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Evaluation of the hematimetric profile of patients with abnormal uterine bleeding treated at a referral hospital in northern Brazil

Avaliação do perfil hematimétrico das pacientes portadoras de sangramento uterino anormal atendidas em um hospital de referência da região norte do Brasil

Evaluación del perfil hematimétrico de pacientes con sangrado uterino anormal atendidas en un hospital de referencia de la región norte de Brasil

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Abstract
The present study aimed to evaluate and compare the hematimetric profile, including hemoglobin, ferritin, and serum iron, of patients with AUB before and after treatment with levonorgestrel IUD or Combined Oral Contraceptives (COC) in a referral hospital in the North Region of Brazil. This is an observational, analytical, retrospective cohort study analyzing a sample of 30 patients, 14 in the IUD group and 16 in the COC group, evaluated at baseline (T0) and after three months of treatment (T1). The statistical analysis employed several tests with a significance level of 5%. The results showed that, at baseline, the IUD group had a more unfavorable profile. In the intragroup evaluation, the use of the levonorgestrel IUD promoted a significant increase in mean hemoglobin. The COC group stood out for the significant increase in mean serum iron, achieving a total absence of serum iron deficiency in the post-treatment period. In the comparison between the groups at T1, there was no statistical difference for hemoglobin or ferritin, but the COC group had significantly higher final serum iron levels. It can be concluded that both methods are effective in restoring hematimetric parameters in the short term, with the Mirena IUD demonstrating high efficacy in restoring hemoglobin even in more severe baseline cases, while COCs favored a more homogeneous normalization of serum iron, meaning that the choice of treatment should be individualized.
Keywords: Uterine Bleeding; Iron Deficiency Anemia; Intrauterine Devices; Oral Contraceptives.

Resumo
O presente estudo teve como objetivo avaliar e comparar o perfil hematimétrico, incluindo hemoglobina, ferritina e ferro sérico, de pacientes portadoras de SUA antes e após o tratamento com dispositivo intrauterino (DIU) de levonorgestrel ou Anticoncepcional Oral Combinado (ACO) no hospital de referência da Região Norte do Brasil. Trata-se de um estudo observacional, analítico, do tipo coorte retrospectiva, analisando uma amostra de 30 pacientes, sendo 14 no grupo DIU e 16 no grupo ACO, avaliadas no momento basal (T0) e após três meses de tratamento (T1). A análise estatística empregou diversos testes com nível de significância de 5%. Os resultados evidenciaram que, basalmente, o grupo DIU apresentava um perfil mais desfavorável. Na avaliação intragrupo, o uso do DIU de levonorgestrel promoveu um aumento significativo da hemoglobina média. Já o grupo ACO se destacou pela elevação significativa do ferro sérico médio, atingindo ausência total de deficiência de ferro sérico no pós-tratamento. Na comparação entre os grupos em T1,

não houve diferença estatística para hemoglobina ou ferritina, mas o grupo ACO apresentou níveis finais de ferro sérico significativamente superiores. Conclui-se que ambos os métodos são eficazes na recuperação dos parâmetros hematimétricos em curto prazo, sendo que o DIU de levonorgestrel demonstrou alta potência na recuperação da hemoglobina mesmo em quadros basais mais graves, enquanto o ACO favoreceu uma normalização mais homogênea do ferro sérico, devendo a escolha terapêutica ser individualizada.
Palavras-chave: Sangramento Uterino; Anemia Ferropriva; Dispositivos Intrauterinos; Anticoncepcionais Orais.

Resumen
El objetivo del presente estudio fue evaluar y comparar el perfil hematológico, incluyendo la hemoglobina, la ferritina y el hierro sérico, de pacientes con SUA antes y después del tratamiento con un dispositivo intrauterino (DIU) de levonorgestrel o con anticonceptivos orales combinados (AOC) en el hospital de referencia de la región norte de Brasil. Se trata de un estudio observacional, analítico, de tipo cohorte retrospectiva, que analizó una muestra de 30 pacientes, 14 en el grupo del DIU y 16 en el grupo del ACO, evaluadas en el momento basal (T0) y tras tres meses de tratamiento (T1). El análisis estadístico empleó diversas pruebas con un nivel de significación del 5 %. Los resultados pusieron de manifiesto que, en la línea de base, el grupo del DIU presentaba un perfil más desfavorable. En la evaluación intragrupal, el uso del DIU de levonorgestrel promovió un aumento significativo de la hemoglobina media. Por su parte, el grupo ACO destacó por el aumento significativo de la media de hierro sérico, alcanzando una ausencia total de deficiencia de hierro sérico tras el tratamiento. En la comparación entre los grupos en T1, no hubo diferencias estadísticas en cuanto a la hemoglobina o la ferritina, pero el grupo ACO presentó niveles finales de hierro sérico significativamente superiores. Se concluye que ambos métodos son eficaces para la recuperación de los parámetros hematológicos a corto plazo; el DIU de levonorgestrel ha demostrado una gran eficacia en la recuperación de la hemoglobina, incluso en casos basales más graves, mientras que el ACO ha favorecido una normalización más homogénea del hierro sérico, por lo que la elección terapéutica debe ser individualizada.
Palabras clave: Hemorragia Uterina; Anemia Ferropénica; Dispositivos Intrauterinos; Anticonceptivos Orales.

1. Introduction

Abnormal uterine bleeding (AUB) is one of the most common gynecological complaints worldwide. Its prevalence varies between 10% and 30% of women of reproductive age. In addition, AUB can profoundly affect quality of life, being related to high financial costs, decreased productivity, compromised health, and increased use of health services (Davis & Sparzak, 2022).

The prevalence of AUB depends on the method used for assessment, such as frequency, duration, regularity, volume, and presence or absence of intermenstrual bleeding (Jain et al., 2022). Estimates based on self-reporting tend to indicate higher values, ranging from approximately 8% to 52%, when compared to objective methods. On the other hand, using objective criteria—such as menstrual losses greater than 80 mL per cycle—prevalence rates range from 9% to 14% (Silva-Filho et al., 2015).

AUB is a symptom, not a diagnosis, and describes bleeding that deviates from the usual menstrual pattern of the population (Munro et al., 2011). It can be classified as acute (an episode intense enough to require immediate intervention), chronic (occurring during most cycles in the previous six months), and intermenstrual bleeding (occurring between regular cycles and predictable menstruations) (Munro et al., 2011).

Furthermore, in order to standardize the treatment and understanding of the etiologies of AUB, the International Federation of Gynecology and Obstetrics (FIGO) classifies this bleeding using the acronym PALM-COEIN, in which each letter is related to a possible etiology, namely: uterine polyps (P), adenomyosis (A), leiomyoma (L), malignancy and endometrial hyperplasia (M), coagulopathy (C), dysfunctional ovulation (O), dysfunctional endometrium (E), iatrogenesis (I), and causes "not classified elsewhere" (N) (Castro et al., 2025).

In general, structural causes are usually identifiable by imaging or histopathology, while non-structural causes require additional evaluation focused on the clinical presentation. The term "dysfunctional uterine bleeding" (DUB) describes causes related to hemostasis, ovulatory, and primary endometrial dysfunction, according to the current FIGO classification system (Munro et al., 2011).

The diagnosis of DUB is based on a detailed medical history, physical examination, and complementary tests. The investigation of menstrual history should include cycle regularity, duration, bleeding volume, age at menarche, medical history, medication use, and sexual history (Yasa & Ugurlucan, 2020).

