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Full length article

Comparison of complications in very obese women undergoing hysterectomy – Abdominal vs laparoscopic approach with short- and long-term follow-up

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ABSTRACT

Background: Surgical treatment of obese female patients represents a real challenge. Over the last decade, minimally invasive techniques for hysterectomy have emerged. These approaches reduce the invasiveness of standard surgical procedures while maintaining efficacy and feasibility.

Objective: To evaluate the rates of perioperative, early, mid-term and late postoperative complications in very obese [body mass index (BMI) $\geq$ 35 and $<$ 40 kg/m^2] and severely obese (BMI $\geq$ 40 kg/m^2) women who underwent total (non-radical) hysterectomy.

Design: A prospective comparative multi-centre non-randomized study.

Methods: In total, 328 consecutive total (non-radical) hysterectomies were performed at seven teaching gynaecological centres. Of these, 153 (46.6%) were performed using an open laparotomy (LT) approach and 175 (53.4%) were performed laparoscopically (LS). All data were collected by medical specialists at the pre-operative examination prior to surgery, during surgery and three times postoperatively (during hospital stay, at 6-week follow-up and 6 months following surgery). Another analysis considered a total of 206 women who underwent laparoscopic hysterectomy. The subjects were divided according to BMI into 120 very obese women (BMI $\geq$ 35 and $<$ 40 kg/m^2) and 86 severely obese women (BMI $\geq$ 40 kg/m^2).

Results: The total number of composite perioperative complications was significantly lower in the LS group (p = 0.006). Composite complications occurred significantly more often in patients in the LT group compared with the LS group in the early ($p < 0.001$) and mid-term ($p < 0.001$) postoperative periods. In the late postoperative period, the total number of composite postoperative complications did not differ significantly between the groups ($p < 0.396$). Among 206 patients who underwent laparoscopic hysterectomy, the number of complications was generally low; the rates of composite perioperative ($p = 0.393$), early ($p = 0.642$), mid-term (p = 0.738) and late ($p = 1$) postoperative complications were generally low; and frequency did not differ significantly with BMI.

Conclusion: The LS approach does not increase intra-operative morbidity associated with surgery, and has significantly better outcomes in terms of the postoperative complication rate.

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Introduction

Obesity is classified according to the World Health Organization (WHO) as class I for body mass index (BMI) of 30–34.9 kg/m^2, class II (very obese) for BMI of 35–39.9 kg/m^2, and class III (severely obese) for BMI $\geq$ 40 kg/m^2. The prevalence of obesity has risen over the past decades. Approximately 13.8% of the female population worldwide is considered to be obese [1,2]. In European women, the prevalence of obesity varies from 6.2% to 36.5% [3], and in the USA, more than one-third of the adult population (34.9%) is obese [4].

Hysterectomy is the second most common gynaecological operation after caesarean section [5]. Several approaches such as vaginal, laparoscopic (LS), robotic and open abdominal can be used. It remains controversial which approach is preferable in very obese and severely obese women. Several studies have demonstrated that obesity increases the rate of major complications among LS hysterectomy, the rate of conversion to laparotomy (LT), and the mean operative time [6], whereas others studies have reported no effects [7].

The primary objective of this study was to evaluate perioperative, early and late postoperative complications in very obese and severely obese patients undergoing abdominal or LS (non-radical) hysterectomy at seven gynaecological centres. In addition, this study aimed to evaluate the rate of complications based on BMI among very obese and severely obese patients undergoing LS hysterectomy.

