Original Article

Influences of Total Laparoscopic Hysterectomy According to Body Mass Index (Underweight, Normal Weight, Overweight, or Obese)

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Abstract

Study Objective: The aim of this study is to evaluate the effect of body mass index (BMI) on laparoscopic hysterectomy outcomes.
Design: This was retrospective study.
Setting: Minoh City Hospital, Japan.
Materials and Methods: Between January 1, 2014, and June 30, 2017, 183 patients underwent total laparoscopic hysterectomy (TLH) at our institution.
Intervention: Patients who underwent TLH were grouped according to BMI, as follows: underweight group (BMI <18.5 kg/m^2), normal-weight group (18.5 ≤BMI <25 kg/m^2), overweight group (25 ≤BMI <30 kg/m^2), and obese group (BMI ≥30 kg/m^2).
Measurements and Main Results: Information on patients' clinical characteristics and surgical results were collected retrospectively by medical record review. The severity of complications was graded according to the Clavien–Dindo classification. We assessed clinical characteristics, surgical results, and the perioperative complications in each BMI group. Surgical results included operation time, nonsurgical operating room time estimated blood loss, uterine weight, and postoperative hospital stay. Compared with the normal-weight group, the obese group had significantly more complications (P = 0.012) and longer operation time (P = 0.04). The underweight and overweight groups did not have significantly different surgical results than the normal-weight group.
Conclusion: Underweight and overweight patients had no significant differences in surgical results, compared with patients of normal weight. Obese patients had significantly longer operation times and more perioperative complications than patients with normal weight. Laparoscopic hysterectomy has burdens and risks for obese patients. Our results suggest that appropriate weight control may decrease the risk of surgery for obese patients.

Keywords: Body mass index, complications, gynecologic laparoscopy, hysterectomy, operation time

Introduction

The World Health Organization defines a body mass index (BMI) under 18.5 kg/m^2 as underweight, a BMI between 18.5 and 24.9 kg/m^2 as normal, a BMI between 25 and 29.9 kg/m^2 as overweight, and a BMI of 30 kg/m^2 or more as obese.[1] The prevalence of obesity among women worldwide increased from 6.4% in 1975–14.9% in 2014. If present trends continue, global obesity prevalence among women will surpass 21% by 2025.

The obesity prevalence in Japan is <5%, which is lower than that in other developed countries. However, the prevalence of overweight and obesity among women in Japan increased to 21.3% from 1975 to 2014.[2]

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Obesity is not associated with increased incision complications but is associated with longer operative times in laparoscopic hysterectomy.[3] A high BMI was reported to be an independent risk factor for difficulty in performing total laparoscopic hysterectomy (TLH).[4]

Japan is distinct among developed countries in having a considerable proportion of underweight people. The underweight prevalence among women in Japan is 11.6%, a prevalence that has significantly increased in the past decade.[5] Low BMI was reported to be a significant predictor of surgical site infections (SSI) after laparoscopic appendectomy.[6] We found few reports concerning the risks of gynecologic laparoscopic surgery among underweight patients.

In this study, we tried to clarify the perioperative risks of TLH in overweight and obese patients. We also evaluated the outcomes of TLH in underweight patients.

Materials and Methods

This retrospective study included 183 women who underwent TLH at Minoh City Hospital between January 1, 2014, and June 30, 2017. Patients provided comprehensive consent for necessary treatment before their surgeries. The study was approved by the ethics committee of Minoh City Hospital.

Four patients were excluded from the analysis: 2 who underwent TLH and ovarian tumor cystectomy, 1 who underwent ureteral stent placement at the beginning of TLH, and 1 in whom Morsafe® (Veol Medical Technologies) was used for the removal of the uterus.

The most common indications for surgery were uterine myoma and adenomyosis. Other a few patients underwent TLH for atypical endometrial hyperplasia, endometrioid carcinoma Grade 1 (Stage IA), or complete hydatidiform mole [Figure 1].

