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ORIGINAL ARTICLE

Determine the Mean Increase in Hemoglobin Levels From Baseline after Liposomal Iron Therapy in Anemic Patients

HINA MEMON[1], KANWAL AYUB[2], GHULAM SUGHRA BHELLAR[3], HALEEMA SHAH[4], WASIFA SHAUKAT[5], KHADIJA BANO[6]
[1,2]Senior Registrar Department of Gynaecology and obstetrics Jinnah Postgraduate Medical Centre (JPMC) karachi
[3,4]Medical Officer Department of Gynaecology and obstetrics,Jinnah Postgraduate Medical Centre (JPMC) karachi
[5]Medical Officer Jinnah Postgraduate Medical Centre (JPMC) karachi
[6]Professor of Gynaecology and obstetrics,Jinnah Postgraduate Medical Centre (JPMC) karachi
Correspondence to: Hina Memon, Email: Memonhina48@gmail.com, Cell: +923341412941

ABSTRACT

Introduction: Encapsulation of iron in a micronized form into liposomes is a recent advancement aimed at improving iron absorption and gastrointestinal tolerance. This innovative oral iron delivery system enhances bioavailability and reduces adverse effects by minimizing direct contact between iron and the intestinal mucosa.

Objectives: To determine the mean increase in hemoglobin levels from baseline after liposomal iron therapy in anemic patients.

Methodology: This Quasi-experimental study was conducted at Department of Obstetrics & Gynecology, Jinnah Postgraduate Medical Centre (JPMC), Karachi from 11th August 2021 to 10th February 2022. A total of 60 anemic female patients aged 18 to 60 years were included. Patients on immunosuppressive therapy or with chronic kidney or liver disease were excluded. Baseline demographic data were recorded. Hemoglobin levels were measured at baseline and after 12 weeks of oral liposomal iron therapy.

Results: The mean age of participants was 36.05 ± 11.22 years, and the majority (63.33%) were between 18 to 40 years. Mean BMI was 28.07 ± 3.31 kg/m². The mean baseline hemoglobin was 8.13 ± 0.85 g/dL, which significantly increased to 10.05 ± 1.05 g/dL after 12 weeks of liposomal iron therapy ($p < 0.001$), indicating a substantial improvement in anemia status among participants.

Conclusion: Liposomal iron therapy resulted in a significant mean increase in hemoglobin levels in anemic patients over 12 weeks, suggesting that it is an effective and well-tolerated treatment option.

Keywords: Anemia, liposomal iron, hemoglobin levels, oral iron therapy, micronized iron.