Methods

This prospective multi-institutional non-randomized study included very obese (BMI $\geq$ 35 and $<$ 40 kg/m^2) and severely obese (BMI $\geq$ 40 kg/m^2) women who underwent total (non-radical) hysterectomy at seven teaching gynaecological centres in the Czech Republic from January 2018 to June 2020. In total, 328 consecutive hysterectomies were included: 153 (46.6%) were performed using an open LT approach and 175 (53.4%) were performed using an LS approach. Patients who underwent LS which was subsequently converted to LT were excluded from the study. In total, nine patients were converted and no complications were observed among these patients. All surgeons involved had completed an adequate learning curve (at least 100 procedures) prior to initiation of this study. The indications for surgery included non-malignant disease such as endometrial atypical hyperplasia, BRCA gene mutation, irregular uterine bleeding and uterine fibroids. All data were collected by medical doctors during the pre-operative examination prior to the procedure, perioperatively, and on three occasions post-operatively (during hospital stay, 6 weeks after surgery, and 6 months after surgery). Transvaginal and abdominal ultrasound were performed at each examination.

All LS cases were initiated with one 10-mm optic subumbilical port, and three 5-mm ancillary trocars were inserted into the suprapubic area. The vaginal vault was closed endoscopically by continuous suturing with absorbable thread. Perioperative complications were defined as any complication that occurred during surgery and within the subsequent 48 h. The total operative time was calculated from skin incision to skin closure. Blood loss from the suction system was noted in both groups. The time interval between the surgical intervention and discharge of the patient from hospital was described as length of hospital stay. Early postoperative complications were defined as all complications that influenced hospital stay. Mid-term and late postoperative complications were characterized as all subjective or objective findings that might be associated with the surgery, and were found upon examinations performed 6 weeks after surgery and 6 months after surgery.

In another analysis, only those women who underwent LS were studied. In total, 206 women who underwent LS (non-radical) hysterectomy between January 2018 and June 2020 were included. The subjects were divided according to BMI into two groups: 120 very obese women (BMI $\geq$ 35 and $<$ 40 kg/m^2) and 86 severely obese women (BMI $\geq$ 40 kg/m^2). The methods for data collection and definitions of complications remained the same.

Informed consent was given by each patient, and the institutional ethics committee approved this study. Data were analysed using SPSS Version 16.0 (IBM Corp., Armonk, NY, USA). Chi-squared test was used to compare the differences between groups. $p < 0.05$ was considered to indicate significance.

Results

Demographic characteristics of the patients in the LT and LS groups are summarized in Table 1. There were no significant differences in social and medical history between the two groups, apart from more patients with a history of cervical conization in the LS group.

The LS approach was associated with less blood loss than the LT approach (234.6 ml vs 397.9 ml; $p < 0.0001$). Operative times were similar in both groups (median 95 min; $p = 0.068$), but the range of operative times was wider in the LT group compared with the LS group (30–310 min vs 35–180 min) (Table 2). Patients undergoing LS procedures had a shorter overall hospital stay (3.8 days vs 6.0 days; $p < 0.001$).

The total number of perioperative complications was significantly lower in the LS group compared with the LT group (2.28% vs 9.15%; $p = 0.006$). Perioperative complications included bowel injury, urinary bladder injury, uretheral injury and reoperation within 48 h, and the differences between particular complication rates were not significant (Table 2).

In the early postoperative period (i.e. during hospital stay), the patients in the LT group had higher rates of postoperative pelvic inflammation requiring antibiotic treatment (8.5 vs 0.57%; $p = 0.0004$), wound healing complications (7.19% vs 0.57%; $p = 0.002$), resuturing (3.27% vs 0.00%; $p = 0.021$) and blood transfusions (7.19 vs 0.57%; $p = 0.002$) compared with the LS group (Table 3). There were two cases of internal complications associated with surgery (deep vein thrombosis of lower limbs and postoperative lung insufficiency) in both groups.

In the mid-term postoperative period (i.e. within 6 weeks after surgery), the rate of wound healing complications was significantly higher in the LT group compared with the LS group (16.34% vs 0.57%; $p < 0.001$). The need for resuturing, including surgically treated hernias, was also higher in the LT group (3.27% vs 0.00%; $p = 0.021$) (Table 3). There were significantly more cases of postoperative pelvic inflammation requiring antibiotic treatment in the LT group (7.19% vs 1.71%; $p = 0.025$), and one case of surgically treated ileus was noted in the LT group.

