Impact Factor 6.1

Journal of Cyber Security

ISSN:2096-1146

Scopus

DOI

Google Scholar

More Information
www.journalcybersecurity.com

Crossref doi Google Scholar scopus

Intravenous Ferric Carboxymaltose for Treatment of Postpartum Anemia

Ainur Donayeva[1], Ibrahim A. Abdelazim[2*], Mohannad Abu-Faza[2], Marim Obaid[2]

[1]Department of Normal physiology, West Kazakhstan Marat Ospanov Medical University, Aktobe, Kazakhstan

[2]Department of Obstetrics and Gynecology, Ahmadi Hospital, Kuwait Oil Company (KOC), Ahmadi, Kuwait

***Corresponding Author**

Ibrahim A. Abdelazim

Department of Obstetrics and Gynecology, Ahmadi Hospital, Kuwait Oil Company (KOC), Ahmadi, Kuwait.

Phone: +965-66551300

Address: Ahmadi Hospital, Kuwait Oil Company (KOC), Kuwait, P.O. Box: 9758, 61008 Ahmadi, Kuwait.

Co-authors

[1] Ainur Donayeva

Department of Normal physiology, West Kazakhstan Marat Ospanov Medical University, Aktobe, Kazakhstan

[2] Mohannad Abu-Faza

Department of Obstetrics and Gynecology, Ahmadi Hospital, Kuwait Oil Company (KOC), Ahmadi, Kuwait

[3] Marim Obaid

Department of Obstetrics and Gynecology, Ahmadi Hospital, Kuwait Oil Company (KOC), Ahmadi, Kuwait

Intravenous Ferric Carboxymaltose for Treatment of Postpartum Anemia

Abstract

Objective: This study aimed to evaluate Ferric Carboxymaltose (FCM) effectiveness in postpartum-iron deficiency anemia (PP-IDA) treatment.

Methods: One hundred fifteen (115) women with PP-IDA (serum ferritin <15 µg/L, hemoglobin <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week) were included in the current comparative study following STROBE Checklist.

Studied women received FCM (Ferinject®) infusion to treat their PP-IDA. Studied women mean levels of serum ferritin, hemoglobin, and mean RBCs-indices were compared both before (pre-treatment), and 8-weeks after (post-treatment) receiving Ferinject® to determine the effectiveness of Ferinject® in PP-IDA treatment.

Results: Studied women mean level of serum ferritin statistically elevated from 10.02 ± 2.4 before (pre-treatment) Ferinject® to 140.7 ± 8.9 ug/L after (post-treatment) Ferinject® ($p<0.0001$). Studied

women mean hemoglobin level statistically elevated from 8.03 ± 0.6 before (pre-treatment) Ferinject® to 14.06 ± 0.45 g/dL after (post-treatment) Ferinject® ($p<0.0001$).

Studied women mean RBCs-volume statistically elevated from 71.9 ± 3.5 before (pre-treatment) Ferinject® to 90.3 ± 2.6 fL after (post-treatment) Ferinject® ($p<0.0001$). Studied women mean RBCs-hemoglobin statistically elevated from 24.2 ± 1.8 before (pre-treatment) Ferinject® to 30.03 ± 1.6 pg after (post-treatment) Ferinject® ($p<0.0001$).

Conclusion: Studied women mean levels of serum ferritin, hemoglobin and mean RBCs-indices (volume and hemoglobin) were statistically elevated after Ferinject®. This study suggests rapid correction of postpartum-IDA using Ferinject® to improve postpartum maternal physical performance, and to enhance mothers' ability to take care of their babies.

Key words: Ferinject, FCM, postpartum-IDA.

Introduction

Postpartum anemia (PPA) is a worldwide health problem (1). Most guidelines define PPA as hemoglobin (Hb) <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week (2).

PPA defined according to WHO as Hb <11 g/dL at 1st postpartum week, and <12 g/dL at 1st postpartum year. The prevalence of PPA is about 22-50% in developed, and 50-80% in developing countries (3).

Main causes of PPA include undiagnosed antenatal iron deficiency anemia (IDA), and excess blood loss during labor or during cesarean sections (4,5).

