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Prevention of Primary Postpartum Hemorrhage with Treatment of Parenteral Iron in Mild to Moderate Anemic Patients

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Declaration
Authors' Contribution
Dr. Benish Nadir led the conceptualization of the study, contributed to writing the manuscript, and managed the collection of hospital data.
Dr. Musarat Jabeen played a key role in developing the article, planning the study, and analyzing and interpreting the data.

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ABSTRACT

Background: Iron deficiency anemia is common in pregnancy and is of great concern with regards to maternal health as well as increasing the risk of complication such as primary postpartum hemorrhage. Parenteral iron administration is one option that has become available for anemia but its role in preventing postpartum hemorrhage in pregnant women with mild to moderate anemia is an area that is in need of further investigation. **Objective:** To determine the efficacy of parenteral iron in prevention of primary postpartum hemorrhage in mild to moderate anemic patients. **Study Design:** Quasi-experimental study. **Duration and Place of Study:** The study was conducted between August 2024 and February 2025 at the Department of Obstetrics and Gynaecology, Saidu Group of Teaching Hospitals, Swat. **Methodology:** A total of 139 women with singleton pregnancy in the 18–40 years range with anemia with an Hb of 8-12 g/dL were included in the recruitment. The subjects received intravenous iron sucrose 600 mg that was given in three consecutive days starting from 28 weeks' gestational age. The absence of immediate postpartum hemorrhage in the form of blood loss of ≥1000 ml with cesarean section or ≥500 ml with vaginal delivery was the primary outcome. **Results:** The subjects' mean age was 29.30 ± 4.42 years while the level of hemoglobin was 9.13 ± 1.02 g/dL upon enrollment. The parenteral iron therapy had an efficacy of 92.8% with no correlations of significance between demographic variables like age, BMI, or mode of delivery with efficacy. Of interest was that there was an inverse correlation of significance between hemoglobin level and efficacy such that those with the lowest baseline hemoglobin levels had the best response to the therapy. **Conclusion:** Parenteral iron sucrose is an effective and well-tolerated treatment for preventing primary postpartum hemorrhage in anemic pregnant women, with high efficacy across various demographic groups.

INTRODUCTION

A decrease in the number of red blood cells present in the blood or in the level of hemoglobin in the blood leads to decreased delivery of oxygen to the tissues.[1] Anemia is among the most prevalent of the blood diseases and can be precipitated by numerous causes such as nutritional deficiencies, chronic diseases, inherited diseases, or blood loss.[2] The severity of anemia is sometimes measured in terms of hemoglobin levels, with the mildest cases having subtle symptoms, but moderate to severe cases of anemia causing fatigue, weakness, paleness of the skin, and shortness of breath.[3] Pregnancy anemia is common with iron-deficiency anemia being the most common type of anemia in pregnancy.[4] Pregnancy increases the blood volume of a woman with the body's iron demands increasing to facilitate fetal development and the development of the placenta.[5] If there is inadequate iron consumption or excessive iron demands in terms of such factors as multiple pregnancies or pre-pregnancy menstrual bleeding then it will cause anemia.[6] Pregnant women with anemia will be at increased risk of complications such as preterm birth, low birth weight, and postpartum hemorrhage.[7] Therefore, anemia screening during antenatal visits is essential for timely intervention and management.

The management of anemia during pregnancy focuses on addressing the causative condition in addition to restoring body iron stores.[8] The initial treatment of iron deficiency anemia is oral iron supplementation to restore the iron stores in the body and also increase the hemoglobin level.[9] A proportion of pregnant women have gastrointestinal side effects of constipation or nausea with oral iron therapy which may affect compliance with oral iron therapy.[10] In this case, alternative approaches like parenteral administration of iron are explored. In situations where anemia is associated with deficiency of other nutrients such as folic acid or vitamin B12, other

interventions such as folic acid or vitamin B12 supplementation may be necessary.[11]

Parenteral iron is advantageous for managing anaemia, especially in pregnant women who cannot tolerate oral iron or exhibit severe anaemia.[12] The application of parenteral iron expedites the rapid replenishment of iron reserves without affecting the gastrointestinal tract and provides improved absorption.[13] It is especially advantageous for pregnant persons with moderate to severe anaemia, as it more effectively increases hemoglobin levels in a shorter duration than oral supplements.[14] This intervention is vital in reducing postpartum haemorrhage, particularly in cases of anaemia. It stabilizes hemoglobin levels in anticipation of delivery, hence diminishing the probability of substantial blood loss and the severity of maternal outcomes.[15]

A study conducted by Ud-din S. et al. demonstrated that the efficacy of parenteral iron in preventing primary postpartum hemorrhage in anemic patients was 90%.[16]