In the late postoperative period (i.e. within 6 months after surgery), the total number of complications did not differ significantly between the two groups ($p < 0.396$) (Table 3).

When considering all complications at the end of follow-up, significant differences were found in almost all complications, apart from ileus, in favour of the LS group (61.44 vs 21.7%; $p < 0.001$).

The characteristics of the 206 patients divided into two groups according to BMI and treated with LS hysterectomy are summarized in Table 4. Severely obese women (BMI $\geq$ 40 kg/m^2) were more likely to have diabetes (21.7% vs 34.9%; $p = 0.004$) and more severe systemic disease based on the American Society for Anesthesiologists classification (20.8% vs 34.9%; $p = 0.004$) compared with very obese women (Table 4). Other social and medical data were similar in both groups. Rates of perioperative, early, mid-term and late postoperative complications were generally low and comparable in both groups (Table 5). Some complications, such as ileus and wound resuturing, were not observed at all.

Discussion

This study evaluated the rates of perioperative, early, mid-term and late postoperative complications in very obese and severely obese patients undergoing total (non-radical) abdominal and LS hysterectomy at

Table 1
Basic patient characteristics in laparotomy (LT) and laparoscopic (LS) groups.

Characteristics		LT	LS	*p*-value
Number of patients (*n*)		*n* = 153	*n* = 175	
Age (years), mean (median) (minimum–maximum)		57.0 (56) (37–81)	56.7 (54) (27–82)	0.528
Pregnancies, mean (Nr)		2.31 (0–7)	2.37 (0–8)	0.955
Deliveries, mean (Nr)		1.66 (0–4)	1.65 (0–5)	0.641
BMI (kg/m^2), mean (median) (minimum–maximum)		41.4 (40.6) (35.0–55.6)	40.5 (39.6) (35.0–55.5)	0.151
PS	0	66 (43.1%)	79 (45.1%)	0.136
	1	56 (36.6%)	68 (38.9%)	
	2	28 (18.3%)	19 (10.9%)	
	3	3 (2.0%)	9 (5.1%)	
ASA score	0	2 (1.1%)	3 (1.5%)	0.459
	1	18 (10.2%)	16 (7.8%)	
	2	80 (45.2%)	106 (51.5%)	
	3	52 (29.4%)	50 (24.3%)	
	4	1 (0.6%)	0 (0.0%)	
Education	Elementary	43 (28.1%)	35 (20.1%)	0.23
	High school	101 (66.0%)	126 (72.4%)	
	University	9 (5.9%)	13 (7.5%)	
Smoking		27 (17.6%)	27 (15.4%)	0.655
Alcohol consumption		78 (51.0%)	96 (54.9%)	0.507
Diabetes mellitus (I, II)		49 (32.0%)	48 (27.4%)	0.397
History of caesarean section		29 (19.0%)	30 (17.1%)	0.773
History of operative laparotomy		53 (34.6%)	64 (36.6%)	0.468
History of operative laparoscopy		27 (17.6%)	40 (22.8%)	0.0791
History of conization		7 (4.6%)	23 (13.1%)	**0.011**

BMI, body mass index; PS, performance status; ASA, American Society of Anesthesiologists.

Table 2
Surgical data and perioperative complications.

Group	LT	LS	*p*-value
Number of patients	153	175	
Time (min), mean (median) (minimum–maximum)	106.97 (95) 30–310	97.06 (95) 35–180	0.068
Blood loss (ml), mean (median) (minimum–maximum)	397.91 (300) 50–4500	234.57 (200) 20–800	**<0.0001**
Weight of uterus (g), mean (median) (minimum–maximum)	227.24 (130) 41–935	197.97 (120) 45–750	0.328
Bilateral adnexectomy	136 (88.89%)	145 (82.86%)	0.155
Adhaesiolysis	51 (37.5%)	58 (33.1%)	0.446
Drain in peritoneal cavity	96 (62.75%)	126 (72.00%)	**<0.001**
Hospital stay (days), mean (median) (minimum–maximum)	5.99 (5) 2–22	3.82 (4) 0–10	**<0.001**
Perioperative complications			
Bowel injury	3 (1.96%)	0 (0.00%)	0.1
Urinary bladder injury	2 (1.31%)	3 (1.71%)	1
Uretheral injury	1 (0.65%)	0 (0.00%)	0.467
Other injury	1 (0.65%)	1 (0.57%)	1
Reoperation within 48 h	7 (4.58%)	1 (0.57%)	**0.028**
With a complication	14 (9.15%)	4 (2.28%)	**0.006**

