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Prevalence and Associated Factors of Perioperative Blood Transfusion in Patients Undergoing Laparoscopic Hysterectomy for Benign Gynecologic Conditions

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ABSTRACT

Objectives: To determine the prevalence and the associated factors of perioperative blood transfusion and to evaluate the efficiency of blood ordering and utilization in patients undergoing laparoscopic hysterectomy for benign gynecologic conditions.

Materials and Methods: A cross-sectional retrospective study was conducted. The medical records of 974 patients who underwent laparoscopic hysterectomy for benign gynecologic conditions from July 2016 through October 2022 were reviewed. The possible associated factors for blood transfusion including demographic data, clinical diagnosis, preoperative and intraoperative data were retrieved and evaluated. Blood utilization indicators such as crossmatch-to-transfusion ratio (C/T ratio), transfusion index (TI), and transfusion probability (%T) were also calculated.

Results: The overall perioperative transfusion rate was 19.4% (189/974). In multivariable regression analysis, patients who had preoperative anemia (adjusted odds ratio (aOR) 6.89; 95% confidence interval (CI) 4.56-10.43), estimated blood loss ≥ 300 milliliters (aOR 8.64; 95%CI 5.46-13.69), uterine size ≥ 500 grams (aOR 1.99; 95%CI 1.23-3.20) and presence of pelvic adhesion (aOR 2.01; 95%CI 1.31-3.09) were independently associated with perioperative blood transfusion. Moreover, natural orifice trans-luminal endoscopic surgery trended towards a lower blood transfusion rate than total laparoscopic hysterectomy (aOR 0.43; 95%CI 0.21-0.89). For blood utilization indicators: C/T ratio was 6.15, TI was 0.35, and %T was 19.4%.

Conclusion: Preoperative anemia, higher blood loss, large uterine size, and pelvic adhesion were transfusion risk factors in patients undergoing laparoscopic hysterectomy. Blood utilization indicators were low, indicating that routine blood crossmatching might be unnecessary for all patients.

Keywords: packed red cell transfusion, transfusion rate, blood utilization, minimally invasive surgery.

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ความชุกและปัจจัยที่มีความสัมพันธ์กับการให้เลือดช่วงระยะการผ่าตัดในผู้ป่วยที่เข้ารับการผ่าตัดมดลูกผ่านกล้องเนื่องจากภาวะทางนรีเวชที่ไม่ใช่มะเร็ง

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บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาความชุกและปัจจัยที่มีความสัมพันธ์กับการให้เลือดช่วงระยะการผ่าตัด และประเมินความเหมาะสมในการจองเลือดและความคุ้มค่าในการใช้เลือด ในผู้ป่วยที่เข้ารับการผ่าตัดมดลูกผ่านกล้องเนื่องจากภาวะทางนรีเวชที่ไม่ใช่มะเร็ง*

วัสดุและวิธีการ: *การศึกษาข้อมูลจุดเวลาใดเวลาหนึ่งแบบย้อนหลัง แบบบันทึกข้อมูลทางการแพทย์ของผู้ป่วยจำนวน 974 คนที่เข้ารับการผ่าตัดมดลูกผ่านกล้องเนื่องจากภาวะทางนรีเวชที่ไม่ใช่มะเร็ง ตั้งแต่เดือนกรกฎาคม พ.ศ.2559 จนถึงเดือนตุลาคม พ.ศ.2565 ได้รับการทบทวน โดยปัจจัยที่เป็นไปได้ที่จะมีความสัมพันธ์กับการให้เลือดช่วงระยะการผ่าตัด รวมถึงข้อมูลทั่วไป การวินิจฉัยทางคลินิก ข้อมูลก่อนการผ่าตัด และข้อมูลการผ่าตัดได้รับการเก็บข้อมูลและประเมิน ตัวบ่งชี้ความคุ้มค่าในการใช้เลือด เช่น crossmatch-to-transfusion ratio (C/T ratio), transfusion index (TI), และ transfusion probability (%T) ได้รับการคำนวณร่วมด้วย*

