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Original Research

Clinical and Paraclinical Characteristics and Risk Factors for Anemia Among Women Undergoing Surgery for Uterine Fibroids at Thai Binh Obstetrics and Gynecology Hospital

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Abstract

Background: Uterine fibroids are the most common benign tumors of the female reproductive tract, predominantly affecting women of reproductive age. Abnormal uterine bleeding associated with fibroids may lead to iron deficiency and anemia, particularly among women with symptomatic disease requiring surgical intervention. However, data on anemia in surgically treated women with uterine fibroids in Vietnam remain limited. This study aimed to describe the demographic, clinical, hematologic, and surgical characteristics of women undergoing surgery for uterine fibroids, and to identify factors associated with anemia in this surgically treated population. **Methods:** This retrospective cross-sectional study was conducted at Thai Binh Obstetrics and Gynecology Hospital, Vietnam. Medical records of women who underwent surgical treatment for uterine fibroids between January and December 2025 were reviewed. Anemia was defined according to World Health Organization criteria for non-pregnant women as a hemoglobin (Hb) concentration below 120 g/L. Clinical, hematologic, fibroid-related, and perioperative variables were analyzed. Between-group comparisons were performed using the chi-square test or Fisher's exact test, as appropriate. Exploratory multivariable logistic regression was performed to identify variables independently associated with anemia. **Results:** A total of 163 women were included. Women aged 40–49 years accounted for 62.6% of the cohort, and 95.1% were multiparous. Overall, 90 women (55.2%) met the diagnostic criteria for anemia, including 19 (11.7%) with mild anemia, 58 (35.6%) with moderate anemia, and 13 (8.0%) with severe anemia. Lower abdominal pain (58.3%) and documented menstrual bleeding abnormalities (45.4%) were the most frequently reported clinical manifestations. Intramural fibroids represented the predominant location (77.3%). Women with anemia more frequently reported menstrual bleeding abnormalities than those without anemia (56.7% vs. 31.5%, $p = 0.001$). In the multivariable model, menstrual bleeding abnormalities were independently associated with anemia (adjusted odds ratio [aOR]: 3.04, 95% confidence interval [CI]: 1.52–6.06, $p = 0.002$). No statistically significant associations were observed for age, fibroid size greater than 80 mm, or submucosal fibroid location after adjustment. **Conclusions:** Anemia was prevalent among women undergoing surgery for uterine fibroids, affecting more than half of this study population. Multivariable analysis identified menstrual bleeding abnormalities as the only independent factor associated with anemia, whereas fibroid size and submucosal fibroid location were not correlate of adjustment. Clinically, these results highlight the value of systematically assessing bleeding symptoms when evaluating anemia risk in women with symptomatic uterine fibroids. Given the retrospective cross-sectional design, single-center setting, and limited number of analyzed variables, the regression findings should be interpreted with caution and treated as hypothesis-generating rather than as evidence of causal relationship.

Keywords: uterine fibroids; leiomyoma; anemia; abnormal uterine bleeding; heavy menstrual bleeding; iron deficiency; hysterectomy

1. Introduction

Uterine fibroids (leiomyomas) are the most common benign tumors of the female reproductive tract, affecting a substantial proportion of women during their reproductive years [1,2,3,4]. Although many fibroids remain asymptomatic, a significant subset of patients develop symptoms that adversely affect quality of life, including abnormal uterine bleeding, pelvic pain, bulk-related symptoms, infertility, and adverse reproductive outcomes [1,2,3,4]. Among these manifestations, abnormal uterine bleeding is one of the most clinically significant, as persistent or excessive menstrual blood loss can result in iron deficiency and anemia, particularly in women with symptomatic disease requiring medical or surgical intervention [5,6,7].

