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Anemia Of Chronic Disease And Kidney Failure

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Abstract

Anemia is a disease that caused due to inflammation, autoimmune disease, or chronic disease as cancer, kidney failure, heart failure, diabetes, but the main reason of anemia is iron deficiency. Breathlessness, weakness, and exhaustion are all possible effects of anemia. Anemia comes in a variety of types. Everyone has a unique reason. Anemia may be chronic or transient. It could be minor or really serious. Anemia may indicate a more serious medical condition. In this research we will explain the anemia due to chronic disease especially kidney failure. Anemia occurs when decreasing the number of red blood cells that carry oxygen to the body. According to world health organization (WHO), the person has anemia when hemoglobin (which is present in red blood cells, transports oxygen from the lungs to every other organ in the body), (Hb) levels <12.0 g/dl in women and <13.0 g/dl in men. We can treat anemia by iron supplement, medications, blood transfusion, vitB12, blood and bone transplant but it occur in hospital and by healthy diet. If anemia remained untreated it will be a risk of irregular heartbeat, heart failure, infection, and in children it may cause developmental delay. We can diagnosis anemia by blood tests which are used by medical practitioners to look for indications of inflammation-related anemia, other anemias, or other health issues. You will give blood to a medical professional who will then submit the sample to a lab for analysis. The National institutes of health (NIH) approved that we can

examine a variety of components and characteristics of your blood, such as how many red blood cells ,the dimensions of red blood cells ,how much hemoglobin is present in your blood and red blood cells ,the quantity of reticulocytes, or growing red blood cells, in your blood. Blood tests are another tool that a medical expert may use to measure how much iron is stored in blood, transferrin, and ferritin. If the results of a blood test indicate that you have anemia low blood iron levels will appear, determining the amount of iron in low and normal range. Adults who suffer from severe anemia may become vulnerable to heart or lung issues. For instance, you might experience heart failure, in which the heart is unable to pump enough blood throughout your body at the proper pressure or tachycardia, which is an unusually rapid heartbeat. Anemia can also come from obesity unlike exception of some people so we should follow health diet has iron supplement such as meat, sugar beet.

Keywords: *Anemia, kidney failure, chronic disease, ACD, hemoglobin.*

Introduction:

The most common cause of anemia is anemia of chronic disease (ACD), also known as anemia of chronic inflammation. Iron deficiency anemia is the primary cause of anemia, but the secondary cause is inflammation. Acute and ongoing infections, autoimmune diseases, persistent kidney failure, and cancers (both hematologic and solid tumors) are the main causes. The anemia is often moderate normocytic/normochromic, but in a small number of cases, it may be microcytic/hypochromic, which would make it identical to iron deficiency anemia. The pathophysiology is multifaceted and intricate, with elevated hepcidin which is a peptide hormone that acts as the primary regulator of iron metabolism that causing abnormal iron metabolism and distribution [1].

ACD is known to be more common as people age; it affects 77% of the senior population for whom there is no recognized cause of anemia, suggesting a multifactorial etiology. Patients with ACD have an active immune or inflammatory response to their present illness, which results in decreased iron absorption at several locations. Patients who experience anemia from their illness or its treatment as is the case with certain cancers and cytotoxic drug use do not have ACD. Patients who have been diagnosed with various chronic illnesses, which may not be exclusively inflammatory case, typically exhibit mild to moderate anemia. It is observed in a variety of disease states, including autoimmune illnesses, chronic infections, and malignancies, demonstrating the diversity of pathogenetic pathways that could result in ACD [2].

