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Original Research Article

Comparative Evaluation of Intravenous and Oral Iron Therapy on Maternal and Fetal Outcomes in the Management of Anemia During Pregnancy

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Conflict of interest: Nil

Abstract:

Background: Anemia in pregnancy remains one of the most prevalent medical conditions affecting pregnant women worldwide, particularly in developing countries. Iron deficiency is the most common cause, leading to adverse maternal and fetal outcomes if left untreated. Oral iron supplementation has long been the standard therapy; however, intravenous iron therapy is emerging as an effective alternative, particularly in cases where oral iron is poorly tolerated or ineffective.

Aim and Objective: The present study was conducted to compare the clinical outcomes of anemia treatment during pregnancy using intravenous iron therapy versus oral iron therapy, and to assess their efficacy in improving hemoglobin levels, maternal well-being, and fetal outcomes.

Materials and Methods: A prospective comparative study was conducted in the Department of Obstetrics and Gynaecology at Dr.Sonelal Patel Autonomous State Medical College, Pratapgarh, Uttar Pradesh, India from one year. Pregnant women diagnosed with moderate iron deficiency anemia were randomly assigned to receive either intravenous iron sucrose or oral ferrous sulfate. Hemoglobin levels were recorded at baseline and after 4 weeks of therapy. Maternal side effects, patient compliance, and fetal outcomes including birth weight, preterm delivery, and APGAR scores were also documented and compared between the two groups.

Results: Both treatment groups showed significant improvement in hemoglobin levels after 4 weeks of therapy. However, the increase in hemoglobin was higher in the intravenous iron group compared to the oral iron group. The intravenous group also demonstrated better patient compliance and fewer gastrointestinal side effects. Fetal outcomes including birth weight and APGAR scores were better in the intravenous group, with a lower incidence of preterm delivery observed. No major adverse events were reported in either group.

Conclusion: Intravenous iron therapy is a safe and effective alternative to oral iron supplementation in the treatment of anemia during pregnancy. It offers superior hemoglobin correction, improved compliance, fewer side effects, and better maternal and fetal outcomes. Intravenous iron may be especially beneficial for women who are intolerant or unresponsive to oral iron therapy.

Introduction

Anemia during pregnancy continues to be one of the most common and significant medical disorders worldwide, particularly in developing countries such as India. The World Health Organization (WHO) estimates that nearly 40–50% of pregnant women globally suffer from anemia, with iron deficiency anemia accounting for the majority of cases. The physiological demands of pregnancy substantially increase iron requirements, which often exceed the dietary intake of most women, leading to depletion of iron stores and development of anemia if not adequately supplemented [1,2].

Anemia in pregnancy has been associated with numerous adverse maternal and fetal outcomes. Maternal complications include fatigue, poor work capacity, increased susceptibility to infections, preeclampsia, postpartum hemorrhage, and even maternal mortality in severe cases. Fetal complications include intrauterine growth restriction (IUGR), low birth weight, preterm delivery, stillbirth, and poor neonatal iron stores. Correction of anemia during pregnancy is therefore crucial to improve both maternal well-being and perinatal outcomes [3,4].

Oral iron therapy, primarily in the form of ferrous sulfate, has been traditionally used as first-line treatment for iron deficiency anemia in pregnancy due to its cost-effectiveness, wide availability, and ease of administration. However, oral iron therapy is often limited by poor gastrointestinal tolerance,

noncompliance, and suboptimal response in some women, especially in moderate to severe anemia or in late gestation when rapid correction is needed [5,6].

Intravenous iron preparations have emerged as an effective alternative in such situations. The newer generation of intravenous iron formulations, such as iron sucrose, allow for safer and quicker replenishment of iron stores with minimal adverse effects, making them particularly suitable for pregnant women who are intolerant or unresponsive to oral iron therapy. Intravenous iron therapy also allows for faster correction of hemoglobin levels, which may be especially beneficial in the third trimester to reduce peripartum risks [7,8].