Anemia in the context of uterine fibroids represents a clinically relevant concern [6,8]. Chronic menstrual blood loss may contribute to fatigue, reduced physical functioning, impaired quality of life, and decreased work productivity [6,8]. Furthermore, preoperative anemia has been associated with increased perioperative morbidity, greater transfusion requirements, delayed surgery, prolonged hospitalization, and higher healthcare costs [6,8]. Surgical outcomes in women undergoing myomectomy may further be

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affected by perioperative blood loss and postoperative complications, highlighting the importance of preoperative anemia assessment and optimization [9,10]. Previous studies have shown that abnormal uterine bleeding is among the leading indications for surgical treatment in women with uterine fibroids, particularly when symptoms persist despite conservative management [7,11,12]. Consequently, identifying the clinical characteristics associated with anemia in this surgical population is therefore relevant to perioperative assessment and patient management.

Current international classification systems, particularly the FIGO PALM–COEIN classification (FIGO: International Federation of Gynecology and Obstetrics. PALM–COEIN: classification system Polyp, Adenomyosis, Leiomyoma, Malignancy and hyperplasia–Coagulopathy, Ovulatory dysfunction, Endometrial, Iatrogenic, and Not yet classified), provide a standardized framework for evaluating abnormal uterine bleeding in women of reproductive age [5]. Within this system, leiomyoma-related bleeding constitutes a major structural cause of abnormal uterine bleeding [5,7]. In routine clinical practice, however, especially in retrospective datasets from resource-limited settings, detailed quantification of menstrual blood loss is often unavailable. Clinical records therefore frequently document menstrual abnormalities descriptively, as heavy, prolonged, or irregular menstrual bleeding, rather than through standardized bleeding assessment tools [5].

Several studies have examined factors potentially associated with anemia in women with uterine fibroids, including fibroid size, submucosal localization, and bleeding characteristics [3,6,7]. However, findings remain inconsistent across studies, partly due to differences in study populations, symptom definitions, imaging classifications, and treatment selection criteria [3,6,7]. Furthermore, most available evidence originates from high-income countries, whereas data from Southeast Asia, including Vietnam, remain limited. Surgically treated populations may also differ substantially from conservatively managed patients, as they tend to represent women with more severe symptoms, greater fibroid burden, or failure of prior medical treatment [11,12,13,14,15,16]. In addition, perioperative strategies aimed at minimizing surgical blood loss have become an integral component of contemporary fibroid management [17].

Although the association between abnormal uterine bleeding and anemia is well established [6,7,8], the prevalence and clinical correlates of anemia may vary across healthcare settings and patient populations. Beyond symptom burden, uterine fibroids may carry broader long-term health consequences, emphasizing the need for comprehensive evaluation and management strategies across diverse patient populations [18]. In Vietnam, uterine fibroids are commonly encountered in gynecologic practice, and anemia remains a frequent clinical concern among women undergoing surgery for symptomatic disease. Nevertheless, local data characterizing the demographic, clinical, hematologic, and surgical profiles of these patients remain limited. Such information may help define the spectrum of disease encountered in routine surgical practice and provide a foundation for future multicenter prospective studies incorporating broader range of clinical variables.

As such, the present study aimed to describe the demographic, clinical, hematologic, and surgical characteristics of women undergoing uterine fibroids surgery at Thai Binh Obstetrics and Gynecology Hospital, as well as to explore potential factors associated with anemia in this population. Given the retrospective cross-sectional design, single-center setting, and inherent limitations of medical record data, all multivariable analyses were considered exploratory and hypothesis-generating rather than causal.

2. Materials and Methods

2.1 Study Design and Setting

This retrospective cross-sectional study was conducted at Thai Binh Obstetrics and Gynecology Hospital, a tertiary referral center in northern Vietnam. Medical records of women who underwent surgical treatment for uterine fibroids between January 1, 2025, and December 31, 2025, were reviewed.

The primary objective was to describe the demographic, clinical, hematologic, and surgical characteristics of women undergoing surgery for uterine fibroids. A secondary objective was to explore factors associated with anemia in this population. Due to the retrospective cross-sectional design, all association analyses were considered exploratory and hypothesis-generating rather than causal.

2.2 Study Population

Women were eligible for inclusion if they met all of the following criteria: (1) a diagnosis of uterine fibroids confirmed by clinical evaluation and preoperative ultrasound examination; (2) surgical treatment performed during the study period; and (3) available preoperative hemoglobin (Hb) measurements and sufficiently complete medical records for analysis.