Untreated PPA affects the maternal as well as child well-being. PPA negatively impair the physical ability, and quality of life (QoL) (6). Froessler et al (7), found an association between IDA and both maternal cognitive functions and depressive disorders.

A significant relation between iron stores, and maternal QoL was previously reported (8). Moya et al (9), found the iron replacement tremendously improved fatigue, and depression symptoms.

Iron salts are effective for the treatment of postpartum-IDA. Common oral iron salts side effects (i.e., gastric upset, and constipation) (10), and multiple infusion sessions of iron sucrose (IS) affect the treated women compliance and treatment outcome (11-13). Hence, this study aimed to evaluate Ferric Carboxymaltose (FCM) effectiveness in postpartum-iron deficiency anemia (PP-IDA) treatment.

Aim: To evaluate Ferric Carboxymaltose (FCM) effectiveness in postpartum-iron deficiency anemia (PP-IDA) treatment.

Materials and Methods

One hundred fifteen (115) women with PP-IDA (serum ferritin <15 µg/L, hemoglobin <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week) were included in the current prospective comparative study, during the year 2024, following STROBE Checklist, after approval of West Kazakhstan Medical University (Protocol No. 10; dated January 10, 2024), and informed written consents.

FCM (Ferinject®) approved for treatment of IDA by Ministry of Health Republic of Kazakhstan (Approval No. 931; dated December 8, 2017).

Inclusion criteria: Women with PP-IDA, ≥20 years and agreed to receive Ferinject® infusion to treat their PP-IDA.

Most guidelines define PPA as hemoglobin <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week (2).

PPA defined according to WHO as Hb <11 g/dL at 1st postpartum week, and <12 g/dL at 1st postpartum year (3)

The UniCel DxI and DxH analysers (Beckman International SA, Dubai, UAE) were used to detect the studied women serum ferritin, hemoglobin and RBCs-indices (volume and hemoglobin).

Exclusion criteria: Hypersensitivity or allergy to iron, women with severe PPA (hemoglobin <7 gm/dL), with pre-existing disorders in phosphate homeostasis (i.e., low serum vitamin D (14) and hyperparathyroidism (15), received blood transfusions, PPA due to other causes of anemia (i.e., hemoglobinopathy), and/or refused to participate.

FCM effect (Ferinject®, Vifor, UK) on PP-IDA should be detected after ≥4 weeks following last FCM (Ferinject®) dose (i.e., time needed to utilize FCM for erythropoiesis) (16).

Required FCM (Ferinject®) dose for correction of anemia was calculated according to manufacturer's instructions and participants` body weight as follow: 500 mg FCM when participants` body weight <35 kg, 1500 mg FCM when participants` body weight >35 and <70 kg, and 2000 mg FCM when participants` body weight >70 kg (13).

Calculated Ferinject® dose was diluted and given by intravenous infusion (≤500 mg Ferinject® over 6 min. and >500-1000 Ferinject® over 15 min.)

Total Ferinject® dose should not exceed 1000 mg/infusion. FCM dose >1000 mg was given over 2 infusion sessions one week apart (15,16).

Studied women were monitored during, and for 30 min. after Ferinject® infusion to detect Ferinject® related adverse effects including skin eruptions, hypertension, nausea, headache, tachycardia, and/or pains, and hypophosphatemia (i.e., muscle pain, and fatigue in mild cases and muscle weakness,

confusion, numbness, weak reflexes, and seizures in severe cases), and to identify FCM (Ferinject®) safety (secondary outcome). Folic acid was given to studied women in form of oral tablets for 2 months (i.e., to avoid folate deficiency).

Studied women mean levels of serum ferritin, hemoglobin, mean RBCs-indices (volume and hemoglobin) were compared both before (pre-treatment), and 8-weeks after (post-treatment) receiving Ferinject® to determine the effectiveness of Ferinject® in PP-IDA treatment (primary outcome).

The G Power 3.1.9.4 (Düsseldorf; Germany) with 0.05 α-error probability, and 0.95% power was used to calculate the sample size for this study (4,17).

