



## BRIEF ORIGINAL ARTICLE

# Management of iron deficiency anaemia by the preanaesthesia nurse with respect to perioperative transfusion rates<sup>☆</sup>



Ana Gómez-Sánchez<sup>a,\*</sup>, Elena Fuente-Alonso<sup>b</sup>

<sup>a</sup> Unidad de Reanimación, Hospital Universitario Marqués de Valdecilla, Santander, Cantabria, Spain

<sup>b</sup> Consulta de Preanestesia, Departamento de Anestesia y Reanimación, Hospital Universitario Marqués de Valdecilla, Santander, Cantabria, Spain

Received 22 June 2018; accepted 6 February 2019

Available online 3 August 2019

### KEYWORDS

Iron-deficiency;  
Iron;  
Intravenous infusions;  
Preoperative period;  
Surgery;  
Blood transfusion

### Abstract

**Objective:** To describe the prevalence of perioperative blood transfusion (BT) for patients with preoperative iron deficiency anaemia and undergoing major elective surgery, included in an intravenous iron protocol (IV Fe) led by the pre-anaesthesia nurse.

**Method:** Observational, descriptive, longitudinal and retrospective study in a population of patients undergoing major elective surgery, seen in anaesthesia nursing consultation in a tertiary hospital between April 2014 and January 2017. The patients with iron deficiency anaemia, included in the study, were included in a protocol of treatment with preoperative IV Fe.

**Results:** Fifty patients were studied. Twelve percent required a BT. A statistically significant association was observed between the need for intraoperative BT and the number of days between the first administration of IV Fe and date of surgery ( $p < .01$ ) and also the number of days between the last administration of IV Fe and the surgical intervention ( $p = .04$ ). The increase in haemoglobin was greater in patients who received more than one dose compared to those who received only one dose of 1000 mg ( $p < .01$ ).

**Conclusions:** In our study, we estimated an increase in haemoglobin greater than in other studies and a low administration rate of BT (12%). The role of the nurse is fundamental for the preselection of these patients.

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DOI of original article: <https://doi.org/10.1016/j.enfcli.2019.02.002>

<sup>☆</sup> Please cite this article as: Gómez-Sánchez A, Fuente-Alonso E. Manejo de la anemia ferropénica por la enfermera de preanestesia respecto a las tasas de transfusión perioperatoria. Enferm Clin. 2020;30:47–52.

\* Corresponding author.

E-mail address: [ana.gomez@scsalud.es](mailto:ana.gomez@scsalud.es) (A. Gómez-Sánchez).

**PALABRAS CLAVE**

Anemia ferropénica;  
 Hierro;  
 Infusión intravenosa;  
 Periodo  
 preoperatorio;  
 Cirugía;  
 Transfusión sanguínea

## Manejo de la anemia ferropénica por la enfermera de preanestesia respecto a las tasas de transfusión perioperatoria

**Resumen**

**Objetivo:** Describir la prevalencia de transfusión sanguínea (TS) perioperatoria en pacientes con anemia ferropénica preoperatoria y sometidos a cirugía mayor electiva, incluidos en un protocolo de hierro intravenoso (FE IV) liderado por la enfermera de preanestesia.

**Método:** Estudio descriptivo, observacional, longitudinal y retrospectivo en una población de pacientes sometidos a cirugía mayor electiva, vistos en consulta de enfermería de anestesia en un hospital de tercer nivel entre abril de 2014 y enero de 2017. Se incluyeron en el estudio aquellos pacientes con anemia ferropénica incluidos en un protocolo de tratamiento con FE IV prequirúrgico.

**Resultados:** Se estudiaron 50 pacientes. El 12% precisó una TS. Se observó una asociación estadísticamente significativa entre la necesidad de TS intraoperatoria y el número de días entre la primera administración de FE IV y la fecha de la cirugía ( $p < 0,01$ ), y también con el número de días entre la última administración de FE IV y la intervención quirúrgica ( $p = 0,04$ ). El aumento de la hemoglobina fue mayor en los pacientes que recibieron más de una dosis frente a los que solo recibieron una dosis de 1.000 mg ( $p < 0,01$ ).

**Conclusiones:** En nuestro estudio hemos estimado un aumento de la hemoglobina mayor que en otros estudios y una tasa de administración de TS baja (12%). El papel de la enfermera es fundamental para la preselección de estos pacientes.

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**What is known?**

Preoperative anaemia is related to a higher risk of adverse effects in the perioperative period. Intravenous iron for treating iron deficiency anaemia during the preoperative period is a controversial issue according to the literature.