Speculum examination is essential to confirm that the source of bleeding is uterine. The physical examination should also evaluate and exclude extrauterine sources of bleeding, such as the urethra, vagina, cervix, vulva, and anus. In adolescents, speculum examination and bimanual examination are indicated only when there is sexual activity. (Ramalho et al., 2021).

The management of AUB varies according to the severity of the condition. In acute situations, the priority is clinical stabilization, usually with the use of hormones and antifibrinolytic agents for immediate control of bleeding. In non-acute cases, treatment is guided by investigation of the underlying cause, initially excluding pregnancy and uterine tumors (Yasa & Ugurlucan, 2020).

Structural causes are addressed according to the specific pathology identified, while non-structural causes can be treated with combined hormonal contraceptives, different progestogen regimens—including the levonorgestrel-releasing intrauterine device (IUD), considered the most effective non-definitive option—as well as antifibrinolytics and anti-inflammatories. Surgical procedures are reserved for selected or refractory situations (Salazar, 2021).

The levonorgestrel IUD, which releases continuously (20 mcg/d), is the most effective approach to prevent excessive menstrual bleeding, resulting in a 71% to 95% reduction in blood loss by inducing endometrial atrophy. This method has a low rate of side effects, the main one being irregular bleeding, which is more common in the first months of use. Users often report high satisfaction and improved quality of life, comparable to hysterectomy or endometrial ablation, with the great advantage of preserving fertility (Salazar, 2021; Soltoski et al., 2023).

Combined oral contraceptives (COCs) can reduce menstrual bleeding by up to 69%, representing a widely accessible and effective therapeutic option for most cases of AUB without structural changes. Formulations with 30 to 35 mcg of ethinyl estradiol are the most studied, although other COC presentations also show efficacy(Wouk; Helton, 2019). Other forms of administration, such as transdermal patches and vaginal rings, are likely to be as effective as oral options and may even be superior when there is a need to avoid first-pass metabolism (Soltoski et al., 2023).

Chronic abnormal uterine bleeding is one of the main causes of iron deficiency, as are gastrointestinal bleeding and nutritional deficiencies, which can result in anemia (Davis; Sparzak, 2022). Anemia is characterized by a reduction in hemoglobin (Hb) concentration in the blood below normal levels and can be caused by several factors. About 50% of anemia cases are classified as iron deficiency anemia (WHO, 2017).

The symptoms of iron deficiency directly compromise functional capacity and daily alertness, manifesting as excessive tiredness, varying degrees of fatigue, headache, irritability, restless legs syndrome, and intolerance to physical activity. Additionally, symptoms may include pica (the desire to consume non-food substances such as clay, paper, or starch) (Jain et al., 2022).

In the psychosocial sphere, the pathology has a significant impact on mental health and quality of life, especially in women. The impact of the disease extends to relationships, work, and social life, and the deterioration in quality of life can even lead to depression associated with the pathology (Jain et al., 2022).

Patients with ferritin deficiency (FD) and without anemia may present the same symptoms. Ice pica, in turn, is considered a very characteristic manifestation of FD. Some patients with FD, with or without anemia, may complain of tongue pain, decreased salivary flow, dry mouth, and taste bud atrophy (Lopez et al., 2016). In addition, other signs may be observed, such as hair loss, dry skin, devitalized hair, and koilonychia (Pasricha et al., 2021).

If ADF or DF is suspected, a complete blood count and ferritin dosage should be requested. Additional tests, such as serum iron, transferrin, and transferrin saturation, are not essential. Patients with iron deficiency anemia usually have low serum iron levels, elevated transferrin, and reduced transferrin saturation (Lopez et al., 2016).

Reticulocyte hemoglobin (RetHb) is a reliable indicator of the amount of iron available in the body, without being influenced by inflammatory processes (Chinudomwong et al., 2020). According to the World Health Organization's diagnostic criteria, IDA is considered mild to moderate when Hb ranges from 7 to 12 g/dL, and severe when Hb is less than 7 g/dL, with slight variations depending on age, sex, or pregnancy. For adult women, anemia is considered when Hb levels are below 12 g/dL, and for men, below 13 g/dL (WHO, 2011).

Serum ferritin concentration is the most reliable marker of iron stores in the body. Normal values range from 30 to 200 ng/mL (mcg/L), and low ferritin levels are pathognomonic of iron deficiency. In patients with iron deficiency anemia and no associated infection or inflammatory diseases, the reference value of 30 ng/mL offers the highest diagnostic efficiency, with sensitivity and specificity of 92% and 98%, respectively. Since ferritin is an acute phase marker, whose levels rise in inflammatory, infectious, malignant, or hepatic conditions, there may be a false elevation of ferritin levels in the presence of these diseases, even in patients with IDA (Means & Brodsky, 2022).

When initial treatment of AUB fails, surgical procedures such as endometrial ablation or hysterectomy are recommended. Although effective, total hysterectomy involves longer hospital stays and a higher risk of complications (Cooper et al., 2019; Soltoski et al., 2023).

Finally, a multidisciplinary approach and longitudinal follow-up are essential to reduce gynecological morbidity associated with AUB, given the diversity of its etiologies. This complexity requires the cooperation of professionals from other specialties. The management of patients with coagulation disorders or those refractory to treatment requires follow-up by a hematologist, while the approach to adolescents should be individualized (Ramalho et al., 2021; Jain et al., 2022). Ultimately, long-term management is crucial, as it prevents future events and mitigates the physical and psychological consequences for women with AUB.

The present study aimed to evaluate and compare the hematimetric profile, including hemoglobin, ferritin, and serum iron, of patients with AUB before and after treatment with levonorgestrel IUD or Combined Oral Contraceptives (COC) in a referral hospital in the North Region of Brazil. Additionally, we seek to compare the impact of these therapeutic methods on the hematimetric parameters of patients with AUB, identifying possible differences between the groups and contributing clinical data that will help improve therapeutic and preventive strategies related to the management of abnormal uterine bleeding and anemia, with a potential impact on the organization of care protocols and public health policies focused on women's health in the North region.

2. Methodology

This study complies with the ethical principles established by the international standards of the Declaration of Helsinki and the Nuremberg Code, as well as the Guidelines for Research Involving Human Subjects (Resolution 466/12) of the National Health Council and Resolutions 580/18 and 510/16 of the National Health Council.

This is an observational, analytical, retrospective cohort study with a quantitative approach (Risemberg et al., 2026; Pereira et al., 2018), using descriptive statistics with means, standard deviations, absolute frequencies, relative frequencies, and inferential statistical analysis (Shitsuka et al., 2014; Costa Neto & Bekman, 2009). The research data were collected from the medical records of patients treated at the Santa Casa de Misericórdia do Pará Foundation who presented with abnormal uterine bleeding and were users of levonorgestrel IUDs or combined oral contraceptives between February 2025 and November 2025.

The final sample analyzed comprised 30 participants, 16 in the COC group and 14 in the IUD group, from February

2025 to November 2025, treated at the Santa Casa de Misericórdia do Pará Foundation who presented with abnormal uterine bleeding. To standardize the information collected from the medical records, a standardized data collection form was used.

Data were included for all female patients aged 18 years or older with abnormal uterine bleeding who were using a levonorgestrel IUD or oral contraceptives between February 2025 and November 2025.