Studied women mean levels of serum ferritin, hemoglobin, mean RBCs-indices (volume and hemoglobin) were compared both before (pre-treatment), and 8-weeks after (post-treatment) receiving Ferinject® to determine the effectiveness of Ferinject® in PP-IDA treatment.

Results

One hundred fifteen (115) women with PP-IDA (serum ferritin <15 µg/L, hemoglobin <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week, with RBCs-indices including volume and hemoglobin <80 fl and <27 pg, respectively), agreed to participate in the current study and received Ferinject® infusion to treat their PP-IDA. **Figure 1**

Studied women were monitored during, and for 30 min. after Ferinject® infusion to detect Ferinject® related adverse effects and Ferinject® safety. Studied women mean levels of serum ferritin, hemoglobin, mean RBCs-indices (volume and hemoglobin) were compared both before (pre-treatment), and 8-weeks after (post-treatment) receiving Ferinject® to determine the effectiveness of Ferinject® in PP-IDA treatment.

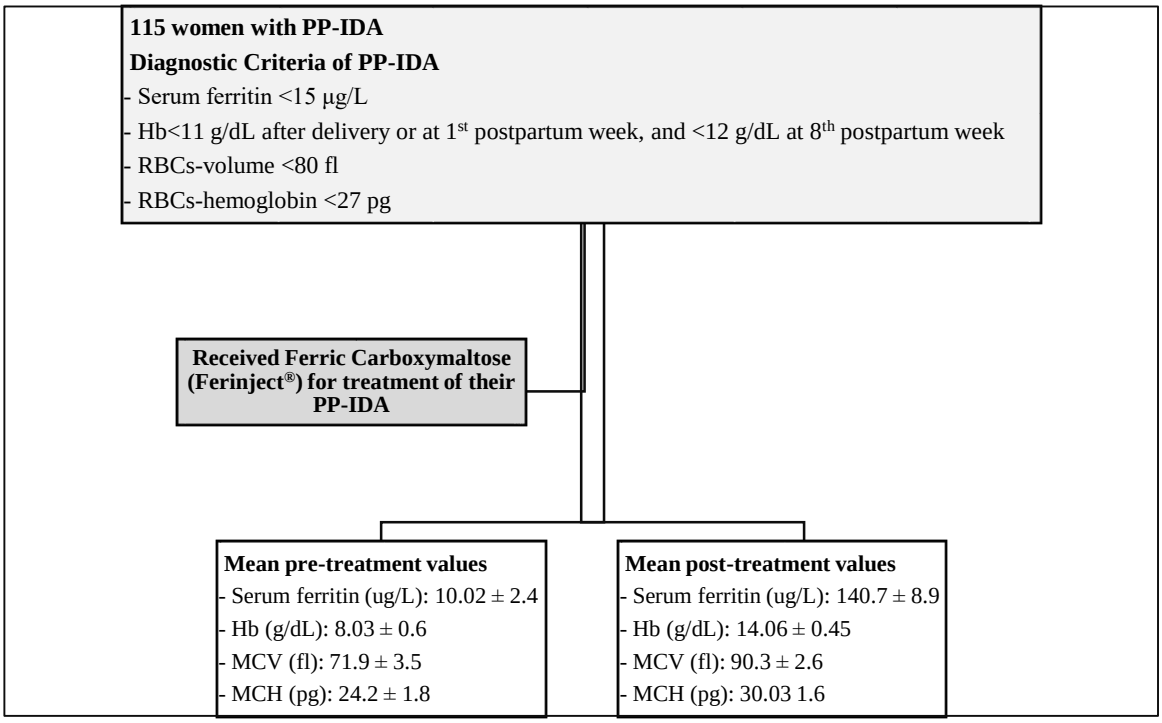

Figure 1: Flow diagram summarizing intervention and results
Hb: Hemoglobin. MCH: Mean corpuscular hemoglobin. MCV: Mean corpuscular volume.
PP-IDA: Postpartum anemia-iron deficiency anemia. RBCs: Red blood cells

Table 1 shows studied women age, BMI, postpartum duration at inclusion, serum ferritin, hemoglobin, and RBCs-indices (volume and hemoglobin) before (pre-treatment) Ferinject®.