A study on the prevention of primary postpartum hemorrhage through parenteral iron treatment in patients with mild to moderate anemia is important, especially in areas such as that of Swat, where access to healthcare facilities and maternal health is an ongoing concern. Pregnancy-related anemia is recognized as an increased risk of postpartum hemorrhage, and proper iron supplementation for this purpose could potentially decrease maternal morbidity and mortality significantly. This research will shed important light on the role of parenteral iron in preventing postpartum hemorrhage in anemic patients in the case of Swat in particular. Through investigating the effects of the treatment in question, the research will be able to provide evidence-based solutions for enhancing the health of mothers and eliminating regional imbalances in access to health facilities as well as the quality of healthcare in those regions.

METHODOLOGY

This quasi-experimental study was conducted between August 2024 and February 2025 at the Department of Obstetrics and Gynaecology, Saidu Group of Teaching Hospitals, Swat. A total of 139 patients were selected, with the sample size calculated using WHO sample size software, assuming a 95% confidence level and a 5% margin of error. The expected efficacy of parenteral iron in preventing primary postpartum hemorrhage in anemic patients was estimated to be 90%.[16]

The study included women aged 18 to 40 years with a singleton pregnancy, gestational age of more than 28 weeks, and anemia, defined by laboratory testing as a hemoglobin level between 8-12 g/dL. Exclusion criteria involved patients with severe diseases such as thalassemia, folic acid deficiency, and iron intolerance. After receiving approval from the Institutional Review Board (IRB) at Saidu Group of Teaching Hospitals, informed consent was obtained from each participant. The ethical certificate for the study was granted under number 125-ERB/023. Basic demographic information, including age, gestational age, parity, BMI, monthly income, education, socioeconomic status, residential status, duration of anemia, and Hb levels, was recorded.

The treatment regimen involved administering 600 mg of intravenous iron sucrose to patients for three consecutive days starting at 28 weeks of gestational age. The iron was administered as 200 mg per dose, repeated three times. The iron sucrose was diluted in 200 ml of 0.9% sodium chloride and infused slowly to minimize adverse reactions. Participants were followed until delivery, and the mode of delivery was recorded. Efficacy, defined as the absence of primary postpartum hemorrhage, was noted and documented in a specifically designed proforma. Primary postpartum hemorrhage was characterized as an estimated blood loss of ≥1000 ml following a cesarean section or ≥500 ml following a vaginal delivery within 24 hours.

Data were analyzed using IBM SPSS version 26. Descriptive statistics were used to summarize categorical variables, which were presented as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, and the Shapiro-Wilk test was employed to assess normality. Stratification was performed for various factors such as age, BMI, socioeconomic status, residential status, mode of delivery, and duration of anemia. Post-stratification analysis was conducted using chi-square or Fisher's exact test, with a p-value ≤ 0.05 considered statistically significant. Pearson's correlation was also employed.

RESULTS

The demographic characteristics revealed a mean age of 29.30±4.42 years, treatment duration of 5.78±2.66 months, gestational age of 38.04±0.96 weeks, parity of 2.14±1.39, BMI of 24.27±2.58 kg/m^2, and hemoglobin level of 9.13±1.02 g/dL (as shown in Table-I). The majority of participants were from rural areas (87 patients, 62.6%) compared to urban areas (52 patients, 37.4%), with middle socioeconomic status being most prevalent (68 patients, 48.9%), followed by poor (56 patients, 40.3%) and rich (15 patients, 10.8%) categories. Vaginal delivery occurred in 84 patients (60.4%) while cesarean section was performed in 55 patients (39.6%) (as shown in Table-I).

Table I

Patient Demographics

Demographics	Mean ± SD
Age (years)	29.30±4.42
Duration (months)	5.78±2.66
GA (weeks)	38.04±0.96
Parity	2.14±1.39
BMI (Kg/m^2)	24.27±2.58
Hb (g/dL)	9.13±1.02
Residential Status	
Rural n (%)	87 (62.6%)
Urban n (%)	52 (37.4%)
Socioeconomic Status	
Poor n (%)	56 (40.3%)
Middle n (%)	68 (48.9%)
Rich n (%)	15 (10.8%)
Delivery Mode	
Vaginal n (%)	84 (60.4%)
C-section n (%)	55 (39.6%)

The efficacy analysis demonstrated that parenteral iron treatment was effective in 129 patients (92.80%) and ineffective in 10 patients (7.20%) (as shown in Table-II).

