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RESEARCH ARTICLE

IRON DEFICIENCY ANEMIA - AN OVERVIEW

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Abstract

The most common nutritional issue worldwide, particularly in underdeveloped nations, is iron deficiency. Pregnant women, newborns, young children, and adolescents have particularly high needs since they are at a higher risk of iron deficiency. Low dietary iron bioavailability is a major contributor to iron insufficiency in underdeveloped nations. The effects of iron deficiency are numerous and severe, having an impact not only on an individual's health but also on the growth of civilizations and nations. Coordinating several approaches is necessary for the prevention and treatment of anemia and iron deficiency in all populations with varying needs for iron. The most prevalent type of anemia in the world is iron deficiency anemia and the most frequent cause of iron deficiency anemia in men and postmenopausal women is blood loss from gastrointestinal tract lesions. Iron deficiency anemia is brought on by either iron malabsorption or blood loss. Individualized treatment plans may be necessary for certain patient populations, including premenopausal women, people with low-normal ferritin levels, and people with iron deficiency but not anemia. Despite normal endoscopies returning negative results, a tiny percentage of patients nevertheless develop recurrent or persistent iron deficiency anemia. Patients must get intravenous iron because oral iron is ineffective in treating anemia. The response to iron supplementation by parenteral route varies but typically causes Hb levels to rise over time compared to people with acquired iron deficiency, the anemia is only partially corrected, and the process is more slower. Additionally, microcytosis persists, Hb levels rarely return to normal, and transferrin saturation is still below the ideal range. Contrarily, serum ferritin rises after iron injections, albeit in a dose-dependent way.

Introduction:-

Anemia is to be the nutritional disorder which is caused by the lack of nutritional supplement like iron, decreased iron absorption, increased iron loss. Iron plays an important role in the production of haem which helps to bind the oxygen to it and transports to the various parts of the body so that it may cause reducing work capability in patients and mainly it shows impact on motor and mental growth of children. Iron deficiency Anemia (IDA) effects cognitive functions such as visual and auditory functions in the children, adults and geriatrics. Women are more easily get affected by anemia due to regular menstrual cycle and during pregnancy[1].

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To ensure that body iron reserves are sufficient for cellular demands without becoming toxic in excess, these reserves are tightly controlled. Homeostasis is strictly regulated by limiting enteric iron intake through poor efflux from enterocytes because the body lacks a mechanism to eliminate excessive iron. Hepcidin, a recently identified hormone created by hepatocytes, controls iron efflux. Hepcidin is secreted and attaches to intestinal ferroportin, internalizing and destroying it when iron reserves are sufficient or high. Dietary iron that has been absorbed stays in the enterocyte where it is excreted by enterocytes due to the reduction in ferroportin. In contrast, hepcidin synthesis and secretion are inhibited when iron reserves are low, increasing iron efflux from enterocytes in the blood[2,3].

The hepcidin-ferroportin interactions provide a simple explanation for the characteristics. In fact, these patients' hepcidin levels guard against boosting intestinal iron absorption in the wake of oral iron therapy or in response to an iron deficiency. They most likely won't be enough to completely stop macrophage iron release, though. Additionally within the normal range, serum ferritin levels show no evidence of macrophage iron retention. Large iron-sucrose complexes suspended in a colloidal solution are typically used in intravenous iron preparations. Macrophages phagocytose and break down these complexes before iron is released to plasma transferrin. Compared to juvenile subjects, adult patients typically require less or no iron supplementation, most likely as a result of the adult body's natural tendency to use less iron[4].

Causes of Iron Deficiency Anemia:
Iron deficiency anemia occurs when the body does not have enough iron to produce hemoglobin and if the persons are not consuming enough iron or if the body is not absorbing enough iron from diet so the iron deficiency anemia will eventually develop.

Causes of IDA includes:
Blood loss: Blood contains iron within the hemoglobin so if the person loses blood automatically iron swill be developed from the blood , women with heavy periods are at risk of IDA. Acute and chronic blood loss is seen in the patients suffering from peptic and chronic ulcer, gastrointestinal bleeding.

Lack of iron in your diet:
Absence or inadequate iron intake in the diet may lead to iron deficiency iron rich food includes meat, eggs, leaf green vegetables for proper growth and development of children.

Malabsorption of iron:
Iron is not absorbed in to the blood stream through intestines because of intestinal disorders like celiac disease which affects the intestine ability to absorb iron that leading to IDA.

Pregnancy:
Iron supplementation is needed for women during pregnancy to meet requirements of both mother and the growing foetus, for the production of hemoglobin for the increased blood volume[5].