ผลการศึกษา: *ความชุกของการให้เลือดทั้งหมดเท่ากับร้อยละ 19.4 (189/974) การวิเคราะห์แบบถดถอยพหุตัวแปร (multivariable regression) พบว่าผู้ป่วยที่มีภาวะซีดก่อนผ่าตัด (aOR 6.89; 95%CI 4.56-10.43) ปริมาณการเสียเลือดมากกว่าหรือเท่ากับ 300 มิลลิลิตร (aOR 8.64; 95%CI 5.46-13.69) มดลูกขนาดใหญ่มากกว่าหรือเท่ากับ 500 กรัม (aOR 1.99; 95%CI 1.23-3.20) และการมีพังผืดในอุ้งเชิงกราน (aOR 2.01; 95%CI 1.31-3.09) เป็นปัจจัยที่มีความสัมพันธ์กับการให้เลือดช่วงระยะการผ่าตัด นอกจากนี้การผ่าตัดมดลูกผ่านทางช่องธรรมชาติใช้การส่องกล้องแบบไร้แผล (Natural Orifice Transluminal Endoscopic Surgery; NOTES) มีแนวโน้มให้เลือดต่ำเมื่อเทียบกับการผ่าตัดมดลูกใช้การส่องกล้องทั้งหมด (Total Laparoscopic Hysterectomy; TLH) (aOR 0.43; 95%CI 0.21-0.89) สำหรับตัวบ่งชี้ความคุ้มค่าในการใช้เลือด C/T ratio เท่ากับ 6.15, TI เท่ากับ 0.35, และ %T เท่ากับร้อยละ 19.4*

สรุป: *ภาวะซีดก่อนผ่าตัด ปริมาณการเสียเลือดมาก มดลูกขนาดใหญ่ และการมีพังผืดในอุ้งเชิงกราน เป็นปัจจัยที่มีความสัมพันธ์กับการให้เลือดในผู้ป่วยที่เข้ารับการผ่าตัดมดลูกผ่านกล้อง ตัวบ่งชี้ความคุ้มค่าในการใช้เลือดต่ำ บ่งชี้ถึงการเตรียมเลือดแบบ crossmatch อาจจะไม่จำเป็นสำหรับผู้ป่วยทุกราย*

คำสำคัญ: *การให้ส่วนประกอบเม็ดเลือดแดง, อัตราการให้เลือด, ความคุ้มค่าในการใช้เลือด, การผ่าตัดมดลูกผ่านกล้อง*

Introduction

Hysterectomy is the most common gynecological operation, which has an incidence of 180-351 cases per 100,000 person-years[1, 2]. Laparoscopic hysterectomy (LH), the less invasive alternative method to laparotomy, is now widely used, and the rate is increasing[2-4]. This is due to several reasons, including a smaller surgical wound, less postoperative pain, faster return to regular activities[5], lower blood loss and reducing perioperative complications when compared to laparotomy[6]. While laparoscopic hysterectomy was safe, it still carried the risk of bleeding that a blood transfusion was required, similar to other surgical procedures. According to previous studies, the incidence of blood transfusion in laparoscopic hysterectomy was 1.2-5.2%[7, 8], which was lower than the incidence of blood transfusion in all hysterectomy surgeries (2.7-11.2%)[7-10]. Although the incidence of perioperative blood transfusion was quite low, it was important to be aware of several adverse sequelae associated with blood transfusions, such as adverse reactions, bloodborne infection, thromboembolic events, and sepsis[9].

A number of retrospective studies had addressed the several factors associated with blood transfusion in patients undergoing total hysterectomy, such as low preoperative hemoglobin/hematocrit levels, higher mean estimated blood loss, large uterine weight, obesity, prolonged operative time and patients with uterine fibroids[7, 8, 10, 11]. Moreover, one retrospective study found a significant association between pelvic adhesion and perioperative blood transfusion in patients who underwent total laparoscopic hysterectomy[7]. Most of previous research reported the incidence and relevant risk factors of blood transfusion in all patients undergoing hysterectomy, regardless of any route. However, there is a paucity of studies on transfusion rate and risk factors of blood transfusion in patients undergoing laparoscopic hysterectomy.