INTRODUCTION

Anemia is a public health problem affecting about a third of the world's population both in developing and in developed countries. It is known to occur at all stages of life; children aged 0 to 5 years, women of childbearing age, and pregnant women are particularly at risk. According to the World Health Organization report, 50% of all cases of anemia is due to iron deficiency.[1] The prevalence of any type of anemia is very high (>95%) among children, adolescents, and pregnant women.[2] The main risk factors for iron deficiency anemia (IDA) are: Low iron intake, different levels of chronic blood loss, and malabsorption. In addition, certain chronic diseases like chronic kidney disease (CKD), chronic heart failure, cancer, and inflammatory bowel disease (IBD) are frequently associated with IDA.[3] Iron deficiency anemia is also known to affect a large part of adult and elderly patients in internal medicine units.[4] Iron deficiency results in reduction in serum iron and ferritin levels, reduction in transferrin saturation (serum iron/TIBC).Pregnancy and bleeding are the most frequent conditions leading to iron deficiency. Other causes include poor dietary intake, worm infestation, occult blood loss, chronic diseases, malabsorption etc. Therapy of iron deficiency involves treatment of the underlying condition as well as re-establishment of iron stores. Oral iron replacement is considered standard front-line therapy for iron-deficiency anemia.[3] Oral therapy is the most easy, safe and economical method of correcting iron deficiency. Oral iron causes constipation, sometimes diarrhoea, a metallic taste, gastric cramping and thick, green, tenacious stool which leads to noncompliance. However, for those who tolerate oral iron, this form of treatment provides an inexpensive solution.[4] Intravenous iron preparations are considered more efficacious in treating iron deficiency anemia, response is rapid but it is expensive and requires supervised treatment in a hospital or outpatient facility. The most appropriate form of iron supplementation is oral, unless it cannot be tolerated or absorbed. Worsening GI symptoms and major bowel surgeries which reduce iron absorption may require parenteral replacement.[5] Oral elemental iron of 30-60 mg/day is required for treating IDA in adults. The total duration of treatment is three months. Adequate response is gauged by a rise in serum Hb levels of 1 g/dL within one month of compliant therapy.[6] Encapsulation of iron in a micronized form in to liposomes is the recent approach to improve iron tolerance and absorption. This new, promising strategy for delivering iron orally is associated with greater GI absorption, higher bioavailability with reduced incidence of adverse effects.[7] It is believed that because of no direct contact of iron with intestinal mucosa, it is better absorbed and tolerated.[8] In a study, the mean serum Hb level at baseline was 8.71 ± 2.24 which increased to 10.47 ± 1.69 by the end of 12 weeks of therapy with liposomal iron ($p < 0.001$).[9] It is seen that in our society, anemia is very common due to unawareness and poverty which hinders the proper dietary intake. As the previously I have found very limited literature regarding effect of liposomal iron in anemia correction. My study will determine the effect of liposomal iron in correction of anemia in local population so that our population can be provide with the better preparation for anemia correction in order to reduce complications of anemia and improve the quality of life.

Objective: The objective of the study was:

- "To determine the mean increase in hemoglobin levels from baseline after liposomal iron therapy in anemic patients.

METHODOLOGY

This was a quasi-experimental study conducted at the Department of Obstetrics & Gynecology, Jinnah Postgraduate Medical Centre (JPMC), Karachi from 11th August 2021 to 10th February 2022. A total of 60 anemic patients were included. The sample size was calculated using the WHO sample size calculator, keeping a 95% confidence level, 5% margin of error, and assuming a mean baseline hemoglobin level of 8.71 ± 2.24 g/dL and post-therapy level of 10.47 ± 1.69 g/dL after 12 weeks of liposomal iron supplementation. Non-probability, consecutive sampling was employed.

Inclusion Criteria:

- Patients aged 18 to 60 years.
- Diagnosed cases of anemia (as per operational definition) for a duration greater than one month.

Exclusion Criteria:

- Patients on immunosuppressive therapy.

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- Post-operative patients.
- Patients with chronic kidney disease (serum creatinine >1.5 mg/dL).
- Patients with chronic liver disease (serum bilirubin >1.2 mg/dL).

Data Collection Procedure: Following ethical approval, 60 eligible patients attending the outpatient gynecology clinic at JPMC were enrolled after informed written consent. Each participant received oral microencapsulated iron pyrophosphate in liposomal form (Ferfer®, PharmEvo Pvt. Ltd., Karachi), containing 14 mg iron, 80 mg vitamin C, and 2.5 mcg vitamin B12 in a 1.5 g orodispersible sachet formulation. The therapy was prescribed for a total duration of 12 weeks. Patient compliance was monitored via direct follow-up and telephonic contact. Side effects were recorded to assess tolerability. Baseline and post-therapy hemoglobin levels were measured through laboratory testing and documented by the principal investigator. Additional information including age, height, weight, BMI, diabetes mellitus status, hypertension, smoking history, place of residence (urban/rural), monthly income (<20,000/20,000–40,000/>40,000 PKR), and educational level (illiterate/primary/middle/matric and above) was recorded using a pre-designed proforma.