Data were excluded for patients under 18 years of age, those seen outside the study period, and patients whose medical records were incomplete or lacked the information necessary for the study.

The data were organized in an Excel spreadsheet. Statistical analyses were performed using Jamovi software, version 2.6.44. Initially, the data were assessed for distribution and variability using the Shapiro–Wilk test, as well as for homogeneity of variances, in order to determine the most appropriate statistical approach. Depending on whether the assumptions of normality were met, parametric or nonparametric tests were employed.

For comparisons between independent groups (COC vs. IUD), we used Student's t-test for continuous variables with an approximately normal distribution and the Mann–Whitney U test when normality was not observed. Intragroup comparisons, involving repeated measures over time (pre- and post-treatment), were performed using the paired t-test or, when appropriate, the Wilcoxon signed-rank test.

Categorical variables were compared between groups using Pearson's chi-square test or Fisher's exact test when indicated by the expected sample size. For the analysis of changes in categorical variables over time within groups, the McNemar test was employed. In all analyses, a significance level of 5% ($p < 0.05$) was adopted.

After the period of contraceptive use (levonorgestrel IUD or COC), changes in hematological parameters were evaluated by comparing baseline values (T0) with post-treatment findings (T1) 3 months after baseline, with each group assessed separately.

It should be noted that four patients initially assigned to the IUD group were excluded from the analyses due to clinical events related to expulsion or displacement of the device, as previously established in the eligibility criteria. Additionally, a sensitivity analysis was conducted excluding one patient from the IUD group (case IUD_11), who had aplastic anemia and extremely high ferritin levels, to assess the impact of this observation on the primary outcomes.

3. Results

3.1 Demographic and clinical profile

The sample had a mean age of 40.63 years in the COC group and 35.14 years in the IUD group, a difference that, although numerically distinct, did not reach statistical significance ($p = 0.076$). Parity followed a similar distribution between the arms: the vast majority of patients were multiparous, representing 87.50% of the COC group and 71.43% of the IUD group (Fisher's Exact Test, $p = 0.272$), with no disparities in the proportion of nulliparous women. Additionally, the prevalence of structural gynecological comorbidities—including myomatosis, adenomyosis, and endometriosis—was equivalent between the groups, ensuring that there was no selection bias related to underlying pathologies.

3.2 Hematological parameters and prevalence of anemia

In the pre-treatment assessment, hematological parameters showed that the groups had similar mean values, but with important differences. The mean baseline hemoglobin (Hb) level was 12.78 g/dL in the COC group versus 11.34 g/dL in the IUD group. In the main analysis, this difference yielded a p-value of 0.037 (Mann–Whitney U test); however, when performing a sensitivity analysis excluding patient IUD_11, the p-value rose to 0.059, maintaining the premise of statistical comparability.

The median hemoglobin level at baseline was 13.25 g/dL in the COC group and 11.60 g/dL in the IUD group, indicating that a larger proportion of patients in the IUD group already had anemia at the initial assessment, although, again, there was no significant difference between the groups.

3.3 Iron kinetics and serum iron stores

Iron reserve markers showed high analytical variability, especially in the IUD group. The mean baseline ferritin level in the IUD group (454.5 ng/mL) was higher than that in the COC group (91.14 ng/mL), a phenomenon explained by an outlier value exceeding 5,700 ng/mL in a single patient; however, this difference was not significant due to the large standard deviation and the skewed distribution ($p = 0.244$). However, analysis of the medians—a more robust measure of central tendency for asymmetric data—revealed lower reserves in the IUD group (37.0 ng/mL) compared to the COC group (71.9 ng/mL).

Regarding baseline serum iron, the means were comparable (82.95 µg/dL in the COC group vs. 86.84 µg/dL in the IUD group; $p = 0.270$). The rates of iron deficiency (low ferritin) were 25.00% in the COC group and 42.86% in the IUD group ($p = 0.301$), while reduced serum iron was identified in 37.50% and 57.14% of patients, respectively ($p = 0.282$). These results reinforce that, despite numerically lower trends in the IUD group, both groups began the protocol with statistically similar iron stores. The median baseline iron levels (72.00 µg/dL in the COC group and 54.00 µg/dL in the IUD group) suggest a trend toward lower levels in the IUD group, but without statistical significance.

3.4 Anemia profile and baseline iron stores (T0)

At the initial assessment (T0), it was observed that the majority of the total sample (63.33%; n=19) did not have anemia. However, the baseline distribution revealed numerical disparities between the groups: the IUD group (n=14) began the study with a significantly higher proportion of anemic patients (57.14%; n=8), with 3 having mild anemia, 4 moderate, and 1 severe, compared to the IUD group (n=16) of anemic patients (18.75%; n=3), which characterized the distribution of cases as 1 mild, 1 moderate, and 1 severe, with statistical significance in the binary analysis ($p = 0.029$). Despite this numerical difference, with a higher proportion of anemia in the IUD group, the comparison of the distribution of baseline anemia severity between the groups did not show a statistically significant difference ($p = 0.162$).

Regarding iron stores, 10 patients (33.33%) had low ferritin at baseline: 4 cases (25.00%) in the COC group vs. 6 cases (42.86%) in the IUD group, with no statistical difference (Fisher's exact test, $p = 0.301$). Low serum iron at T0 occurred in 14 patients (46.67%), with 6 (37.50%) in the COC group and 8 (57.14%) in the IUD group, also without a significant difference ($p = 0.282$). These data suggest that, although the IUD group tended to have a worse baseline profile, differences in iron stores were similar between the groups (Table 1).

Table 1 - Baseline characteristics by group (COC vs. IUD) at baseline (T0).

Variable	Measure	COC (n=16)	IUD (n=14)	p (n=14)	IUD (n=13)	p (n=13)*
		General characteristics				
N		16	14	—	13	—
Age (years)	Mean	40,63	35,14		34,69	
	Standard deviation	7,33	8,99	0,076	9,19	0,063
	Median	41,50	34,00		33,00	

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Parity – multiparous women	n (%)	14 (87,5%)	10 (71,4%)	0,378	9 (69,2%)	0,364
Gynecological comorbidities						
Adenomyosis	n (%)	10 (62,50%)	7 (50,00%)	—	6 (46,15%)	—
Uterine fibroids	n (%)	5 (31,25%)	2 (14,29%)	—	1 (15,38%)	—
Endometriosis	n (%)	3 (18,75%)	3 (21,43%)	—	2 (15,38%)	—
Baseline hematological parameters (T0)						
Hemoglobin (g/dL) at T0	Mean	12,78	11,34	0,037	11,53	0,059
	Standard deviation	1,93	2,08		2,03	
	Median	13,25	11,60		11,60	
Ferritin (ng/mL) at T0	Mean	91,14	454,50	0,244	50,58	0,114
	Standard deviation	82,37	1512,00		47,83	
	Median	71,90	37,00		30,00	
Serum iron (µg/dL) at T0	Mean	82,95	86,84	0,270	53,29	0,130
	Standard deviation	59,94	130,60		37,67	
	Median	72,00	54,00		54,00	
Anemia and deficiencies at T0						
Anemia at T0	n (%)	3 (18,75%)	8 (57,14%)	0,029	7 (53,85%)	0,048
Low ferritin at T0	n (%)	4 (25,00%)	6 (42,86%)	0,442	6 (46,15%)	0,270
Low serum iron at T0	n (%)	6 (37,50%)	8 (57,14%)	0,282	8 (61,54%)	0,198

Notes: Continuous variables are presented as mean ± SD and median [IQR]. p-values: continuous variables by Mann–Whitney (except age, which was analyzed using Student's t-test); categorical variables by χ^2 (where applicable). "—" = test not applied for that specific row.
* Sensitivity analysis excluding patient IUD_11. Source: Prepared by the Authors (2026).