When Helicobacter pylori (H. pylori) colonizes the gastric mucosa, it can reduce iron absorption and increase iron loss, which could result in IDA. Helicobacter pylori infection as a cause of iron deficiency anemia of unknown origin. High prevalence of Helico bacter pylori infection and the possibility of a complex IDA etiology (malnutrition, vitamin deficiencies, chronic parasite infections, malaria)[6].

Pathophysiology:
Iron is an important element that mainly acquired by dietary intake. Iron can be found in two forms haem and non-haem. Haem can be easily absorbed in to the blood stream where as non-haem cannot be absorbed easily because haem is available from meat and fish non-haem is available from green leafy vagetables. This non-haem needs separate carriers for absorption in to the blood stream[7].

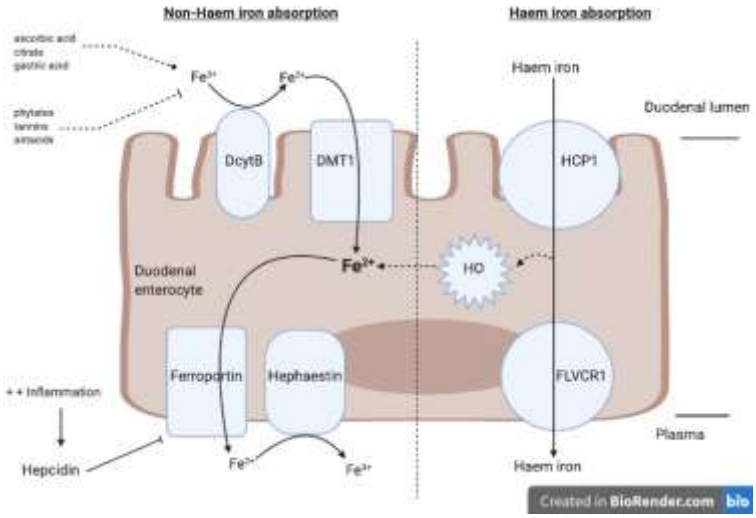

Figure 1:- Pathological absorption mechanisms of Haem iron absorption and non- heam absorption.

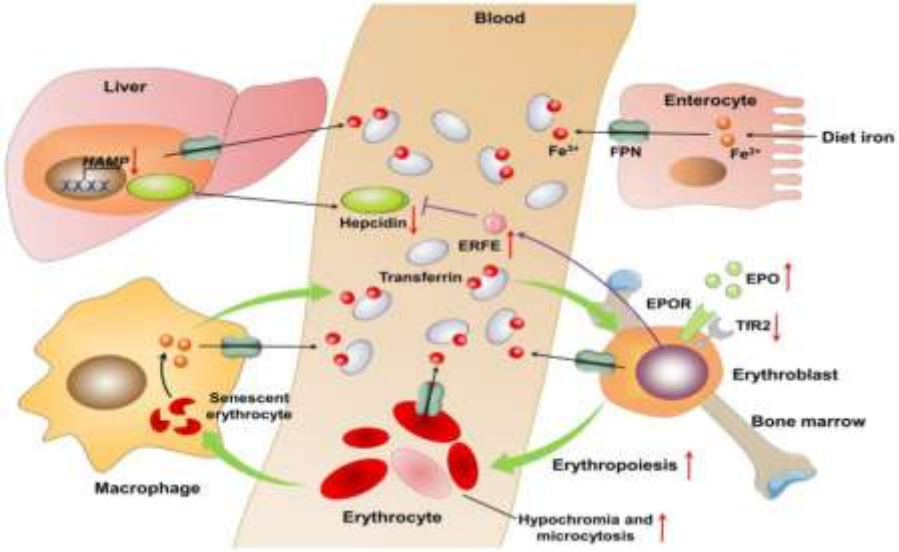

Figure 2:- Process of erythropoiesis.

The majority of iron in the body is utilized during erythropoiesis, phagocytosis, and the macrophages' breakdown of senescent erythrocytes (light green arrows). The primary regulator of systemic iron metabolism is hepcidin, which is generated and secreted by hepatocytes. The transcription of the HAMP gene, which codes for hepcidin, is down-regulated in iron shortage. Iron exporter ferroportin (FPN) activity is increased in low hepcidin levels, which increases recycling by macrophages and iron absorption by enterocytes. Low hepcidin levels also cause erythroblasts to lose iron through FPN, which lowers the erythroblasts' intracellular iron availability. By increasing the production of erythropoietin (EPO) and erythroblastic EPO sensitivity due to the genetic loss of the EPO receptor's (EPOR) partner transferrin receptor, iron deprivation drives erythropoiesis[8].

