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Review Article

Recent updates in the management of iron deficiency anemia in Indian patients: literature review and expert opinion

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ABSTRACT

Iron deficiency anemia (IDA) is a global issue, particularly affecting pregnant women and children in India. It can lead to severe outcomes such as preterm birth, low birth weight, and increased maternal and perinatal risks. An expert panel of Indian obstetrics and gynecology specialists reviewed the literature and proposed recommendations on IDA's prevalence, diagnosis, management, and challenges such as healthcare access, patient education, and awareness. Management strategies for IDA include dietary adjustments and lifestyle changes, alongside pharmacological treatments, including oral and parenteral iron therapy. Oral iron, though accessible, can cause gastrointestinal side effects, and prevailing misconceptions about its impact on fetal growth affect adherence. Intravenous (IV) iron administration should be considered for patients who experience intolerance, poor adherence, or lack of efficacy with oral iron. Ferric carboxymaltose, a newer IV formulation, is gaining popularity due to its rapid iron replenishment, efficacy and safety, single infusion convenience, and cost-effectiveness in treating pregnant women. Public health initiatives in India like National Nutritional Anemia Control Program and Anemia Mukt Bharat aim to reduce IDA through supplementation programs and education. However, challenges like low adherence to iron supplementation, parasitic infections, and micronutrient deficiencies remain. Overcoming these requires a comprehensive approach, including patient education and effective public health strategies. According to the expert recommendations, managing IDA during pregnancy is vital for maternal and fetal health. A combination of dietary modifications, pharmacological treatments, and public health interventions is crucial to combat this prevalent condition in India and improve maternal and fetal health outcomes.

Keywords: Ferric carboxymaltose, Intravenous iron, Iron deficiency anemia, Oral iron, Pregnancy

INTRODUCTION

The World Health Organization (WHO) defines anemia as hemoglobin (Hb) levels <130 g/l in men, <120 g/l in non-pregnant women, and <110 g/l in pregnant women.[1] The WHO has identified iron deficiency anemia (IDA) as the most prevalent form of anemia globally, particularly affecting pregnant women and children.[2]

The increasing global burden of IDA underlines the need to implement targeted strategies for its prevention and control. This article explores the prevalence and causes of IDA with a focus on risk factors pertaining to the Indian population. It also highlights diagnostic aspects of IDA, including clinical presentation, tests, biomarkers, and differential diagnosis. Management strategies for IDA in pregnant women with a focus on the needs and benefits of intravenous (IV) formulations, has been discussed along with a comprehensive assessment of challenges associated with IDA management.

METHODS

A panel of healthcare providers specializing in obstetrics and gynecology from different regions of India convened during multiple advisory board meetings held in late 2023 and early 2024, organized by Dr. Reddy's Laboratories, India. These meetings aimed to improve the diagnosis, management, and treatment of IDA among pregnant women in India, enhancing healthcare outcomes in this population. The assembled evidence on the following key topics was collated and presented during the meeting: prevalence of IDA, diagnosis of IDA, management strategies, and challenges associated with IDA in India.

Each topic was thoroughly examined, utilizing insights from published research and established guidelines. The panel integrated these evaluations with their own clinical experiences to adapt the findings to the Indian healthcare context. Following detailed discussions, the expert committee documented the final recommendations and key points clearly and concisely.

PREVALENCE OF IDA

The WHO estimates approximately 40% of children aged 6–59 months, 37% of pregnant women, and 30% of women aged 15–49 years are affected by anemia worldwide.[1] The Global Burden of Disease (GBD) Study 2021 reported a 24.3% global prevalence of anemia corresponding to 1.92 billion cases, with 66.2% attributed to dietary iron deficiency (ID).[3] Based on the World Nutrition Assessment (2016), India has the highest prevalence of IDA, ranking 170th out of 180 countries in terms of women affected by this condition.[4] The National Family Health Survey (NFHS) (2019-21) conducted in India, reported anemia rates to be 25.0% in men, 57.0% in women, 52.2% in pregnant women, and 67.1% in children, with anemia in Indian pregnant women rising from 50.4% in 2015-16 to 52.2% in 2020-21.[5,6] IDA is common in pregnancy due to increased iron needs for expanding plasma volume, producing more red blood cells (RBCs), supporting fetal and placental growth, and preparing for iron loss during childbirth.[7] Additionally, India accounts for about 80% of maternal deaths caused by anemia in South Asia.[8]

Certain demographic groups in low- and middle-income nations, such as young children, menstruating adolescent girls and women, and pregnant women, are particularly vulnerable to IDA due to low income and limited education.[9,10] In rural communities, these vulnerabilities are increased by limited healthcare facilities, a shortage of qualified medical personnel, physical barriers like distance, the absence of established healthcare infrastructure, and financial constraints, which can impede timely diagnosis and treatment.[11]

Expert opinion

The experts agree on the increasing prevalence of IDA among pregnant women, as indicated by NFHS data. In clinical practice, anemia among pregnant women shows significant variability, with approximately 5 to 6 out of every 10 individuals showing symptoms or presenting as asymptomatic. According to WHO criteria (Hb <11 g/dl), around 50% to 70% of individuals are anemic, with about 30% having levels below 8 to 9 g/dl, often attributable to factors such as vomiting and malabsorption. IDA affects a substantial majority, with over 50% of pregnant women affected, and moderate to severe anemia is observed in approximately 20% of cases, predominantly in the third trimester. Among women of childbearing age, not exclusively pregnant patients, approximately 50% to 60% experience anemia, typically at mild to moderate levels. Furthermore, subclinical anemia is widespread, affecting nearly 80% to 90% of individuals.

