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Original Article

The impact of body mass index on surgical outcomes of total laparoscopic radical hysterectomy in women with early-stage cervical cancer

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Abstract: Purpose: We sought to review our experience with total laparoscopic radical hysterectomy (TLRH), comparing surgical outcomes in women with ideal, overweight, and obese body mass indices (BMI). Materials and methods: We reviewed records from all TLRHs performed at our institution between 6/2012 and 2/2016. Comparison among groups was performed using single factor Analysis of Variance (ANOVA) or Fisher's Exact Test, with *P* values < 0.05 considered statistically significant. Results: Thirty-seven patients underwent TLRH. Of these, 35 were treated for early-stage cervical cancer (stage IA = 6; IB = 29), 1 for clinical stage II uterine cancer, and 1 for suspected adenoma malignum. The median cervical tumor diameter was 2.0 cm (range 0-6 cm). Five patients had cancer-positive lymph nodes. The mean BMI was 29.2 (range 20.5-39.7). Specifically, 7 patients (19%) had an ideal body weight (BMI less than 25), 17 patients (46%) were overweight (BMI between 25 and 30), and 13 women (35%) were obese (BMI greater than 30). The mean operating room time was not significantly different among the three groups (*P* = 0.29). Similarly, the estimated blood loss among the three groups (146 mL vs 140 mL vs 140 mL; *P* = 0.98) did not differ. The mean number of lymph nodes removed was 22.9 in women with ideal body weight, 19 in overweight women, and 21.2 in obese women (*P* = 0.61). The mean duration of bladder catheterization was 14.1 days, with no difference among the three groups. There was a significant difference in length of post-operative hospitalization (*P* = .02) with a longer length of stay in the patients with BMI between 25 and 30 (1.8 days) vs BMI < 25 (1.3 days) and BMI > 30 (1.2 days). There were no significant intraoperative complications and no significant differences in postoperative complications among groups. Conclusions: TLRH in overweight and obese women did not confer increased operative or postoperative morbidity relative to women with normal BMI. TLRH should be considered in overweight and obese patients requiring radical hysterectomy.

Keywords: Laparoscopic radical hysterectomy, cervical cancer, obesity

Introduction

Radical hysterectomy with pelvic lymphadenectomy is an option for definitive management of early-stage cervical cancer. It is the preferred approach for women with cervical cancer who are appropriate surgical candidates and wish to preserve ovarian and sexual function. Radical hysterectomy may also be performed as definitive management of endometrial or uterine cancer that grossly involves the cervix. Traditional radical hysterectomy is typically performed by laparotomy.

The laparoscopic approach to radical hysterectomy was first introduced in 1992 and is used now at several centers as an alternative that is technically feasible and offers comparable oncologic outcomes [1-4]. A minimally invasive approach to gynecologic oncology surgery is also associated with improved short-term quality of life and postoperative recovery [5]. TLRH has been associated with intraoperative and postoperative complication rates of 3-13% and 3-29%, respectively [3]. One meta-analysis comparing laparoscopy and laparotomy for radical hysterectomy demonstrated at 54% reduction in postoperative complications. Notably, patients in these studies were predominantly normal weight or overweight [3]. Despite the suggested lowering of complication rates, minimally invasive radical hysterectomy has also been associated with higher rates of tumor-positive vaginal cuff margins and cuff recurrence compared with abdominal radical hysterectomy [10].

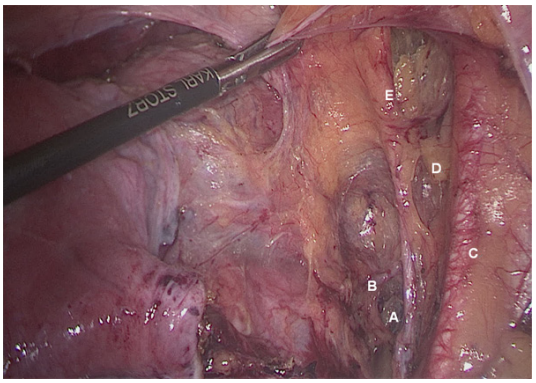

Figure 1. Pararectal and paravesical spaces. A: Pararectal space; B: Uterine artery; C: External iliac vessels; D: Paravesical space; E: Internal iliac artery terminating as superior vesical artery.

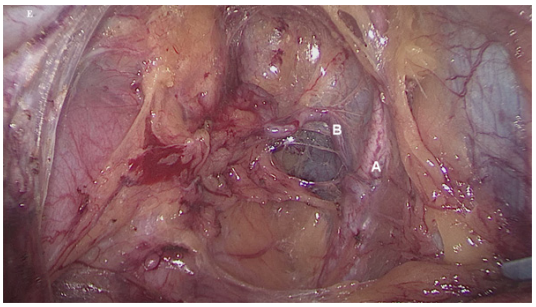

Figure 2. Isolation of the uterine artery. A: Ureter; B: Uterine artery.

