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Original Research

Factors related to blood loss in laparoscopic hysterectomy

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Background: In this study, we aimed to retrospectively investigate the effects of patients' age, body mass index (BMI), uterine size, presence of fibroids, previous surgery, and the experience of surgeons on blood loss during total laparoscopic hysterectomy. *Methods*: Data of 416 patients who underwent total laparoscopic hysterectomy in our gynecology clinic were retrospectively evaluated. Several factors that may be correlated with blood loss were investigated based on the changes in their hemoglobin levels. *Results*: In this study, BMI (under 30: 1.25 g/dL and over 30: 1.10 g/dL, p = 0.140), age (over 50 years: 1.05 g/dL and under 50 years: 1.20 g/dL, p = 0.196), uterus size (above 500 cm^3: 1.00 g/dL and below 500 cm^3: 1.20 g/dL, p = 0.227), presence of fibroids (fibroids: 1.20 g/dL and without fibroids: 1.10 g/dL) mg/dL, p = 0.843), previous operation history (surgical history: 0.90 g/dL and no surgical history: 1.00 g/dL, p = 0.631) were not correlated with blood loss. Case experience (inexperienced period: 1.10 g/dL and experienced period: 1.20 g/dL, p = 0.185) of each surgeon was not correlated with blood loss. When we examined the blood loss of 11 surgeons separately, it ranged from 0.75 g/dL (0.4–1.9 g/dL) to 1.65 g/dL (0.83–2.15 g/dL). Correlation of the individual surgeon factor with blood loss was statistically significant (p = 0.041). *Discussion*: Age, BMI, uterine size, presence of fibroids and previous operation history were not correlated with blood loss during total laparoscopic hysterectomy. We determined the individual surgeon as the only aspect affecting blood loss.

Keywords

Total laparoscopic hysterectomy; Blood loss; Hemoglobin levels; Surgeon

1. Introduction

Every year, thousands of hysterectomies are performed worldwide for benign or malignant reasons. Abdominal and vaginal hysterectomies have been performed since the middle of the twentieth century [1]. Laparoscopic hysterectomy was first described in 1989 [2]. Laparoscopic hysterectomy has proven advantages over abdominal surgery, such as faster recovery, less pain, and less abdominal infection [3].

Ever since, there has been an increasing frequency and variety of minimally invasive operation techniques, innovative energy systems, and the development of advanced surgical instruments. Laparoscopic single-port hysterectomy, natural orifice transvaginal laparoscopic hysterectomy, mini laparoscopic hysterectomy, laparoscopy-assisted robotic hysterectomy can be mentioned as examples [4]. Although minimally invasive techniques are employed with the advancement of technology, the effects of compelling factors such as uterine volume, presence of uterine fibroids, obesity, surgical experience, previous abdominal surgery on operative bleeding, and decrease in hemoglobin have not been comprehensively studied in extant literature. In this study, we aimed to retrospectively investigate whether such challenging factors have an effect on change in hemoglobin and amount of bleeding in laparoscopic hysterectomy.

2. Materials and methods

A total of 416 female patients who underwent total laparoscopic hysterectomy (TLH) for benign reasons in the gynecology clinic of our hospital between September 2016 and August 2020 were included in this study.

Factors that may be associated with blood loss-including uterine volume, presence of fibroids, surgeon, BMI, age, and a history of previous surgery-were investigated. Our study was conducted retrospectively with the information obtained by screening patient files. The study was approved by the local ethics committee of our hospital with the 16/10/2020 dated and 2020/604 numbered decision and conducted in accordance with the ethical principles of the Declaration of Helsinki.

Patients' age, height-weight, operation date, indication for operation, pre- and postoperative hemoglobin levels, estimated blood loss, blood transfusion, previous history of surgery, preoperative USG (Ultrasonography) records, postoperative pathology reports, operating surgeon, duration of stay, and complications were obtained from patient files. The amount of blood loss was estimated considering the difference between hemoglobin values just before the operation and at the postoperative sixth hour. Any blood transfusion during this period was taken into account in the calculation of the difference in hemoglobin.

The uterine size was calculated by multiplying the three dimensions of the uterus from the pathology report. Accordingly, uteri below 500 cm^3 were defined as small and those above 500 cm^3 were defined as large. For example, a 9 $\times$ 8 $\times$ 7 cm surgical piece corresponded to a volume of approximately 500 cm^3. Again, according to the pathology report, the patients were divided into two groups-those with myoma and those without myoma-and the relationship with blood loss was examined. Moreover, patients were also categorized as under 50 and over 50 years of age. According to their BMIs, those weighing less than 30 kg/m^2 were classified as non-obese and those weighing over 30 kg/m^2 were categorized as obese.