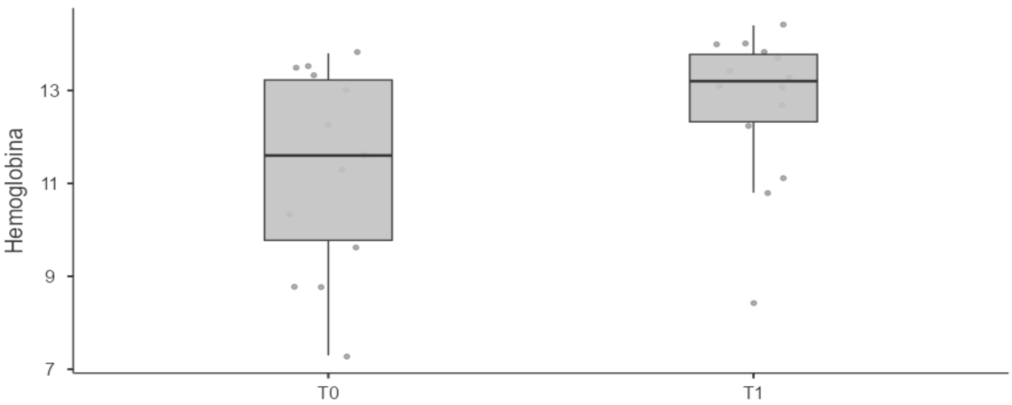
3.5 Intra-group changes (Pre-treatment vs. Post-treatment)

After the period of contraceptive use (Mirena IUD or COCs), changes in hematological parameters were assessed within each group by comparing baseline values (T0) with post-treatment values (T1) in each group separately. The results indicate significant improvements in the hematological profile, particularly among Mirena IUD users, while changes in the COC group were more subtle.

3.6 Levonorgestrel IUD group (n = 14)

Patients who used the levonorgestrel-releasing IUD showed a significant increase in hemoglobin concentration after treatment. The mean hemoglobin level rose from 11.34 g/dL at T0 to 12.71 g/dL at T1 (mean change +1.38 g/dL), indicating an improvement in anemia in this group. This improvement is illustrated in Figure 1, which shows a shift in the hemoglobin distribution toward higher values following the use of the levonorgestrel IUD.

Figure 1 - Intra-group change in hemoglobin (T0 vs. T1) in the levonorgestrel IUD group.



Source: Prepared by the Authors (2026).

At the three-month follow-up, the group that underwent IUD insertion showed a statistically significant increase in Hb levels compared to baseline (T0). Intragroup analysis revealed a consistent increase (p = 0.011, paired t-test; p = 0.010, Wilcoxon test), indicating that the intervention was effective in improving hematological parameters in the short term.

Clinically, an increase in the median Hb level was observed, from 11.60 g/dL to 13.20 g/dL, which resulted in the reversal of anemia in several patients, raising the parameters above the normal threshold. Table 2 summarizes this progression.

Table 2 - Intra-group changes (T0 vs. T1), continuous variables (IUD Group, n=14).

Variable	T0 mean	T0 standard deviation	T0 median	T1 mean	T1 standard deviation	T1 median	Δ mean (T1–T0)	p (Student's t-test)	P (Wilcoxon)
Hemoglobin (g/dL)	11,34	2,08	11,60	12,71	1,63	13,20	1,38	0,011	0,010
Ferritin (ng/mL)	454,50	1512	37,00	322,90	837,70	66,50	-131,60	0,493	0,530
Serum iron (µg/dL)	86,84	130,60	54,00	113,20	134,10	78,50	26,37	0,083	0,038

Source: Prepared by the Authors (2026).

Consequently, there was a substantial reduction in the proportion of anemic women within this group, dropping from 57.14% at baseline to 21.43% after IUD use (p = 0.025 by the McNemar test). Five patients in the IUD group who were anemic at T0 were no longer anemic at T1 (i.e., 62.50% of those with anemia improved), while 3 remained anemic (all with non-severe anemia), as shown in Table 3.

No patient progressed to a more severe degree of anemia; on the contrary, there were no remaining cases of severe anemia at T1 in this group. These findings suggest a significant intra-group improvement in hematological status with the IUD.

Regarding iron stores in the IUD group, the results also indicate improvement, although the magnitude varied depending on the parameter. Serum ferritin levels showed, on average, a slight increase between T0 and T1 in the IUD group, rising from a median of 37.00 ng/mL to a median of 66.50 ng/mL at T1.

3.7 Changes in serum ferritin and iron stores

When the influence of the outlier patient was disregarded, it was observed that the majority of levonorgestrel IUD users showed an increase or normalization of ferritin levels after the intervention period, reflecting an effective replenishment of iron stores. Quantitatively, the mean increase in the group was $\Delta = 50.97$ ng/mL. Although the analysis of means using the Wilcoxon test did not reach statistical significance ($p = 0.235$), the categorical analysis revealed a clinically significant benefit: the proportion of patients with low ferritin levels decreased dramatically from 42.86% at T0 to just 7.14% at T1 (McNemar's test, $p = 0.025$) in the IUD group. In practice, this data confirms that 83.3% of patients who began the study with depleted stores achieved laboratory normalization by the end of follow-up (Table 3).

For serum iron, which more directly reflects circulating iron, the IUD group also showed improvement, although this was less consistent. The mean serum iron concentration increased from 86.84 µg/dL at T0 to 113.20 µg/dL at T1 (Δ +26.37 µg/dL) in the IUD group (n=14), with an increase also in the median (from 54.00 to 78.50 µg/dL). The Student's t-test indicated a non-significant trend ($p = 0.083$), while the Wilcoxon test showed a significant difference ($p = 0.038$), suggesting an asymmetric distribution and/or outliers influencing the parametric analysis. Clinically, there was a reduction from 8 (57.14%) to 5 (35.71%) cases of low serum iron at T1, which was not significant according to the McNemar test ($p = 0.180$): 4 patients normalized, 4 remained with low iron, and there was 1 new case at T1 (Table 3).

Table 3 - Intra-group changes (T0 vs. T1), categorical outcomes (IUD Group, n=14).

Outcome	T0 – n (%) n = 14	T1 – n (%) n = 14	p (McNemar) n = 14	T0 – n (%) n = 13	T1 – n (%) n = 13	p (McNemar) n = 13
Anemia	8 (57,14)	3 (21,43)	0,025	7 (53,85)	2 (15,38)	0,025
Low ferritin	6 (42,86)	1 (7,14)	0,025	6 (46,15)	1 (7,69)	0,025
Low serum iron	8 (57,14)	5 (35,71)	0,180	8 (61,54)	5 (38,46)	0,180

Source: Prepared by the Authors (2026).