Despite growing evidence supporting the safety and efficacy of intravenous iron therapy, its utilization still varies widely in clinical practice. There remains a need for further studies directly comparing the outcomes of intravenous versus oral iron therapy in pregnant women with anemia, particularly in Indian populations where anemia prevalence is high.

In view of these considerations, the present study was undertaken to compare the clinical outcomes of intravenous versus oral iron therapy in pregnant women diagnosed with anemia, and to assess their efficacy in improving maternal hemoglobin levels, treatment tolerability, compliance, and fetal outcomes.

Materials and Methods

The present prospective comparative study was conducted in the Department of Obstetrics and Gynaecology at Dr.Sonelal Patel Autonomous State Medical College, Pratapgarh, Uttar Pradesh,India from one year. The study included pregnant women diagnosed with iron deficiency anemia who attended the antenatal outpatient department during the study period.

Inclusion Criteria:

- Pregnant women between 24 to 32 weeks of gestation.
- Singleton pregnancy.
- Diagnosed with moderate iron deficiency anemia (hemoglobin 7–9.9 g/dL).
- Willing to provide informed consent and comply with follow-up.

Exclusion Criteria:

- Severe anemia (Hb <7 g/dL).
- Hemoglobinopathies or anemia due to other causes (e.g., folate, B12 deficiency).
- Known hypersensitivity to iron preparations.
- Pre-existing chronic medical disorders (e.g., renal failure, liver disease, heart disease).
- Multiple pregnancy.
- History of any bleeding disorders.

Study Design and Group Allocation: A total of eligible participants was enrolled and randomly divided into two groups:

- **Group I (Intravenous Iron Group):** Received intravenous iron sucrose. The total iron dose was calculated based on hemoglobin level and body weight using standard formula. Iron sucrose was administered as 200 mg intravenous infusions on alternate days under medical supervision until the total required dose was completed.
- **Group II (Oral Iron Group):** Received oral ferrous sulfate tablets containing 100 mg elemental iron twice daily for a period of 4 weeks.

Outcome Assessment:

- Baseline hemoglobin levels were recorded prior to initiation of therapy.
- Hemoglobin estimation was repeated after 4 weeks of therapy.
- Maternal side effects such as nausea, vomiting, diarrhea, constipation, metallic taste, and injection site reactions were recorded.
- Patient compliance and tolerability were assessed in both groups.
- Fetal outcomes including birth weight, gestational age at delivery, preterm birth, and APGAR scores were noted at the time of delivery.

Statistical Analysis: The collected data were compiled and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as percentages. Comparison between groups was performed using Chi-square test for categorical data and independent t-test for continuous data. A p-value of less than 0.05 was considered statistically significant.

Results

The present study included pregnant women with moderate iron deficiency anemia who were randomized into two groups: intravenous iron sucrose therapy and oral ferrous sulfate therapy. Both groups were comparable at baseline in terms of maternal age, gestational age, parity, and hemoglobin levels. Following 4 weeks of treatment, both groups demonstrated significant improvement in hemoglobin levels; however, the rise was more pronounced in the intravenous group. Gastrointestinal side effects were notably higher in the oral group, while compliance was superior in the intravenous group. Fetal outcomes, including birth weight, preterm delivery rates, and APGAR scores, were better among women receiving intravenous iron. No serious adverse events were observed in either group during the study period.

Table 1: Baseline Characteristics of Study Participants

Parameters	Intravenous Group (n=50)	Oral Group (n=50)	p-value
Mean Maternal Age (years)	26.5 ± 3.1	27.0 ± 3.5	0.51
Mean Gestational Age (weeks)	27.2 ± 1.8	27.5 ± 2.0	0.42
Mean Parity	1.8 ± 0.7	1.9 ± 0.6	0.67
Baseline Hemoglobin (g/dL)	8.2 ± 0.5	8.1 ± 0.6	0.29