LT, laparotomy group; LS, laparoscopy group.

seven gynaecological centres. Extended analysis evaluated the rates of perioperative, early, mid-term and late postoperative complications in groups of very obese and severely obese patients undergoing LS hysterectomy.

Obese women represent a growing group of patients in developed countries, and carry greater anaesthetic, surgical and postoperative risks. Obesity has the most significant impact on operative and postoperative complications in women undergoing hysterectomy based on Tyan et al:s retrospective study of 159,025 obese patients [5]. The study showed that the incidence of postoperative morbidity within 30 days of surgery increased irrespective of the surgical approach when patients have BMI $\geq$ 40 kg/m^2. For patients undergoing an abdominal hysterectomy, the complication rate was significantly higher in women with BMI $>$ 30 kg/m^2, and followed a linear upward trend as BMI increased. For patients undergoing LS hysterectomy, the morbidity rate was not significantly different in women with BMI $<$ 40 kg/m^2 [5]. In another study, an increased adjusted odds ratio could be seen for bleeding $>$ 1000 ml, perioperative complications, operative time $>$ 120 min, postoperative complications and postoperative infections in women with BMI $\geq$ 30 kg/m^2 undergoing abdominal hysterectomy [8]. With LS hysterectomy, women with BMI $\geq$ 30 kg/m^2 had a higher adjusted odds ratio for prolonged surgery [8]. Due to the need to combine hysterectomy with salpingectomy in premenopausal women and adnexectomy in postmenopausal women due to the known reduction in risk of ovarian cancer, indications for sole vaginal hysterectomy have declined in recent years [9]. As the number of patients who underwent vaginal hysterectomy was very small (n = 8), only cases of hysterectomy performed with LS or LT were included in this study.

As expected, women undergoing LT had significantly higher blood loss in this study, in agreement with studies comparing LT and LS hysterectomy among women of all BMIs [5,10–12]. The vast majority of studies have reported less blood loss in hysterectomies performed laparoscopically. However, two similar studies with cumulative analysis of LS hysterectomy in obese patients reported mean blood loss of 204 ml and 215 ml, which is close to the value of 234 ml found in the present study [11,13]. Importantly, the operative time was the same for both surgical groups (p = 0.068), with a trend in favour of the LS group. This is in agreement with another study [14], and was also shown in a systematic review [13].

Regarding early postoperative complications, wound dehiscence and pelvic infection requiring antibiotic treatment were associated with longer hospital stay, therefore favouring LS [12,13]. The length of hospital stay is always dependent on local policy regarding cultural habits and refunding system. The mean hospital stay of 3.82 days in this study was longer than that reported by some studies following LS hysterectomy [8,15]. However, other studies have reported similar [13,16] or even longer hospital stays [7,11]. The internal complication rate (deep vein thrombosis in the lower extremities, postoperative severe respiratory insufficiency) was the same in both groups, and appears to be related to high BMI rather than type of hysterectomy.

Higher rates of complications in the mid-term postoperative period (6 weeks after surgery) were found in the LT group (Table 3). These complications included problems following wound healing (p < 0.001). Re-suturing was performed in five women after LT (two cases related to incisional hernias). This type of complication is associated with the LT approach, and obesity increases the risk of wound healing disorders up to 20-fold [17,18]. Studies using the American College of Surgeons

Table 3
Early, mid-term and late postoperative complications in patients undergoing hysteectomy via laparotomy (LT) and laparoscopy (LS).