In urban private sectors, women are becoming more conscientious, frequently planning their pregnancies and proactively checking their Hb levels. Consequently, anemia affects around 20-30% of middle-class patients, often emerging during the second trimester. In contrast, due to a lack of awareness about the necessity of iron supplementation in pregnant women, rural areas frequently report higher prevalence rates, sometimes exceeding 70% as per the panels' experience. Other challenges in managing anemia include prevalent nutritional deficiencies in rural populations, inconsistent adherence to iron supplementation, and socioeconomic disparities, which impact access to comprehensive prenatal care in rural settings.

PATHOPHYSIOLOGY OF IDA

Causes and risk factors specific to the Indian population

In India, poverty significantly contributes to IDA due to a lack of access to nutritious, iron-rich diets, and poor sanitation, which often leads to malaria and worm infestations.[12] Regular blood donation can also deplete iron stores, while blood loss from menstruation or internal sources, like ulcers or colorectal cancer, exacerbates anemia.[12] Moreover, factors such as increased iron demand from repeated pregnancies and lactation, and low iron reserves at birth also contribute to IDA.[13] Various causes of IDA are summarized in Table 1.

Expert opinion

Experts believe that the prevalence of anemia, particularly among pregnant women and adults, is alarmingly high, posing significant challenges in treatment compliance. Many women find it challenging to stick to iron therapy due to busy schedules and are deterred by side effects like gastrointestinal (GI) issues and constipation. During the first trimester of pregnancy, nausea and vomiting can make it difficult for women to take iron-folic acid (IFA) supplements. Because of these continued GI issues, this hesitation leads to severe anemia in the second trimester. Furthermore, cases of GI bleeding have also contributed to the increasing risk of anemia. Additionally, due to the prevalence of worm infestations, all pregnant women should receive deworming treatment after 24 weeks of gestation.

DIAGNOSIS OF IDA

Clinical presentation and symptoms

Initial IDA diagnosis involves reviewing medical history, symptoms like pale skin, eyes, nail beds, vertigo, fatigue, syncope, and details on recent blood loss, GI symptoms, medication use, and family history.[12] Moreover, the ethnicity of patients should be assessed for the risk factors associated with certain genetic conditions such as thalassemia or celiac disease.[12] All pregnant women should be assessed for additional symptoms such as hair loss, unusual cravings, restless leg syndrome, koilonychia, glossitis, and stomatitis.[8]

Expert opinion

During the discussion, experts agreed that symptoms such as fatigue and hair loss in young girls aged 15-16 often suggest anemia, prompting dermatologists to refer them for appropriate management. It has also been noted that symptoms of anemia in pregnant women may vary from typical presentations, potentially influencing both diagnosis and treatment.

Biomarkers and diagnostic tests for IDA

Complete blood cell count (CBC), peripheral blood smear, reticulocyte count, and serum iron analysis can evaluate causes, while Hb/hematocrit levels can evaluate the severity of anemia.[8,14,15] The description of serum markers and diagnostic criteria of various tests used for IDA are provided in Tables 2 and 3, respectively.

Expert opinion

As per the collective expert opinion, Hb levels are the primary diagnostic measure for IDA. Doctors emphasized the need for basic blood tests, including an Hb test, at the first patient visit. When anemia persists, performing a CBC is essential for a comprehensive understanding of the patient's condition. Moreover, the standard diagnostic tests that should be included in the evaluation are Hb, hematocrit, and serum ferritin levels. Ferritin levels, although checked occasionally, are critical for assessing iron stores and determining the extent of ID.

Ferritin in the context of iron homeostasis

Ferritin, an iron-binding protein, plays a critical role in iron homeostasis by functioning as a ferroxidase that converts ferrous iron (Fe^{2+}) to ferric iron (Fe^{3+}) and sequesters iron in its mineral core.[16] It is considered the most sensitive and accurate biomarker for assessing IDA due to its reflection of iron stores.[16,17] Low ferritin is defined by the WHO as levels <12 µg/l for children and <15 µg/l for adults.[17] In clinical practice, ID is determined when ferritin levels fall below 30 µg/l.[17] Ferritin outperforms other markers such as transferrin saturation (TSAT), mean cell volume, and red cell zinc protoporphyrin in terms of sensitivity and specificity at any level.[16]

Iron serves as a key component by converting oxygen into usable cellular energy in the electron transfer chain.[16] In addition to its role in respiration, iron is a co-factor in several biochemical reactions. One such reaction is necessary for DNA replication and cell division, where ribonucleotide reductase, in the presence of iron, converts ribose nucleotides to deoxyribose nucleotides.[16] However, despite the essential role of iron in the human body, it can also be toxic due to the production of free radicals.[16] To mitigate this risk, the body has developed carefully regulated mechanisms to transport iron across biological membranes, distribute it, and store it in an inert form as ferritin until needed.[16,18]