During the four-year study period, the surgeries performed by the surgeons within the first two years were compared with the surgeries performed by the same surgeons within the last two years in order to investigate the effect of case experience of the surgeons on blood loss.

Seventeen obstetricians who were deemed to be able to perform TLH (total laparoscopic hysterectomy) alone were included in our study. Eleven surgeons with similar case experience were compared with each other. The date of specialty of the 11 surgeons was close to that of each other. By the time the study began, they each had an experience of 20–40 cases on average. None of them had completed the learning curve, but they were able to manage the TLH case independently. All surgeons exceeded 50 cases, which constituted the learning curve within the four-year study period.

Further, all the surgeons employed a similar operation technique. The abdomen was operated ipsilaterally. In cases where the patient was younger than 60 years of age, hysterectomy and bilateral salpingectomy were performed. However, hysterectomy and bilateral salpingo-oophorectomy were performed in those over the age of 60 and those with risk ovarian cancer. All the surgeons used the same surgical instruments. Rumi was used as the uterine manipulator, ligasure for vessel sealing, and hook for the vaginal incision. All the surgeons preferred to close the cuff vaginally.

Cases revealed by laparoscopy, patients with additional surgeries, malignant pathology results, and those with bleeding diathesis were excluded from the study.

2.1 Statistical analysis

Normality of the data was evaluated using the Kolmogorov-Smirnov test, histograms, and skewness and kurtosis values. Categorical data are reported as frequencies and percentages, while continuous variables are expressed as mean $\pm$ standard deviation and median (interquartile range). The relationship among decrease in hemoglobin, uterine volume, and BMI was analyzed with Spearman's rho correlation analysis. Further, Mann Whitney and Kruskal-Wallis tests were used to compare the groups in terms of the decrease in the hemoglobin of patients. Data were analyzed using SPSS version 23.0 (SPSS Statistical Package for Social Sciences, IBM Inc., Chicago, IL, USA) statistical software; $p < 0.05$ values were considered statistically significant.

3. Results

As indicated in Table 1, a total of 416 patients were included in this study. The median hemoglobin decrease was 1.10 (Q1–Q3: 0.60–1.80), the median uterine volume was 378.00 (Q1–Q3: 240.00–575.00), the mean duration of hospitalization was 2.07 days (1–5) and the median BMI was 28.26 (Q1–Q3: 23.26–33.26). A total of 220 (53.0%) in patients were in $\leq$49 years age group Uterine volume was $\leq$499 cm^3 in 271 (65.6%) patients. The BMI of 242 (58.9%) patients was $\leq$29.99. Of all patients, 235 (56.7%) had no uterine myoma and 330 (80.2%) had no history of previous surgery.

The results of the Mann Whitney test are presented in Table 2. Regarding the decrease in hemoglobin, there was no significant difference between the age groups, uterine myoma status, history of surgery, and groups of uterine volume and BMI ($p > 0.05$).

3.1 Correlation analysis of variables

Spearman's correlation analysis revealed a significant negative correlation between the uterine volume and BMI (r = –0.124, $p < 0.05$). However, the relationship between hemoglobin decrease and uterine volume (r = –0.017, $p >$ 0.05) and the relationship between uterine volume and BMI (r = –0.042, $p > 0.05$) were not statistically significant ($p >$ 0.05). Age was negatively correlated with uterine volume (r = –0.217, $p < 0.001$), but decrease in hemoglobin and BMI were not ($p > 0.05$).

3.1.1 Comparison of low hemoglobin levels according to surgeon's experience

A total of 206 cases performed within the first two years and 210 cases performed within the last two years were compared in order to determine the effect of inter-surgeon experience on blood loss. The amount of blood loss was found to be 1.10 (0.50–1.78) g/dL in the unexperienced period and 1.20 (0.70–1.80) g/dL in the experienced period. The difference was not statistically significant ($p = 0.185$).

3.2 Comparison of decrease in hemoglobin according to surgeon

A Kruskal-Wallis test was performed to evaluate significant differences between different surgeons in the decrease in hemoglobin. The test indicated that different operators did differ significantly in terms of the decrease in hemoglobin (χ^2 (10) = 15.888, $p = 0.041$, Table 3).