3.8 COC Group (n = 16)

In patients who used combined oral contraceptives, improvements in hematological parameters were also observed, although these were of lesser magnitude and statistical significance compared to the IUD group. The mean hemoglobin level in the COC group increased from 12.78 g/dL to 13.37 g/dL after treatment (Δ +0.59 g/dL), indicating a modest improvement (Table 4).

This intra-group difference was not significant ($p = 0.139$, Student's t-test), suggesting that, on average, COC use did not robustly increase hemoglobin levels in the group as a whole. Nevertheless, it is noted that few patients in the COC group were anemic at baseline, which limits the potential for improvement; in fact, the proportion with anemia fell slightly from 18.75% to 12.50% after COC, but this reduction (only 1 fewer patient with anemia) was not statistically significant ($p = 0.564$, McNemar).

Table 4 - Within-group changes (T0 vs. T1), continuous variables (COC Group, n=16).

Variable	T0 mean	T0 standard deviation	T0 median	T1 mean	T1 standard deviation	T1 median	Δ mean (T1–T0)	p (Student's t-test)	p (Wilcoxon)
Hemoglobin (g/dL)	12,78	1,93	13,25	13,37	1,46	13,35	0,59	0,139	0,088
Ferritin (ng/mL)	91,14	82,37	71,90	127,30	103,80	100,90	36,15	0,291	0,079
Serum iron (µg/dL)	82,95	59,94	72,00	121,30	42,07	108,50	38,39	0,036	0,025

Source: Prepared by the Authors (2026).

Of the 3 patients with anemia at baseline in the COC group, 1 had normalized hemoglobin levels at T1 and 2 remained with mild anemia; there were no cases of worsening anemia. In other words, 33.33% of the anemic patients in the COC group showed improvement, a lower proportion than that observed with the IUD, although the sample size is small.

Regarding ferritin, the COC group showed a mean increase from 91.14 to 127.30 ng/mL (Δ +36.15 ng/mL) at the end of treatment. Similar to what was observed with the IUD, this positive change was not statistically significant ($p = 0.291$).

However, the individual outcomes of the patients show favorable progress: the frequency of low ferritin in the COC group was reduced by half (from 25.00% to 12.50%), dropping from 4 cases at T0 to 2 cases at T1, although this improvement did not reach statistical significance ($p = 0.317$). Of the 4 patients with initially low ferritin levels, 3 normalized their iron stores and 1 remained with low ferritin after COC.

The most notable positive finding in the COC group was the change in serum iron levels. In contrast to the IUD group, where some patients maintained low iron levels, in the COC group all patients with low serum iron at baseline resolved their deficiency after treatment (Table 5).

Table 5 - Intra-group changes (T0 vs. T1), categorical outcomes (COC Group, n=16)

Outcome	T0 – n (%)	T1 – n (%)	p (McNemar)
Anemia	3 (18,75)	2 (12,50)	0,564
Low ferritin	4 (25,00)	2 (12,50)	0,317
Low serum iron	6 (37,50)	0 (0,00)	—*

*The McNemar test was not calculated due to the absence of cases at T1 (all patients with low iron levels at T0 had normalized by T1).
Source: Prepared by the Authors (2026).

A significant increase in mean serum iron levels was observed in the COC group, ranging from 82.95 µg/dL to 121.30 µg/dL (Δ +38.39 µg/dL; $p = 0.036$), a greater mean increase than that observed in the IUD group. At T1, there was complete resolution of iron deficiency cases (0% vs. 37.5% baseline), indicating absolute normalization of circulating iron. Although COC did not increase hemoglobin as much as the IUD, it was effective in normalizing serum iron levels in patients with functional iron deficiency.

In summary, both interventions improved intragroup hematological parameters. The levonorgestrel IUD demonstrated a greater impact on the recovery of hemoglobin and ferritin, while COC stood out for the consistent normalization of serum iron, with no reports of clinical worsening in either group.

3.9 Comparisons between groups (COC vs. IUD)

After analyzing intra-group changes, the final outcomes (T1) and changes (Δ) were compared between the IUD and COC groups to assess the potential superiority of one method over the other in improving hematological parameters. Overall, no statistically significant differences were observed between IUD and COC in the main hematological outcomes, except for serum iron at T1.

Regarding absolute values at T1, final hemoglobin and ferritin did not differ significantly between the groups. The mean final hemoglobin was 13.37 g/dL in the COC group and 12.71 g/dL in the IUD group (p = 0.338; Mann–Whitney U test), with medians within the normal range (13.35 g/dL in COC vs. 13.20 g/dL in IUD) in both groups, indicating a mean reversal of the anemic state.

For ferritin at T1, despite the elevated mean in the IUD group (322.90 ng/mL) influenced by an outlier, there was no statistically significant difference between groups (127.30 ng/mL in COC vs. 322.90 ng/mL in IUD; p = 0.371). Considering the asymmetric distribution, the medians were numerically lower in the IUD group (66.50 ng/mL) compared to the COC group (100.90 ng/mL). In the sensitivity analysis, excluding the outlier patient reduced the mean for the IUD group, while the median remained lower than that of the COC group (61.00 ng/mL), indicating lower final ferritin levels in the IUD group (Table 6).

For serum iron at T1, a statistically significant difference was observed between the groups (p = 0.016; Mann–Whitney U test), with higher final values in the COC group (121.30 µg/dL) compared to the IUD group (113.20 µg/dL). Categorical analysis corroborated this finding: no COC patient had low iron at T1 (0%), while 35.7% (5/14) of IUD patients remained below normal (p = 0.009 by χ^2; p = 0.014 in Fisher's exact test), suggesting a more homogeneous outcome for COC in this specific aspect.

Furthermore, regarding ΔSerum Iron, although the COC group showed a higher mean numerical increase (+38.39 µg/dL) than the IUD group (+26.37 µg/dL), the difference between the changes was not statistically significant (p = 0.835). In the sensitivity analysis, the results supported the general interpretation. It is worth noting that even when patient IUD_11 was excluded—a move that did not yield statistical significance—the results remained consistent with the general interpretation: ΔHb in the IUD group remained numerically higher (+1.52 g/dL), and ferritin began to show a positive mean change (+50.97 ng/mL).

Analysis of categorical outcomes also failed to demonstrate overall superiority of either method. Resolution of anemia (anemic patients at T0 who became non-anemic at T1) occurred in 12.5% (2/16) of the COC group and 35.7% (5/14) of the IUD group, with no statistically significant difference (p = 0.204). The distribution of anemia severity at T1 was similar between the groups (p = 0.785), with a predominance of patients without anemia and no severe cases after treatment.

Overall, the data indicate that both methods promoted a significant improvement in the hematological profile, with similar final results for hemoglobin and ferritin. The only intergroup difference observed was the better final serum iron profile in the COC group, a finding that should be interpreted in light of the sample size and data variability.

Table 6 - Between-group comparison at T1 and for Δ (COC vs. IUD), including sensitivity without IUD_11.