Generally, there are two standard methods for blood preparation, the first one is type and screen and the second one is crossmatching. In our institution, only crossmatching method is currently used for blood preparation and transfusion in gynecologic surgery. However, several studies found that blood ordering and utilization are still inefficient and need to be improved[12-14]. Furthermore, a previous study had shown that the type and screen method, which determined the blood type using the ABO and Rh group systems, was not only safe but also more cost-effective compared to crossmatching[15].

The primary objective of this study was to determine the prevalence of perioperative blood transfusion in patients undergoing laparoscopic hysterectomy of benign conditions. The second objectives were to identify the associated factors for perioperative blood transfusion and to evaluate the efficiency of blood ordering and utilization. The blood utilization indicators were crossmatch-to-transfusion ratio (C/T ratio), transfusion index (TI), and transfusion probability (%T).

Materials and Methods

After obtaining Bangkok Metropolitan Administration (BMA) Human Research Ethics Committee (BMAHREC) approval, a cross-sectional retrospective chart review was conducted at Charoenkrung Pracharak Hospital. The patients who had undergone elective laparoscopic hysterectomy for benign gynecological indication between July 1, 2016 and October 31, 2022 were included. The patients who had a bleeding disorder or were converted to laparotomy were excluded. The patients whose

pathology reports provided the definitive cancer diagnosis were also excluded.

A total of 974 patients elective laparoscopic hysterectomy for benign gynecological indication were enrolled and reviewed. Of these patients, those who required perioperative blood transfusions were considered case or transfusion group. On the other hand, those who did not require any transfusion were considered control group or non-transfusion group.

The medical records were reviewed to determine the prevalence of blood transfusion. Patient demographic data, preoperative comorbidities, and perioperative data were retrieved. Variables included age, parity, body mass index (BMI), past medical history (history of diabetes mellitus and hypertension), smoking status, preoperative hemoglobin/hematocrit level, preoperative platelet count, anticoagulant/ antiplatelet use, history of previous abdominal surgery, and American society of anesthesiologists classification (ASA class) were obtained. The types of hysterectomy procedure were classified into total laparoscopic hysterectomy (TLH), laparoscopic assisted vaginal hysterectomy (LAVH), and natural orifice transluminal endoscopic surgery (NOTES). Perioperative variables included surgeon experience, surgical indication, concomitant adnexal surgery, uterine size, pelvic adhesion, endometriosis, estimated blood loss (EBL), operative time, major complications (include bowel injury, ureteric/bladder injury and vascular injury), and length of hospital stay were evaluated.

In our institution, the decision of perioperative blood transfusion depended on the transfusion trigger of the patients' hematocrit levels less than 30%[16]. The decision to give blood transfusion relied on many factors such as preoperative hemoglobin and hematocrit levels, the amount of estimated intraoperative blood loss (EBL), intraoperative hemodynamic changes, and signs of organ ischemia. These determinations are made based on the clinical judgment and expertise of the attending surgeon.

To determine the efficiency of blood ordering and utilization, blood utilization indicators such as crossmatch-to-transfusion ratio (C/T ratio), transfusion index (TI), and transfusion probability (%T) were also calculated. The C/T ratio represented the ratio of blood crossmatching units to the number of transfused blood units. The C/T ratio greater than 2.5 suggests that less than 40% of the crossmatched units were used. The TI represented the number of transfused blood units per number of patients crossmatched, a value of 0.5 or more of TI indicated a substantial blood utilization during surgery. Lastly, the %T signified the percentage of patients who received transfusions among those who underwent crossmatching. The %T of more than 30 indicated a significant need for blood during surgery[16] while a %T below 30 was associated with a reduced transfusion risk and was recommended for type and screen method.

Statistical analysis

The data analysis was performed using IBM SPSS version 26 software. Continuous variables were computed and presented as means with standard deviations or medians with an interquartile range where appropriate. Categorical variables were presented as numbers with percentages. Patient demographic data, preoperative comorbidities, and perioperative data were compared across an incidence of packed red blood cell transfusion using chi-square, independent t-tests, Fisher's exact test and Mann-Whitney U tests where appropriate. A p value of < 0.05 was considered statistically significant. Multivariable logistic regression modeling identified independent variables associated with perioperative transfusion and presented as adjusted odds ratio (aOR) with 95% confidence intervals (CI). A two-tailed p value < 0.05 was considered statistically significant.