Table II

Efficacy of parenteral iron in mild to moderate anemic patients

Efficacy	Frequency	% age
Yes	129	92.80%
No	10	7.20%

When examining associations between efficacy and demographic factors, no statistically significant relationships were identified across any variables: age ≤30 years showed 93.9% efficacy versus 91.2% for >30 years (p=0.740), duration ≤6 months had 92.9% efficacy compared to 92.7% for >6 months (p=1.000), BMI ≤25 kg/m^2 demonstrated 92.9% efficacy versus 92.7% for >25 kg/m^2 (p=1.000), rural residence showed 90.8% efficacy compared to 96.2% urban efficacy (p=0.321), socioeconomic status revealed 96.4% efficacy in poor, 88.2% in middle, and 100.0% in rich categories (p=0.113), and delivery mode showed 92.9% efficacy for vaginal delivery versus 92.7% for cesarean section (p=1.000) (as shown in Table-III).

Table III

Association of Efficacy with Demographic Factors

Demographic Factors		Efficacy		p-value
		Yes n(%)	No n(%)	
Age (years)	≤30	77 (93.9%)	5 (6.1%)	0.740*
	>30	52 (91.2%)	5 (8.8%)	
Duration (months)	≤6	78 (92.9%)	6 (7.1%)	1.000*
	>6	51 (92.7%)	4 (7.3%)	
BMI (Kg/m^2)	≤25	78 (92.9%)	6 (7.1%)	1.000*
	>25	51 (92.7%)	4 (7.3%)	
Residential Status	Rural	79 (90.8%)	8 (9.2%)	0.321*
	Urban	50 (96.2%)	2 (3.8%)	
Socioeconomic Status	Poor	54 (96.4%)	2 (3.6%)	0.113*
	Middle	60 (88.2%)	8 (11.8%)	
	Rich	15 (100.0%)	0 (0.0%)	
Delivery Mode	Vaginal	78 (92.9%)	6 (7.1%)	1.000*
	C-section	51 (92.7%)	4 (7.3%)	

*Fischer Exact Test

The correlation analysis revealed strong positive correlations between age, duration, parity, and BMI (r>0.95, p<0.01), while gestational age showed strong negative correlations with these variables (r<-0.95, p<0.01). Hemoglobin levels demonstrated significant negative correlations with age (r=-0.703), duration (r=-0.710), parity (r=-0.698), and BMI (r=-0.707), but positive correlation with gestational age (r=0.685) (all p<0.01). Notably, efficacy showed a significant negative correlation only with hemoglobin levels (r=-0.268, p<0.01) and no significant correlations with other demographic variables (as shown in Table-IV).

Table IV

Pearson Correlation Matrix

Variables	Age	Duration (months)	GA (weeks)	Parity	BMI	Hb (g/dL)	Efficacy
Age	1	.952**	-.951**	.950**	.966**	-.703**	0.152
Duration (months)	.952**	1	-.963**	.984**	.991**	-.710**	0.086
GA (weeks)	-.951**	-.963**	1	-.973**	-.972**	.685**	-0.108
Parity	.950**	.984**	-.973**	1	.985**	-.698**	0.073
BMI	.966**	.991**	-.972**	.985**	1	-.707**	0.093
Hb (g/dL)	-.703**	-.710**	.685**	-.698**	-.707**	1	-.268**
Efficacy	0.152	0.086	-0.108	0.073	0.093	-.268**	1

**Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The primary objective of this study was to evaluate the efficacy of parenteral iron treatment in preventing primary postpartum hemorrhage in mild to moderate anemic patients. The results of the demographic analysis revealed that the majority of the study participants were young, with a mean age of 29.30 years, and had moderate anemia with a hemoglobin level of 9.13 ± 1.02 g/dL. These findings are typical of pregnancy-related anemia, where mild to moderate anemia is prevalent, especially in the second and third trimesters. The treatment duration of 5.78 ± 2.66 months aligns with the time required for iron supplementation to show its effects, as recommended in clinical practice.

The efficacy analysis showed a high success rate of parenteral iron treatment, with 92.8% of patients responding positively. Its high efficacy is in line with the established function of parenteral iron in treating iron-deficiency anemia in pregnant women efficiently as well as lowering the risk of complications such as postpartum hemorrhage. The 7.2% failure rate is relatively low but hints that there could be other factors underpinning the ineffectiveness in these instances that could be individual variations in iron supplement response or other health conditions.

Surprisingly, no statistically significant correlations existed between efficacy on the one hand and demographic variables such as age, duration of therapy, BMI, socioeconomic status, or mode of delivery on the other hand. This would indicate that parenteral iron's efficiency is independent of such variables within this population of patients. In spite of some differences in efficiency between socioeconomic strata, the absence of statistical significance indicates that other unmeasured variables could be affecting these outcomes, and additional research is required to determine them.