One of the most common disease associated with kidney failure is anemia, patient quality of life may be impacted if treatment is not received, patients suffer from anemia due to kidney failure may experience iron insufficiency due to declining kidney function, prescription side effects, and dietary restrictions. This may lower the amount of iron supplied to the bone marrow which is the organ in the body that responsible of producing various blood constituents. Patients with chronic kidney disease may not be able to efficiently use the iron stores in their bodies. As a result, many patients, especially those undergoing hemodialysis, may need supplemental iron treatment, which is typically given via infusion. Patients with chronic renal disease may require extra treatment with erythropoietin, a drug that stimulates the bone marrow to make blood, as their kidney function continues to deteriorate. Patients suffering from chronic renal disease experience a relative deficiency of this naturally occurring chemical produced by the kidneys. All patients will eventually need to be treated with injectable erythropoietin or a comparable medication [3].

The reduced erythrocyte synthesis linked to long-term inflammatory conditions is referred to as anemia of chronic illness, according to the National Health and Nutrition Examination Study (NHANES III) study on one million Americans over 65 have inflammatory anemia; it approved that a low serum iron level (10.74 M or 60 g/dL) without signs of poor iron reserves, transferrin saturation 15%, serum ferritin 12 ng/mL, or erythrocyte protoporphyrin concentration, 1.24 M was considered anemia of inflammation in NHANES III. Anemia of inflammation also manifests as abnormally low erythropoietin levels and high levels of inflammatory markers, such as C-reactive protein [4].

According to National Health and Nutrition Examination Survey (NHANFS) III study in chronic kidney disease, normochromic normocytic anemia is the biggest complication. In NHANFS study the mean age was 48 years old, show that the prevalence and severity of anemia rise as kidney function falls below a level of roughly 60 mL/min, and that hemoglobin levels normally start to decline as the glomerular filtration rate

(GFR) falls below 70 mL/min for men and 50 mL/min for women. The likelihood of having hemoglobin levels below 11 g/dL rises when one's GFR falls below roughly 30 mL/min/1.73 m2 [5].
In study done in US on 4.8 million people approved that the prevalence of anemia was 7.6% but the prevalence of anemia of chronic kidney disease increased to 15.4%,and it was classified (CKD) into five stage, when the stage of (CKD) increase the prevalence of anemia increased as in stage1: the prevalence is 8.4%, in stage2: the prevalence is 12.2%, in stage3: the prevalence is 17.7%, in stage 4: the prevalence is 50.3%, in stage 5: the prevalence is 53.4%. So this study approved by statistics increased anemia by increased (CKD) [6].
According to CHIANTI study in Tuscany and Italy which explain the relationship between the degree of anemia and the age of the patient and this study proved that future population-based elderly resident survey on people were at least 65 years old (mean 74.5 years; range 65–102 years) and in whom the world health organization (WHO) criteria for anemia (hemoglobin <12 g/dL in women and <13 g/dL in males) were applied. Anemia was more common in older age groups in both men and women, and as people aged, their 24-hour creatinine clearance and hemoglobin levels decreased [5].
Globally, there are a growing number of patients with end-stage renal disease (ESRD) who need continuous dialysis. Anemia usually appears in the early stages of CKD and is frequent in ESRD patients. One non-traditional risk factor linked to the advancement of CKD is hypoxia. Retarding the course of renal failure and improving quality of life (QOL) and survival in CKD are the anticipated benefits of early anemia management. Erythropoiesis stimulating agent (ESA) must be used appropriately and promptly in order to improve clinical indices and slow the course of renal failure. It has been demonstrated that treating anemia with ESA improves mortality rates in patients with renal failure and also congestive heart failure [7].
In this topic we will explain the anemia of chronic disease such as cancer, diabetes, heart failure, and kidney failure.

