassaemia intermedia have mild to moderate anemia. They may also have other health problems including: slowed growth and delayed puberty; bone problems; and an enlarged spleen. People with beta thalassaemia major have severe thalassaemia. Symptoms occur within the first two years of life and include severe anemia and other serious health problems. Pale and listless appearance, Poor appetite, Dark urine, Slowed growth and delayed puberty, Jaundice, Enlarged spleen, liver and heart, Bone problems. **Treatment** for thalassaemias depends on the type and severity of the disorder. People who are carriers need little or no treatment. Three standard treatments are used to treat moderate and severe forms of thalassaemia, these include blood transfusions, iron chelation therapy, and folic acid supplements. **Signs and symptoms** Symptoms of thalassaemias are caused by a lack of oxygen in the blood stream.

6- Sickle Cell Anemia : is a serious disease in which the body makes sickleshaped ("C"-shaped) red blood cells. Normal red blood cells are diskshaped and move easily through blood vessels. Sickle cells contain abnormal hemoglobin that causes the cells to have a sickle shape, which don’t move easily through the blood vessels – they are stiff and sticky and tend to form clumps and get stuck in the blood vessels. The clumps of sickle cells block blood flow in the blood vessels that lead to the limbs and organs. Blocked blood vessels can cause pain, serious infections, and organ damage. In sickle cell anemia, a lower-than-normal number of red blood cells occur because sickle cells don't last very long. Sickle cells usually die after about 10 to 20 days and the body can't reproduce red blood cells fast enough to replace the dying ones, which causes anemia. **Causes** Sickle cell anemia is an inherited, lifelong

disease. People who have the disease inherit two copies of the sickle cell gene – one from each parent. **Signs and Symptoms** The most common symptoms of sickle cell anemia are linked to anemia and pain .Sudden pain throughout the body is a common symptom of sickle cell anemia. This pain is called a "sickle cell crisis", and often affects the bones, lungs, abdomen, and joints.

Treatment Sickle cell anemia has no widely-available cure. However, treatments can help relieve symptoms and treat complications. The goals of treating sickle cell anemia are to relieve pain, prevent infections, eye damage and strokes, and control complications. Bone marrow transplants may offer a cure in a small number of sickle cell anemia cases.

Diagnosis of iron deficiency anemia 1- CBC : In iron deficiency anemia, red blood cells are smaller and paler in color than normal(.Microcytic,hypochromic)

2- Ferritin This protein helps store iron in the body, and a low level of ferritin usually indicates a low level of stored iron .

3.Total iron binding capacity Total iron binding capacity (TIBC) is a blood test to see if there is too much or too little iron in blood.

4- Serum iron test

Interpretation

Bleeding time is affected by platelet function, Certain vascular disorders and von Willebrand Disease—not by other coagulation factors such as haemophilia. Diseases that cause prolonged bleeding time include thrombocytopenia , disseminated intravascular coagulation (DIC)

Asprin and other cyclooxygenase inhibitors can affect bleeding time

Other medication like wafarin and heparin also increase bleeding time .

Clotting time : is the time required for a sample of blood to coagulate in vitro under standard conditions. It is affected by calcium ion levels and many diseases. Normal value of clotting time is 8 to 15 minutes

A prothrombin time (pt) . this test used to detect and diagnosis a bleeding disorder or excessive clotting disorder ,used when the patient taking warfarin or when the patient have unexplained or prolonged bleeding or inappropriate blood clotting prolong in the pt may indicate decrease in the vitamine K or defective in factor VII ,or chronic low grade disseminated intravascular coagulation (DIC)

The partial thromboplastin time (PTT) or activated partial thromboplastin time (aPTT or APTT) is a medical test that characterizes blood coagulation .the typical reference range is betwen 30-50 sec.

Deficiency of factors factors VIII, IX, XI and XII and rarely caused , von Willebrand factor (if causing a low factor VIII level) may lead to a prolonged aPTT

Erythrocyte Sedimentation Rate (ESR) is a type of blood test that measures how quickly erythrocytes (red blood cells) settle at the bottom of a test tube that contains a blood sample. Normally, red blood cells settle relatively slowly. A faster-than-normal rate may indicate inflammation in the body. Inflammation is part of the immune response system. It can be a reaction to an infection or injury.

Other names: ESR, SED rate sedimentation rate; Westergren sedimentation rate

 Headaches, Fever Weight loss, Joint stiffness Neck or shoulder pain, Loss of appetite Anemia

What do the results mean to the dentist?

 Infection, Rheumatoid arthritis Rheumatic fever, Vascular disease Inflammatory bowel disease, Heart disease Kidney disease , Certain cancers

A slow ESR may indicate a blood disorder, such as:

 Polycythemia Sickle cell anemia Leukocytosis, an abnormal increase in white blood cells

If the results are not in the normal range, it doesn't necessarily mean that the patient have a medical condition that requires treatment. A moderate ESR may indicate pregnancy, menstruation, or anemia, rather than an inflammatory disease.