Regulation and absorption of systemic iron balance occur primarily in the proximal small intestine, where enterocytes transport iron across the cellular membrane via the divalent metal transporter 1 (DMT1) as there is no physiological process to excrete excess iron.[16,19] DMT1 transport requires iron in the Fe^{2+} state, which is facilitated by brush border ferri-reductases that convert dietary non-heme iron into Fe^{2+} for absorption via a proton-coupled process.[16,20] In response to systemic ID, DMT1 levels are upregulated, increasing iron uptake.[16] Although some iron is stored in the enterocyte as ferritin, the majority is transported to other sites within the body after being converted to Fe^{3+} and loaded onto transferrin, the primary transporter of iron in circulation.[16,21]

Transferrin-bound iron is soluble and non-reactive, allowing it to safely enter the circulatory system.[16,21] Ferritin helps buffer the intracellular iron pool, preventing the formation of reactive species that can damage DNA and proteins.[16,21] Most of the iron in humans is integrated within globin proteins that facilitate oxygen transport throughout the body.[16,19] The continuous turnover of RBC demands the recycling of the iron within Hb.[16,19] This recycling is primarily carried out by macrophages, which phagocytose erythrocytes and break them down. Iron is then liberated from heme within the phagolysosome via heme oxygenase.[16,22] Furthermore, the unstored iron in the macrophage is exported, a process thought to be dependent on ferroportin.[16]

Serum ferritin is mostly collected as part of the work-up for unexplained anemia, often to distinguish between ID and anemia of chronic disease.[16] However, ferritin is also an acute-phase reactant that increases during inflammation, which can complicate its interpretation.[23] In patients with chronic inflammation, IDA is likely when ferritin levels are less than 50 ng/ml (112.35 pmol/l), while levels ≥100 ng/ml (224.70 pmol/l) generally exclude IDA.[23] When ferritin levels are between 100–300 µg/l, TSAT values of less than 20% should be used to diagnose ID.[17] Moreover, serum iron levels are not reliable for diagnosing IDA as they fluctuate throughout the day.[17]

Expert opinion

The experts agreed to follow the FOGSI GCPR recommendations for assessing IDA, as illustrated in Figure 1. The diagnosis of IDA involves four primary groups of tests. The evaluation begins with assessing RBC parameters and indices. The direct measurement of iron stores is conducted, which includes analyzing serum iron levels, total iron-binding capacity, percentage saturation, serum ferritin, and, in some cases, performing a bone marrow biopsy. The third group of tests focuses on assessing heme iron levels and involves estimating free erythrocyte protoporphyrin levels. The fourth category involves evaluating iron uptake by measuring the soluble serum transferrin receptor, the soluble transferrin receptor-log [ferritin] index, and zinc protoporphyrin.

Differential diagnosis

IDA is identified by the presence of microcytic, hypochromic RBCs and depleted iron reserves.[12] The differential diagnosis of IDA includes several conditions such as lead poisoning, anemia of chronic disease, hemoglobin CC disease, autoimmune hemolytic anemia, and hemoglobin S-beta thalassemia that share overlapping clinical features (microcytic anemia) with IDA.[12,24]

Expert opinion

According to the experts, in clinical practice, it is frequently noted that certain patients present with anemia resulting from chronic infections or hemoglobinopathies (sickle cell, thalassemia). Treating anemia without addressing underlying causes can complicate management and potentially worsen patient outcomes. This necessitates a thorough diagnostic assessment before initiating iron therapy. A comprehensive evaluation, including a CBC, is crucial to identify the specific type of anemia, whether microcytic or macrocytic, which guides tailored treatment strategies for patients.

MANAGEMENT OF IDA

Inadequate anemia management during pregnancy can result in preterm birth, low birth weight, impaired neurodevelopment, and maternal and perinatal mortality,[25,26] and in breastfeeding mothers increases the risk of IDA in infants.[25,27] Thus, consuming more iron-rich foods to enhance iron absorption is critical in managing IDA during this crucial period.[25] Avoiding substances that inhibit iron absorption (tea, coffee, phytates, and polyphenols), and use of food processing techniques (soaking and fermentation) to improve absorption are recommended.[25]

Pharmacological interventions whether oral, parenteral [IV/intramuscular (IM) or intradialytic], or through transfusion, depends on the cause, treatment goals, symptom severity, prior response, patient preference, and treatment availability and cost.[25]

Oral iron

Oral iron, available in various formulations, is the first-line treatment choice due to its affordability, accessibility, and overall effectiveness (Table 4).[25,28] In a pooled analysis of trial data, 72.8% of patients with IDA showed a satisfactory response to oral iron therapy, defined as an increase in Hb of more than 10 g/dl within 2 weeks.[29] Compared to placebo, oral iron replacement therapy significantly enhances Hb levels in IDA and likely decreases the need for blood transfusions.[30] Common side effects of oral iron include constipation, diarrhea, and stomach upset, leading to non-adherence in up to 50% of patients.[31]

Parenteral iron

Parenteral iron can be administered intramuscularly, intravenously or intradialytically. IM iron though less preferred due to poor absorption and pain than IV iron.[8] IV iron is effective for IDA, as it bypasses the GI tract to reduce side effects, but its use is limited by availability and cost.[8] Intradialytic iron supplementation, using ferric pyrophosphate citrate, is used in patients with chronic kidney disease during hemodialysis sessions.[25] Table 5 outlines the various parenteral recommendations for IDA.