Results

A total of 974 hysterectomies were recruited during the study period. Among these, 516 (53%) were TLH, 325 (33.4%) LAVH, and 133 (13.6%) NOTES hysterectomy. The overall perioperative transfusion rate was 19.4% (189/974). The transfusion group consists of 189 patients who had a blood transfusion. The non-transfusion group consists of 785 patients

who did not receive a blood transfusion.

Patient demographic and preoperative data between transfusion group and non-transfusion group were compared and shown in Table 1. Baseline characteristic of age, body mass index, parity, past medical history, smoking status, anticoagulant and antiplatelet use, thrombocytopenia, ASA class and previous abdominal surgery were not different between the two groups. Patients in transfusion group were more likely to have lower hemoglobin (10.45 vs 12.16 g/dl, p < 0.001), lower hematocrit level (32.69 vs 37.01%, p < 0.001) and had anemia (75.1 vs 37.2%, p < 0.001) when compared to non-transfusion group.

Table 1. Comparison of demographic and preoperative data between transfusion and non-transfusion groups.

Variables	Non-transfusion n = 785	Transfusion n = 189	p value
Age (years), mean ± SD	45.07 ± 9.05	45.02 ± 6.76	0.925
BMI (kg/m^2), mean ± SD	24.91 ± 4.73	24.08 ± 4.42	0.028
BMI, n (%)			0.212
Underweight	34 (4.3)	13 (6.9)	
Normal	281 (35.8)	67 (35.4)	
Overweight	141 (18.0)	41 (21.7)	
Obesity	329 (41.9)	68 (36.0)	
Parity, n (%)			0.113
Nulliparous	315 (40.1)	64 (33.9)	
Multiparity	470 (59.9)	125 (66.1)	
Past medical history, n (%)			
Diabetes	76 (9.7)	19 (10.1)	0.877
Hypertension	165 (21)	30 (15.9)	0.112
Smoker, n (%)	14 (1.8)	4 (2.1)	0.764
Anticoagulant/Antiplatelet use, n (%)	22 (2.8)	1 (0.5)	0.065
Previous abdominal surgery*, n (%)	323 (41.1)	92 (48.7)	0.060
Hemoglobin (g/dl), mean ± SD	12.16 ± 1.17	10.45 ± 1.72	< 0.001
Hematocrit (%), mean ± SD	37.01 ± 3.07	32.69 ± 4.43	< 0.001
Anemia, n (%)	292 (37.2)	142 (75.1)	< 0.001
Thrombocytopenia, n (%)	5 (0.6)	1 (0.5)	0.999
ASA classification, n (%)			0.615
1	423 (53.9)	98 (51.9)	
≥ 2	362 (46.1)	91 (48.1)	

SD: standard deviation, BMI: body mass index, ASA: American society of anesthesiologists
Anemia: hematocrit < 36%, Thrombocytopenia: platelet count < 150 x10^3/uL,
* Previous abdominal surgery included cesarean section, tubal sterilization, laparotomy, laparoscopy (uterine or adnexal surgery) and non-gynecologic surgery

Surgical and intraoperative data between two groups were compared and shown in Table 2. Uterine fibroid was the most common indication for hysterectomy (55.9%) and TLH was the most common route of surgery (53%). In the bivariable analysis, the factors such as surgical indication (p = 0.009), route of surgery (p = 0.006) were significantly different between the two groups. Moreover, the transfusion group were likely to have larger uterine size (370 vs 230 gm, p < 0.001), longer operative time (205 vs 162 min, p < 0.001), more

EBL (600 vs 150 ml, p < 0.001), presence of pelvic adhesion (52.4 vs 32%, p < 0.001) and presence of endometriosis (24.3 vs 15.5%, p = 0.004) than the non-transfusion group. However, there was no significant difference in surgeon experience and concomitant adnexal surgery between two groups. In this study, the three most common complications in our study were bowel injury (1.03%), followed by ureteric/bladder injury (0.72%) and vascular injury (0.31%).

Table 2. Comparison of surgical and intraoperative data between transfusion and non-transfusion groups.