**What does this study contribute?**

Adherence to a preoperative intravenous iron protocol led by the preanaesthesia nurse in patients with iron deficiency anaemia undergoing major elective surgery could reduce the rate of perioperative blood transfusions and their associated risks.

**Introduction**

Preoperative anaemia appears in a third of patients undergoing elective surgery, related to a higher risk of adverse effects during the perioperative period. Standard practice is to treat with blood transfusion (BT) although this is not exempt from complications, since it increases the risk of infection, the number of heart complications, the length of hospital stay and the number of deaths.

The main cause of anaemia in the general population in developed countries is insufficient iron.<sup>1</sup> Although this

is a controversial matter, several studies and clinical practice guidelines support the use of intravenous iron (IV Fe) for treating iron deficiency anaemia in the preoperative period.<sup>2-4</sup> The literature states that IV FE is highly effective in replacing iron reserves and increasing haemoglobin (Hb) in iron deficiency anaemia by 50% in 5 days, 75% in 10–14 days and to a maximum in 3 weeks.<sup>3</sup>

The early detection programme for patients with major elective presurgical iron deficiency anaemia is based on the coordination of an interdisciplinary circuit, conducted in our centre from April 2014 by the nurse in the preanaesthesia unit (PN). The haematologist refers patients to the PN with anaemia criteria, in order to coordinate diagnosis of iron deficiency anaemia in patients at moderate-severe risk of bleeding (major visceral surgery, heart surgery and large vessel surgery, reconstructive plastic, urological, head and neck, advanced oncological, neurosurgery and surgery of the spinal column). If the patient meets with the iron deficiency anaemia criteria they are included in the preoperative IV Fe administration programme. Administration is usually made during the 24 h after preoperative consultation. The optimum dose is calculated using the following formula:  $\text{weight} \times [(\text{Hb}_{\text{ideal}} - \text{Hb}_{\text{patient}}) \times 2.4] + 500$ . In our centre, the PN, together with the haematologist, preselects the patients who will probably benefit from this treatment.

The main aim of the study was to describe the prevalence of the perioperative BT in patients with iron deficiency anaemia and undergoing major elective surgery included in a IV FE protocol led by the PN. A secondary aim was to determine what factors are associated with the need for perioperative BT and the analytical parameters related to anaemia.

## Method

A descriptive, longitudinal and retrospective study, conducted in a population of patients who underwent major elective surgery and who were assessed by the PN in a tertiary level hospital. Patients who were over 18 who met the iron deficiency anaemia criteria from the preanaesthetic analytical study were included in the study (concentration of Hb < 12 g/dl in women and 13 g/dl in men, ferritin < 100 ng/ml and/or index of iron saturation < 20  $\mu$ g/dl<sup>3</sup>) and who were treated with IV FE prior to surgery.

Patients whose surgical intervention date was less than a week from the date of preanaesthesia consultation, pregnant women and those with intolerance/allergy to IV FE were excluded. No patients were excluded for maximum time from administration of iron to date of surgery.

A consecutive sample of the patients who were included in the programme between April 2014 and January 2017 was made, collecting data in the preanaesthetic consultation and during surgery. In order to calculate the sample size, it was taken into account that, according to the literature, 3% could possibly require a BT.<sup>5</sup> A sample size of 50 individuals was estimated (95% confidence level, 5% precision rate, 10% replacement rate), calculated with the GRANMO 7.12. statistical package.

The patients were included in the programme after signing an informed consent form. The study was approved by the Hospital Research Committee. Research took place based on the Declaration of Helsinki, complying with the regulation of Good Clinical Practice. All data were treated in keeping with Organic Law 15/1999, of 13th December, governing personal data protection.

Data collection was performed by the PN, who consulted the patient's medical history, retrospectively, using a standard data collection notebook. The following socio-demographical and clinical variables were recorded: age, gender, type of surgery, anaesthetic risk according to the ASA scale, anticoagulant treatment, suspension of the anticoagulation prior to surgery, antiaggregation therapy, suspension of the antiaggregation prior to surgery.

Analytical parameters of the preoperative period and admittance to surgery were recorded: Hb, haematocrit, glomerular filtrate, iron, ferritin, mean corpuscular volume and iron saturation index. The need and number of perioperative (intraoperative and immediate postoperative – first 6 h after surgery) BT was noted. Regarding treatment with IV FE, the following variables were collected: active substance, dose, frequency, days between first dose and surgery, days between last dose and surgery, days between initial administration and last dose of IV FE and adverse effects relating to administration.