Complications	Period									Total count of complications		
	Early (hospital stay)			Mid-term (6 weeks)			Late (6 months)					
	LT (n = 153)	LS (n = 175)	p-value	LT (n = 153)	LS (n = 175)	p-value	LT (n = 153)	LS (n = 175)	p-value	LT (n = 153)	LS (n = 175)	p-value
Blood transfusion	11 (7.19%)	1 (0.57%)	**0.002**	0 (0.0%)	1 (0.57%)	1	0 (0.0%)	0 (0.0%)	–	11 (7.19%)	2 (1.14%)	**0.008**
Antibiotic treatment	13 (8.50%)	1 (0.57%)	**0.0004**	11 (7.19%)	3 (1.71%)	**0.025**	1 (0.65%)	1 (0.57%)	1	25 (16.34%)	5 (2.86%)	**<0.001**
Ileus	1 (0.65%)	0 (0.00%)	0.467	1 (0.65%)	0 (0.00%)	0.467	0 (0.0%)	0 (0.0%)	–	2 (1.31%)	0 (0.00%)	0.217
Wound complication	11 (7.19%)	1 (0.57%)	**0.002**	25 (16.34%)	1 (0.57%)	**<0.001**	2 (1.31%)	0 (0.00%)	0.217	38 (24.84%)	2 (1.14%)	**<0.001**
Wound re-suturing (including hernia)	5 (3.27%)	0 (0.00%)	**0.021**	5 (3.27%)	0 (0.00%)	**0.021**	3 (1.96%)	0 (0.00%)	0.1	13 (8.50%)	0 (0.00%)	**<0.001**
Other	2 (1.31%)	2 (1.14%)	1	1 (0.65%)	4 (2.29%)	0.377	2 (1.31%)	4 (2.29%)	0.689	5 (3.27%)	10 (5.71%)	0.058
Vault dehiscence	0 (0.00%)	0 (0.00%)	–	1 (0.65%)	2 (1.14%)	1	0 (0.00%)	0 (0.00%)	–	1 (0.65%)	2 (1.14%)	1
Total	43 (28.10%)	5 (2.85%)	**<0.001**	44 (28.76%)	11 (6.23%)	**<0.001**	8 (5.23%)	5 (2.85%)	0.396	95 (62.09%)	40 (22.86%)	**<0.001**

Table 4
Patient characteristics, basic surgical data and perioperative complications in patients undergoing laparoscopic hysterectomy.

Characteristics	BMI ≥ 35 and < 40 kg/m^2	BMI ≥ 40 kg/m^2	p-value
Number of patients	120	86	
Age (years), mean (median) (minimum–maximum)	55.2 (53) 27–82	57.6 (57) 32–81	0. 226
Pregnancies, mean (median) (minimum–maximum)	2.4 0–8	2.3 0–6	0.817
Deliveries, mean (median) (minimum–maximum)	1.66 0–6	1.64 0–5	0.880
BMI (kg/m^2), mean (median) (minimum–maximum)	36.6 (36.3) (35.0–39.8)	44.0 (42.8) (40.0–55.5)	–
PS 2–3	18 (15.0%)	14 (16.3%)	0.363
ASA score 3	25 (20.8%)	30 (34.9%)	**0.004**
Smoking (Nr)	23 (19.2%)	11 (12.8%)	0.257
Alcohol consumption (Nr)	70 (58.3%)	48 (55.8%)	0.776
Diabetes mellitus (I, II) (Nr)	26 (21.7%)	30 (34.9%)	**0.004**
History of caesarean section	22 (18.3%)	12 (14.0%)	0.878
History of operative laparotomy	40 (33.3%)	31 (36.0%)	0.799
History of operative laparoscopy	40 (33.3%)	18 (20.9%)	0.269
History of conization	46 (28.3%)	37 (43.0%)	0.097
Time (min), mean (median) (minimum–maximum)	92.2 (90) 45–180	99.1 (95) 35–180	0.142
Blood loss (ml), mean (median) (minimum–maximum)	224.1 (200) 10–800	240.8 (200) 10–800	0.431
Weight of uterus (g), mean (median) (minimum–maximum)	129.2 (100) 40–690	145.4 (103) 58–750	0.230
Drain in peritoneal cavity	85 (70.8%)	64 (74.4%)	0.638
Reoperation within 48 h	0 (0.0%)	1 (1.16%)	0.418
Hospital stay (days), mean (median) (minimum–maximum)	3.77 (4) 1–10	3.72 (4) 1–9	0.802
Without complications	116 (96.67%)	85 (98.84%)	0.393
Bowel injury	0 (0.0%)	0 (0.00%)	–
Urinary bladder injury	3 (2.59%)	0 (0.0%)	0.267
Ureter injury	0 (0.0%)	0 (0.00%)	–
Other injury	1 (0.83%)	1 (1.16%)	1