Variables	Non-transfusion n = 785	Transfusion n = 189	p value
Experience, n (%)			0.765
Fellow	147 (18.7)	30 (15.9)	
Staff < 3 years	98 (12.5)	26 (13.8)	
Staff 3-5 years	108 (13.8)	29 (15.3)	
Staff > 5 years	432 (55.0)	104 (55.0)	
Indication, n (%)			0.009
Uterine fibroids	425 (54.1)	119 (63.0)	
Endometriosis/Adenomyosis	204 (26.0)	50 (26.5)	
Other	156 (19.9)	20 (10.6)	
Route, n (%)			0.006
TLH	414 (52.7)	102 (54.0)	
LAVH	251 (32.0)	74 (39.2)	
NOTES	120 (15.3)	13 (6.9)	
Size (gm), median (range)	230 (15-2800)	370 (10-5300)	< 0.001
Size (gm)			< 0.001
< 500	655 (83.4)	122 (64.6)	
≥ 500	130 (16.6)	67 (35.4)	
Time (min), mean ± SD	162.19 ± 62.68	205.95 ± 65.44	< 0.001
Time (min), n (%)			< 0.001
< 180	513 (65.4)	70 (37.0)	
≥ 180	272 (34.6)	119 (63.0)	
EBL (ml), median (range)	150 (10-1400)	600 (10-3000)	< 0.001
EBL (ml), n (%)			< 0.001
< 300	547 (69.7)	38 (20.1)	
≥ 300	238 (30.3)	151 (79.9)	
Pelvic adhesion, n (%)	251 (32.0)	99 (52.4)	< 0.001
Endometriosis, n (%)	122 (15.5)	46 (24.3)	0.004
Concomitant adnexal surgery, n (%)	732 (93.2)	179 (94.7)	0.464
Admission day (days), median (range)	3 (2-15)	4 (2-34)	< 0.001
Major complication*, n (%)	12 (1.5)	8 (4.2)	0.024

TLH: total laparoscopic hysterectomy, LAVH: laparoscopic assisted vaginal hysterectomy, NOTES: natural orifice translumenal endoscopic surgery, EBL: estimated blood loss, SD: standard deviation
*Major complication included bladder injury, ureteric injury, bowel injury and vascular injury

Multivariable logistic regression analysis identified the independent factors associated with blood cell transfusion, as demonstrated in Table 3. According to EBL, the patients who had EBL ≥ 300 milliliters were strongest associated with increased perioperative blood transfusion (aOR 8.64; 95%CI 5.46-13.69). As for preoperative variables, it was observed that only preoperative anemia, defined as a hematocrit level below 36%, was significantly associated with an increased transfusion rate (aOR 6.89; 95%CI 4.56-10.43). There was a trend towards a decreased risk of blood transfusion associated with NOTES hysterectomy when compared to TLH (aOR 0.43; 95%CI 0.21-0.89). Additionally, patients with pelvic adhesion (aOR 2.01; 95%CI 1.31-3.09) and uterine size ≥ 500 grams (aOR 1.99; 95%CI 1.23-3.20) were associated with increased risk for perioperative blood transfusion. In contrast, surgical indication, operative time, endometriosis, and major complications therefore were not significantly associated with perioperative blood transfusion.

A total of 974 patients had 2,105 crossmatched units requested, but only 342 units were used. The indicator to evaluate efficacy of blood product utilization was calculated, crossmatch-to-transfusion ratio (C/T ratio) was 6.15 (the appropriate value is ≤ 2.5), transfusion index (TI) was 0.35 (the appropriate value is ≥ 0.5), and transfusion probability (%T) was 19.4% (the appropriate value is ≥ 30%). These results indicated excessive blood ordering for elective laparoscopic hysterectomy in our institution.

Table 3. Regression analysis for factor associated with perioperative blood transfusion in patients undergoing laparoscopic hysterectomy for benign gynecologic conditions.