Variable	Measure	COC (n=16)	IUD (n=14)	p (n=14)	IUD (n=13)*	p (n=13)*
Hematological parameters after treatment (T1) by group						
Hemoglobin (T1)	Mean	13,37	12,71	0,256	13,05	0,516
	Standard deviation	± 1,46	± 1,63		± 1,10	

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	Median	13,35	13,20		13,30	
Ferritin (T1)	Mean	127,30	322,90		101,60	
	Standard deviation	± 103,80	± 837,70	0,371	± 131,90	0,254
	Median	100,90	66,50		61,00	
Serum iron (T1)	Mean	121,30	113,20		78,23	
	Standard deviation	± 42,07	± 134,10	0,016	± 30,26	0,004
	Median	108,50	78,50		78,00	
Change in Hematological Parameters after Treatment (Δ T1–T0) by Group						
Δ Hemoglobin	Mean	0,59	1,38	0,318	1,51	0,188
	Median	0,45	0,65		0,80	
Δ Ferritin	Mean	36,15	-131,60	0,632	50,97	0,878
	Median	21,60	20,30		25,00	
Δ Serum iron	Mean	38,39	26,37	0,835	24,94	0,726
	Median	34,00	32,00		31,00	
Anemia and deficiencies following treatment (T1)						
Anemia (T1)	Mean	2 (12,50)	3 (21,43)	0,642	2 (15,38)	1,000
Low ferritin (T1)	Standard deviation	2 (12,50)	1 (7,14)	1,000	1 (7,69)	1,000
Low serum iron (T1)	Median	0 (0,00)	5 (35,71)	0,014	5 (38,46)	0,011

*Sensitivity analysis excluding patient IUD_11. Source: Prepared by the Authors (2026).

3.10 Multivariate models and sensitivity analysis

To investigate whether the type of contraceptive method independently influenced hematological improvement, multiple linear regression models were constructed with changes in the parameters (ΔHemoglobin, ΔFerritin, and ΔSerum Iron) as dependent variables. In each model, the following were included as predictors: group (IUD vs. COC), age, parity, and the baseline value of the respective parameter, with the aim of adjusting for possible initial differences and potential confounders.

Overall, these exploratory models (Table 7) were consistent with the bivariate analyses, suggesting that the magnitude of the observed changes depends primarily on baseline status and not exclusively on the method, within the study's sample limits.

Table 7 - Multiple linear regression (effect of the IUD vs. COC group), adjusted for age, parity, and baseline value.

Outcome (Δ = T1–T0)	Analysis	Group β (IUD vs COC)	p	Adjusted R²	N
ΔHemoglobin	With IUD_11	0,15	0,781	0,393	30
ΔFerritin	With IUD_11	10,86	0,831	0,931	30
ΔSerum iron	With IUD_11	-7,59	0,745	≈ 0,008	30
ΔHemoglobin	Sensitivity (without IUD_11)	0,35	0,450	0,558	29
ΔFerritin	Sensitivity (without IUD_11)	-15,68	0,761	0,190	29
ΔSerum iron	Sensitivity (without IUD_11)	-41,91	0,017	0,579	29

Source: Prepared by the Authors (2026).

In the regression model for ΔHemoglobin, the coefficient associated with the group (binary variable) was small (+0.15) and not significant ($p = 0.781$), indicating that, after adjusting for covariates, there was no independent difference in the variation in Hb attributable to the contraceptive method. In contrast, baseline hemoglobin showed a strong inverse association with ΔHb: for every 1 g/dL increase at T0, a mean reduction of 0.53 g/dL in the variation was observed (coefficient −0.529; $p < 0.001$), consistent with a regression-to-the-mean effect, in which lower initial values tend to show greater gains. Age and parity had no significant effect ($p = 0.457$ and $p = 0.800$), and the model explained approximately 39% of the variability in ΔHb (adjusted $R^2 = 0.393$).

A similar pattern was observed for ΔFerritin. The group was not an independent predictor of variation after adjustment for baseline value (coefficient +10.86 ng/mL; $p = 0.831$). The main determinant of the change was baseline ferritin, with a robust inverse association (coefficient −0.458; $p < 0.001$), reflecting the expected trend of greater increases in patients with lower initial values. Age and parity were again not significant ($p = 0.783$ and $p = 0.610$). This model showed a high adjusted R^2 (0.931), highlighting the strong influence of the baseline value on the variation, especially in the context of wide dispersion and the presence of outliers.

In the serum ΔFerro model, the explanatory power was low (adjusted $R^2 \approx 0.008$), suggesting high individual variability not captured by the covariates. The group did not show a significant effect (coefficient −7.59 μg/dL; $p = 0.745$), nor did age and parity ($p = 0.877$ and $p = 0.727$). Baseline iron showed a trend toward an inverse association (coefficient −0.218; $p = 0.066$), indicating that lower initial levels may allow for greater gains, although this was not statistically significant at the 5% level.

Given the identification of patient IUD_11 as an outlier—primarily due to extremely elevated baseline ferritin—a sensitivity analysis was performed excluding this case. Consequently, the IUD group consisted of n = 13 patients, and there was a significant reduction in ferritin variability. The baseline mean in the IUD group decreased from 454.50 ng/mL to 50.58 ng/mL, becoming lower than that of the COC group (91.14 ng/mL).

Despite this significant descriptive change, the between-group comparison of baseline ferritin remained non-significant ($p = 0.114$; Mann–Whitney U test). Post-treatment, the mean ferritin level in the IUD group rose to approximately 101.60 ng/mL, resulting in a positive ΔFerritin (+50.97 ng/mL) and numerically higher than that observed in the COC group (+36.15 ng/mL);

however, the between-group difference remained non-significant (p = 0.878), supporting the conclusion of no superiority between methods regarding iron stores replenishment when individual variability is considered.

In the sensitivity analysis, the most evident difference occurred for serum iron at T1: excluding the outlier, the IUD showed a lower final mean (78.23 µg/dL) than the COC (121.30 µg/dL), with a statistically significant difference (p = 0.004). This finding is consistent with the categorical analysis, in which the COC group had 0% low iron at T1, while the IUD group maintained a significant proportion of cases, reinforcing a more favorable final serum iron profile in the COC group. Nevertheless, both means remained within the normal range, and the small sample size calls for interpretive caution.

Excluding patient IUD_11 did not alter the overall direction of the results. Baseline differences remained largely nonsignificant; for example, the intergroup comparison of baseline hemoglobin shifted from p = 0.037 to p = 0.059. Intragroup improvements remained consistent, with a significant increase in hemoglobin in the IUD group and normalization of serum iron in the COC group.

In the multivariate models of the sensitivity analysis, the group remained a non-independent predictor of ΔHb (coefficient +0.36; p = 0.450) and of ΔFerritin (coefficient −15.68; p = 0.761). In contrast, a specific change was observed in the ΔSerum Iron model, in which the group became an independent predictor (coefficient −41.91 µg/dL; p = 0.017), while baseline iron maintained a robust inverse association (coefficient −0.960; p < 0.001), suggesting greater iron gain in the COC after adjustment—a finding that should be interpreted with caution given the small sample size and high individual variability.

4. Discussion

Abnormal uterine bleeding (AUB) is one of the leading causes of gynecological morbidity in women of reproductive age, often associated with iron-deficiency anemia and progressive depletion of iron stores (Davis & Sparzak, 2022). In this study, we evaluated the impact of the Mirena IUD and combined oral contraceptives (COCs) on the hematological profile of patients with AUB, demonstrating that both methods promoted significant hematological improvement, albeit with distinct response patterns.

4.1 Baseline hematological profile and sample characterization

At baseline (T0), a high prevalence of anemia and abnormalities in iron metabolism was observed, particularly in the IUD group, which began follow-up with a higher proportion of anemic patients. This finding is consistent with the literature, which describes IUD as a determining factor for chronic iron loss, leading to iron-deficiency anemia in up to 30–50% of affected women, particularly when bleeding is heavy or prolonged (Wouk & Helton, 2019; Barros et al., 2022).