Certain medicines and supplements can also affect the results. These include oral contraceptives, aspirin, cortisone, and vitamin A.

●**Biopsy :** is a way of diagnosing diseases. A doctor removes a sample of tissue or cells to be examined by a pathologist, usually under a microscope.

Types of biopsy:- 1-Excisional 2-Incisional 3-FNA 4- Thick (core) needle biopsy 5-Exfoliative cytology 6-Frozen section 7-Oral brush biopsy

An excisional biopsy is when a whole lump or targeted area is surgically removed. **An incisional biopsy**, or core biopsy, involves taking a sample of tissue

●**cytology** mean the study of the microscopic appearance of cells, esp. for the diagnosis of abnormalities and malignancies.

Fine needle aspiration (FNA) is sometimes considered a cytology test and is sometimes considered a biopsy. During fine-needle aspiration, a long, thin needle is inserted into the suspicious area. A syringe is used to draw out fluid and cells for analysis & smeared on slide, it is rapid & usually effective to diagnose of malignant from benign neoplasm although it is not completely conclusive. Small size of the needle avoid damage to vital structure & it is valuable in case when incisional biopsy contra indicated as in pleomorphic adenoma or other types of malignant lesions in parotid gland Disadvantage: it requires experience, small specimen may be unrepresentative, definitive diagnosis is not always possible

Core needle biopsy: A larger needle with a cutting tip is used during core needle biopsy to draw a column of tissue out of a suspicious area. The sample are larger than FNA & preserve architecture of tissue ,give more definitive diagnosis than FNA , but there is increase of the risk of seeding of neoplasm into the tissue & risk of damaging vital structures. It is used when incisional biopsy is inaccessible e.g. laryngeal tumor.

Exfoliative cytology : which is the examination of cells scraped from the surface of a lesion , it is quick & easy ,no local anesthesia is required also special techniques such as immune-staining can be applied. It is useful in detection of virally damaged

cells, acantholytic cells of pemphigues & candidal hyphae. But it provides no information on deeper tissue & has no value in diagnosis of cancer.

Frozen sections : allows a stained slide to examined within 10 min of taking the specimen , the tissue is send fresh to lab. To be quickly frozen to about -70 c by liquid nitrogen or dry ice. Section is cut on refrigerated microtome and stained The main advantage: is the time is too little so frozen section can be established at operation to determine whether tumor benign or malignant, but the section appear different from fixed material , also freezing artifacts can distort the cellular picture ,and definitive diagnosis sometimes impossible.

Immunofluorecent staining. e.g used to identify pemphigus vulgaris as autoantibody bound to epithelial prickle cells (to desmosomes) & in mucous membrane pemphigoid autoantibodies bond to the basement membrane.

●**Diagnostic ultrasound** used in the soft tissue lumps and salivary gland ●**Radioisotope imaging** (nuclear scaning) image parts of the body may be used in salivary gland scanning like in the sjogrens or in the bone scanning

Imaging Conventional radiography example (bitwing ,periapical)….

Computed tomography .in CT the dense bone is whit , soft tissue is present mid gray ,fat is dark gray and air is black and the dental filling may cause artifact **Magnetic resonance imaging (MRI)** : for the soft tissue salivary gland and TMJ ●**molecular –biological test**

 chromosome studies comparative genomic hybridization DNA microarrays fluorescence in situ hybridization (FISH) polymerase chain reaction gene map

Culture and Sensitivity Testing if the body has an infection of any kind--from an upper respiratory infection ,to a jaw abscess to a urinary tract infection--it's critical to know which antibiotics will be effective against the particular pathogen (i.e., disease-causing agent) causing the problem.

Fungi by the direct smear from the area stained by the periodic acid shift or gram stain and the presence of the typical hyphae indicate the Candida proliferation. Isolation and identification of candida albicans Specimen collection Samples were

taken by a sterile swab, which rubbed and rotated vigorously over the mucosa, pressure put on the swabs in an attempt to pick up deeply seated microorganism. e.g. Swab was taken from the mucosa of palate beneath the upper complete denture. Cultivation of candida albicans The sample that collected was cultured on sabouraud dextrose agar (SD) for the growth of candida albicans, and then the plates were incubated aerobically for 48-72 hrs at 37C. Identification Colony morphology: The Candida species was identified according to the following morphological appearance on sabouraud dextrose agar. The colonies appeared medium size, moist, creamy, having a yeasty like odor, whitish cottony colonies **Viruses:** the use of the virology lab from the fresh vesicle or by the titer of the antibody in the patient serum

●**IMMUNOLOGIGICAL TESTS** Immunoglobulin's rheumatoid factor HLA(human leukocyte antigens) type antinuclear antibody .