Anemia of chronic kidney failure (CKD):
A common comorbidity of chronic kidney disease (CKD) is anemia, which carries a significant burden due to higher healthcare resource usage and a decline in patient health-related quality of life. According to observational evidence, anemia is linked to a higher chance of the advancement of CKD [3].
Anemia of CKD is due to: 1.Erythropoietin deficiency, 2. Iron deficiency, 3. Hyperparathyroidism, 4. Hemodialysis, 5. Build-up of uremic inhibitory poisons [8].
1. Erythropoietin (EPO): Impaired EPO production by failing kidneys is a decisive element in the decline in Hb observed with progressive CKD, but a complex combination of variables is responsible for this as well. EPO is a unique hematopoietic hormone that is produced by the EPO gene on chromosome 7, a glycoprotein hormone that acts as a messenger for progenitor erythrocytes, and is distinct from other hematopoietic growth factors in that it is not made in the bone marrow [9].
2. Iron deficiency: Hepcidin, a hepatic peptide that prevents iron absorption and release from iron stores and macrophages, is the mechanism via which iron insufficiency is commonly observed in people with chronic kidney disease (CKD). IV iron is thought to be preferable to oral iron in individuals with chronic kidney disease (CKD) because it enables the administration of greater doses with improved tolerability [10].
3. Hyperparathyroidism: anemia and hyperparathyroidism results from renal failure. While the pathophysiology of the former is complex and mostly caused by decreased erythropoietin secretion, the latter is primarily caused by a combination of hypocalcemia, phosphate retention, and decreased 1,25-(OH)2D3 levels. Recombinant human erythropoietin Epoetin) has been shown during the past ten years to be helpful in treating anemia in the majority of patients, albeit substantial dosages may be necessary in certain cases [11].
4. Hemodialysis: For patients receiving maintenance hemodialysis (HD), the treatment of anemia continues to be a contentious and expensive issue. An essential benefit of dialysis would be a technique that increases hemoglobin (Hb) concentration while reducing the dose requirements of erythropoietin-stimulating agents (ESAs). Through enhancing the uremic milieu, decreasing inflammation, and ultimately lowering ESA resistance, more frequent HD may be able to lower ESA doses. When more frequent HD treatments lower the quantities of uremic toxins, red blood cell survival may rise toward normal or fall when more frequent HD treatments cause harm to red blood cells in the extracorporeal circuit. More frequent treatments may result in an increase in total blood loss from blood loss from leftover blood in the dialyzer after each session [12].
5. Accumulation of uremic toxins: leading to inflammation and endothelial dysfunction. The European Uremic Toxin (EUTox) Work Group has produced an authoritative list of 146 substances that are recognized to be uremic toxins. These substances are divided into three groups according to their physicochemical properties, which include molecular weight, protein-binding ability, and dialysis removal pattern. 27.8% from these uremic toxin are protein highly bounding capacity which is difficult to remove by kidney, When uremic

toxins are not removed by the kidneys, they have a deleterious effect on biological processes. These uremic toxins build up in the blood and cause the kidney's interstitial fibroblasts, or peritubular cells, to produce insufficient amounts of erythropoietin (EPO), which impairs erythropoiesis by reducing the formation of erythrocytes. Iron and EPO insufficiency are the primary causes of anemia, a well-known side effect of chronic kidney disease [13].

Anemia of cancer:

Anemia affects more than 40% of cancer patients, making it a common observation. Anemia can strike as many as 90% of people receiving chemotherapy. Patients with cancer experience a lower quality of life due to anemia, which may be a contributing factor in cancer-related fatigue. Anemia caused by cancer and anemia from chronic illnesses are caused by a variety of reasons as well as the delicate interaction between pro- and antiapoptotic factors, which causes a precisely calibrated selective differentiation of the trilineage-committed hematopoietic stem cell. One of the numerous manifestations of blood count changes from anemia to thrombocytosis, which is frequently observed in cancer patients, will be a minor disturbance of this equilibrium. Tumor necrosis factor-a (TNF-a), GATA-1 and GATA-2, and other variables are involved in this (dis) equilibrium [14].

We can management the anemia of cancer through using of erythropoiesis stimulating agent (ESAs) in patients receiving chemotherapy for nonmyeloid malignancies is debatable and should be carefully considered while treating them. Furthermore, an analysis of 11 studies revealed that early intervention may yield the greatest clinical benefit from erythropoietin (EPO) treatment of chemotherapy-induced anemia, as it reduced the likelihood of transfusions and hemoglobin levels dropping to less than 10 g/dl in comparison to late ESA use. The second method of management is blood transfusion to treat anemia in cancer patients. Transfusions are primarily intended to treat anemia-related signs and symptoms right away. Individual cancer patients usually require more blood transfusions as the number of chemotherapy rounds they receive rises. Nonetheless, there is significant fluctuation in the hemoglobin level that necessitates blood transfusions between studies and between cancer types [15].