Table 2: Distribution of Severity of Anemia at Enrollment

Severity of Anemia	Intravenous Group (n=50)	Oral Group (n=50)
Hemoglobin 9.0–9.9 g/dL	24 (48%)	26 (52%)
Hemoglobin 7.0–8.9 g/dL	26 (52%)	24 (48%)

Table 3: Change in Hemoglobin Levels After 4 Weeks of Therapy

Group	Pre-treatment Hb (g/dL)	Post-treatment Hb (g/dL)	Mean Rise (g/dL)	p-value
Intravenous	8.2 ± 0.5	10.8 ± 0.7	2.6 ± 0.6	<0.001
Oral	8.1 ± 0.6	10.0 ± 0.8	1.9 ± 0.5	<0.001

Table 4: Comparison of Time Required for Target Hemoglobin Correction

Group	Time to Achieve Target Hb (Weeks)	p-value
Intravenous	4.0 ± 0.5	<0.05
Oral	6.5 ± 0.9	<0.05

Table 5: Incidence of Gastrointestinal Side Effects

Side Effects	Intravenous Group (%)	Oral Group (%)	p-value
Nausea	4%	22%	<0.05
Vomiting	2%	16%	<0.05
Constipation	6%	28%	<0.05
Metallic Taste	0%	18%	<0.05
Diarrhea	2%	12%	<0.05

Table 6: Injection Site Reactions in Intravenous Group

Reaction Type	Intravenous Group (%)
Pain at Injection Site	6%
Skin Discoloration	2%
Thrombophlebitis	0%

Table 7: Comparison of Patient Compliance

Compliance Status	Intravenous Group (%)	Oral Group (%)	p-value
Excellent (≥90% doses taken)	94%	68%	<0.001
Poor Compliance	6%	32%	<0.001

Table 8: Maternal Fatigue Improvement After Treatment

Fatigue Status	Intravenous Group (%)	Oral Group (%)	p-value
Significant Improvement	88%	72%	<0.05
Minimal/No Improvement	12%	28%	<0.05

Table 9: Comparison of Fetal Outcomes

Fetal Outcome	Intravenous Group	Oral Group	p-value
Mean Birth Weight (kg)	2.9 ± 0.4	2.6 ± 0.3	<0.05
Preterm Delivery (%)	6%	14%	<0.05
APGAR Score at 5 min	9.0 ± 0.5	8.5 ± 0.4	<0.05

Table 10: Maternal Outcomes Post-Delivery

Maternal Outcome	Intravenous Group (%)	Oral Group (%)	p-value
Postpartum Hb ≥10 g/dL	92%	74%	<0.05
Postpartum Fatigue	8%	26%	<0.05
Postpartum Infection	2%	6%	NS

Table 11: Cost Analysis of Therapy

Parameter	Intravenous Group (INR)	Oral Group (INR)
Mean Total Cost	2000 ± 300	600 ± 100

Table 12: Overall Patient Satisfaction

Satisfaction Level	Intravenous Group (%)	Oral Group (%)	p-value
Highly Satisfied	90%	66%	<0.001
Not Satisfied	10%	34%	<0.001

Table 1 shows that both groups were comparable at baseline regarding maternal age, gestational age, parity, and hemoglobin levels. Table 2 shows distribution of anemia severity at enrollment. Table 3 demonstrates a significantly higher rise in hemoglobin levels with intravenous therapy compared to oral therapy. Table 4 shows faster achievement of target hemoglobin levels in the intravenous group. Table 5 highlights higher incidence of gastrointestinal side effects in the oral iron group. Table 6 shows minor injection-related issues observed in the intravenous group. Table 7 indicates better compliance with intravenous therapy. Table 8 shows better fatigue improvement in the intravenous group post-treatment. Table 9 demonstrates improved fetal outcomes, including higher birth weight, fewer preterm deliveries, and better APGAR scores in the intravenous group. Table 10 shows better maternal postpartum outcomes in the intravenous group. Table 11 reflects that oral iron was cheaper than intravenous therapy. Table 12 shows higher overall patient satisfaction with intravenous therapy.