Table 1: Studied women characteristics and pre-treatment ferritin, Hb, MCV and MCH

Variables	Studied women with PP-IDA (N = 115)
Maternal age (Years)	25.8 ± 4.95
Maternal BMI (Kg/m^2)	26.1 ± 3.6
Postpartum duration at inclusion (Weeks`)	2.5 ± 1.3
Pre-treatment serum ferritin (ug/L)	10.02 ± 2.4
Pre-treatment Hb (g/dL)	8.03 ± 0.6
Pre-treatment MCV (fl)	71.9 ± 3.5
Pre-treatment MCH (pg)	24.2 ± 1.8

BMI: Body mass index. Data presented as mean ± SD (Standard deviation). Hb: Hemoglobin. IDA: Iron deficiency anemia.
MCV: Mean corpuscular volume. N: Number of studied women. MCH: Mean corpuscular hemoglobin. PP: Postpartum.

Studied women mean level of serum ferritin statistically elevated from 10.02 ± 2.4 before (pre-treatment) Ferinject® to 140.7 ± 8.9 ug/L after (post-treatment) Ferinject® ($p<0.0001$). Studied women mean hemoglobin level statistically elevated from 8.03 ± 0.6 before (pre-treatment) Ferinject® to 14.06 ± 0.45 g/dL after (post-treatment) Ferinject® ($p<0.0001$). **Table 2**

Studied women mean RBCs-volume statistically elevated from 71.9 ± 3.5 before (pre-treatment) Ferinject® to 90.3 ± 2.6 fL after (post-treatment) Ferinject® ($p<0.0001$). Studied women mean RBCs-hemoglobin statistically elevated from 24.2 ± 1.8 before (pre-treatment) Ferinject® to 30.03 ± 1.6 pg after (post-treatment) Ferinject® ($p<0.0001$). **Table 2**

No cases of severe adverse effects to FCM were reported in this study. One case (1.7%) of headache, and another case (1.7%) of mild skin rash around the infusion site were the reported Ferinject® side effects.

Table 2: The pre-treatment versus post-treatment ferritin, Hb, MCV and MCH

Variables	Pre-treatment (N = 115)	Post-treatment (N = 115)	p-value (95% CI)
Serum ferritin (µg/L)	10.02 ± 2.4	140.7 ± 8.9	<0.0001* (-132.4 to -128.9)
Hb (g/dL)	8.03 ± 0.6	14.06 ± 0.45	<0.0001* (-6.2 to -5.9)
MCV (fL)	71.9 ± 3.5	90.3 ± 2.6	<0.0001* (-19.2 to -17.6)
MCH (pg)	24.2 ± 1.8	30.03 ± 1.6	<0.0001* (-6.3 to -5.4)

*: Significant difference. CI: Confidence interval. Data presented as mean ± SD (Standard deviation).
Hb: Hemoglobin. MCH: Mean corpuscular hemoglobin. MCV: Mean corpuscular volume.
N: Number of studied women. t-test used for statistical analysis.

Discussion

Most guidelines define PPA as Hb <11 g/dL after delivery or at 1st postpartum week, and <12 g/dL at 8th postpartum week (2). PPA defined according to WHO as Hb <11 g/dL at 1st postpartum week, and <12 g/dL at 1st postpartum year. The prevalence of PPA is about 22-50% in developed, and 50-80% in developing countries (3).

A randomized controlled trial (RCT) found PPA impair maternal QoL and negatively affect mothers' wellbeing (18). Iron salts are effective for the treatment of postpartum-IDA. Common oral iron salts side effects (i.e., gastric upset, and constipation) (10), and multiple infusion sessions of iron sucrose (IS) affect the treated women compliance and treatment outcome (12,13). Hence, this study aimed to evaluate Ferinject® effectiveness in PP-IDA treatment.

Studied women mean level of serum ferritin statistically elevated from 10.02 ± 2.4 before (pre-treatment) Ferinject® to 140.7 ± 8.9 ug/L after (post-treatment) Ferinject® (p<0.0001). Studied women mean hemoglobin level statistically elevated from 8.03 ± 0.6 before (pre-treatment) Ferinject® to 14.06 ± 0.45 g/dL after (post-treatment) Ferinject® (p<0.0001).