There was no significant correlation between decrease in hemoglobin and uterine volume (r = –0.017, $p > 0.05$). Fig. 1 depicts the scatterplot between low hemoglobin level and uterine volume.

There was no significant relationship between decrease in hemoglobin and BMI (r = –0.042, $p > 0.05$). Fig. 2 depicts the scatterplot between low hemoglobin level and BMI.

There was not a significant relationship between decrease in hemoglobin and age (r = –0.093, $p > 0.05$). Fig. 3 presents the scatterplot between low hemoglobin level and age.

Table 1. Demographic characteristics of the study population.

	Total patients
Hemoglobin decrease (n = 416) median (IQR)	1.10 (0.60–0.1.80)
Uterine volume (n = 416) median (IQR)	378.00 (240.00–575.00)
Body mass index (n = 416) median (kg/m^2)	28.26 (23.26–33.26)
Duration of hospitalization, mean (days)	2.07 (1–5)
Uterine volume	
$\leq$499, n (%)	271 (65.6)
$\geq$500, n (%)	145 (34.4)
Body mass index	
$\leq$29.99, n (%)	242 (58.9)
$\geq$30.00, n (%)	123 (29.5)
Not evaluated, n (%)	51 (11.6)
Age groups	
$\leq$49 years old, n (%)	220 (53.0)
$\geq$50 years old, n (%)	196 (47.0)
Uterine myoma	
No, n (%)	235 (56.7)
Yes, n (%)	181 (43.3)
History of abdominal surgery	
No, n (%)	330 (80.2)
Yes, n (%)	86 (19.8)

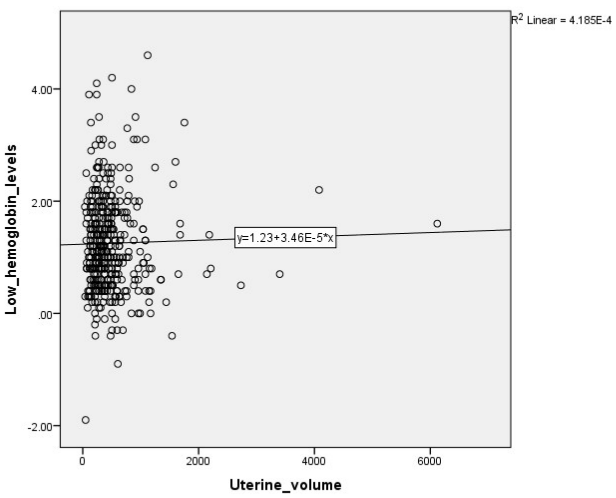

Fig. 1. The scatterplot between hemoglobin decreases and uterine volume.

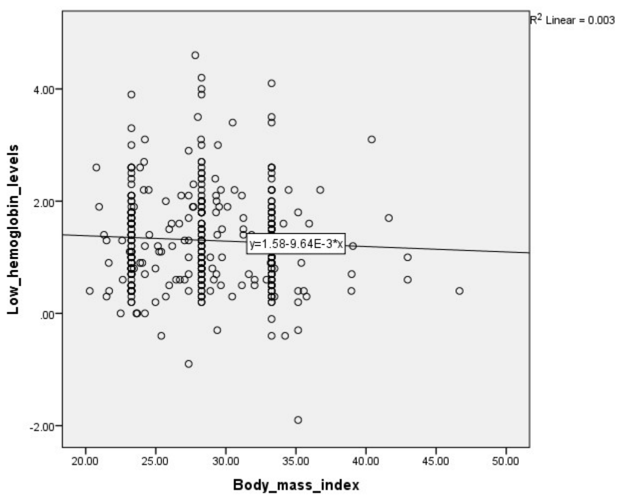

Fig. 2. The scatterplot between hemoglobin decreases and body mass index.

4. Discussion

In laparoscopic hysterectomy, changes in the patient's anatomy due to obesity and abdominal surgery, and enlargement of the uterus size due to fibroids that cause insufficient visual exploration and working ergonomics are among the challenging factors for the surgeon.

In our study on the effects of these factors on changes in hemoglobin, uterine volumes were examined in two groups: one below 500 cm^3 and one above 500 cm^3. There was no significant difference in hemoglobin changes and bleeding between the two groups (p = 0.227). Sinha *et al.* [5] observed a low hemoglobin difference of 1.7 g/dL in their series of patients undergoing laparoscopic hysterectomy led to an enlarged uterus. Further, they reported that laparoscopic hysterectomy is a safe method in a large uterus. In a large uterus, appropriate port placement can be performed safely with accurate uterine extraction methods, adequate surgical experience, providing appropriate intraoperative vision, and patient and surgeon ergonomics [6].