Patients were divided into four groups according to the World Health Organization classification, as follows: "underweight group" (BMI <18.5 kg/m^2), "normal weight group" (18.5 ≤BMI <25 kg/m^2), "overweight group" (25 ≤BMI <30 kg/m^2), and "obese group" (BMI ≥30 kg/m^2).[1]

We retrospectively evaluated clinical characteristics, surgical results, and postoperative course according to BMI group. We collected information on the patient's age, parity, BMI, history of low abdominal surgery or cesarean section, presence of diabetes, smoking status, operation time, nonsurgical operating room time, estimated blood loss, uterine weight, postoperative hospital stay, revised American Society for Reproductive Medicine score, absence of cystoscopy, and complications.

The presence of endometriosis often shows adhesion in the pelvis and leads to the difficulty of the operation.

In our hospital, we adopted revised American Society for Reproductive Medicine score score (rASRM) as the classification of endometriosis because rASRM score had its longevity and universally familiar.[7,8]

We assessed clinical characteristics, surgical results, and the perioperative complications in each BMI group.

All operations were performed under general anesthesia with a pneumoperitoneum of ≤10 mmHg in the lithotomy position or the supine position if lithotomy position was not possible. We performed TLH with four ports including an umbilical trocar (12 mm) and three lower abdomen trocars (5 mm). The uterine manipulator was used if possible. After inspection of the abdominal and pelvic cavities, hysterectomy was initiated with transection of the round ligament. The retroperitoneal space was opened, and the uterine artery and ureter were identified. The uterine arteries were isolated and ligated. The bladder peritoneum was dissected, and then the infundibulopelvic or ovarian ligaments were coagulated and cut. The mesometrium was cut, and the ureter was isolated. The uterosacral ligaments were coagulated and cut. The ascending uterine vessels were

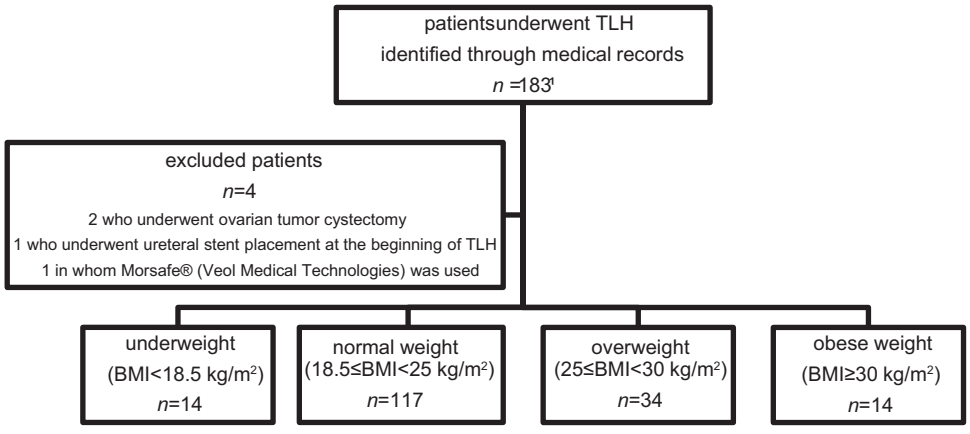

Figure 1: Study flowcharts. [1]The most common indications for surgery were uterine myoma and adenomyosis. One case underwent TLH for atypical endometrial hyperplasia, one case for endometrioid carcinoma Grade 1 (Stage IA), and one case for complete hydatidiform mole

ligated and dissected at the internal cervical os after bipolar coagulation. The cardinal ligaments were coagulated and transected. Posterior colpotomy was performed if possible.

After removal of the uterus through the vagina or through the umbilical trocar incision, if the vaginal removal was not possible, the vaginal cuff was closed with laparoscopic suturing. After hemostasis was achieved, cystoscopy was performed, and the trocar sites were closed. All surgeries were supervised by skilled laparoscopic gynecologic surgeons and performed by a skilled surgeon or the attending physician.