Need for IV therapy

IV iron administration should be considered for patients demonstrating intolerance, poor adherence, or lack of efficacy with oral iron.[32] It is also preferable when rapid iron correction is needed before surgery or when ongoing blood loss exceeds the absorptive capacity of oral iron.[33] In a systematic analysis including pregnant women, those receiving IV iron more consistently reach their target Hb levels within a 4-week period and experience fewer adverse events (AEs) compared to those using oral iron formulations.[32] Figure 2 highlights the advantages of IV therapy for IDA.

The American College of Obstetricians and Gynecologists, the Federation of Obstetric and Gynecological Societies of India, and the British Society of Haematology recommend IV iron for patients who are intolerant or unresponsive to oral iron or require rapid correction.[33] It is advised to consider IV iron from the second trimester onward for women with confirmed IDA and for those presenting after 34 weeks of gestation with low Hb levels.[33]

Expert opinion

Expert recommendations highlight starting treatment with oral iron if Hb levels are below 10 g/dl during the first and second trimesters of pregnancy. Despite initiating oral iron supplementation, it's common to observe Hb levels persisting between 8 to 9 g/dl beyond 26-28 weeks due to work stress and other factors, they may have reduced absorption and tolerance to oral iron. Thus, experts recommend switching to parenteral therapy at the beginning of the third trimester. Furthermore, in clinical practice, IV iron therapy is crucial for patients who are noncompliant with oral iron due to GI issues like vomiting and nausea in later pregnancy stages. IV iron becomes necessary for moderate to severe anemia when oral supplements are inadequate providing faster correction of ID. IV therapy is typically initiated in the second trimester of pregnancy when Hb levels are 8 to 9 grams or lower, ensuring fetal development is not compromised by ID.

Significant improvement in Hb levels typically reaching 10 to 10.5 g/dl by the end of pregnancy is often observed through the use of iron sucrose (IS) injections. This rapid correction of iron deficiency ID during pregnancy is crucial to promptly increasing Hb levels, ensuring maternal and fetal health, and addressing complications like severe anemia or placenta previa that require swift intervention. IV therapy sessions are relatively quick, typically lasting around 15 minutes per session, enhancing convenience for patients undergoing treatment. In regions such as Tamil Nadu, where anemia prevalence is high and severe, IV iron therapy is mandated when Hb levels fall below 8-9 g/dl.

Ferric carboxymaltose

Ferric carboxymaltose (FCM), a newer IV formulation, addresses the limitations of conventional IV agents like multiple dosing requirements of IS.[34] FCM allows for a single 1000 mg infusion in just 15-20 minutes.[34] This makes FCM more convenient for patients and healthcare providers than other IV options.[34] FCM delivers iron gradually to the liver's reticuloendothelial system at neutral pH and physiological osmolarity and unlike iron dextran, ferumoxytol, and iron isomaltoside 1000, FCM contains no dextran thereby eliminating the risk of dextran-induced anaphylactic reactions.[35] Moreover, pregnant women well tolerate high doses of FCM, effectively addressing anemia within 4 weeks in the second and third trimesters, across all severities of IDA.[36] Also, compared to oral iron and IS, FCM is more affordable, and increased use may lower per-infusion costs.[37] Furthermore, the reduced need for multiple FCM infusions decreases visit frequency to healthcare facilities and lowers the risk of infection associated with multiple venous interventions.[34]

Expert opinion

Experts recommend FCM for its capability to deliver a substantial amount of iron in a single dose and simple administration process, which is considered more effective in managing ID compared to alternative therapies Despite initial cost concerns, recent adjustments have made FCM more accessible across various healthcare settings, promoting its broader utilization.

In clinical practice, FCM is particularly favored in the third trimester of pregnancy for women with Hb levels <10 g/dl due to its proven efficacy, safety profile, and the convenience of a single, cost-effective dose. Healthcare providers recommend monitoring patients for about two hours' post-administration to ensure safety and efficacy, reflecting ongoing efforts to optimize its clinical application and enhance patient outcomes.

Blood transfusion

Blood transfusions are recommended for chronic IDA with active bleeding, critical anemia (Hb level <7 g/dl), acute myocardial ischemia, or treatment failure to address the anemia.[8]

Expert opinion

The comprehensive treatment strategy of switching oral therapy to IV therapy such as FCM has proven highly effective, with fewer than one percent of patients requiring blood transfusions due to complications. Furthermore, experts underscore the risks of blood transfusions, including the transmission of parasites, viral infections, and non-viral fevers, which most healthcare providers prefer to avoid.