Adaptive processes on the hepcidin-ferroportin (FPN) axis, the iron regulatory protein (IRP)/iron responsive element (IRE) machinery, and other regulators are triggered by iron deprivation, which has a significant impact on iron homeostasis. The goal is to maximize erythropoiesis use of iron and combat the body's natural resistance to absorb it[9].

Signs & Symptoms:

Along with the typical symptoms of anemia, such as weariness, pallor, and a decreased capacity for exertion, signs and symptoms of iron deficiency depend on the degree and duration of anemia Reduced blood oxygen levels and

peripheral hypoxia are the main causes of anemia's major symptoms, including dyspnea and tachycardia. Fatigue, weakness, dizziness, irritability, decreased stamina, hair loss, and dyspnea are just a few of the symptoms that are frequently related to the physiological changes that occur during pregnancy. As a result, many patients are left untreated, increasing the hazards to the health of pregnant women, fetuses, and newborns[10].

Symptoms of central hypoxia include headache, nausea, vertigo, and tinnitus. It has been shown in numerous research that treating anemia improves cognitive performance. Hemoglobin, myoglobin, cytochromes, and numerous other enzymes all contain iron as a component. Therefore, anemia has a negative effect on practically every element of everyday life for IBD patients. Impotence in men with iron deficiency anemia (IDA) is a possibility. Both sexes experience lower quality of life as a result of libido loss. Latent iron deficiency may also be the cause of "non-hematological" symptoms like cognitive decline, paresthesias in the hands and feet, and hair loss. It may also be strongly linked to restless leg syndrome[11].

Diagnosis:

Most kids with moderate anemia don't exhibit any symptoms or indicators. Some may exhibit palpitations, jaundice (from hemolysis), shortness of breath, or irritability (in iron insufficiency). In children with severe or acute anemia, physical examination may reveal jaundice, tachypnea, tachycardia, and heart failure.

Hemoglobin levels below 12 g/dL for non-pregnant women and 13 g/dL for men are considered anemia, according to the WHO. International and national standards frequently prescribe serum ferritin and hemoglobin as indicators of IDA, and the majority of these guidelines concur with the WHO's cutoff value for hemoglobin. The recommended serum ferritin cutoff threshold for diagnosing IDA varies between 12 and 30 g/L in the absence of inflammation and between 30 and above 100 g/L in the presence of inflammation, according to many standards. To confirm IDA, other indicators, such as transferrin saturation, may be needed because serum ferritin is an acute-phase reactant. Measurement of transferrin saturation is advised by three guidelines, with 16% or less as the acceptable criterion for IDA diagnosis[12] .

RBCs have a lifespan and can retain iron from up to 120 days ago, Hemoglobin measurements frequently miss situations of early or mild iron shortage. Reticulocyte hemoglobin content (RHC) provides a more precise "real-time" indicator of bone marrow iron status since reticulocytes only remain in the peripheral for one or two days. On the other hand, iron deficiency is not always the cause of childhood anemia. As a result, the measurement of just one Hgb level could lead to needless medication and retesting. RHC measurement could help prevent this problem. An Hgb level of less than 11 g per dL (110 g per L) was only 26% sensitive in identifying iron in a study of infants aged nine to twelve months[13].

With a thorough history, physical exam, and diagnostic evaluation, iron deficiency anemia can be diagnosed by determining the underlying condition or cause. A thorough examination of the patient's medications, nutrition, concurrent medical conditions, fecal features, exposure to fleas and ticks, and careful questioning of the owner regarding potential sources of blood loss should all be part of the history [12,13].

Iron Deficiency Anemia Diagnostic Parameters

Mean corpuscular volume (MCV)	REDUCED (N: 80-100fl)
IRON	REDUCED (N: 4 gm)
FERRITIN	REDUCED (N:0.015-0.300mg/l)
RETICULOCYTES	NORMAL / LOW (N: 0.5-2.5)
TRANSFERIN SATURATION	REDUCED (N: 16-50%)
MCH	REDUCED (N: 27-32pg)
MCHC	REDUCED (N: 30-34 mg/dl)
PLATELETS	NORMAL

The development of sensitive, accurate and reproducible immunoassays and mass-spectrometric assays for human hepcidin has allowed detailed definition of physiologic and pathologic changes of hepcidin in healthy volunteers and in patients. The assays will be useful in improving our understanding of the pathogenic role of hepcidin in various iron disorders, and in the development of appropriate therapeutic interventions. In contrast to ferritin, changes in hepcidin concentrations are the cause of, rather than the result of, iron disorders. Human hepcidin immunoassays

and mass spectrometric assays have been developed, and this has enabled for the precise description of physiological and pathologic alterations of hepcidin in healthy volunteers and patients[14].

