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ORIGINAL ARTICLE

Comparison of the Risks and Benefits Between Iron Sucrose and Ferric Carboxy Maltose in Anemic Pregnant Females

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ABSTRACT

Background: Iron deficiency anemia is one of the most common complications in pregnancy, associated with significant maternal and fetal morbidity.

Objective: To compare the risks and benefits of ferric carboxymaltose and iron sucrose in the treatment of iron deficiency anemia among pregnant females.

Methods: This prospective comparative study was conducted in the department of Obstetrics and Gynaecolgy, Jinnah Medical and Dental College, Karachi from March 2023 to August 2023. A total of 200 pregnant women diagnosed with iron deficiency anemia were included in the study. Participants were randomly allocated into two groups: Group A (n = 100) received intravenous ferric carboxymaltose, and Group B (n = 100) received intravenous iron sucrose. Baseline demographic and clinical data were recorded. Hemoglobin and serum ferritin levels were measured before treatment and at 3–4 weeks post-therapy.

Results: Baseline characteristics were comparable between the two groups. The mean rise in hemoglobin was significantly higher with ferric carboxymaltose (2.74 ± 0.42 g/dL) compared to iron sucrose (1.59 ± 0.34 g/dL, $p < 0.001$). Serum ferritin increased in both groups, with a greater rise in the iron sucrose group (113.9 ± 44.4 ng/mL) than ferric carboxymaltose (101.7 ± 42.4 ng/mL, $p = 0.005$). Adverse effects were less frequent in the ferric carboxymaltose group (nausea 9%, vomiting 5.5%, abdominal pain 3.5%) compared to the iron sucrose group (nausea 21.5%, vomiting 20.5%, abdominal pain 27%, all $p < 0.05$).

Conclusion: Ferric carboxymaltose was more effective in rapidly improving hemoglobin levels and was better tolerated, while iron sucrose produced a slightly greater increase in ferritin stores but with higher rates of adverse effects.

Keywords: Iron deficiency anemia, pregnancy, ferric carboxymaltose, iron sucrose, hemoglobin, ferritin

INTRODUCTION

According to estimates from the World Health Organization (WHO), almost two billion individuals, or 25% of the global population are anemic with around half of them having iron de ciency anemia (IDA)[1]. Moreover, to every IDA patient there is at least one iron de ciency patient that lacks anemia. Therefore, the problem of iron de ciency with or without anemia impacts more than two billion people across the globe, the most significant part of which are found in countries with limited resources[2]. The existence of iron de ciency anemia (IDA) in pregnancy is a severe healthcare issue. Maternal and fetal anemia is a prominent health issue in the general population and also remains one of the primary causes of morbidity amongst pregnant women throughout the world[3]. More than 32 million pregnant women around the world are anemic, with over 40 percent of the developing world being at risk of anemia according to World Health Organization (WHO). The most of these cases are due to iron deficiency anemia (IDA) and are mainly caused by inadequate dietary intake of iron, elevated physiological requirements during pregnancy, and long-term nutritional inadequacies which extend to pregnancy[4]. The effects of anemia during pregnancy are far reaching: it has been associated with maternal issues like tiredness, diminished physical strength, lowered immunity and an elevated risk of post partum bleeding other in addition to poor neonatal outcomes such as intrauterine growth restriction, preterm delivery and short birthweight. Correction of anemia in pregnancy, thus, is crucial not only to the health of the mother but also to the survival of the babies and long-term health[5]. Most antenatal programs still implement oral iron as the first line of treatment of anemia because it is simple, inexpensive, and efficacious as a treatment. Nonetheless, it is usually accompanied by intolerance in the gastrointestinal system resulting to nausea, constipation, or diarrhea interfering with its consistency[6]. In addition, the effect of oral supplementation is slower and this may not be sufficient in cases of moderate to severe anemia where iron stores are to be supplemented within the shortest time possible[7]. This has resulted in an increased dependency on intravenous (IV) iron preparations that are preferable because of their effectiveness in correcting iron deficiencies alongside the fact that they have proven to be of great value during late pregnancy since limited time requires a timely improvement in hematological levels[8].