Statistical Analysis: Data analysis was performed using SPSS version 25.0. Mean and standard deviation were calculated for quantitative variables including age, height, weight, BMI, and hemoglobin levels (pre- and post-treatment). Frequencies and percentages were computed for categorical variables such as comorbidities, smoking status, socioeconomic class, and education. To assess the effectiveness of liposomal iron therapy, a paired sample t-test was applied to compare baseline and post-treatment hemoglobin levels. A p-value ≤ 0.05 was considered statistically significant. Effect modifiers including age, BMI, baseline hemoglobin, pregnancy status, diabetes mellitus, and place of residence were controlled through stratification. Post-stratification paired t-tests were applied within each subgroup, with statistical significance again defined as $p \leq 0.05$.

RESULTS

A total of 60 anemic patients were enrolled in this quasi-experimental study. The mean age of the participants was 36.05 ± 11.22 years. Most patients (63.33%) were between 18 to 40 years of age, while 36.67% were aged 41 to 60 years. The majority (68.33%) had a body mass index (BMI) of less than 30 kg/m², with a mean BMI of 28.07 ± 3.31 kg/m². Regarding baseline hemoglobin levels, 25 patients (41.67%) had Hb ≤8 g/dL, and 35 (58.33%) had Hb between 8.1–9.9 g/dL. A total of 16 patients (26.67%) were pregnant at the time of enrollment. Diabetes mellitus and hypertension were present in 12 (20.0%) and 16 (26.67%) patients respectively. A majority of the patients (55.0%) were from rural areas. Only 4 patients (6.67%) reported a history of smoking.

Table 1: Demographic and Baseline Characteristics (n = 60)

Characteristic	Value
Mean Age (years)	36.05 ± 11.22
Age 18–40	38 (63.33%)
Age 41–60	22 (36.67%)
Mean BMI (kg/m²)	28.07 ± 3.31
BMI <30	41 (68.33%)
BMI ≥30	19 (31.67%)
Pregnant	16 (26.67%)
Non-pregnant	44 (73.33%)
Diabetic	12 (20.0%)
Non-diabetic	48 (80.0%)
Hypertensive	16 (26.67%)
Non-hypertensive	44 (73.33%)
Smokers	4 (6.67%)
Non-smokers	56 (93.33%)
Rural Residence	33 (55.0%)
Urban Residence	27 (45.0%)

In terms of education level, 41.67% had completed matriculation or higher, 18.33% had reached middle school, 23.33% had primary-level education, while 16.67% were illiterate.

Table 2: Educational Status of Participants

Education Level	No. of Patients	Percentage (%)
Illiterate	10	16.67
Primary	14	23.33
Middle	11	18.33
Matric & Above	25	41.67

The mean hemoglobin level at baseline was 8.13 ± 0.85 g/dL. After 12 weeks of oral liposomal iron therapy, a statistically significant increase was observed, with mean Hb rising to 10.05 ± 1.05 g/dL ($p = 0.0001$). This indicates a mean increase of approximately 1.92 g/dL, confirming the efficacy of liposomal iron in improving hemoglobin levels in anemic patients.

Table 3: Hemoglobin Levels Before and After Liposomal Iron Therapy

Hemoglobin Level	Mean ± SD	p-value
Baseline	8.13 ± 0.85	
Post-Therapy	10.05 ± 1.05	0.0001

Stratification based on age revealed a slightly higher mean post-therapy Hb in the 41–60 years group (10.19 ± 0.81 g/dL) compared to the 18–40 years group (9.99 ± 1.17 g/dL), though this was not statistically significant ($p = 0.518$). Similarly, patients with BMI >30 kg/m² had a higher mean post-therapy Hb (10.37 ± 0.88 g/dL) than those with BMI ≤30 kg/m² (9.90 ± 1.09 g/dL), with a p-value of 0.109. A significant difference in post-therapy Hb was observed when stratified by baseline hemoglobin levels: patients with initial Hb ≤8 g/dL had a post-therapy Hb of 9.51 ± 0.85 g/dL, while those with Hb 8.1–9.9 g/dL had a significantly higher mean of 10.44 ± 1.01 g/dL ($p = 0.0001$). Pregnancy status showed no significant influence on treatment outcome, with pregnant patients having a mean post-therapy Hb of 10.24 ± 1.21 g/dL and non-pregnant patients 9.98 ± 0.99 g/dL ($p = 0.403$). Similarly, no significant difference was found in post-therapy Hb when stratified by diabetes ($p = 0.608$), or place of residence ($p = 0.179$).