Management of IDA:

Oral iron supplements provided as ferrous or ferric salts have a limited bioavailability, which can be further reduced by foods, meals, inflammation, proton pump inhibitors, and antacids. Iron supplements tolerance and adherence may be lowered by gastrointestinal adverse effects. Low single day dosages of 60 mg or 100 mg every other day may minimize side effects and maximize fractional absorption. A 2-month therapy of 50 mg of elemental iron daily in senior IDA patients improved Hb and ferritin just as well as 150 mg daily, but with less gastrointestinal side effects. A retrospective study on primary hip replacement revealed that liposome-encapsulated ferric pyrophosphate iron (30 mg/day for 3–4 weeks before to surgery) was well tolerated, decreased the need for transfusions, shortened hospital stays, and improved patient outcomes as compared to no iron supplementation[15].

Children aged 6-23 months (10-12.5 mg elemental iron daily - drops/syrups, three consecutive months in a year), 24-59 months (30 mg elemental iron daily - drops/syrups/tablets, three consecutive months in a year), and 5-12 years (30-60 mg elemental iron daily - tablets/capsules, three consecutive months in a year) are the age groups for which the WHO recommends iron supplementation to prevent ID/IDA. Iron supplementation for infants and children in malaria-endemic areas should be done in conjunction with public health initiatives to prevent, identify, and treat IDA[16].

When transfusing packed red blood cells to individuals with iron deficiency anemia, there is no set standard. Guidelines frequently list specific hemoglobin values as reasons to transfuse, although the clinical state and symptoms of the patient are also crucial factors. In order to prevent aberrant fetal oxygenation that could lead to non-reassuring fetal cardiac tracings, low amniotic fluid volumes, fetal cerebral vasodilation, and fetal death, transfusion is advised in pregnant women with hemoglobin levels of less than 6 g/dL. Two units of packed red blood cells should be administered if transfusion is necessary, and the clinical status should then be reviewed to determine the best course of action[17].

Ferrous fumarate, ferrous sulfate, and ferrous gluconate are the three forms of ferrous iron supplements that are typically administered; they differ in the percentage of elemental iron (the form of iron in the supplement that is available for absorption by the body) and contain 33%, 20%, and 12% iron, respectively. The Centers for Disease Control and Prevention (CDC) recommends treating patients with elemental iron in divided dosages two to three times per day, ranging from 150 mg to 180 mg per day [CDC, 1998]. Within the first week of iron therapy, the reticulocyte count starts to rise, whereas the hemoglobin often lags by 1-2 weeks.

Oral iron supplements deliver 60–80 mg of iron per day, whereas intravenous iron or nonviable red blood cells deliver 80–160 mg. They discovered that patients who had mean serum iron levels less than 70 g/100 ml had maximum red blood cell production that ranged between 2.5 and 3.5 times normal. Patients were able to obtain serum iron levels between 70 g/100 ml and 150 g/100 ml with oral iron supplementation, and red blood cell production was able to increase to four to five times normal. The iron supply wasn't sufficient to raise serum iron levels to more than 200 g/100 ml with a concurrent rise in marrow production to 4.5-7.8 times normal until nonviable red cells or intravenous iron dextran were given. It is crucial[18].

Additionally, even in patients who are not anemic after GI bleeding stops, iron tests should be done because repeated bleeding can deplete body iron stores without directly resulting in anemia. All cells in the body require iron, thus replacing it in non-anemic but iron-deficient patients may enhance their quality of life and cognitive abilities. It may also delay or prevent the development of IDA in patients who experience regular GI bleeding, such as those with IBD and angiodysplastic diseases[19].

Conclusion:-

As a result, iron is essential for a variety of metabolic processes, most notably oxygen transport via hemoglobin. After the body's iron reserves have been depleted due to prolonged blood loss, iron deficiency anemia often develops. Microcytosis, hypochromasia, insufficient regeneration, and low blood iron, iron saturation, and ferritin levels are the hallmarks of iron deficiency anemia. Animals sometimes develop severe anemia if iron deficiency is not treated, although this condition is surprisingly well-tolerated unless the animal is under stress. Prior to starting treatment, samples should be collected for diagnostic testing. Preventing more blood loss, using parenteral or oral

iron supplements, and treating the underlying condition are all part of the treatment for iron deficiency anemia. Patients with iron deficiency anemia can have a fair prognosis with the right treatment as long as the underlying illness is treated.

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