The presence of cases of moderate and severe anemia exclusively in the IUD group (T0) suggests that, in the clinical practice of the service where the study was conducted, patients with more severe blood loss and more critical iron stores may be preferentially directed toward the use of the intrauterine system (Santos et al., 2024). This clinical approach is supported by Febrasgo guidelines described by Salazar (2021) and review studies such as those by Lethaby et al. (2019) and Rana, Saxena, and Firdous (2012), which recommend the levonorgestrel IUD as the first-line treatment for heavy uterine bleeding due to its high efficacy in reducing blood loss.

Despite this clinical focus, the groups were statistically equivalent in terms of baseline iron stores. The IUD group had numerically higher rates of iron deficiency (42.8% vs. 25.0% in the COC group) and serum iron deficiency (57.1% vs. 37.5% in the COC group), with no statistically significant difference between the groups (p = 0.301 and p = 0.282), suggesting baseline comparability regarding iron stores, as seen in the results published by Temuroğlu et al. (2025). According to research conducted by Thomas et al. (2020), this equivalence is essential to ensure that the increases in hemoglobin observed at the end of the protocol reflect the efficacy of the interventions, rather than a significant difference in the patients' prior nutritional status.

When evaluating the demographic profile, the sample was characterized by women in late reproductive age, with a mean age of 40.63 years in the COC group and 35.14 years in the IUD group. Although the COC group had a numerically higher mean, there was no statistically significant difference, which ensures that age did not act as a confounding variable in the therapeutic response. This age profile is consistent with the peak incidence of benign uterine pathologies and ovulatory dysfunction leading to AUB, as described by Figueiredo et al. (2022) and Yaşa and Uğurlucan (2020), who highlight the prevalence of these complaints in women over 35 years of age.

4.2 Impact on Hematological Parameters

The results demonstrated that clinical treatment of AHS not only has a positive impact on blood loss but also facilitates the physiological recovery of iron stores, findings consistent with those of Santos et al. (2024), Buhur and Ünal (2023), and Ilyin et al. (2021).

A notable finding of this study was the behavior of the IUD group, which, starting from a more unfavorable baseline scenario with a higher prevalence of anemia and lower baseline Hb levels, showed a numerically greater increase in hemoglobin than the COC group (+1.38 g/dL vs. +0.59 g/dL); this pattern was similar to that observed in the publications by Yu et al. (2022) and Douligeris et al. (2025). Although this difference in gain was not statistically significant between the groups, it confirms that lower baseline levels were robust predictors of greater therapeutic gains (Thomas et al., 2020). This statistical phenomenon does not invalidate the efficacy of the Mirena IUD, but it reinforces the importance of interpreting absolute gains in light of the patients' baseline status.

This study suggests that the levonorgestrel IUD is a powerful tool for patients with heavy menstrual bleeding, possibly due to local endometrial atrophy that induces amenorrhea or severe hypomenorrhea—a mechanism widely described in the literature as superior to the cycle control provided by oral estrogens/progestins (Lethaby et al., 2019; Jain et al., 2022).

The maintenance of the therapeutic response over the long term is also supported by recent literature. The Mirena Extension Trial, a multicenter study that evaluated the efficacy and safety of the 52-mg intrauterine system for up to 8 years, demonstrated that the reduction in menstrual volume is progressive and sustained (Jensen et al., 2022).

This finding corroborates the hypothesis by Buhur and Ünal (2023) that the hematimetric recovery observed in the short-term study tends not only to persist but to intensify with prolonged use, consolidating the method's efficacy in controlling chronic blood loss and consequently protecting iron stores (Ilyin et al., 2021).

However, the kinetics of recovery show qualitative differences between the methods. While both improved Hb and ferritin levels, the COC group stood out for the complete normalization of serum iron, in contrast to the persistence of abnormal levels in the IUD group, with a significant difference observed between the groups. Serum iron reflects a more dynamic compartment sensitive to recent changes, whereas ferritin represents more stable stores (Pasricha et al., 2021).

One hypothesis for this superior short-term outcome is the greater predictability of the bleeding pattern with COC. The continuous use of estrogens and progestins tends to regulate the menstrual cycle early on, reducing erratic losses and facilitating the replenishment of circulating iron in the short term (Lethaby et al., 2019; Salazar et al., 2021). While IUD users may experience breakthrough bleeding (spotting) during the first few months of adaptation, maintaining a residual loss of circulating iron, which may delay its full normalization in the dynamic compartment (Figueiredo et al., 2022).

Thus, the observed discrepancy may reflect temporal differences in iron recovery kinetics rather than an intrinsic inferiority of the IUD. It is plausible to assume that, with longer follow-up and the consolidation of amenorrhea induced by the levonorgestrel IUD, this difference tends to diminish or even disappear (Buhur & Ünal, 2023).

This premise is corroborated by the systematic review conducted by Rodriguez et al. (2022), who, upon analyzing data from more than 20 randomized clinical trials, demonstrated that the levonorgestrel intrauterine system is consistently superior to or equivalent to other medical interventions in reducing menstrual bleeding and consequently improving hematological parameters in the long term.

The ability of the levonorgestrel IUD to reverse iron depletion is confirmed by Rana et al. (2012), who, when evaluating women in contexts of high vulnerability to anemia, observed that menstrual suppression induced by the device not only reduced the number of bleeding days (from 4.96 to 3.14 days), but also significantly increased serum ferritin (24.17 ± 5.97 ng/mL) and hemoglobin levels over 12 months.

Similarly, the study by Buhur and Ünal (2023) underscores the levonorgestrel IUD's ability to restore hematological parameters. In a robust cohort, the authors observed that the device increased the mean baseline hemoglobin level from 8.73 g/dL to 11.51 g/dL by the end of the sixth month—a statistically significant increase of 2.78 g/dL ($p < 0.0001$). This finding suggests that the recovery trend observed post-intervention (T1) tends to consolidate and increase with duration of use, validating the method as an effective strategy for reversing anemia in the medium term.

4.3 Comparison of methods and clinical implications

From a practical standpoint, the study did not show that any method was inferior in treating anemia. Both methods raised the median hemoglobin level to within the normal range (≥13 g/dL) in most patients at the end of follow-up. The clinical choice, therefore, need not be guided by concerns about the hematological efficacy of one method over the other, but rather by the patient's profile: reproductive desires, tolerance for systemic hormonal side effects, or preference for dosing convenience. The data presented in this study validate the use of both strategies as first-line treatments in the conservative management of AUS in our setting (Salazar et al., 2021).

While the efficacy of COCs depends on the user's discipline and daily adherence—a factor that can compromise therapeutic outcomes in cases of missed doses or poor gastrointestinal absorption—the levonorgestrel IUD provides autonomous protection without requiring daily patient intervention. This feature of dosing convenience is a decisive advantage in outpatient management, ensuring continuous endometrial stability without the fluctuations typical of oral methods (Moreira et al., 2022; Andrade et al., 2023).