LT, laparotomy group; LS, laparoscopy group; BMI, body mass index; PS, performance status; ASA, American Society of Anesthesiologists.

National Surgical Quality Improvement Program data to evaluate the association between BMI and postoperative morbidity found an adverse association between higher BMI and longer operative time, wound dehiscence, wound infection and sepsis [15]. According to the study results, operative times were the shortest in women undergoing vaginal hysterectomy regardless of BMI or uterine size (all $p < 0.02$). However, total LS hysterectomy was associated with less need for blood transfusion (all $p < 0.02$) and shorter hospitalization (all $p < 0.03$) regardless of uterine size or BMI. The authors concluded that major operative morbidity following minimally invasive hysterectomy is rare regardless of the surgical approach [15]. A strong positive association was found between BMI and the risk of wound dehiscence after LT, with 5–10-fold higher risk for women with BMI > 40 kg/m^2 [15,18,19]. There were no significant differences in the adjusted odds ratio of wound dehiscence between women of various BMIs following LS hysterectomy, but a strong positive association was found between BMI and the odds ratio of wound dehiscence following abdominal hysterectomy. A significantly higher odds ratio for dehiscence was found in both obese (adjusted OR 2.21) and morbidly obese (adjusted OR 5.33) women compared with normal BMI reference values [15]. This was also confirmed by a large Danish study where the authors observed an increased risk of wound complications after abdominal hysterectomy, but found minimal effects of BMI on morbidity following LS or vaginal hysterectomy [20].

In total, 24 cases (13 in early postoperative period and 11 in mid-term postoperative period) of postoperative pelvic inflammatory disease requiring antibiotic therapy were reported in patients in the LT group in this study, compared with four cases in the LS group. Other studies also showed that increased rates of infection occur after LT. Shah et al. found an almost two-fold risk of postoperative sepsis in patients with BMI > 40 kg/m^2 [15]. Similarly, a lower risk of sepsis was observed following LS hysterectomy [15,17,18].

Regarding late postoperative complications, comparable complication rates were found in the surgical groups (Table 3). Data do not exist in the literature for comparison of the rates of late postoperative complications among very obese and severely obese patients within 6 months of hysterectomy. Some studies compared late postoperative complications in patients of all weights following LT and LS hysterectomy in terms of malignancy [11]. Incisional hernia was found to be the most common complication in the LT group [11]. In the present study, there were three cases of incisional hernia in the LT group and no cases in the LS group; however, the difference was not significant.

In the subanalysis of a cohort of 206 patients undergoing LS hysterectomy, there were no differences in the frequency of perioperative, early, mid-term and late postoperative complications between the two groups of 120 very obese women and 86 severely obese women (Table 5). Although severely obese women were more ill and had higher American Society of Anesthesiologists scores, the difference in the frequency of all composite complications throughout the study period was not significant (Tables 4 and 5). According to Siedhoff et al., for every 10-unit increase in BMI, the complication rate following LS

Table 5
Early, mid-term, and late postoperative complications in patients undergoing laparoscopic hysterectomy – extended group.