The operative time was recorded from the first skin incision to the last suture placement. Blood loss was estimated from the contents of suction devices and the weight of gauze. Complications included intraoperative and postoperative complications. Organ damage was considered an intraoperative complication. Postoperative complications within 30 days after patients left the hospital were evaluated. Complications were graded according to the Clavien–Dindo classification.[9]

Statistical analysis

Normality was assessed with the Shapiro–Wilk W-test. Normal variables were expressed as the mean ± standard deviation and 95% confidence interval; nonnormally distributed variables were expressed as median and range. The homogeneity of the variances was assessed with the Bartlett-test.

The normal-weight group (18.5 ≤BMI <25) was set as the control group. For the continuous variables, pairwise comparisons with the control group were analyzed with Dunnett's multiple comparison test in those cases in which the homogeneity of variances was verified. In cases in which the variances were unequal, the data were analyzed with Steel's multiple comparison test.

Statistical results of the continuous variables were considered statistically significant when the value of $P < 0.05$.

Categorical variables were analyzed by χ^2-test, except when expected cells were found to be <5, in which case we used Fisher's exact test.

Post hoc multiple comparisons were made with the Bonferroni method and statistical results of the categorical variables were considered statistically significant when the $P < 0.017$.

Statistical analysis was performed with JMP 11.2.0 (SAS, Cary, NC, USA).

Results

Fourteen (7.8%) of 179 patients were classified as underweight (BMI <18.5 kg/m^2), 117 (65.3%) were classified as normal weight (18.5 ≤BMI <25 kg/m^2), 34 (19.0%) were classified as overweight (25 ≤BMI <30 g/m^2), and 14 (7.8%) were classified as obese (BMI ≥30 kg/m^2) [Figure 1].

The patients' clinical characteristics are shown in Table 1.

Compared with the normal-weight group, a higher percentage of patients in the obese groups had diabetes (obese group, $P = 0.0087$). The obese group also had a higher proportion of patients who smoked than the normal-weight group ($P = 0.016$). There were no differences in patient age, parity, history of low abdominal surgery, or cesarean section between the normal-weight group and the other three groups.

Surgical results are shown in Table 2.

Compared with the normal-weight group, the obese group had significantly longer operation times (172 ± 48.1 min. vs. 207 ± 62.3 min., $P = 0.04$) and more perioperative complications (15.3% vs. 42.8%, $P = 0.012$). However, no significant differences were found in the nonsurgical operating room time, blood loss or postoperative hospital stay between the obese group and normal-weight group. There were also no significant differences in the hospital readmission rate within 30 days after discharge between the obese group and normal-weight group. The underweight and overweight groups had no significant differences in surgical

Table 1: Clinical characteristics according to body mass index group

	Underweight (BMI <18.5)	*P*	Normal-weight control group (18.5≤ BMI <25)	Overweight (25≤ BMI <30)	*P*	Obese (BMI ≥30)	*P*
n	14		117	34		14	
BMI, kg/m^2, mean±SD	17.3±0.8	<0.001	21.5±1.7	27.0±1.4	<0.001	32.8±2.3	<0.001
Age, years, mean±SD	44.2±4.3		46.4±4.3	48.0±7.0		47.6±5.7	
Parity, median (range)	2 (0-3)		2 (0-4)	2 (0-3)		1 (0-4)	
Previous low abdominal surgery, *n* (%)	1 (7.1)		20 (17.0)	5 (14.7)		2 (14.2)	
Previous cesarean section, *n* (%)	3 (21.4)		12 (10.2)	5 (14.7)		2 (14.2)	
Diabetes mellitus, *n* (%)	0 (0)		2 (1.7)	4 (11.8)	0.023	3 (21.4)	0.0087*
Smoking, *n* (%)	0 (0)		3 (2.6)	4 (11.8)		3 (21.4)	0.016*

*Compared with the normal-weight group, a higher percentage of patients in the obese groups had diabetes. The obese group also had a higher proportion of patients who smoked than the normal-weight group. BMI: Body mass index, SD: Standard deviation