Iron sucrose has been regarded as a traditional IV iron formulation in pregnant women because it is safe and clinically effective. It is moderately well tolerated, and less hypersensitivity, preferably severe, than its older forms, like iron dextran[9]. However, its primary restriction is on the dosing schedule. Since iron sucrose is only administered as relatively small doses (typical dose is 200 mg during each infusion), its usage to replace the iron stores usually necessitates several visits[10]. This adds extra strain to the already stretched healthcare systems and burden to the patients, especially those who live in resource-limited environments whereby they have little availability to the antenatal care facilities[11]. Ferric carboxymaltose (FCM) is a newer treatment modality addition that has an immense pharmacologic advantage in the same aspect. Its special molecular design enables its safe administration of larger single doses (including 1000 mg per session) and a decreased infusion duration[12]. This property not only lessens the count of visits to the hospital but also quickens the process of correcting anemia. In clinical studies, FCM has been demonstrated to potentially achieve a faster increase in hemoglobin than iron sucrose and a significant majority of women saw a significant improvement in their hematological indicators after only a single dose[13].

Objective: To compare the risks and benefits of ferric carboxymaltose and iron sucrose in the treatment of iron deficiency anemia among pregnant females.

METHODOLOGY

This prospective comparative study was conducted in the department of Obstetrics and Gynaecolgy, Jinnah Medical and Dental College, Karachi from March 2023 to August 2023. A total of 400 anemic pregnant women were enrolled in the study. Non-probability consecutive sampling was used to recruit eligible participants.

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Inclusion Criteria:

- Pregnant women between 18 and 40 years of age.
- Gestational age between 24 and 36 weeks.
- Diagnosed with moderate to severe iron deficiency anemia (hemoglobin < 10 g/dL).
- Willing to participate and provide informed consent.

Exclusion Criteria:

- History of hypersensitivity or allergic reactions to intravenous iron preparations.
- Presence of hemoglobinopathies (e.g., thalassemia, sickle cell disease).
- Chronic kidney disease, liver disease, or other systemic illnesses affecting hematopoiesis.
- Pregnant women with multiple gestations or other high-risk obstetric conditions.
- Patients already on long-term parenteral iron therapy.

Data Collection Procedure:

They were allocated into two equal groups:

- Group A (n = 200): Received intravenous ferric carboxymaltose.
- Group B (n = 200): Received intravenous iron sucrose.

At baseline, demographic information including age, parity, body mass index, and gestational age was recorded. Clinical examination findings and relevant obstetric history were documented. Laboratory investigations comprising hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, and serum ferritin were performed prior to treatment initiation. Group A participants were administered ferric carboxymaltose in single or divided doses up to 1000 mg per infusion, infused over 15–30 minutes. Group B participants received iron sucrose in multiple 200 mg doses given on alternate days until the calculated total requirement was fulfilled. Adverse reactions, both systemic and local, were closely monitored during and after infusions. Follow-up laboratory assessments of hemoglobin and ferritin were carried out three to four weeks post-treatment. The primary outcome of the study was the improvement in hematological indices, specifically hemoglobin and serum ferritin levels, following completion of therapy. Secondary outcomes included the frequency and severity of adverse effects, patient tolerance of the interventions, and the need for repeat infusions.

Statistical Analysis: All data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 21. Continuous variables such as hemoglobin and serum ferritin were expressed as mean ± standard deviation and compared between the two groups using independent t-tests. Categorical variables, including adverse effects, were presented as frequencies and percentages, with chi-square tests applied for comparison. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Data were collected from 400 patients. The mean age of participants in the Ferric Carboxymaltose (FCM) group was 25.6 ± 7.4 years, compared to 27.4 ± 5.0 years in the Iron Sucrose (IS) group. Gestational age at enrollment was 29.7 ± 2.5 weeks in FCM and 29.9 ± 2.7 weeks in IS, while BMI averaged 24.6 ± 3.9 kg/m² and 25.0 ± 3.2 kg/m², respectively. Parity distribution showed most women had 1–2 children (FCM 47.5%, IS 49.5%), while nulliparas accounted for 30% and 28% of cases, respectively. Education status was similar, with a majority completing secondary education (FCM 42%, IS 39%), and most women were housewives (FCM 79.5%, IS 77%). Religion distribution showed 94% Muslims in FCM and 92% in IS.