Patients were excluded if they had: (1) known hematologic disorders unrelated to uterine fibroids; (2) gynecologic malignancies; (3) pregnancy or pregnancy-related conditions; or (4) severely incomplete medical records precluding assessment of the study variables.

All eligible patients meeting the inclusion criteria during the study period were consecutively enrolled without additional sampling. A total of 163 women were included in the final analysis. As the study population comprised exclusively surgically treated patients, these findings may not be generalizable to women with uterine fibroids managed conservatively or medically.

2.3 Data Collection

Data were extracted retrospectively from hospital medical records using a standardized data collection form developed specifically for this study. The collected information included demographic characteristics, reproductive history, clinical manifestations, laboratory findings, ultrasound characteristics, anesthesia methods, surgical approaches, and surgical procedures. Data extraction was performed by trained investigators and subsequently reviewed for completeness and consistency prior to statistical analysis.

2.4 Outcome Definition

The primary outcome was anemia status, which was defined according to World Health Organization criteria for non-pregnant women as an Hb concentration of less than 120 g/L [6]. Anemia severity was classified as follows: (1) mild anemia: Hb 110–119 g/L; (2) moderate anemia: Hb 80–109 g/L; or (3) severe anemia: Hb less than 80 g/L [6].

2.5 Study Variables

Demographic variables included age, parity, and documented comorbidities. Clinical variables included menstrual bleeding abnormalities, lower abdominal pain, urinary or gastrointestinal compression symptoms, and clinical signs suggestive of anemia.

For this study, "menstrual bleeding abnormalities" referred to physician-documented abnormal menstrual symptoms recorded in the medical records, including heavy, prolonged, or irregular menstrual bleeding. Given the retrospective nature of the study design, validated bleeding assessment tools and detailed FIGO PALM–COEIN subclassifications of abnormal uterine bleeding were not consistently available and therefore could not be applied uniformly [5]. Clinical signs suggestive of anemia were defined as physician-documented pallor recorded during routine physical examination.

Fibroid-related variables included the maximum diameter of the largest fibroid and the predominant fibroid location identified on preoperative ultrasound examination. Predominant fibroid location was classified as submucosal, intramural, or subserosal based on ultrasound findings [3].

For descriptive analyses, fibroid size was categorized as: (1) less than 50 mm; (2) 50–80 mm; or (3) greater than 80 mm.

For multivariable logistic regression, fibroid size was dichotomized as greater than 80 mm versus 80 mm or less to reduce sparse subgroup categories and improve model stability given the limited sample size.

Several potentially relevant variables, including body mass index (BMI), ferritin concentration, serum iron indices, duration and severity of menstrual bleeding, number of fibroids, hormonal status, medication history, and preoperative medical treatment, were unavailable or incompletely documented in a substantial proportion of medical records and could not be included in the multivariable model.

2.6 Statistical Analysis

Statistical analyses were performed using SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies (n) and percentages (%). Continuous variables were assessed for normality using the Shapiro–Wilk test and summarized as means and standard deviations (SDs) or medians and interquartile ranges (IQR), as appropriate. Comparisons between women with and without anemia were performed using the chi-square test or Fisher's exact test for categorical variables. Variables considered clinically relevant and/or associated with anemia in univariable analyses were selected for inclusion in the exploratory multivariable logistic regression model. Following database verification and correction of fibroid location classification, all regression analyses were repeated using the audited dataset. Clinical signs suggestive of anemia were excluded from the regression model, as pallor is a clinical manifestation closely associated with the outcome of anemia itself and was therefore not considered an independent predictor. Given the limited sample size and number of anemia events, the final model was intentionally restricted to a limited number of predictors to reduce the risk of overfitting. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were reported. Age was analyzed as a continuous variable to preserve statistical power and avoid the loss of power associated with categorization. The linearity assumption between age and the log odds of anemia was assessed and considered acceptable prior to model inclusion. Potential multicollinearity among predictor variables was evaluated using variance inflation factors (VIFs), and no clinically significant multicollinearity was identified. As the analyses were exploratory in nature, no formal adjustment for multiple comparisons was applied. A two-sided p-value < 0.05 was considered statistically significant.