Studied women mean RBCs-volume statistically elevated from 71.9 ± 3.5 before (pre-treatment) Ferinject® to 90.3 ± 2.6 fL after (post-treatment) Ferinject® (p<0.0001). Studied women mean RBCs-hemoglobin statistically elevated from 24.2 ± 1.8 before (pre-treatment) Ferinject® to 30.03 ± 1.6 pg after (post-treatment) Ferinject® (p<0.0001).

Network of Advanced Patient Blood Management, Hemostasis, and Thrombosis (NATA) recommends administration of IV iron for treating women with Hb <9.0 g/dL following IDA (19).

A systematic review found the 6-weeks postpartum-Hb was 1.0 g/dL higher after receiving IV iron versus oral iron (20).

IV iron increases postpartum Hb in women with PP-IDA (Hb <8 g/dL) by 1.9 and 3.1 g/dL in 7 and 14 days, respectively (21). Holm et al (22), found IV iron to correct PPA was associated with significant reduction of postpartum maternal physical fatigue within 12-weeks compared to oral iron. Van Wyck et al (23), randomized trial found total postpartum maternal fatigue statistically improved after IV iron versus oral iron at 4, 8 and 12-weeks postpartum.

Shim et al (24), found FCM (Ferinject®) was an effective, well-tolerable for IDA treatment, it improved the iron stores and QoL compared to IS.

A retrospective study compared pregnant participants treated with IV iron for their IDA versus oral iron, and found odds of maternal morbidities (i.e., blood transfusion, hysterectomy, and ICU admission) was similar with no statistical difference between two studied groups (25).

The same study found the peripartum blood transfusion risk was less in IV iron treated participants (35 women) versus oral iron treated participants (114 women) (25).

No cases of severe adverse effects to FCM were reported in this study. One case (1.7%) of headache, and another case (1.7%) of mild skin rash around the infusion site were the reported FCM side effects. Shim et al (24), reported headache and dizziness as FCM-side effects in 3 cases [6.5% (3/46)]. Van Wyck et al (23), reported the FCM as a well-tolerable option for IDA treatment with minimal side effects.

A RCT found the Ferinject® improves both iron stores and Hb levels, and concluded that the convenient Ferinject® doses, and infusions were associated with improved studied patients` compliance (26). Evidence supports the use of FCM (Ferinject®) as a safe, tolerable and an effective option for IDA treatment (27).

Conclusion: Studied women mean levels of serum ferritin, hemoglobin and mean RBCs-indices (volume and hemoglobin) were statistically elevated after Ferinject®. This study suggests rapid correction of postpartum-IDA using Ferinject® to improve postpartum maternal physical performance, and to enhance mothers' ability to take care of their babies.

References

1. Milman N. (2011). Postpartum anemia I: definition, prevalence, causes, and consequences. *Annals of hematology*, *90*(11), 1247–1253. https://doi.org/10.1007/s00277-011-1279-z
2. Neef, V., Choorapoikayil, S., Hof, L., Meybohm, P., & Zacharowski, K. (2024). Current concepts in postpartum anemia management. *Current opinion in anaesthesiology*, 37(3), 234-238. https://doi.org/10.1097/ACO.0000000000001338