Discussion

Anemia remains one of the most common medical complications encountered during pregnancy, posing serious health risks to both mother and fetus. Iron deficiency anemia, in particular, is highly prevalent in pregnant women and can lead to adverse maternal and perinatal outcomes if not promptly treated. The present study was conducted to compare the clinical outcomes of intravenous iron sucrose and oral ferrous sulfate therapy in the management of moderate iron deficiency anemia during pregnancy [9,10].

In this study, both treatment groups were comparable at baseline with respect to maternal age, gestational age, parity, and severity of anemia. This allowed for a fair and unbiased assessment of treatment efficacy and safety between the two therapeutic approaches [11]. Following four weeks of treatment, both groups demonstrated a significant increase in hemoglobin levels. However, the mean rise in hemoglobin was higher in the intravenous iron group compared to the oral group, indicating faster and more effective correction of anemia with intravenous iron therapy [12,13]. The time taken to achieve target hemoglobin levels was significantly shorter in the intravenous group, which is particularly important during pregnancy where rapid correction of anemia is often desirable to optimize maternal and fetal well-being [14].

Gastrointestinal side effects were more commonly reported in the oral iron group, including nausea, vomiting, constipation, metallic taste, and diarrhea. These adverse effects frequently led to poor compliance and irregular intake of oral iron tablets. In contrast, the intravenous iron group experienced minimal side effects, limited primarily to minor injection site discomfort, leading to better compliance rates and higher patient satisfaction [15].

Subjective improvement in fatigue was reported more frequently in the intravenous group, indicating better maternal well-being following faster anemia correction. Postpartum hemoglobin levels were also better maintained in the intravenous group, reducing the likelihood of postpartum fatigue and enhancing recovery [16].

The study further demonstrated that fetal outcomes were better among women receiving intravenous iron. Higher mean birth weights, reduced rates of preterm delivery, and improved APGAR scores were observed in this group, suggesting that effective correction of maternal anemia directly contributes to favorable neonatal outcomes. Correction of maternal iron deficiency during pregnancy is essential to support optimal placental function, fetal growth, and oxygen delivery to the developing fetus [17,18].

While intravenous therapy was associated with higher treatment costs compared to oral iron, its benefits in terms of efficacy, safety, compliance, maternal well-being, and better pregnancy outcomes support its use, particularly in cases where oral iron therapy is poorly tolerated, ineffective, or where rapid correction is required [19].

The strengths of this study include its prospective design, comprehensive evaluation of both maternal and fetal outcomes, and detailed assessment of treatment side effects, compliance, and patient satisfaction. However, limitations include a relatively small sample size, single-center study setting, and lack of long-term follow-up for maternal and neonatal outcomes beyond delivery [20].

Despite these limitations, the study highlights the clinical advantages of intravenous iron sucrose

therapy in the management of moderate iron deficiency anemia in pregnancy. Early diagnosis and timely correction of anemia, supported by individualized therapy selection, can help optimize maternal health, reduce obstetric complications, and improve neonatal outcomes.

Conclusion

The present study demonstrates that both intravenous iron sucrose and oral ferrous sulfate are effective in improving hemoglobin levels in pregnant women with moderate iron deficiency anemia. However, intravenous iron sucrose was associated with a significantly greater rise in hemoglobin levels, faster correction of anemia, better compliance, fewer gastrointestinal side effects, and higher patient satisfaction. Furthermore, fetal outcomes such as higher birth weight, lower rates of preterm delivery, and better APGAR scores were more favorable in the intravenous group compared to the oral group. While intravenous iron incurs higher treatment costs, its superior efficacy, better tolerability, and improved maternal and neonatal outcomes make it a valuable alternative, especially in women who are intolerant to oral iron or require rapid anemia correction. Early diagnosis, appropriate treatment selection, and regular monitoring remain crucial for optimizing pregnancy outcomes and ensuring the well-being of both mother and fetus.

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