Variables	Adjusted odds ratio (95%CI)[t]	p value
Anemia	6.89 (4.56-10.43)	< 0.001
Indication		
Uterine fibroids	Ref	
Endometriosis/Adenomyosis	0.88 (0.45-1.69)	0.875
Other	0.97 (0.48-1.93)	0.966
Route		
TLH	Ref	
LAVH	0.85 (0.55-1.29)	0.435
NOTES	0.43 (0.21-0.89)	0.023
Size ≥ 500 gm	1.99 (1.23-3.20)	0.005
Time ≥ 180 min	1.31 (0.86-2.01)	0.211
EBL ≥ 300 ml	8.64 (5.46-13.69)	< 0.001
Pelvic adhesion	2.01 (1.31-3.09)	0.001
Endometriosis	0.94 (0.57-1.57)	0.825
Major complication	2.45 (0.77-7.85)	0.131

TLH: total laparoscopic hysterectomy, LAVH: laparoscopic assisted vaginal hysterectomy, NOTES: natural orifice translumenal endoscopic surgery, EBL: estimated blood loss, CI: confidence interval

*Complications include bladder injury, ureteric injury, bowel injury and vascular injury

t Adjusted for anemia, indication for surgery, operative route, uterus size ≥ 500 gm, operative time ≥ 180 min, EBL ≥ 300 ml, pelvic adhesion, endometriosis, and major complication

Discussion

Among the 974 patients included in our study, the prevalence of blood transfusion in women who underwent laparoscopic hysterectomy was estimated

to be as high as 19.4%. Our findings revealed a higher transfusion rate compared to previous studies. This difference could be attributed to our hospital's status as a laparoscopic center, where we routinely handle complex laparoscopic cases. The percentage of women with pelvic adhesions in our study was higher (35.9%) than previous studies, which ranged from 18% to 25%[7, 17]. Furthermore, a contributing factor was the high prevalence of enlarged uterus, with 20.2% of patients presenting uterine weighing in excess of 500 grams. These factors reflected the surgical complexity and might potentially increase the risk of bleeding and transfusion during surgery. In addition, our hospital has not been implemented a restricted blood transfusion protocol. The decision relied on the judgment and expertise of attending surgeons and anesthesiologists. These factors can result in variability in transfusion practices among different surgeons and potentially lead to an increase in unnecessary transfusions.

In our study, we also classified EBL in two groups: the first group is EBL < 300 milliliters and the second group is EBL ≥ 300 milliliters. The requirement for perioperative blood transfusion was higher in the group of EBL ≥ 300 milliliters which increased by approximately 8.6-fold compared to the group with EBL < 300 milliliters. In agreement with previous retrospective studies, a higher incidence of perioperative bleeding was significantly correlated with a higher transfusion rate[10, 11].

Obviously, patients who required a transfusion were more likely to have preoperative anemia than those who did not. This finding correlated with previous reports[10, 18], which indicated a significantly higher risk of transfusion in anemic patients. Preoperative anemia is a reversible factor that can be identified prior to surgery. Elfazari et al[8] also reported a significant reduction in the requirement of blood transfusion in patients with higher preoperative hematocrit levels during hysterectomy. To provide the best patient care, surgeons should consider preoperative preparation alternative strategies, including oral iron administration, preoperative intravenous iron infusion, erythropoietin, and gonadotropin-releasing hormone analog therapy which can increase the hemoglobin level before the day of surgery.

The patients with pelvic adhesions were more likely to receive a blood transfusion than those without adhesions. Saad-Naguib et al[7] identified one of the risk factors for blood transfusion in patients who underwent hysterectomy, the presence of pelvic adhesions during intraoperative TLH increased the risk of transfusion. Maclaran et al[19] reported a significant trend toward increasing blood loss in patients with adhesions. Preexisting intra-abdominal adhesion can complicate hysterectomy due to limitations in manipulating the uterus, distortion of normal pelvic anatomy and obscuring visualization of the operative field. All of these reasons could induce accidental vascular injury and bleeding complications.

This study also observed that patients with uterus ≥ 500 grams had a higher overall transfusion rate compared to those with uterine weight < 500 grams. In consistent with Huang et al[20], in single-port laparoscopic hysterectomy, patients with a uterine weight 500 grams or more experienced higher blood loss and a greater likelihood of blood transfusion compared to those with uterine weight less than 500 grams. Another retrospective study on laparoscopic supracervical hysterectomy also indicated that large uterus, particularly it weighed more than 500 grams, were associated with an increased risk of blood loss and prolonged intraoperative time[21]. In general, a large uterus had more vascular supply and distortion of uterine anatomy due to uterine pathology, such as uterine fibroids. These factors might make it more challenging to visualize structures and achieve effective hemostasis.