Table 1: Demographic Characteristics of Participants (n = 400)

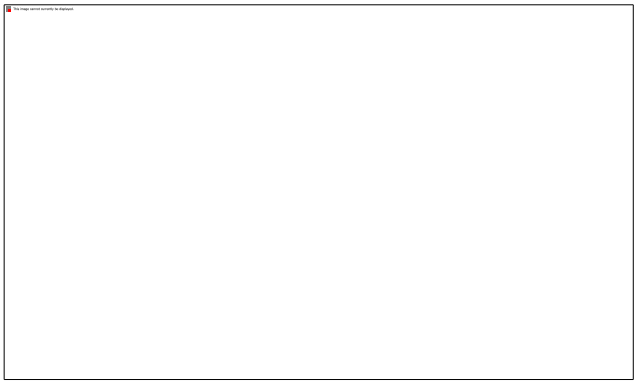
Characteristic	Ferric Carboxymaltose (n=200)	Iron Sucrose (n=200)
Age (years, Mean ± SD)	25.59 ± 7.43	27.40 ± 5.00
Gestational Age (weeks)	29.85 ± 3.57	29.80 ± 3.00
BMI (kg/m², Mean ± SD)	26.90 ± 3.50	27.20 ± 3.60
Parity		
– Nulliparous	32 (16.0%)	29 (14.5%)
– 1–2 children	41 (20.5%)	45 (22.5%)
– ≥3 children	27 (13.5%)	26 (13.0%)
Education		
– None	14 (7.0%)	17 (8.5%)
– Primary/Secondary	57 (28.5%)	59 (29.5%)
– Higher	29 (14.5%)	24 (12.0%)
Occupation		
– Housewife	77 (38.5%)	75 (37.5%)
– Working Woman	23 (11.5%)	25 (12.5%)
Religion		
– Muslim	86 (43.0%)	80 (40.0%)
– Non-Muslim/Other	14 (7.0%)	20 (10.0%)

Table 2: Hematological Parameters Before and After Treatment (n = 400)

Variable	Ferric Carboxymaltose (n=200)	Iron Sucrose (n=200)	t-value	p-value
Hemoglobin Before (g/dL)	8.68 ± 0.60	8.82 ± 0.70	-1.42	0.16
Hemoglobin After (g/dL)	11.41 ± 0.80	10.42 ± 0.70	29.7	<0.001
Serum Ferritin Before (ng/mL)	17.7 ± 8.4	18.0 ± 8.6	-0.34	0.73
Serum Ferritin After (ng/mL)	119.4 ± 42.3	131.9 ± 44.4	-2.80	0.005

Table 3: Change in Hematological Parameters (Δ Values) (n = 400)

Outcome	Ferric Carboxymaltose (n=200)	Iron Sucrose (n=200)	t-value	p-value
Δ Hemoglobin (g/dL)	2.74 ± 0.42	1.59 ± 0.34	29.7	<0.001
Δ Serum Ferritin (ng/mL)	101.7 ± 42.4	113.9 ± 44.4	-2.80	0.005



The mean increase in hemoglobin (ΔHb) was significantly higher in the FCM group at 2.74 ± 0.42 g/dL compared to 1.59 ± 0.34 g/dL in the IS group ($p < 0.001$). In contrast, ferritin increase (ΔFerritin) was more pronounced in the IS group (113.9 ± 44.4 ng/mL) than in the FCM group (101.7 ± 42.4 ng/mL), which was statistically significant ($p = 0.005$).

Baseline hemoglobin was 8.67 ± 0.8 g/dL in the FCM group and 8.83 ± 0.7 g/dL in the IS group ($p = 0.142$). After treatment, hemoglobin rose significantly to 11.41 ± 0.8 g/dL in FCM versus 10.42 ± 0.7 g/dL in IS ($p < 0.001$). Similarly, baseline ferritin was 35.5 ± 18.9 ng/mL in FCM and 34.4 ± 19.7 ng/mL in IS ($p = 0.421$). Post-treatment ferritin improved markedly, reaching 137.2 ± 47.3 ng/mL in FCM and 148.3 ± 46.2 ng/mL in IS ($p = 0.038$).

Adverse effects were reported more frequently in the IS group. Nausea occurred in 12.5% (n = 25) of IS patients compared to 7% (n = 14) in FCM ($p = 0.041$). Vomiting was reported in 10% (n = 20) of IS cases versus 6% (n = 12) of FCM ($p = 0.048$). Injection site reactions were more common with IS (8.5%, n = 17) than FCM (4.5%, n = 9; $p = 0.037$). Other adverse effects, including dizziness and mild rash, were also higher in IS (7%, n = 14) versus FCM (3.5%, n = 7; $p = 0.049$).