Figure 3 outlines the management of IDA in pregnancy.

Table 1: Causes of IDA.[45,46]

Cause	Examples
Physiological	Infancy, increased demand due to rapid growth in adolescence, blood donation, pregnancy, menstrual blood loss
Dietary or environmental	Malnutrition or insufficient iron intake resulting from poor nutrition, vegetarian diet, or poverty
Pathological	Decreased absorption (e.g., gastrectomy, inflammatory bowel diseases, *Helicobacter pylori* infection); chronic blood loss (e.g. gastrointestinal tract, including esophagitis, erosive gastritis, benign tumors hemorrhoids, hookworm infestation); Genitourinary system issues (e.g. heavy

Continued.

Cause	Examples
	menses, menorrhagia, intravascular hemolysis); systemic bleeding (e.g. hemorrhagic telangiectasia, chronic schistosomiasis, Munchausen's syndrome)
Drug-associated	Side effects of medications like glucocorticoids, salicylates, NSAIDs, and proton-pump inhibitors
Genetic	IRIDA
Iron-restricted	Treatment with ESA, chronic kidney disease, and anemia of chronic disease

NSAIDs: Non-steroidal anti-inflammatory drugs; IRIDA: iron-refractory iron-deficiency anemia; ESA: erythropoiesis-stimulating agents

Table 2: Serum markers for IDA.

Serum marker	Role in IDA diagnosis
Hb	Most common marker for IDA; < 13 g/dl in men and <12 g/dl in women indicate anemia
Ferritin	Storage molecule for iron; <30 ug/l suggest isolated iron deficiency
Transferrin	Responsible for iron transport; elevated in IDA
TIBC	Reflects the capacity of transferrin to bind iron; elevated in IDA
Serum iron	Measures the actual iron content in the blood; decreased in IDA
Transferrin saturation	Calculated as (serum iron/TIBC) × 100%; low saturation indicates IDA
MCV	Measures the average size of RBCs; increased in IDA
Hepcidin	Recent diagnostic marker; low levels observed in children and pregnant women with IDA
% Hypochromic reticulocytes	Indicates iron-deficient erythropoiesis; early response indicator to iron therapy
CHr	Indicator of iron-deficient erythropoiesis; useful for monitoring therapy
% Circulating microcytes	Additional marker for iron deficiency; compared to MCV, better for assessing therapy response during pregnancy

Hb: Hemoglobin; TIBC: total iron binding capacity; CHr: reticulocyte Hb; MCV: mean corpuscular volume; RBC: red blood cells