SA descriptive analysis of the study variables was made, using central tendency measures for the quantitative variables and frequencies and percentages for the qualitative variables. To determine which factors impacted the need for perioperative BT and in the analytical parameters related to anaemia bivariate analysis was performed between the Hb levels, the need for BT and the different days between IV FE administrations and surgery. The ASA-BT relationship and the number of adverse reactions. For

statistical inference the student's T-test was used, as was the Mann-Whitney *U* test and the Wilcoxon ranges. A *p* values of .05 was considered statistically significant. The statistical software package IBM SPSS Statistics version 20.0 was used.

## Results

During the study period 93 patients were diagnosed with iron deficiency anaemia and were included in the administration programme of preoperative IV FE. Of these, 43 were ruled out for not complying with the inclusion criteria (2 because they had not performed surgery when data was collected and 41 because data was incomplete).

Finally 50 patients were studied. The socio-demographic and clinical variables of the sample studied is reflected in Table 1. Mean age was 59 years (range 26–88 years, standard deviation 18 years). Anticoagulant treatment was suspended to all anticoagulated patents. Antiaggregation was suspended in 2 of the 13 antiaggregated patients (15.4%). Table 2 shows the central tendency measures for the analytical parameters, the number of BT and the days between the first dose and surgery, and the days between the initial administration and the final dose of IV FE of the population under study.

The initial dose of IV FE in all cases was 1000 mg of carboxymaltose iron. Patients who were to undergo surgical intervention with over 30 days between the initial dose and surgery (*n* = 27) had a mean increase of Hb of  $2.237 \pm 2.34$  g/dl, compared with a mean increase of Hb of  $.730 \pm 1.03$  g/dl in those with 30 days or less between the initial dose and surgery (*n* = 23; *t* = -3.015; 95% CI -2.5193/- .4940; *p* = .005).

Twelve per cent required a BT: 8% required an intraoperative BT (*n* = 4) and 4% required a BT during the immediate postoperative period (*n* = 2). Between the patients who required an intraoperative BT a mean of  $8.75 \pm 5.56$  days had passed since the last dose up to surgery, compared with a mean of  $24.28 \pm 26.54$  days of those who required a BT (*t* = -3235; 95% CI 25.512/-5.553; *p* = .004).

There was a statistical association of the days between the initial dose and surgery with the need for an intraoperative BT:  $12.25 \pm 4.64$  days in those who required a BT compared with  $46.83 \pm 36.31$  days of those who did not (*t* = -5.925; 95% CI 46.358/-22.794; *p* < .01). There was no statistical association between the days between initial dose and surgery and the days from the final dose until surgery with the postoperative BT.

Regarding the total IV FE dose administered prior to surgery, 80% (*n* = 40) received a dose > 1000 mg. In this patient group the increase of mean Hb was  $1.903 \pm 2.046$  compared with  $.11 \pm .77$  g/dl compared with the group who received a single dose of 1000 mg (*t* = -4.416; 95% CI 2.6131/-0.9719; *p* < .01). Equally, those who received more than one dose (*n* = 39) presented a mean increase of the Hb higher than those who received a single dose (*n* = 11):  $1.954 \pm 2.047$  compared with  $.091 \pm .738$  g/dl, respectively (*t* = -4.702; 95% CI 2.6609/-1.0649; *p* < .01).

No patient presented with adverse effects relating to the administration of IV FE.

**Table 1** Socio demographic and clinical data of the sample (n = 50).

Characteristics	Drug	n	%
<i>Sex</i>			
Man		21	42
Woman		29	58
<i>ASA anaesthetic risk (scale)</i>			
I		13	26
II		21	42
III		16	32
<i>Type of surgery</i>			
General		16	32
Gynaecological		19	38
Obstetric		1	2
Adult orthopaedic		1	2
Chest		1	2
Traumatological		1	2
Urological		7	14
Vascular		4	8
<i>Anticoagulated</i>			
No		44	88
Yes		6	12
	Acenocumarol	5	83
	Apixaban	1	17
<i>Antiaggregate</i>			
No		37	74.0
Yes		13	26.0
	AAS	10	77
	Thienopyridines	3	33
<i>Intraoperative transfusion</i>			
No		46	92
Yes		4	8
<i>Postoperative transfusion</i>			
No		48	96
Yes		2	4

AAS: acetylsalicylic acid; ASA: American Society of Anaesthesiologists.