Interestingly, our study demonstrated that the rate of blood transfusion following NOTES hysterectomy was lower than TLH. This discrepancy can be attributed to several factors. Firstly, NOTES hysterectomy used a vaginal incision without abdominal incision, which reduced the amount of bleeding. Secondly, it provided the advantage of earlier access to and blockage of the uterine vessels,

resulting in reduced intraoperative blood loss[22]. Lastly, patients with high-complexity factors, such as preexisting endometriosis and a history of pelvic adhesion were not considered candidates for NOTES hysterectomy. A meta-analysis that included 6 studies comparing vaginal NOTES and laparoscopic hysterectomy revealed that blood loss was lower in patients who underwent vaginal NOTES[23]. In another aspect, Puisungnoen et al[24] reported that there was no significant difference in the requirement for blood transfusion between the NOTES hysterectomy and TLH groups. These findings suggested that NOTES hysterectomy was safe and might be a potential alternative to TLH.

There are two methods of preoperative blood preparation. One is crossmatching, which involved fully typing the blood. The other is type and screen, which involved matching only essential processes, including the ABO and Rh group systems, as well as an antibody screening test. In our hospital, for elective laparoscopic hysterectomy procedures, it is our standard practice to crossmatch a minimum of two units of packed red cell. For the evaluation of blood utilization, the result showed a high C/T ratio of 6.15, which correlated with previous literatures[13, 14, 25]. Furthermore, the low %T of 19.4 and TI of 0.35 in our study indicated a low probability of a patient requiring a blood transfusion during surgery. These indicators underscored the importance of improving an effective blood request model to reduce unnecessary blood ordering and transfusion. It is essential to develop the maximum surgical blood ordering system (MSBOS). This provides guidelines for preoperative blood preparation for each surgical procedure and implies the type and screen (T&S) protocol[26]. Previous study reported after adapting MSBOS could achieve a substantial reduction in the number of crossmatching[27]. Similarly, a recent study conducted in a tertiary care center in India also observed a trend of overordering blood for most laparoscopic surgeries. After adapting MSBOS, they achieved a substantial reduction in the number of crossmatching, approximately 2,152 units, and saved 75,320 man-hours in their laboratory[28].

The strengths of our study included being the first to evaluate the prevalence and associated factors of blood transfusion that scope in only laparoscopic hysterectomy and including various types of laparoscopy. However, there were some limitations. Firstly, its single-center design and retrospective nature introduced biases during the medical record review. Secondly, there were gaps in data for some participants, and key information like preoperative preparation, which could influence surgical outcomes, reasons for transfusions, and individual transfusion thresholds were missing. Another limitation was the variation in skills and expertise among the surgeons involved in the study. Lastly, the study's primary focused on determining prevalence led to the calculation of the sample size using a prevalence formula, potentially affecting the accuracy of associations between the factors.

Understanding the prevalence of perioperative blood transfusion and associated factors relating to transfusion requirement is valuable for preoperative blood preparation, surgical planning, and patient counseling. Patients at a higher risk of requiring a transfusion should receive more preoperative treatments to mitigate the risk of transfusion. In our opinion, based on our hospital data and our finding of ineffective blood ordering, we recommend introducing the MSBOS policy in transfusion practice. For low-risk patients, complete cross-matching should be replaced by preoperative type and screen to avoid unnecessary investigations, save hospital costs, and reserve blood units for emergency patients.

Conclusion

The overall prevalence of blood transfusion was as high as 19.4%. Preoperative anemia, intraoperative blood loss ≥ 300 milliliters, larger uterine size ≥ 500 grams, and pelvic adhesions were significantly associated with an increased risk of perioperative blood transfusion in patients undergoing laparoscopic hysterectomy for benign gynecologic conditions. Data of impulsive over-ordering of blood in our study might be useful in developing a new transfusion strategy in

our setting. Moreover, we recommend the type and screen method for preoperative blood preparation in low-risk patients undergoing elective laparoscopic hysterectomy for benign gynecologic conditions.

Potential conflicts of interest

The authors declare no conflicts of interest.

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