Anemia of diabetes:

Individuals with type 2 diabetes mellitus are twice as likely as those without the disease to experience anemia. According to certain research, patients with renal insufficiency who also have diabetes have a higher chance of acquiring anemia than people with normal diabetes because their kidneys' capacity to manufacture erythropoietin is diminished. Furthermore, diabetic neuropathy affects the hormone that produces red blood cells (RBCs), which can lead to anemia. Individuals with diabetes also have iron, folate, and cyanocobalamin deficits, which can lead to various forms of anemia [16].

The development of an inflammatory state is directly linked to hyperglycemia, as seen in the increased expression of proinflammatory cytokines such NFκB, TNF-α, and IL-6. As a result, due to their inherent characteristics, both diabetes and hyperglycemia are inflammatory diseases. Research indicates that the inflammatory process increases with the length of the illness. An important factor in insulin resistance is the increase of proinflammatory cytokines. It should be mentioned that nephropathy may develop as a result of diabetes mellitus, which further impairs the kidneys' ability to produce erythropoietin and favorably contributes to an elevated anemic framework [17].

Anemia of heart failure (HF):

Hematinic deficits are common in individuals with heart failure (HF), with iron deficiency accounting for around half of the cases. Erythropoietin resistance and (functional) iron deficiency are both significantly influenced by the chronic inflammation that exists in HF patients. On the other hand, because erythropoietin is produced in the kidney, patients with concurrent CKD frequently have inadequate quantities of the protein. Furthermore, anemia susceptibility is further increased by intrinsic bone marrow abnormalities that result in unresponsive bone marrow to erythropoietin. This action is linked to individuals with heart failure having abnormally high erythropoietin levels and having preserved erythropoietin production; high erythropoietin levels are linked to poor patient outcomes and the onset of HF in the general population. Furthermore, salt and fluid retention brought on by the activated renin-angiotensin-aldosterone system results in pseudo-anemia [18].

Because iron deficiency is the cause of anemia of HF we can use iron supplement to manage anemia as Tissue Doppler and stain rate imaging investigations have shown that iron supplementation treatment improves cardiac function in ID patients with CHF. Intravenous iron therapy enhances exercise tolerance, heart function, and anemia, all of which increase quality of life [19].

Anemia of hypertension:
The deadly clinical condition known as pulmonary hypertension (PH) is linked to increasing right ventricular (RV) dysfunction and significant death rates. Despite a number of novel treatments, patients with PH with RV dysfunction seem to have even worse clinical outcomes. It is unknown what the range of hemoglobin levels is in people with PH. Moreover, it seems that PH has a more complicated effect on erythropoiesis than it does on left ventricular (LV) failure. Due to RV dysfunction, low cardiac output—one of the theories explaining anemia in individuals with LV dysfunction, is also common in PH patients. However, hypoxia is also rather prevalent, especially in those with cyanotic congenital heart disease, interstitial lung disease, collagen-vascular disease, and idiopathic pulmonary hypertension [20].