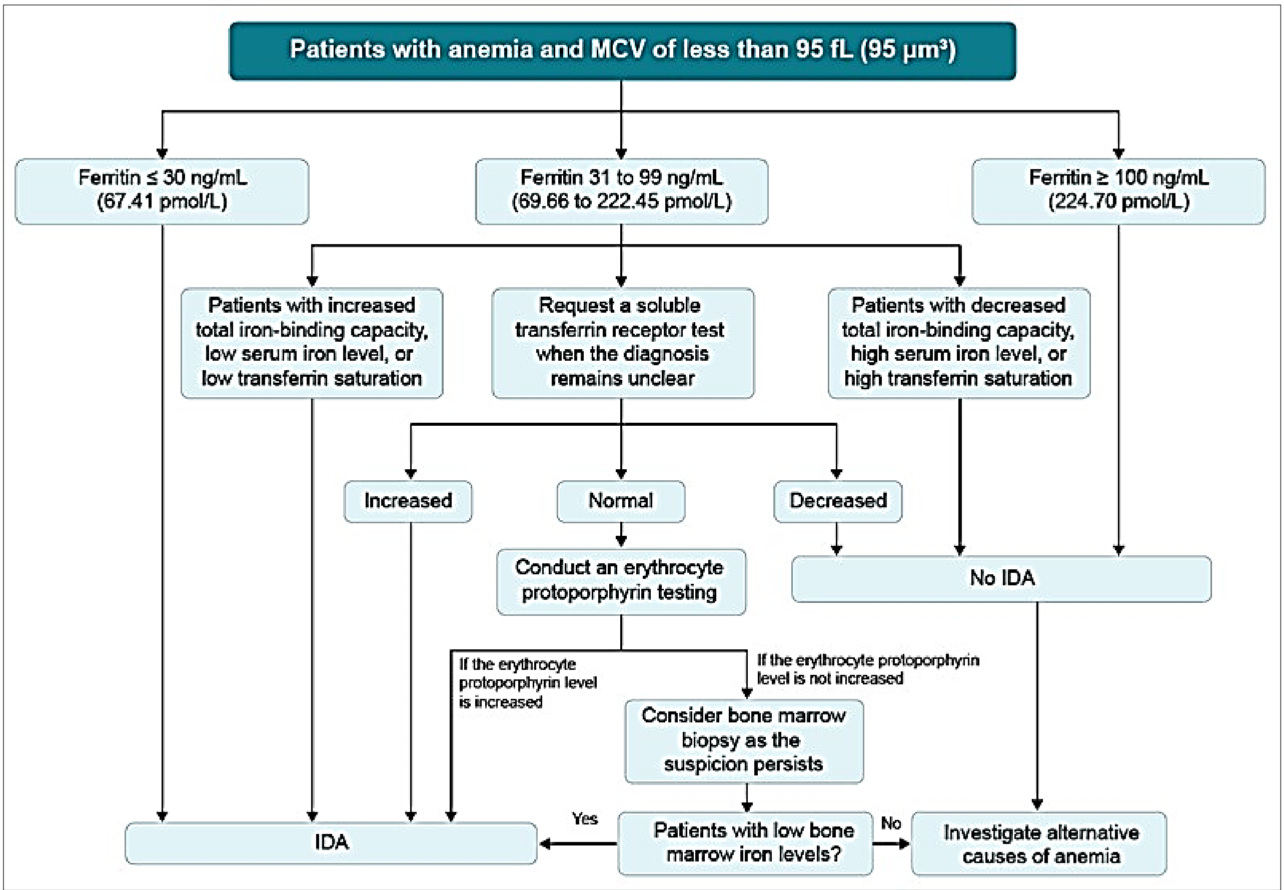

Figure 1: Ferritin algorithm for diagnosis of IDA.

MCV: Mean corpuscular volume; IDA: iron deficiency anemia

Table 3: Description of tests used for IDA.

Test	Description	Normal range	Diagnosis for IDA
Hemoglobin concentration	Amount of hemoglobin present in a given volume of blood	14-18 g/dl in men 12-16 g/dl in women	<13 g/dl in men; <12 g/dl in women 1st and 3rd trimesters <11 g/dl, 2nd trimester <10.5 g/dl; postpartum <12 g/dl
MCV	Measure of the average RBC volume	80–100 fl	<80 fl
Mean corpuscular hemoglobin concentration	Measure of the concentration of hemoglobin in a given volume of packed RBCs	320–360 g/l	<32 g/l
RCDW	Measure of the variation of RBC width (used in combination with the MCV to distinguish an anemia of mixed cause from that of a single cause)	11–14%	>14%
Platelet count	Number of platelets in blood	150,000-450,000/µl of blood	>450,000/µl of blood
Ferritin levels	Stored iron in the body	varies	<30 µg/l if no inflammation <100 µg/l if inflammation
Peripheral smear	Examination of the erythrocytes	-	Presence of hypochromic, microcytic erythrocytes
TIBC	Blood's ability to attach itself to iron and its transportation	300-360 µg/dl	>360 µg/dl
Serum iron	Measures how much iron is in your blood	50-150 µg/dl	<50 µg/dl
Transferrin saturation	Ratio of the serum iron concentration and the TIBC	20-45%	<20%
sTFR	Measure of tissue iron supply	2 to 5 mg/l	>5 mg/l
Erythrocyte ZPP and ZPP/heme ratio	Reflects iron status by indicating the presence of iron in protoporphyrin during heme synthesis	<2.3 µ ZPP/g Hb	>2.3 µ ZPP/g Hb

MCV: Mean corpuscular volume; RCDW: red cell distribution width; RBC: red blood cell; TIBC: total iron-binding capacity; sTFR: soluble transferrin receptor; ZPP: zinc protoporphyrin

Table 4: Common oral iron formulations: doses and elemental iron content.

Form	Formulation (tablet)	Elemental iron	Adult dosage
Ferrous fumarate	325 mg	106 mg (33%)	1 tablet, once per day or once every other day
Ferrous gluconate	325 mg	38 mg (12%)	1-3 tablets, once per day or once every other day
Ferrous sulfate	325 mg	6 mg (20%)	1-2 tablets, once per day or once every other day
Haem iron polypeptide	398 mg	11 mg	1-3 tablets per day
Polysaccharide iron complex	150 mg	150 mg	1 tablet, once per day
Ferric citrate	1,000 mg	210 mg	1 tablet, once every other day

Table 5: Available parenteral iron formulations.[25]

Compound	Concentration of elemental iron	Recommended amount per dose	Infusion time
LMW ID	50 mg/ml	1,000 mg (single; diluted in 250 ml normal saline) or 100 mg (multiple)	2–6 hours
FG	12.5 mg/ml	125-250 mg (multiple)	12.5 mg/min
Iron sucrose (or iron saccharate)	20 mg/ml	200-300 mg (multiple) ranging from 1-3 weeks	100 mg/30 min
Ferumoxytol	30 mg/ml	1,020 mg (single) or 510 mg (2 doses; given 3-8 days apart	15 min

Continued.