Table 4: Stratified Analysis of Post-Therapy Hemoglobin (g/dL)

Stratification Variable	Mean Hb	SD	p-value
Age 18–40	9.99	1.17	0.518
Age 41–60	10.19	0.81	
BMI ≤30	9.90	1.09	0.109
BMI >30	10.37	0.88	
Baseline Hb ≤8	9.51	0.85	0.0001
Baseline Hb 8.1–9.9	10.44	1.01	
Pregnant	10.24	1.21	0.403
Non-pregnant	9.98	0.99	
Diabetic	9.91	0.99	0.608
Non-diabetic	10.09	1.07	
Rural Residence	10.22	1.11	0.179
Urban Residence	9.85	0.95	

DISCUSSION

Encapsulation of iron in micronized liposomal form represents a novel strategy aimed at enhancing iron tolerance and absorption. Unlike conventional iron salts, liposomal iron bypasses direct mucosal contact, leading to reduced gastrointestinal (GI) irritation and improved bioavailability. This property is particularly valuable in pregnant or anemic populations, where poor tolerance to oral iron contributes to low compliance and suboptimal outcomes.[10] In the present study, we observed a statistically significant increase in mean serum hemoglobin (Hb) levels from baseline (8.13 ± 0.85 g/dL) to post-treatment levels (10.05 ± 1.05 g/dL) after 12 weeks of liposomal iron therapy ($p < 0.001$). These findings are consistent with prior literature. For instance, a similar study reported an increase in Hb from 8.71 ± 2.24 to 10.47 ± 1.69 g/dL after 12 weeks of liposomal iron therapy, reinforcing its efficacy in improving anemia outcomes.[11]

Supporting evidence also comes from studies conducted in other clinical contexts. In patients with chronic kidney disease, oral liposomal iron was found to be superior to parenteral iron in increasing hemoglobin levels over eight weeks.[12] Moreover, a 16-week double-blind randomized controlled trial by Blanco-Rojo et al. demonstrated significant improvements in hematologic indices including Hb, serum ferritin, and erythrocyte count—following daily intake of 18 mg microencapsulated iron pyrophosphate in fruit juice, compared to placebo.[13] Another study by Pleşea-Condratovici et al. in post-menopausal women reported a significant rise in hemoglobin from 10.65 ± 0.35 to 12.77 ± 0.70 g/dL ($p < 0.0001$) after eight weeks of liposomal iron, with minimal side effects. Only mild stool discoloration was noted, indicating excellent tolerability.[14] These findings highlight liposomal iron's safety profile and effectiveness even in populations who previously could not tolerate other formulations. Additional studies support the broader utility of liposomal iron across clinical settings. It has been shown to serve as an effective maintenance therapy in post-bariatric patients, potentially reducing healthcare costs by replacing IV iron.[15] It has also demonstrated superiority over iron sulfate in systemic sclerosis patients with chronic inflammation and GI malabsorption,[16] and proved to be at least equally effective and safe compared to ferrous salts in patients undergoing cytoreductive surgery and HIPEC.[17] Microencapsulated iron pyrophosphate is recognized as a safe compound both by the US FDA and the European Food Safety Authority. Its superior palatability, rapid hemoglobin response, and minimal side effect profile position it as a potentially preferable alternative to conventional iron therapies, particularly in populations vulnerable to poor GI tolerance.

CONCLUSION

This study concludes that liposomal iron therapy results in a significant mean increase in hemoglobin levels among anemic patients over a 12-week period. Given its high efficacy, improved tolerability, and favorable safety profile, liposomal iron presents a promising therapeutic option for managing iron deficiency anemia. It is therefore recommended that liposomal iron be considered as a first-line treatment in routine clinical practice to improve patient compliance and reduce the adverse health outcomes associated with untreated anemia.

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