Anemia of obese people:
Two global health issues that impact billions of people globally are obesity and iron deficiency (ID). Although being overweight or obese is a major risk factor for a number of chronic conditions, including diabetes, heart disease, and several types of cancer, the most common micronutrient shortfall worldwide is hypoferremia, or iron deficiency. Iron deficiency anemia, a serious health issue characterized by fatigue, decreased life productivity, and poor maternal health, particularly in pregnant women, can result from untreated iron deficiency. There is mounting evidence that there is a connection between iron deficiency and obesity. Children, adolescents, and adults were found to be connected .study done involving 619 women between the ages of 20 and 49 found that iron deficiency was present in 23.5, 41.9, and 45.6% of women who were overweight, obese, and normal weight, in turn. Another study found that among male adolescents (n=772) with underweight, normal weight, overweight, and obesity, 13.5, 13.6, 23.5, and 21.7% had iron deficiency (serum iron <60 µg/dl). According to Egwurugwu's study in (2018), adult men with normal weight, overweight, grade 1 obesity, and grade 2 obesity had mean serum iron levels of 72.6, 64.2, 59.1, and 54.7 µg/dl, respectively. By comparison, the adult women's values were 61.2, 52.9, 44.8, and 39.6 µg/dl [21]. ID was not correlated with age, race, dietary iron intake, years since menstruation began, and physical activity. Adolescent females in the US who were overweight or obese had a considerably higher prevalence of ID, which was strongly correlated with both BMI and inflammation (as indicated by C-reactive protein) [22].

Types of anemia:
Aplastic Anemia: rare bone marrow insufficiency disorder that can be especially deadly if left untreated, According to specialized trials, aplastic anemia is a rare disorder with an incidence of two to three cases annually; however, in asian populations, the prevalence may be three times higher [23].
Sickle Cell Anemia: A condition called sickle cell disease, or sickle cell anemia, occurs when the body lacks sufficient healthy red blood cells to deliver oxygen throughout the body. RBCs have a sickle shape or resemble crescent moons when they are part of sickle cells. These stiff may become lodged in tiny blood arteries and obstruct blood flow. Around five months of age is when signs and symptoms first arise. They differ from person to person and evolve with time. Red blood cells are insufficient because sickle cells divide readily and eventually perish [23].
Hemolytic Anemia: This particular form of low hemoglobin is brought on by decreasing hemoglobin levels, increased hemoglobin catabolism, red blood cell loss, and increased bone marrow efforts to replenish products. Its nature could be extrinsic or internal. Examples of extrinsic causes include pharmacological side effects, infections, and cancer [23].

Symptoms of anemia:
Almost every organ and tissue in the human body is susceptible to a variety of symptoms and deficits caused by anemia. The degree of anemia, the speed of onset, compensatory mechanisms, comorbidities, and, most importantly, the patient's physiological state all influence how severe these symptoms. Hemoglobin (Hb) levels can be used to categorize anemia into three levels: mild, moderate, and severe. The following classification for anemia has been agreed upon by the National Cancer Institute and others: Severe: Hb 6.5 to 7.9 g/dL; life-threatening: Hb less than 6.5 g/dL; Mild: Hb 10 g/dL to normal limits; Moderate: Hb 8.0 to 10.0 g/dL. In cardiovascular system anemia cause hypoxia of peripheral tissue by decreasing blood oxygen, decrease blood viscosity, increase production of lactate. It's impact on immune system in body thar decrease of immunity overall the body by decrease B-cells, T-cells, Research has indicated that peripheral blood mononuclear cells from anemic dialysis patients secrete significantly less interleukin-2 when compared to normal controls. Restoring numerous immune function parameters can be achieved by correcting anemia in

these patients. Impact of anemia in all over the body is dizziness, headache, fatigue, and inability of practice any activity [24].
In diabetic patients who have anemia it is a high risk to chronic kidney failure, because damaged kidneys can't produce EPO, which signals to the bone marrow that the body needs more red blood cells to function [25].

Conclusion:

In conclusion, anemia of chronic disease and kidney failure are both serious health conditions that can have a significant impact on an individual's quality of life. Both conditions are characterized by a decrease in red blood cell production, leading to symptoms such as fatigue, weakness, and shortness of breath. It is important for individuals with these conditions to work closely with their healthcare providers to manage their symptoms and prevent further complications. Treatment options may include medication, dietary changes, and in some cases, dialysis or kidney transplantation. By staying informed and proactive in managing these conditions, individuals can improve their overall health and well-being.

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