In our study, there was no difference between the changes in hemoglobin and the amount of bleeding between the two groups of obese and non-obese in the patient group (p = 0.140).

Güraslan *et al.* [7] found no difference in hemoglobin changes in patients with normal BMI, obese, and morbidly

Table 2. Comparison of decrease in hemoglobin according to age groups, presence of uterine myoma, history of surgery, groups of uterine volume, and BMI.

	Median (IQR)	MWU u	MWU z	MWU *p*
Age groups		18816.50	−1.293	0.196
≤49 years old (n = 220)	1.20 (0.68–1.80)			
≥50 years old (n = 196)	1.05 (0.60–1.73)			
Uterine myoma		19807.50	−0.198	0.843
No (n = 235)	1.10 (0.60–1.80)			
Yes (n = 181)	1.20 (0.60–1.80)			
History of abdominal surgery		2011.500	−0.481	0.631
No (n = 330)	1.00 (0.45–1.75)			
Yes (n = 86)	0.90 (0.40–1.68)			
Uterine volume		17070.50	−1.209	0.227
≤499 (n = 271)	1.20 (0.70–1.80)			
≥500 (n = 145)	1.00 (0.50–1.80)			
Body mass index		12805.50	−1.476	0.140
≤29.99 (n = 242)	1.25 (0.70–1.90)			
≥30.00 (n = 123)	1.10 (0.60–1.70)			

Table 3. Comparison of decrease in hemoglobin according to surgeon.

	Median (IQR)	χ^2	df	*p*
Operators (n = number of cases)		15.888	10	0.041
1. (n = 21)	0.80 (0.65–1.75)			
2. (n = 54)	0.75 (0.40–1.90)			
3. (n = 30)	0.95 (0.38–1.53)			
4. (n = 23)	1.30 (0.90–1.90)			
5. (n = 24)	1.65 (0.83–2.15)			
6. (n = 60)	1.00 (0.53–1.60)			
7. (n = 22)	1.45 (0.70–2.05)			
8. (n = 20)	1.15 (0.55–1.75)			
9. (n = 29)	1.10 (0.55–1.50)			
10. (n = 28)	1.50 (0.90–1.88)			
11. (n = 26)	1.05 (0.30–1.48)			

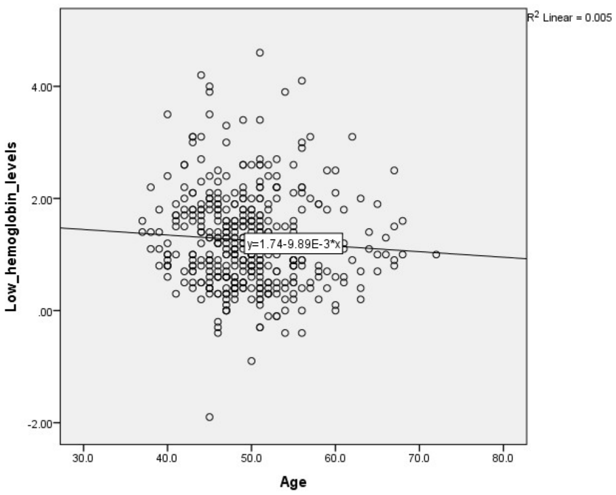

Fig. 3. The scatterplot between decrease in hemoglobin and age.

obese patients undergoing a total laparoscopic hysterectomy 1.11 ± 1.5 g/dL, 1.15 ± 1.7 g/dL, 1.11 ± 1.8 g/dL (p = 0.427), respectively. They recommended TLH as a safe and viable alternative to abdominal hysterectomy in obese and morbidly obese patients. Further, studies have reported that there is no significant difference in the estimated amount of blood loss between women with high and low body mass indices [8, 9], while certain studies have stated that obesity increases the amount of bleeding and causes low hemoglobin [10, 11]. There are studies that have associated a lower BMI and/or higher intraoperative intravenous fluid volume with a greater reduction in postoperative hemoglobin level [12].