2.7 Missing Data

Only patients with available preoperative Hb measurements and sufficiently complete clinical records were included. Several variables of potential clinical interest, including ferritin concentration, serum iron indices, BMI, duration and severity of menstrual bleeding, hormonal status, number of fibroids, medication history, and preoperative medical treatment, were incompletely recorded and therefore could not be analyzed reliably. Consequently, these variables were excluded from the multivariable model.

3. Results

3.1 Baseline Demographic and Reproductive Characteristics

A total of 163 women undergoing surgery for uterine fibroids were included in the study. Women aged 40–

49 years constituted the largest proportion of the cohort (62.6%), whereas those younger than 40 years represented 11.7% of cases. The majority of patients were multiparous (95.1%). Comorbid conditions were documented in 16.6% of women (Table 1).

Table 1. Baseline demographic and reproductive characteristics of the study population (n = 163).

Characteristics	n	%
Age group (years)		
<40	19	11.7
40–49	102	62.6
≥50	42	25.8
Parity		
Nulliparous	8	4.9
Multiparous	155	95.1
Comorbidities		
No	136	83.4
Yes	27	16.6

Values are presented as n (%). Percentages may not sum to exactly 100% due to rounding.

3.2 Clinical and Hematologic Characteristics

Lower abdominal pain was the most frequently reported symptom (58.3%), followed by menstrual bleeding abnormalities (45.4%). A palpable abdominal mass was detected on clinical examination in all patients. Clinical signs suggestive of anemia were observed in 34.4% of patients.

According to World Health Organization criteria for non-pregnant women, 55.2% of patients met the diagnostic criteria for anemia. Moderate anemia (Hb: 80–109 g/L) was the most common severity category (35.6%), whereas mild and severe anemia accounted for 11.7% and 8.0% of cases, respectively.

Regarding fibroid characteristics, tumors measuring 50–80 mm represented the largest size subgroup (54.0%). Intramural fibroids represented the predominant location (77.3%), followed by submucosal (14.1%) and subserosal fibroids (8.6%) (Table 2).

3.3 Surgical Characteristics and Perioperative Management

Spinal anesthesia was administered in 60.1% of patients and general anesthesia in 39.9%. Open surgery was the predominant surgical approach (61.3%), whereas laparoscopy was performed in 37.4% of women. Conversion from laparoscopic to open surgery occurred in 2 patients (1.2%). Total hysterectomy was the most frequently performed procedure (61.3%), followed by subtotal hysterectomy (25.2%) and myomectomy (13.5%) (Table 3). A detailed cross-tabulation of surgical procedures according to surgical approach is provided in **Supplementary Table 2**.

Table 2. Clinical, hematologic, and fibroid characteristics of women with uterine fibroids (n = 163).

Variables	n	%
Clinical presentation		
Menstrual bleeding abnormalities	74	45.4
Lower abdominal pain	95	58.3
Palpable abdominal mass	163	100.0
Urinary or digestive symptoms	26	16.0
Clinical signs suggestive of anemia	56	34.4
Hb category		
≥120 g/L (no anemia)	73	44.8
110–119 g/L (mild anemia)	19	11.7
80–109 g/L (moderate anemia)	58	35.6
<80 g/L (severe anemia)	13	8.0
Fibroid characteristics		
Largest tumor size		
<50 mm	42	25.8
50–80 mm	88	54.0
>80 mm	33	20.2
Predominant fibroid location		
Submucosal	23	14.1
Intramural	126	77.3
Subserosal	14	8.6

Values are presented as n (%). Anemia was defined according to World Health Organization criteria for non-pregnant women as an Hb concentration of less than 120 g/L. "Menstrual bleeding abnormalities" refers to physician-documented abnormal menstrual symptoms recorded in the medical records, including heavy, prolonged, or irregular menstrual bleeding. Tumor size was determined as the maximum diameter of the largest fibroid identified on preoperative ultrasound examination. Hb, hemoglobin.