Complications	Period									Total count of complications		
	Early (hospital stay)			Mid-term (6 weeks)			Late (6 moths)					
	BMI ≥ 35 and < 40 kg/m^2 (n = 120)	BMI ≥ 40 kg/m^2 (n = 86)	p-value	BMI ≥ 35 and < 40 kg/m^2 (n = 120)	BMI ≥ 40 kg/m^2 (n = 86)	p-value	BMI ≥ 35 and < 40 kg/m^2 (n = 120)	BMI ≥ 40 kg/m^2 (n = 86)	p-value	BMI ≥ 35 and < 40 kg/m^2 (n = 120)	BMI ≥ 40 kg/m^2 (n = 86)	p-value
Blood transfusion	0 (7.19%)	1 (1.16%)	0.417	1 (0.83%)	0 (0.0%)	1	0 (0.0%)	0 (0.0%)	–	1 (0.83%)	1 (1.16%)	1
Antibiotic treatment	1 (0.83%)	0 (0.0%)	1	3 (2.50%)	0 (0.0%)	0.267	1 (0.83%)	0 (0.0%)	1	5 (4.17%)	0 (0.0%)	0.077
Ileus	0 (0.00%)	0 (0.0%)	–	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–	0 (0.0%)	0 (0.0%)	–
Wound complication	1 (0.83%)	0 (0.0%)	1	1 (0.83%)	0 (0.0%)	1	0 (0.0%)	0 (0.0%)	–	2 (1.67%)	0 (0.0%)	0.511
Wound resuture	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–	0 (0.00%)	0 (0.00%)	–	0 (0.0%)	0 (0.0%)	–
Others	1 (0.83%)	0 (0.0%)	1	1 (0.83%)	3 (3.49%)	0.310	2 (1.67%)	2 (2.33%)	1	4 (3.33%)	5 (5.81%)	0.495
Vault dehiscence	0 (0.0%)	0 (0.0%)	–	1 (0.83%)	1 (1.16%)	1	0 (0.0%)	0 (0.0%)	–	1 (0.83%)	1 (1.16%)	1
Total	3 (2.50%)	1 (1.16%)	0.642	7 (5.83%)	4 (4.65%)	1	3 (2.50%)	2 (2.33%)	1	13 (10.83%)	7 (8.14%)	0.636

LT, laparotomy group; LS, laparoscopy group; BMI, body mass index.

hysterectomy increases 1.5-fold [21]. Morgan-Ortiz et al. reported similar results [22]. However, most studies on LS hysterectomy and obesity reported no association between BMI and operative complications [23], which was further confirmed by the results of the present study.

It is known that the type of surgical management chosen in very obese and severely obese women affects operative and postoperative morbidity. In a Cochrane review, the risk was significantly reduced when hysterectomy was performed via the vaginal or LS route, rather than via the open abdominal pathway [24]. This was also confirmed in a study by the American College of Surgeons [15].

Minimally invasive hysterectomy in obese women represents a difficult task for both the surgeon (mainly the visceral obesity) and the anaesthesist (maintainance of the Trendelenburg position and proper ventilation of the patient) [25]. Obesity carries a greater risk of conversion to LT in obese patients than in patients of normal weight, although, to the authors‘ knowledge, no randomized, controlled studies have been undertaken to date [25]. With the availability of skilled endoscopic surgeons, an LS approach does not increase the rate of intraoperative morbidity associated with surgery, and has significantly better outcomes in terms of postoperative complication rate and faster patient resumption of full activities postoperatively [25]; therefore, the outcomes demonstrated in this study should encourage providers to use the LS approach instead of the LT approach.

The main strength of this study was the multi-centric and prospective study design mimicking real-world data. Moreover, it is one of the largest prospective studies on the subject focusing on very obese and severely obese women, which is of high importance. Additionally, a 6-month follow-up period was used, which is exceptional for most studies of this nature. The main weakness of this study was its non-randomized design.

Conclusion

LS hysterectomy should be considered as the preferred option in very obese and severely obese women.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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