Table 2: Surgical results according to body mass index group

	Underweight (BMI <18.5)	*P*	Normal-weight control group (18.5≤ BMI <25)	Overweight (25≤ BMI <30)	*P*	Obese (BMI≥30)	*P*
n	14		117	34		14	
Operative time (min), mean±SD	167±55.3		172±48.1	184±52.4		207±62.3	0.04*
Nonsurgical operating room time (min), mean±SD	70±15.2		66±14.8	58±17.8		72±21.6	
Blood loss (g), median (range)	52.5 (10-425)		60 (10-970)	100 (10-700)		100 (12-475)	
Uterine weight (g), mean±SD	232±131.5		276±142.8	281±160.0		352±223.8	
re ASRM score, median (range)	0 (0-22)		0 (0-74)	0 (0-144)		0 (0-49)	
Cystoscopy, *n* (%)	11 (78.6)		92 (78.6)	24 (70.5)		11 (78.6)	
Postoperative hospital stay (days), median (range)	5 (3-7)		5 (3-13)	5 (4-10)		5 (4-37)	
Complications, *n* (%)	3 (21.4)		18 (15.3)	6 (17.6)		6 (42.8)	0.012†
Readmission within 30 days after discharge, *n* (%)	0		2 (0.02)	0		1 (0.07)	
Conversion to laparotomy, *n* (%)	0		0	0		0	

*Compared with the normal-weight group, the obese group had significantly longer operation times, †Compared with the normal-weight group, the obese group had significantly more perioperative complications. BMI: Body mass index; re ASRM: Revised American Society for Reproductive Medicine score, SD: Standard deviation

Table 3: Details of intraoperative and postoperative complications and their severity

	Underweight (BMI <18.5)	Normal-weight control group (18.5≤ BMI <25)	Overweight (25≤ BMI <30)	Obese (BMI ≥30)
Complications, *n* (%)	3 (21.4)	18 (15.3)	6 (17.6)	6 (42.8)
Intraoperative complications, *n*				
Bladder injury	1	0	0	0
Bowel injury	0	0	2	1
Urinary injury	0	1	0	0
Postoperative complication, *n* (C-D grade)				
Cuff hematoma	0	5 (I)	1 (I)	2 (I)
Pelvic infection disease	0	6 (I)	2 (I)	0
Emphysema	0	1 (I)	0	0
Pelvic funnel ligament vein thrombus	0	1 (I)	0	0
Wound infection	2 (IIIa, I)	2 (I)	1 (I)	1 (I)
Urinary injury	0	1 (IIIa)	0	0
Bleeding	0	1 (IIIb)	0	0
Hip arthritis	0	0	0	1 (II)
Bowel perforation	0	0	0	1 (IIIb)

BMI: Body mass index, kg/m^2, C-D grade: Clavien-Dindo classification grade

results, compared with the normal-weight group. None of the patients underwent conversion to laparotomy.

Table 3 shows surgical complications, both intraoperative and postoperative. All groups except the overweight group had a grade 3 complication that required surgical endoscopic treatment.

Discussion

The study showed that obese patients had significantly longer operation times and more perioperative complications than patients with normal weight. The obese group did not have longer postoperative hospital stays or higher hospital readmission rates within 30 days after discharge compared with the normal-weight group.

A recent study reported that higher BMI in laparoscopic hysterectomy was significantly associated with longer operative time, longer nonsurgical operating time, longer total operating time, greater estimated blood loss, and greater complication severity.[10] Another study reported that there was no correlation between higher BMI and surgical complication rates in patients undergoing laparoscopic gynecological surgery for benign pathology.[11] However, that study also found that as BMI increased, the ease of identification of important anatomical landmarks significantly decreased. Our data are generally consistent with these studies.

Laparoscopic hysterectomy in obese patients is certainly associated with burdens and risks. These problems may be overcome by skilled surgeons, anesthetists, and medical staff in the operating room.