Compound	Concentration of elemental iron	Recommended amount per dose	Infusion time
FCM	50 mg/ml	Weight ≥50 kg: of 750 mg (1/2 doses) at least 7 days apart; weight <50 kg: 15 mg/kg (1/2 doses) at least 7 days apart	15 min
Ferric derisomaltose (formerly called iron isomaltoside)	100 mg/ml	Weight ≥50 kg: 1,000 mg (single) or 500 mg (up to 3 doses) over 7 days; for weight >50 kg: 20 mg/kg (single)	>15 to ≥30 min

FG: Ferrous gluconate; FCM: Ferric carboxymaltose; LMW ID: Low-molecular-weight iron dextran

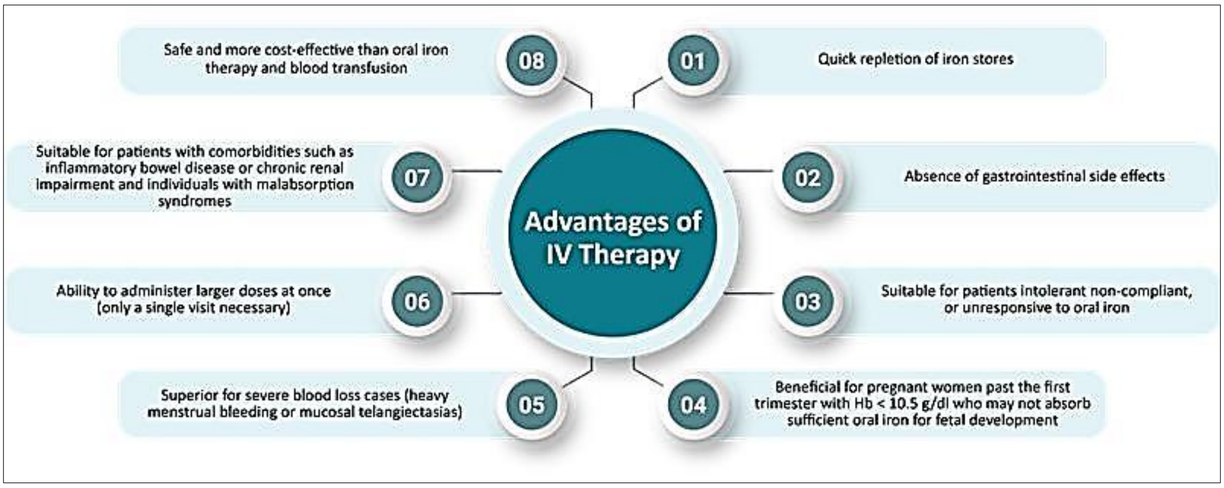

Figure 2: Advantages of IV treatment for IDA.[25,32,33,47]

IV: Intravenous

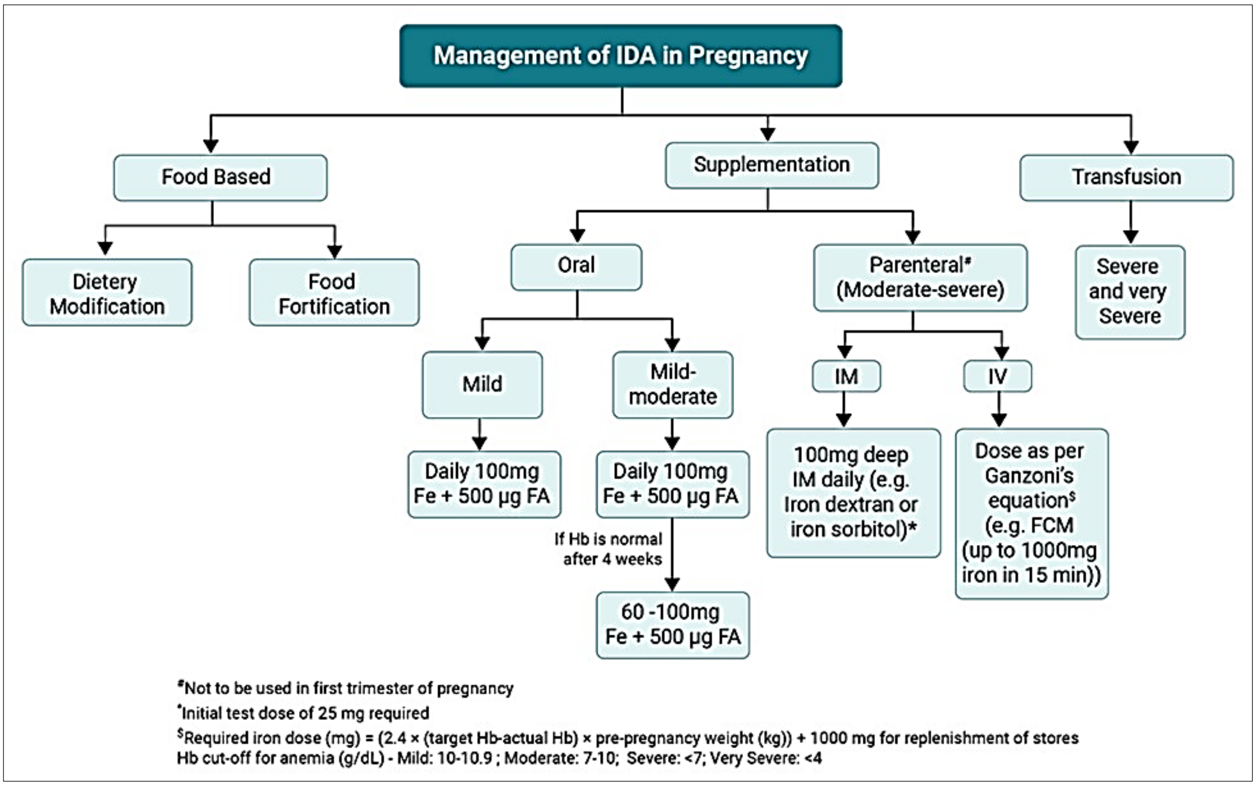

Figure 3: Management of IDA in pregnancy.[8,26,48]