The hematological superiority of the levonorgestrel IUD becomes even more evident when compared to the performance of the copper intrauterine device (IUD) in the context of abnormal uterine bleeding (Elshamy et al., 2021). While the copper IUD is frequently associated with an increase in menstrual flow volume and cycle duration, which may exacerbate iron-deficiency anemia in predisposed women, the levonorgestrel IUD acts in the opposite manner, promoting endometrial atrophy and reducing blood loss by up to 90% (Santos et al., 2024; Lethaby et al., 2019).

According to Barros et al. (2022), while combined oral contraceptives reduce menstrual flow by 35% to 69%, the levonorgestrel-releasing intrauterine system can reduce blood loss by 71% to 95% through the induction of endometrial atrophy. This difference in the magnitude of flow control explains how the IUD group managed to compensate for its initial hemoglobin and ferritin deficit, catching up to the COC group by the end of follow-up, since the near-total cessation of blood loss allows for a more efficient replenishment of iron stores, as observed by Andrade et al. (2023) and Jensen et al. (2022).

4.4 Analysis of outliers and the reliability of iron stores markers

Barros et al. (2022) emphasize that ferritin is the most reliable marker of iron stores, with a sensitivity of 92% for values below 30 ng/mL. However, they caution that inflammatory processes can falsely elevate these levels, which underscores the importance of sensitivity analysis in excluding patients with extreme values (>5,000 ng/mL), ensuring the integrity of the assessment of actual iron deficiency in the sample (Foppa et al., 2024; Alberti & Daltro, 2025).

Interpretation of ferritin levels requires caution due to its nature as an acute-phase protein (Foppa et al., 2024). The presence of a patient in the IUD group with ferritin > 5,700 ng/mL skewed the mean but did not invalidate the trend toward improvement observed in the median and in the sensitivity analysis. In this scenario, it is recognized that the concomitant assessment of markers of inflammatory activity, such as C-reactive protein (CRP) or erythrocyte sedimentation rate (ESR), would have aided in the interpretation of this discrepant value, helping to explain the elevated level by suggesting an associated inflammatory component. This approach is supported by Muñoz et al. (2017) and Foppa et al. (2024), whose studies also emphasize the need to rule out inflammatory processes for the accurate estimation of iron stores.

After excluding this outlier, it was confirmed that ferritin levels in the IUD group also showed a positive trend, although the heterogeneity of the response was greater than in the COC group. However, due to the inherent limitations of ferritin as an isolated marker, it is essential that its levels be interpreted with caution, as they may rise in response to systemic inflammatory stimuli, masking potential iron deficiency (Lopez et al., 2016; Pasricha et al., 2021).

This reinforces the clinical need to evaluate the iron profile comprehensively (Hb + Serum Iron + Ferritin), avoiding misdiagnoses based on isolated parameters that may be altered by inflammatory or infectious processes unrelated to ACS (WHO, 2017; Pasricha et al., 2021).

4.5 Quality of life and public health in the northern region

In addition to hematological parameters, effective treatment of AUB plays a key role in promoting quality of life and the socioeconomic reintegration of women in the Northern Region. Excessive bleeding and chronic iron-deficiency anemia are not merely clinical conditions but barriers that limit work capacity, social interaction, and psychological well-being, exerting a substantial impact (Charles et al., 2025; Temuroğlu et al., 2025; Santos et al., 2024).

The ability to reverse anemia through outpatient intervention (IUD or COC), without the need for transfusions or surgical procedures, represents a direct positive impact on local public health. In addition to reducing the fatigue and malaise associated with anemia, it contributes to the restoration of work capacity and quality of life for these women, as well as potentially reducing hospital costs associated with invasive surgical treatments such as hysterectomy (Salazar et al., 2021; Yu et al., 2022; Charles et al., 2025).

According to Bianchi et al. (2022), an improvement in reported quality of life is evident when comparing the levonorgestrel IUD to other medical therapies. Users' high satisfaction with the method, coupled with reduced bleeding and pain, highlights the importance of considering not only objective clinical outcomes but also the subjective impact on patients' well-being. The levonorgestrel IUD offers an effective and well-tolerated therapeutic alternative, avoiding more invasive surgical interventions such as hysterectomy in many cases (Santos et al., 2024; Douligeris et al., 2025).

In the context of public health, the safety of the method broadens its clinical applicability. Buhur and Ünal (2023) highlight that the levonorgestrel IUD is a cost-effective and safe option even for patients with common comorbidities, such as hypertension, diabetes, and thyroid disorders, which often contraindicate the use of COCs (Hassanin et al., 2021).

In this context, the importance of a multidisciplinary approach combined with long-term follow-up of patients with AUBis particularly noteworthy. Given the wide range of underlying causes, appropriate management often requires the integrated involvement of various medical specialties in addition to gynecology. Long-term follow-up is essential to prevent recurrences, reduce future complications, and mitigate the physical and psychological impacts of AUB, thereby establishing a patient-centered care strategy aligned with regional needs (Dickerson et al., 2018; Ramalho, Leite, & Águas, 2021).

4.6 Strengths and limitations of the study

The interpretation of the results should take into account limitations inherent in the study design. The small sample size (n = 30), combined with the observational nature of the study, limits the statistical power to detect smaller differences between groups, increasing the risk of type II error. In this context, the absence of a statistically significant difference in hemoglobin variation between the IUD and COC groups may reflect this limitation, especially given the greater numerical increase observed in the IUD group.

The three-month follow-up period, although sufficient to demonstrate hemoglobin recovery, may not be adequate for a complete assessment of iron stores replenishment, as normalization tends to occur later. Thus, a longer follow-up could reveal additional benefits, particularly in the IUD group, considering the progressive occurrence of amenorrhea associated with the method.

Additionally, a possible selection bias is observed, with the IUD group presenting a worse baseline hematological profile, suggesting its preferential indication in more severe cases. Nevertheless, the achievement of similar final hemoglobin levels between the groups reinforces the method's effectiveness even under unfavorable initial conditions.

Key strengths include the epidemiological relevance of the study population, which comes from a context that is often underrepresented, and the methodological rigor employed, including sensitivity analyses and multivariate models, which contribute to the robustness of the findings.

Finally, the demonstration of the short-term efficacy of both interventions provides support for clinical practice, allowing therapeutic choices to be guided not only by hematologic response but also by individual, clinical, and contextual factors.

5. Conclusion

This study demonstrated that both the levonorgestrel-releasing intrauterine system and combined oral contraceptives (COCs) are effective strategies for managing abnormal uterine bleeding (AUB), promoting significant improvement in hematological parameters in the short term, with increased hemoglobin levels and restoration of iron metabolism.

Despite having worse baseline conditions, the IUD group achieved final hemoglobin levels similar to those of the COC group, reinforcing its effectiveness even in more severe cases. The greater numerical gain observed in this group suggests a potential benefit in patients with greater blood loss.

COC, in turn, proved effective in achieving earlier normalization of serum iron, possibly related to the greater predictability of the initial bleeding pattern. This difference appears to reflect temporal variations in iron recovery rather than superiority between the methods.

The findings highlight the importance of a comprehensive evaluation of hematological markers and the use of sensitivity analyses to enhance the robustness of the results. In the context of Northern Brazil, the data are clinically and publicly health-relevant, as they demonstrate the efficacy of conservative interventions in controlling acute upper gastrointestinal bleeding and reversing anemia.

Finally, it is concluded that the choice between the levonorgestrel IUD and COCs should be individualized, considering clinical characteristics, disease severity, and patient preferences, as both methods are effective as first-line treatments in the conservative management of AUB.

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