In our study, no significant difference was found between changes in hemoglobin and the amount of bleeding in patients ≤50 years old and >50 years old (p = 0.196). Studies in the literature regarding changes in bleeding in premenopausal and postmenopausal patient groups are limited. In the study by Çağlar *et al.* [13] -which compared laparoscopic hysterectomy operations according to age, parity, menopausal status, and previous pelvic surgery history-it was reported that the difference in hemoglobin was not significant in the hysterectomy group of those under 50 years of age (p = 0.161).

In our study, there was no difference in the changes in hemoglobin in the differentiation of patients with and without previous abdominal surgery (p = 0.631). Seo *et al.* [14] did not observe a difference in the retrospective review of 331 patients with those who had no history of abdominal surgery in terms of bleeding, transfusion, and complications. Koroğlu *et al.* [15] reported that there was no significant difference in the hemoglobin levels between total laparoscopic hysterectomy patients with and without cesarean section (p = 0.785). Studies have reported that operation time, postoperative hospital stay, blood loss, operative complication rate, or conversion rate for open surgery were similar between patients with and without abdominal surgery history [16, 17]. In line with extant literature, we believe that surgeons must be less worried about previous surgery in preoperative surgical planning.

In our study, the difference between surgeons was found to be significant in evaluating the effect of individual surgeons' effects on hemoglobin changes (p = 0.041). Terzi *et al.* [18] reported that 257 patients undergoing total laparoscopic hysterectomy reached a level in the learning curve for TLH after the first 75 cases and that there was no significant difference in decrease in hemoglobin between the groups (p = 0.20). Similar to our study, Naveiro *et al.* [19] classified surgeons into three groups according to the experience of the surgeon, where they classified the first 75 hysterectomies (initial period), the next 75 hysterectomies (middle), and the next 86 hysterectomies (routine period). In terms of the surgeon's experience in performing the laparoscopic hysterectomy, bleeding reportedly played an important role in reducing the risk of complications. Studies have reported an opportunity to reduce preventable damage with minimally invasive hysterectomies performed by high case volume surgeons for benign indications, while certain publications have stated that surgeons with higher monthly minimally invasive hysterectomy case volume are associated with a higher rate of intraoperative and postoperative adverse events [20]. We can conclude that there is a learning curve for TLH, along with a decrease in the amount of bleeding associated with gained experience. In the process of reaching the learning curve, the surgeon should have no difficulty in attaining endoscopic training. Twijnstra *et al.* [21] reported that the independent surgical skill factor may differ in terms of competence among individuals and the fact that a surgeon who has performed numerous laparoscopic hysterectomies does not necessarily guarantee a good surgical result and is also dependent on the effectiveness of individual skill. Moreover, we were unable to find evidence that the same surgeon caused less bleeding with an increase in case experience (p = 0.185).

Further, there was no difference between the decrease in hemoglobin and the amount of bleeding in the patient groups that were divided into those with and without fibroids (p = 0.843). Sinha *et al.* [22] reported that the learning curve in laparoscopic hysterectomy cases with myomas is approximately 50 cases and that surgery for fibroids can be performed by experienced surgeons regardless of the size, number, or location of myomas without much morbidity.

Further, it has been reported that laparoscopic hysterectomy is not a limiting factor in complex cases with an increasing trend over the years [23]. Continuing advances in instrumentation, energy sources, hemostatic agents, and vaginal cuff closure techniques have expanded the use of minimally invasive hysterectomy [24]. Despite all these progressive advances in laparoscopic hysterectomy, there are no equal training opportunities among surgeons. In addition to ensuring equality of education, the positive effect of surgical skill level on hemoglobin changes must not be ignored.

5. Conclusions

In laparoscopic hysterectomy, we determined that the parameters of age, BMI, previous surgical history, presence of fibroids, and uterine size did not affect blood loss. The use of laparoscopy technology and vessel-sealing devices are determining factors in the fate of the surgery. Thus, we believe that numerous variables of the patient have limited effects on blood loss. Further, greater surgeon experience did not decrease blood loss. However, in our study, different surgeons were the only factor affecting blood loss. Therefore, we believe that surgeons' individual characteristics and working styles affect blood loss.

Author contributions

CA and SA conceived and designed the experiments; CA, SA, MRG, and ST performed the experiments; CA and SA analyzed the data; MRG and ST contributed reagents and materials; CA and ST wrote the paper. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

All subjects provided their informed consent for inclusion before they participated in the study. The study was performed in accordance with the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Gazi Yasargil Training and Research Hospital (approval number: 2020/604).

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Conflict of interest

The authors declare no conflict of interest.

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