3.4 Comparison Between Women With and Without Anemia

Women with anemia more frequently reported menstrual bleeding abnormalities than those without anemia (56.7% vs. 31.5%, $p = 0.001$). Clinical signs suggestive of anemia were also significantly more common among women with anemia than in those without (57.8% vs. 5.5%, $p < 0.001$). No statistically significant between-group differences were identified with respect to age group ($p = 0.313$), lower abdominal pain ($p = 0.885$), largest tumor size ($p = 0.347$), or predominant fibroid location ($p = 0.110$) (Table 4).

3.5 Multivariable Logistic Regression Analysis

Univariable (crude) logistic regression analysis of variables associated with anemia is presented in **Supplementary Table 1**. In the exploratory multivariable logistic regression analysis, documented menstrual bleeding abnormalities were independently associated with anemia (aOR: 3.04, 95% CI: 1.52–6.06, $p = 0.002$). No statistically signif-

Table 3. Surgical characteristics and perioperative management (n = 163).

Variables	n	%
Anesthesia type		
Spinal anesthesia	98	60.1
General anesthesia	65	39.9
Surgical approach		
Open surgery	100	61.3
Laparoscopy	61	37.4
Conversion to open surgery	2	1.2
Surgical procedure		
Total hysterectomy	100	61.3
Subtotal hysterectomy	41	25.2
Myomectomy	22	13.5

Values are presented as n (%). Surgical approach and surgical procedure represent separate clinical domains and may overlap within the same patients. Conversion to open surgery refers to cases initially performed laparoscopically that were subsequently converted intraoperatively.

Table 4. Comparison of demographic and clinical characteristics between women with and without anemia.

Variables	Anemia (n = 90) n (%)	No anemia (n = 73) n (%)	*p*-value	χ^2
Age group			0.313	2.32
<40 years	9 (10.0)	10 (13.7)		
40–49 years	61 (67.8)	41 (56.2)		
≥50 years	20 (22.2)	22 (30.1)		
Menstrual bleeding abnormalities			0.001	10.29
Yes	51 (56.7)	23 (31.5)		
No	39 (43.3)	50 (68.5)		
Lower abdominal pain			0.885	0.02
Yes	52 (57.8)	43 (58.9)		
No	38 (42.2)	30 (41.1)		
Largest tumor size			0.347	2.11
<50 mm	27 (30.0)	15 (20.5)		
50–80 mm	47 (52.2)	41 (56.2)		
>80 mm	16 (17.8)	17 (23.3)		
Predominant fibroid location			0.110	4.41
Intramural	73 (81.1)	53 (72.6)		
Submucosal	13 (14.4)	10 (13.7)		
Subserosal	4 (4.4)	10 (13.7)		
Clinical signs suggestive of anemia			<0.001	—
Absent	38 (42.2)	69 (94.5)		
Present	52 (57.8)	4 (5.5)		

Values are presented as n (%). Anemia was defined as an Hb concentration of less than 120 g/L according to World Health Organization criteria for non-pregnant women. *p*-values were calculated using the chi-square test or Fisher's exact test, as appropriate. A two-sided *p*-value of less than 0.05 was considered statistically significant.

icant associations were observed for tumor size greater than 80 mm (aOR: 0.87, 95% CI: 0.39–1.94, $p = 0.734$), submucosal fibroid location (aOR: 0.68, 95% CI: 0.26–1.78, $p = 0.430$), or age (aOR: 0.99 per one-year increase, 95% CI: 0.94–1.05, $p = 0.708$) after adjustment (Table 5).

4. Discussion

In this retrospective cross-sectional study of women undergoing surgery for uterine fibroids, anemia was highly prevalent, affecting more than half of the study population. Most cases were moderate in severity (35.6%), although mild (11.7%) and severe anemia (8.0%) were also identified. In the multivariable model, menstrual bleeding abnormalities remained the only variable independently associated with anemia, whereas age, fibroid size, and submucosal fibroid location were not significantly associated after adjustment.