## Discussion

The prevalence of BT is estimated at 12% in our series. Calleja et al.<sup>6</sup> refer to a significant reduction of BT requirements in patients who undergo colorectal surgery treated with IV FE preoperatively, 38.7% compared with 9.9% in the control group, whilst the Quinn rate in similar patients is 0%. However, the Muñoz ET al.<sup>7</sup> series shows a BT rate of 32.4% in patients who undergo major orthopaedic surgery treated with IV FE. This suggests that the results may vary depending on the type of surgery which in our case was mostly general, gynaecological and urological (84%).

Previous cohort studies have demonstrated that correction of preoperative anaemia is associated with a reduction in perioperative BT.<sup>8</sup>

The results from our sample have an estimated increase of Hb which is higher than that of other studies.<sup>9</sup>

Our results prove that the higher the time between the initial dose of IV FE and surgery, the lower the rate of perioperative BT, compared with other studies which show that, although the administration of iron is given early preoperatively, the need for perioperative BT decreases.<sup>8</sup>

With regard to adverse effects, Auerbach et al. describe iron preparations as effective and having improved greatly in their safety profiles.<sup>10</sup> The prevalence of serious adverse effects associated with IV FE is very low, lower than that described with the use of allogenic BT.<sup>3</sup> Our results coincide with these data, since incidence was null.

Our study has limitations on being descriptive and non experimental, single-centred and with a small sample, which may have affected variability. We planned to conduct a quasi-experimental pre/post implementation study of the described protocol, but until it was put into place with coordination from the PN, in our hospital no iron study

**Table 2** Measures of central tendency for the analytical parameters, the number of blood transfusions and days between administration of iron and surgery.

	Mean	Median	Maximum	Minimum	Standard deviation
Preoperative haemoglobin (g/dl)	10.5	10.6	12.9	7.9	1.2
Preoperative haematocrit (%)	32.9	33.8	38.7	25.0	3.2
Preoperative MCV (fL)	79.4	80.4	96.7	60.5	9.0
Preoperative iron ( $\mu\text{g}/\text{dl}$ )	31	23	204	8	32
ISF preoperative (%)	8	6	40	2	7
Pre-SI haemoglobin (g/dl)	12.0	11.9	17.3	8.4	1.7
Pre-SI haematocrit (%)	37.1	36.8	52.3	27.1	4.9
Pre-SI MCV (fL)	87	87	99	67	6
Pre-SI iron ( $\mu\text{g}/\text{dl}$ )	65	59	125	11	6
Pre-SI TSI (%)	23	21	45	4	2
Pre-SI ferritin (ng/ml)	307	260	738	63	183
Total IV FE (mg) dose	1560	1500	2800	1000	480
Number of intraoperative CE	1	1	2	0	1
Number of postoperative CE	1	1	2	0	1
Increase in haemoglobin (g/dl)	1.5	1.1	8.1	-3.3	2.0
Days between last dose of IV FE and SI	23	14	127	1	26
Days between first dose of IV FE and SI	44	36	155	5	36

CE: concentrates of erythrocytes; IV FE: intravenous iron; SI: surgical intervention; TSI: transferrin saturation index; pre-SI: presurgical intervention; BT: blood transfusion; MCV: mean corpuscular volume.

was conducted in the patients who presented with anaemia preoperatively, and we therefore do not have any reliable data prior to start-up of the programme.

The creation of an interdisciplinary circuit together with specific nursing for anaesthetic activity outside the operating theatre optimises resources, improves standard clinical practice, facilitates universal pre- anaesthetic assessment and boosts care.<sup>11</sup> The nurses in charge of pre-anaesthesia are essential in preselecting patients with iron deficiency anaemia since once they determine the analytic data issued by the haematologist and collate them with the date for surgery, they propose the inclusion of IV FE into the preoperative administration protocol. Correct training and awareness among the medical and nursing staff would be useful for increasing adherence to the protocol and for preventing the exposure of anaemic patients to BT with all the risks this may entail.<sup>7</sup> The patient's status would be optimised and postoperative morbimortality reduced. Future lines of investigation could determine how the figure of the nurse may improve the protocol sequence.

## Conflict of interests

The authors have no conflict of interests to declare

## Acknowledgements

Firstly, the study subjects without whose collaboration this study could not have been conducted and secondly, to José Luis Cobo Sánchez, the nurse from the Quality, Training, R+D+i of Nursing in our hospital.

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