IDA: Iron deficiency anemia; IM: intramuscular; IV intravenous; Fe: iron; FA: folic acid

Public health initiatives

National Nutritional Anemia Control Program (NNACP) (1970) aimed to reduce anemia prevalence and incidence among women of reproductive age.[38] Weekly iron and folic acid supplementation, 2012, targeted adolescents (10–19 years) and provided IFA supplements, deworming, and counseling.[39] National iron + initiative (2013) aimed to address IDA across all life stages, expanding guidance for children, pregnant, and lactating women to include adolescents of age (10–19 years) and women of reproductive age (15–49 years).[40] In 2018, Anemia Mukt Bharat was launched to intensify efforts toward an anemia-free India, incorporating interventions like iron supplementation, dietary diversification, and awareness campaigns.[41]

Expert opinion

Experts have observed that increased government involvement has led to a significant reduction in severe IDA. This initiative of providing free iron supplements has notably decreased the number of severely anemic patients, even among low socioeconomic groups. As a result, nutritional deficiencies, once common in these communities, have become rare.

The government also provides iron supplementation through programs targeting school-going girls, contributing to a decrease in the prevalence of IDA in India compared to a decade ago. Moreover, in Andhra Pradesh, there is a system involving auxiliary nurse midwives and ASHA workers who are assigned to visit families regularly and provide them with iron supplementations leading to a decrease in the prevalence of anemia in the state, even in the rural population over the past 3 to 4 years. Similarly, in Tamil Nadu, several government programs provide IFA supplements starting early in pregnancy, even at primary health centers to manage anemia.

CHALLENGES ASSOCIATED WITH IDA

In developing countries, including India, eliminating IDA depends on various factors. The primary challenge lies in low adherence to iron supplementation due to side effects.[42] Other barriers including parasite and worm infections, obscured symptoms, micronutrient deficiencies, poor monitoring, unequal gender norms, and misconceptions (e.g. causing a “big baby”) also persist.[41] Addressing gaps in patient education, including ignorance of anemia symptoms, inconsistent iron supplement use, and intolerance to oral iron, is crucial with primary education initiatives playing a key role in raising awareness and promoting traditional iron-rich foods.[43]

Key strategies include increasing patient visits to healthcare centers, accurate diagnosis of anemia, prioritizing infection control, providing iron-rich diets, and monitoring AEs of iron supplements.[44] To tackle these issues, healthcare programs must prioritize health promotion, enhance monitoring, improve adherence, promote hygiene practices, balanced nutrition, consistent supply of iron supplements, persistent counseling for pregnant women, and preventive measures alongside treating anemia in pregnancy.[42,44]

Expert opinion

According to the expert panel, many healthcare providers face numerous challenges in effectively managing anemia during pregnancy, including the cost of treatments, and issues with patient compliance. The impact of hemodynamic changes during pregnancy if not diagnosed can lead to complications. Women often struggle to maintain consistent iron supplementation due to their busy schedules, resulting in frequent lapses in anemia. Furthermore, common side effects such as upper GI issues and constipation discourage adherence to therapy. The panel agreed to the unfounded beliefs, such as the fear that iron tablets can lead to excessive fetal growth and cesarean sections, causing hesitation in taking iron supplements and poor compliance. Also, regular follow-up visits are difficult in rural settings and contribute to patient reluctance towards frequent monitoring and management.

Additionally, a higher prevalence of worm infestations worsens the problem of anemia among pregnant women. Patient education is crucial for addressing misconceptions about FCM and promoting its adoption. Patients should be informed about the potential side effects and hypersensitivity reactions associated with IV iron therapy. Despite governmental efforts to promote iron supplementation, awareness about FCM remains low, particularly in rural areas where misconceptions about its efficacy and safety prevail. These barriers underscore the importance of targeted patient education initiatives and awareness campaigns in India.

CONCLUSION

In the Indian population, IDA is a major public health concern. Its effective management necessitates a multifaceted approach including regular monitoring, timely diagnosis, and tailored treatment strategies. Enhancing dietary iron absorption is vital, especially in resource-limited settings. Both oral and parenteral iron supplementation play crucial roles, with IV formulations like FCM providing faster and more convenient correction of ID, especially during later pregnancy stages. Public health initiatives like the NNACP and Anemia Mukt Bharat have made significant progress in mitigating severe IDA through free iron supplementation in government hospitals and patient awareness campaigns. Nevertheless, challenges persist, including treatment adherence and limited healthcare access. A comprehensive strategy combining dietary modifications, appropriate oral and parenteral iron supplementation, patient education, adherence to treatment protocols, and ongoing public health efforts is essential for reducing IDA, ultimately improving maternal and fetal health outcomes.

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