Another retrospective case-control study found no significant differences among four BMI groups (underweight, normal weight, overweight, and obese) in surgical results

(including operation time, rate of laparotomy conversion, perioperative complications, and hospital stay) in patients who underwent laparoscopic surgery for uterine fibroids, benign adnexal masses, endometriosis, or endometrial cancer (stage I). However, that study showed that pelvic lymphadenectomy required significantly longer surgical time in obese patients with endometrial cancer than in the control group.[12]

That retrospective case-control study also pointed out the technical difficulties by high BMI could be solved if skilled surgeons. Compared with the facility in that study, the obese group in our study had worse surgical results as follows; long operative time and more perioperative complications. These challenging problems may be overcome when the level of surgical expertise in our hospital grow up.

In our study, the obese group also had a higher proportion of patients who smoked than the normal-weight group ($P = 0.016$).

The previous systematic review and meta-analysis showed that preoperative smoking was associated with an increased risk of the following postoperative complications: general morbidity, wound complications, general infections, pulmonary complications, neurological complications, and admission to the intensive care unit.[13]

The obese group in our study had significantly more perioperative complications. Moreover, as the postoperative complication, only one obese patient of all patients in our study admitted to the intensive care unit because of bowel injury.

In the present study, the underweight group had no significant differences in surgical results compared with other groups, including operation time, blood loss, postoperative hospital stay, and complications. However, the incidence of SSI was 14% (2/14) in the underweight group, which was higher than that in other BMI groups (normal group, 1.7% [2/117]; overweight group, 2.9% [1/34]; and obese group, 7.1% [1/14]). Moreover, the most severe SSI, in which the patients needed debridement for cutaneous necrosis because of wound infection, only occurred in the underweight group in this study. These data suggest that being underweight may increase the risk of SSI after TLH. Our data agree with a report that low BMI was a significant predictor of SSI after laparoscopic appendectomy.[6]

A prospective, randomized, multicenter study of 4718 patients who underwent noncolorectal abdominal surgery revealed that low BMI was a risk factor for global infectious complications.[14] Being underweight was also significantly correlated with SSI, parietal complications, and deep infectious complications with or without fistulas in univariate analysis. That study recommended that a low BMI is modified to decrease infectious complications. A low BMI may reflect malnutrition.[15]

A weight deficit exceeding 10% of the patient's ideal weight has been shown to be a risk factor for postoperative infectious complications caused by changes in the defense system against infection.[16-18] This interrelationship between being underweight and the risk of infectious complications may be explained regarding nutritional status.

Only one study of gynecologic laparoscopic surgery reported no difference in complication rates between underweight patients (BMI <18.5 kg/m^2) and normal-weight patients (18.5 ≤BMI <25 kg/m^2).[19] We could not evaluate the risk of SSI in the underweight group because of the small number of patients. A future study is needed to evaluate the risk of SSI among underweight patients undergoing gynecologic laparoscopic surgery.

Our study has some limitations. This was a retrospective study, and the number of patients was small. In addition, all patients were Japanese. However, comparing outcomes in the normal-weight group with those of other weight groups (underweight, overweight, and obese) is worthwhile.

Our results may indicate that appropriate weight control before gynecologic laparoscopic surgeries may decrease surgical risks for obese patients.

Further studies are needed for the risk of SSI in the underweight patients.

Conclusion

Compared with patients of normal weight, in both underweight and overweight patients, no significant differences were found in surgical results as follows: operating room time, nonsurgical operating room time, estimated blood loss, postoperative hospital stay, and the incidence of intraoperative and postoperative complications.

Obese patients had significantly longer operation times and more perioperative complications than patients of normal weight. However, the obese group had no increase in postoperative hospital stay or hospital readmission rate within 30 days after discharge, compared with the normal-weight group.

Laparoscopic hysterectomy has certain burdens and risks in obese patients. These problems may be overcome by skilled surgeons, anesthetists, and medical staff.

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Conflicts of interest

There are no conflicts of interest.

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