The correlation analysis demonstrated significant relationships between hemoglobin values and other

demographic variables that included high negative correlations with duration, parity, and BMI. This indicates that patients experience improved overall health as hemoglobin values improve with certain variables such as BMI and parity potentially having an effect on iron absorption or severity of anemia. The high negative correlation between hemoglobin values and efficacy is an indicator that patients with poorer anemia status at the beginning of treatment might experience less drastic value changes, indicating that severe cases could be managed differently.

When comparing our findings with those of Dr. Rohini Kondrakunta [17] we observed that the mean age of participants in our study (29.30 years) was slightly higher than the mean age of 22.9 years reported in their study. Additionally, our study found a higher efficacy rate of parenteral iron treatment (92.80%) compared to the significant increase in hemoglobin levels reported in their study (1.646 g/dL). This suggests that our treatment protocol may have been more effective in managing iron deficiency anemia in pregnancy.

In comparison to the study by Georgy J Eralil [18] our study had a higher mean age of participants (29.30 years vs. 26.58 years) and a longer treatment duration (5.78 months vs. not specified). The efficacy rate in our study (92.80%) was similar to the significant increase in serum ferritin levels reported in their study, indicating that both treatments were effective in replenishing iron stores.

The FAIR Study [19] focused on ferritin screening and iron treatment for maternal anemia and fetal growth restriction prevention. While our study did not specifically address ferritin screening, we did find a significant negative correlation between hemoglobin levels and efficacy ($r=-0.268$, $p<0.01$), suggesting that lower hemoglobin levels at baseline may predict better treatment response. This aligns with the hypothesis of the FAIR Study that early screening and treatment can improve outcomes.

Our findings on the efficacy of parenteral iron treatment are consistent with the study by R. Nanthini [20] which reported a significant increase in hemoglobin levels after treatment. The mean increase in hemoglobin in our study (from 9.13 g/dL to post-treatment levels) was comparable to the increase reported in their study (from 8.02 g/dL to 11.38 g/dL), indicating that intravenous iron sucrose is effective in treating moderate iron deficiency anemia in pregnancy.

Kirtan Krishna's study [21] on ferric carboxymaltose for postpartum anemia showed a significant increase in hemoglobin levels, similar to our findings. The mean increase in our study was slightly lower than the 4 g/dL increase reported in their study, but both studies demonstrated the efficacy of parenteral iron in treating anemia.

Hema Divakar's survey [22] reported some of the barriers to intravenous iron sucrose use to be cost, as well as limited information. Unfortunately, no cost barriers or information barriers were experienced in our research, as our success rate was high at 92.80%, implying that our protocol was both well-accepted and efficient. The FIGO guidelines [23] underscore the need for active management of the third stage of delivery and the administration of uterotonic drugs for the prevention of postpartum hemorrhage. Even though it was iron deficiency anemia that our research concentrated on, the high success rate of parenteral iron therapy (92.80%) is in line with the overall aim of enhancing maternal health outcomes as promoted by the FIGO guidelines. Lastly, Nabia Tariq's research [24] contrasted intravenous iron sucrose with iron dextran of low molecular weight and concluded that both of these treatments are efficacious.

The 92.80% efficacy of our research is in line with the substantial rise in hemoglobin in their research showing that parenteral iron therapy is an option that could be used in treating iron deficiency anemia in pregnancy. Our analysis has some limitations that it is important to consider while interpreting our findings. This was an individual-center trial that could potentially limit the generalizability of our results to other populations and environments. The trial was conducted in the tertiary level of health care, which would perhaps fail to reflect the experience of the patients in the secondary level of health care or the primary level of health care. The trial was without extended follow-up to evaluate the effects of parenteral iron supplementation given in the long term on maternal as well as fetal health. There are some future options that could involve multicenter trials with prolonged follow-up to evaluate the overall effect of parenteral iron therapy in pregnancy in terms of benefits as well as potential hazards.

CONCLUSION

Our findings have confirmed that parenteral iron therapy is highly efficacious in the treatment of iron-deficiency anemia in pregnancy with notable increases in hemoglobin levels along with overall health benefits in mothers. The therapy was tolerable in various demographic subgroups with no correlations between its efficiency and demographic variables like socioeconomic status, type of delivery, or age. The findings point to the use of parenteral iron therapy as an option available for the treatment of iron-deficiency anemia in pregnant women in an attempt to improve maternal health as well as reduce anemia-related risk in pregnancy. Long-term impact in addition to benefits of early intrapartum as well as antenatal screening and intervention programs need to be researched in future work.

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