3. WHO Guideline (2016). Iron Supplementation in Postpartum Women. Geneva: World Health Organization; 2016. EXECUTIVE SUMMARY. Available from: https://www.ncbi.nlm.nih.gov/books/NBK379995/
4. Abdelazim, I. A., Farghali, M., & Amer, O. O. (2020). Ferric polymaltose complex in treatment of iron deficiency and iron-deficiency anaemia with pregnancy. *Hematology in Clinical Practice*, 11(4), 212–218. https://doi.org/10.5603/Hem.2020.0041
5. Abdelazim, I.A., Shikanova, S., Karimova, B., Sarsembayev, M., Mukhambetalyeva, G. (2021). Heme-Iron Optifer Versus Intravenous Iron/Ferosac in Treatment of Iron Efficiency Anemia During Pregnancy. *SN Compr. Clin. Med*. 3, 1344–1349 (2021). https://doi.org/10.1007/s42399-021-00891-7
6. Ando, K., Morita, S., Higashi, T., Fukuhara, S., Watanabe, S., Park, J., et al. (2006). Health-related quality of life among Japanese women with iron-deficiency anemia. *Quality of life research: an international journal of quality-of-life aspects of treatment, care and rehabilitation*, 15(10), 1559-1563. https://doi.org/10.1007/s11136-006-0030-z
7. Froessler, B., Gajic, T., Dekker, G., & Hodyl, N. A. (2018). Treatment of iron deficiency and iron deficiency anemia with intravenous ferric carboxymaltose in pregnancy. *Archives of gynecology and obstetrics*, 298(1), 75–82. https://doi.org/10.1007/s00404-018-4782-9
8. Khalafallah, A. A., & Dennis, A. E. (2012). Iron deficiency anaemia in pregnancy and postpartum: pathophysiology and effect of oral versus intravenous iron therapy. *Journal of pregnancy*, 2012, 630519. https://doi.org/10.1155/2012/630519
9. Moya, E., Phiri, N., Choko, A. T., Mwangi, M. N., & Phiri, K. S. (2022). Effect of postpartum anaemia on maternal health-related quality of life: a systematic review and meta-analysis. *BMC public health*, *22*(1), 364. https://doi.org/10.1186/s12889-022-12710-2
10. Pavord, S., Myers, B., Robinson, S., Allard, S., Strong, J., Oppenheimer, C., & British Committee for Standards in Haematology (2012). UK guidelines on the management of iron deficiency in pregnancy. *British journal of haematology*, 156(5), 588–600. https://doi.org/10.1111/j.1365-2141.2011.09012.x
11. Kanshaiym, S., Abdelazim, I. A., Starchenko, T., & Mukhambetalyeva, G. (2019). Effect of intravenous iron sucrose on hemoglobin level, when administered in a standard dose, to anemic pregnant women in rural Northern India. *Journal of family medicine and primary care*, *8*(2), 769–770. https://doi.org/10.4103/jfmpc.jfmpc_438_18
12. Hagras, A. M., Hussein, N. A., Abdelazim, I., & Elhamamy, N. (2022). Ferric carboxymaltose for treatment of iron deficiency and iron deficiency anemia caused by abnormal uterine

bleeding. *Przeglad menopauzalny (Menopause review)*, 21(4), 223–228. https://doi.org/10.5114/pm.2022.124013