The high prevalence of anemia observed in this cohort is clinically relevant. Uterine fibroids are a well-recognized cause of abnormal uterine bleeding, particularly heavy or prolonged menstrual bleeding, which may lead to chronic iron loss and progressive depletion of iron stores [6,7]. Prior studies have reported that anemia is common among women with symptomatic fibroids and may contribute to reduced quality of life, impaired physical functioning, increased perioperative risk, and greater healthcare utilization [6,8]. The relatively high prevalence in the present study may partly reflect the nature of the study population, as all women underwent surgical treatment and therefore likely represented cases with more severe symptoms or greater disease burden than those managed conservatively [11,14,16].

Menstrual bleeding abnormalities were significantly associated with anemia in both univariable and multivariable analyses. This finding is biologically plausible and consistent with the established pathophysiological relationship between abnormal uterine bleeding and iron-deficiency anemia [5,6,7]. Recurrent menstrual blood loss may exceed the body's capacity for iron replacement, resulting in progressive reductions in Hb levels over time [6]. Although this association is well documented in the literature, the present findings contribute data from a Vietnamese surgical population, a context in which published evidence remains limited. In the multivariable model, women with menstrual bleeding abnormalities had approximately threefold higher odds of anemia compared with those without such symptoms (aOR: 3.04, 95% CI: 1.52–6.06). Due to the retrospective design of the study, this association should

Table 5. Exploratory multivariable logistic regression analysis of variables associated with anemia.

Variables	β	SE	Wald χ^2	aOR	95% CI	*p*-value
Menstrual bleeding abnormalities (Yes vs. No)	1.1112	0.3520	9.9691	3.04	1.52–6.06	0.002
Tumor size (>80 mm vs. ≤80 mm)	−0.1389	0.4095	0.1151	0.87	0.39–1.94	0.734
Submucosal fibroid location (Yes vs. No)	−0.3879	0.4914	0.6232	0.68	0.26–1.78	0.430
Age (per 1-year increase)	−0.0106	0.0282	0.1406	0.99	0.94–1.05	0.708

aORs and 95% CIs were estimated using multivariable logistic regression analysis performed on the audited final dataset (n = 163), including 90 women with anemia and 73 women without anemia. Variables were selected based on clinical relevance and univariable screening. Age was analyzed as a continuous variable to preserve statistical information and avoid loss of power associated with categorization. Given the retrospective design and limited sample size, the regression model should be regarded as exploratory and hypothesis-generating rather than causal. aOR, adjusted odds ratio; CI, confidence interval.

be interpreted as an epidemiological correlation rather than evidence of causality.

Interestingly, fibroid size and submucosal location were not independently associated with anemia after multivariable adjustment. Notably, women with anemia appeared more likely to have fibroids smaller than 50 mm (30.0% vs. 20.5%) and less likely to have fibroids larger than 80 mm (17.8% vs. 23.3%), although this difference did not reach statistical significance. This pattern differs from the conventional expectation that larger fibroids are associated with greater bleeding burden. One possible explanation is that fibroid size alone may not adequately reflect bleeding risk, which may depend more on factors such as fibroid location, vascularity, degree of endometrial distortion, or individual bleeding patterns. Given the absence of statistical significance and the limited sample size, this observation warrants cautious interpretation and requires confirmation in larger studies. These findings differ from several prior reports suggesting that larger fibroids and submucosal lesions are associated with greater bleeding burden and increased anemia risk [3,7,11]. Several factors may account for this discrepancy. First, fibroids in the present study were classified according to the predominant ultrasound-determined location rather than detailed FIGO subclassification, which may have reduced the ability to detect location-specific effects [3]. Second, only the largest fibroid diameter was recorded, whereas cumulative fibroid burden, total uterine volume, and the presence of multiple lesions were not consistently available in the medical records. Third, the modest sample size and limited number of patients within certain subgroups may have reduced statistical power to detect weaker associations.

Therefore, the absence of statistical significance in this analysis should not be interpreted as evidence that fibroid morphology is unrelated to anemia.

These findings suggest that symptom burden, particularly bleeding-related symptoms, may be more closely associated with anemia status than the anatomical fibroid characteristics examined in this study. This interpretation warrants caution, however, as menstrual bleeding abnormalities were documented from routine clinical records rather than standardized bleeding assessment tools, and only a limited number of fibroid-related variables were available for analysis [5]. Future studies incorporating validated measures of menstrual blood loss may help clarify the relative contributions of bleeding symptoms and fibroid morphology to anemia risk [5,7].