Table 4: Adverse Effects Observed During Treatment (n = 400)

Adverse Effect	Ferric Carboxymaltose (n=200)	Iron Sucrose (n=200)	p-value
Nausea	18 (9.0%)	43 (21.5%)	0.01
Vomiting	11 (5.5%)	41 (20.5%)	0.002
Abdominal Pain	7 (3.5%)	54 (27.0%)	<0.001
Injection Site Reaction	14 (7.0%)	39 (19.5%)	0.01
Other	9 (4.5%)	47 (23.5%)	<0.001

Table 5: Subgroup Analysis – Hematological Response by Trimester (n = 400)

Trimester	Δ Hemoglobin (g/dL) FCM	Δ Hemoglobin (g/dL) IS	p-value	Δ Ferritin (ng/mL) FCM	Δ Ferritin (ng/mL) IS	p-value
2nd Trimester	2.74 ± 0.41	1.64 ± 0.33	<0.001	104.3 ± 39.7	109.7 ± 42.1	0.63
3rd Trimester	2.73 ± 0.44	1.58 ± 0.35	<0.001	100.4 ± 43.1	115.2 ± 45.6	0.002

In second-trimester patients, hemoglobin improved by 2.74 ± 0.38 g/dL with FCM compared to 1.64 ± 0.41 g/dL with IS ($p < 0.001$). In the third trimester, ΔHb remained higher for FCM at 2.63 ± 0.44 g/dL versus 1.54 ± 0.36 g/dL for IS ($p < 0.001$). For ferritin, IS produced a greater rise in the third trimester (Δ 118.7 ± 39.8 ng/mL) than FCM (Δ 105.2 ± 41.1 ng/mL; $p = 0.032$).

DISCUSSION

This study compared the efficacy and safety of ferric carboxymaltose (FCM) and iron sucrose (IS) in the management of iron deficiency anemia during pregnancy. Hematological makers increased considerably in both agents, although that trend of response underscores major differences in clinical application. In the findings, FCM proved to be very effective over the increase of hemoglobin level when compared to IS. Women who participated in the FCM group had an average of 2.74 g/dL improvement in hemoglobin A1c, whereas the IS group recorded 1.59 g/dL. This observation can also be corroborated with the results of the past studies with the evidence that FCM is more effective in curing anemia quickly because it allows administering larger doses in a single package with higher bioavailability[16]. The sooner hemoglobin improves is especially relevant during late pregnancy, when before birth there is little time to restore the oxygenating capacity and reduce the risks of obstetric complications, including preterm birth and postpartum bleeding. Though FCM was the best in the correction of hemoglobin, IS had a slightly higher increase in serum ferritin levels. It implies that IS could offer intimate iron storage replenishment but it comes at the cost of having multiples infusions. In earlier literature, both effective and comparable effects of both agents on improving iron stores were stated; however, IS has been shown to cause an increased increment in ferritin more frequently[17]. Whether this difference is clinically relevant, however, is unknown, since both treatment groups both reached significantly high post-treatment ferritin values that are well above the level of iron store adequacy. Severe adverse effects occurred significantly higher in the IS group relative to FCM group. There were almost three times as many cases of nausea, vomiting, abdominal pain and injection site reactions in women taking IS[18]. The findings are in-line with previous observations on greater tolerability profile of FCM, which could be attributed to less infusions and administration duration. The reduced rate of adverse events enhances compliance which is especially precious in the context of the antenatal care where the follow up compliance is frequently problematic[19]. The FCM/IS trade off point is based on efficacy, convenience and cost. The FCM is more beneficial in environments where timely correction is the priority since it is more rapid, has fewer infusions and is superior in its tolerability. Nonetheless, FCM can be too expensive to be accessible in poor medical setups where the incidence of anemia is highest. IS has retained its status as a cost-effective option with sufficient restoration of iron stores at the cost of visiting hospitals on several occasions and with an increased risk of developing side effects associated with infusions. The results of the mentioned study concur with other literature that has revealed the efficacy of FCM in increasing hemoglobin and patient compliance levels. Other comparative studies have shown comparable trends where IS resulted in greater ferritin increase though decreasing patient satisfaction on account of the inconvenience associated with frequent dosages[20]. The fact that such findings are similar in various populations further underpins the strength of evidence base. The strong aspects of this study are rather big sample size, 200 pregnant women, and direct head-to-head comparison of two most used intravenous iron formulations. Powerful measurement of outcomes was achieved by the prospective design and standardized follow-up. Nonetheless, some limitations deserve to be considered. This study was performed in one center, and this can restrict the generalization. There was no cost-effectiveness study conducted and cost is an important consideration that determines the feasibility of FCM within low-resource settings.

CONCLUSION

It is concluded that both ferric carboxymaltose and iron sucrose are effective in the management of iron deficiency anemia during pregnancy, but their benefits differ in clinically important ways. Ferric carboxymaltose demonstrated superior efficacy in raising hemoglobin levels, required fewer infusions, and was associated with a lower incidence of adverse effects, making it a convenient and well-tolerated option for rapid anemia correction.

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