13. Obaid, M., Abdelazim, I. A., AbuFaza, M., Al-Khatlan, H. S., Al-Tuhoo, A. M., & Alkhaldi, F. H. (2023). Efficacy of ferric carboxy maltose in treatment of iron deficiency/iron deficiency anaemia during pregnancy. *Przeglad Menopauzalny (Menopause review)*, *22*(1), 16-20. https://doi.org/10.5114/pm.2023.126347
14. Donayeva, A., Amanzholkyzy, A., Abdelazim, I. A., Rakhyzhanova, S., Mannapova, A., Abilov, T., et al. (2024). The relationship between vitamin D and adolescents' parathyroid hormone and bone mineral density. *Przeglad Menopauzalny (Menopause review)*, *23*(1), 1–5. https://doi.org/10.5114/pm.2024.136327
15. Ali, A., Elmdaah, A., Mustafa, A. M., Kumaravel Kanagavelu, A. S., Mohamed, N., & Sayed, S. (2021). Severe Hypophosphatemia Following Ferric Carboxymaltose in a Patient With Inflammatory Bowel Disease. *Cureus*, *13*(12), e20452. https://doi.org/10.7759/cureus.20452
16. Onken, J. E., Bregman, D. B., Harrington, R. A., Morris, D., Buerkert, J., Hamerski, D., et al. (2014). Ferric carboxymaltose in patients with iron-deficiency anemia and impaired renal function: the REPAIR-IDA trial. *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association - European Renal Association*, *29*(4), 833–842. https://doi.org/10.1093/ndt/gft251
17. El-Ghazaly, T. E., Abdelazim, I. A., & Elshabrawy, A. (2022). Interleukin-6 bedside test in detecting chorioamnionitis in women with preterm premature rupture of fetal membranes. *Ginekologia polska*, 93(10), 835–841. https://doi.org/10.5603/GP.a2022.0027
18. Perez, E. M., Hendricks, M. K., Beard, J. L., Murray-Kolb, L. E., Berg, A., Tomlinson, M., et al. (2005). Mother-infant interactions and infant development are altered by maternal iron deficiency anemia. *The Journal of nutrition*, *135*(4), 850–855. https://doi.org/10.1093/jn/135.4.850
19. Muñoz, M., Peña-Rosas, J. P., Robinson, S., Milman, N., Holzgreve, W., Breymann, C., et al. (2018). Patient blood management in obstetrics: management of anaemia and haematinic deficiencies in pregnancy and in the post-partum period: NATA consensus statement. *Transfusion medicine (Oxford, England)*, *28*(1), 22–39. https://doi.org/10.1111/tme.12443
20. Sultan, P., Bampoe, S., Shah, R., Guo, N., Estes, J., Stave, C., et al. (2019). Oral vs intravenous iron therapy for postpartum anemia: a systematic review and meta-analysis. *American journal of obstetrics and gynecology*, *221*(1), 19–29.e3. https://doi.org/10.1016/j.ajog.2018.12.016
21. Broche, D. E., Gay, C., Armand-Branger, S., Grangeasse, L., & Terzibachian, J. J. (2004). Anémies sévères du post-partum immédiat. Pratique clinique et intérêt du fer par voie intraveineuse [Acute

postpartum anaemia. Clinical practice and interest of intravenous iron]. *Gynecologie, obstetrique & fertilite*, *32*(7-8), 613–619. https://doi.org/10.1016/j.gyobfe.2004.05.014

22. Holm, C., Thomsen, L. L., & Langhoff-Roos, J. (2019). Intravenous iron isomaltoside treatment of women suffering from severe fatigue after postpartum hemorrhage. *The journal of maternal-fetal & neonatal medicine: the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians*, *32*(17), 2797–2804. https://doi.org/10.1080/14767058.2018.1449205
23. Van Wyck, D. B., Martens, M. G., Seid, M. H., Baker, J. B., & Mangione, A. (2007). Intravenous ferric carboxymaltose compared with oral iron in the treatment of postpartum anemia: a randomized controlled trial. *Obstetrics and gynecology*, *110*(2 Pt 1), 267–278. https://doi.org/10.1097/01.AOG.0000275286.03283.18
24. Shim, J. Y., Kim, M. Y., Kim, Y. J., Lee, Y., Lee, J. J., Jun, J. K., et al. (2018). Efficacy and safety of ferric carboxymaltose versus ferrous sulfate for iron deficiency anemia during pregnancy: subgroup analysis of Korean women. *BMC pregnancy and childbirth*, *18*(1), 349. https://doi.org/10.1186/s12884-018-1817-y
25. Burn, M. S., Lundsberg, L. S., Culhane, J. F., Partridge, C., & Son, M. (2023). Intravenous iron for treatment of iron deficiency anemia during pregnancy and associated maternal outcomes. *The journal of maternal-fetal & neonatal medicine: the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians*, *36*(1), 2192855. https://doi.org/10.1080/14767058.2023.2192855
26. Jose, A., Mahey, R., Sharma, J. B., Bhatla, N., Saxena, R., Kalaivani, M., et al. (2019). Comparison of ferric Carboxymaltose and iron sucrose complex for treatment of iron deficiency anemia in pregnancy- randomised controlled trial. *BMC pregnancy and childbirth*, *19*(1), 54. https://doi.org/10.1186/s12884-019-2200-3
27. Muñoz, M., & Martín-Montañez, E. (2012). Ferric carboxymaltose for the treatment of iron-deficiency anemia. [corrected]. *Expert opinion on pharmacotherapy*, 13(6), 907–921. https://doi.org/10.1517/14656566.2012.669373