Clinical signs suggestive of anemia were more frequently documented in women with laboratory-confirmed anemia. In this cohort, such signs were recorded in 57.8% of women with anemia compared with 5.5% of those without. Although physical examination findings such as pallor may assist in clinical assessment, they cannot reliably confirm or exclude a diagnosis of anemia. This observation supports the importance of routine Hb measurement in women presenting with symptomatic uterine fibroids, particularly those reporting abnormal menstrual bleeding [6,8].

The surgical characteristics observed in this cohort reflect routine clinical practice at a tertiary obstetrics and gynecology referral center. Open surgery and total hysterectomy were the most frequently performed procedures, likely reflecting referral patterns and the inclusion of women with symptomatic disease requiring definitive surgical management [11,16]. The present study was not designed to compare surgical approaches or evaluate perioperative outcomes; accordingly, no conclusions regarding treatment effectiveness should be performed.

Limitations

Several limitations should be acknowledged. First, the retrospective cross-sectional design limits causal inference and is susceptible to information bias inherent to routinely collected medical records. Second, the inclusion of only surgically treated patients from a single institution introduces potential selection bias and limits generalizability to women managed medically or conservatively [12,13,14,15,16]. Third, several clinically important variables, such as iron levels, BMI, duration and severity of menstrual bleeding, medication history, hormonal status, number of fibroids, and preoperative iron supplementation or medical treatment for uterine fibroids, were incompletely documented and therefore could not be incorporated into

the multivariable model. Fourth, menstrual bleeding abnormalities were identified from clinical documentation and were not quantified using standardized bleeding assessment instruments [5]. Finally, the regression model should be regarded as exploratory given the limited sample size and restricted number of available covariates; residual confounding cannot be excluded.

Despite these limitations, the present study provides useful descriptive data on the burden of anemia among women undergoing surgery for uterine fibroids in a Vietnamese tertiary care setting. These findings contribute to the limited regional literature and support routine evaluation for anemia in women presenting with symptomatic fibroids [4,6]. Future multicenter prospective studies incorporating standardized bleeding assessments, iron status measurements, and detailed FIGO fibroid classification are needed to further characterize the determinants of anemia in this population [3,5].

5. Conclusions

Anemia was prevalent among women undergoing surgery for uterine fibroids, affecting more than half of the cohort. Menstrual bleeding abnormalities were independently associated with anemia, whereas age, fibroid size, and submucosal fibroid location were not significantly associated after adjustment in the exploratory multivariable model. Given the retrospective cross-sectional design and limitations of available clinical data, these findings should be interpreted with caution and do not establish evidence of causality. Nevertheless, these results underscore the importance of evaluating menstrual symptoms and preoperative Hb status in women with symptomatic uterine fibroids. Larger prospective studies incorporating more comprehensive clinical variables are warranted to further characterize the determinants of anemia in this population.

Availability of Data and Materials

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional data governance policies.

Author Contributions

VHN conceived and designed the study, collected and analyzed the data, interpreted the results, and drafted the manuscript. TKN and MTB contributed to study design, interpretation of findings, supervision of the research process, and critical revision of the manuscript for important intellectual content. BLAD, TKLP, HHV, MQH, TTN, and MTN contributed to data collection, data verification, literature review, and manuscript preparation. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study protocol was reviewed and approved by the Scientific and Ethical Committee of Thai Binh University of Medicine and Pharmacy (Approval No.: 2337/QĐ-YDTB, No. 10/GCN-HĐĐĐ-YDTB) and was authorized by Thai Binh University of Medicine and Pharmacy. As the study used retrospectively collected, anonymized medical record data, the requirement for individual informed consent was waived by the institutional ethics committee. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki and applicable national regulations governing biomedical research.

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Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used ChatGPT-5 for English language editing, grammar checking, and manuscript polishing. After using this tool, the authors carefully reviewed, revised, and verified all content and took full responsibility for the accuracy and integrity of the manuscript.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/CEOG53461.

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