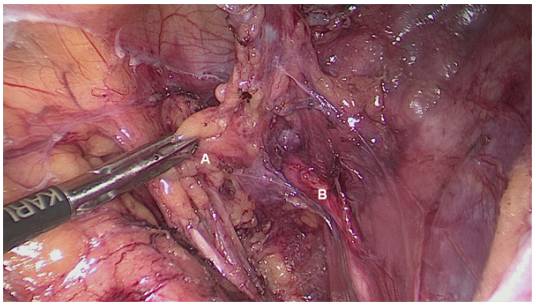

Figure 3. Development of ureteric tunnel. A: Reflected uterine artery; B: Ureter entering ureteric tunnel.

Although various studies have reviewed oncologic and post-operative outcomes with TLRH, further studies are needed, and especially ones studying outcomes in obese patients [11]. During laparoscopy, obesity makes peritoneal entry more difficult, limits the amount of tolerated Trendelenburg positioning, and reduces visualization of pelvic and abdominal anatomy [6]. These contribute to obesity being a significant factor for aborting a laparoscopic approach and converting to laparotomy. Conversion rates

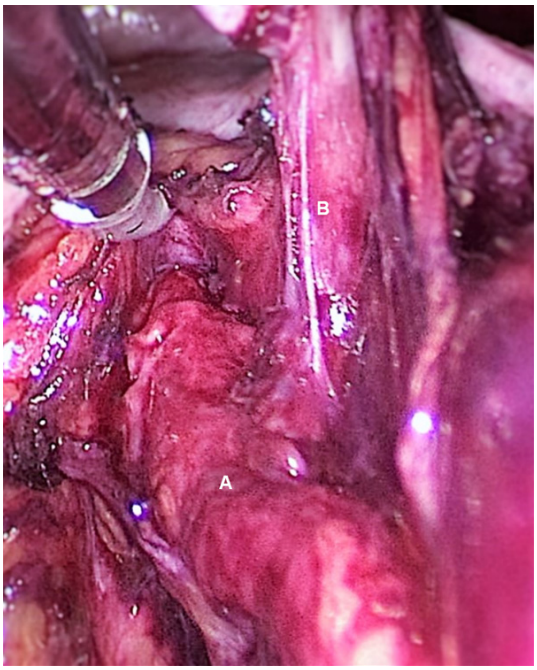

Figure 4. Vesicouterine ligament over distal ureter. A: Unroofed distal ureter; B: Reflected vesico-uterine ligament (VUL).

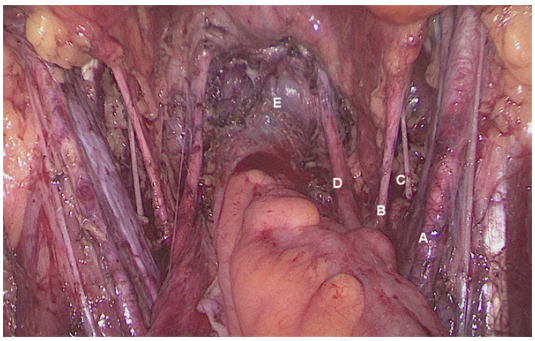

Figure 5. Completed laparoscopic radical hysterectomy. A: External iliac vessels; B: Superior vesical artery; C: Obturator nerve; D: Ureter; E: Vaginal cuff.

to laparotomy range from 14-36% in obese patients compared with 5-6% in non-obese patients [9]. Obesity is also linked to a higher risk of perioperative complications [7, 8]. To date, most study cohorts have had a median BMI < 30 kg/m^2 [12]. The objective of our study was to review our institution's experience with TLRH and compare surgical outcomes in ideal body weight, overweight, and obese patients.

Method

All women who underwent TLRH at Parkland Health and Hospital, the county hospital for

Table 1. Patient demographics

	BMI < 25 (n = 7)	BMI 25-30 (n = 17)	BMI > 30 (n = 13)
Age	44.6	45.6	42.5
Race			
Hispanic	6	9	5
African American	1	1	2
White	0	6	6
Other	0	1	0
Stage			
IA	0	3	3
IB	7	14	8
II	0	0	0
Other*	0	0	2
Histologic Subtype			
Squamous cell carcinoma	2	10	10
Adenocarcinoma	5	7	1
Other*	0	0	2

*Endometrial cancer and benign pathology (adenoma).

Table 2. Patient pre-existing comorbidities

Medical Comorbidities	N (%)
None	23 (59%)
Hypertension	12 (28%)
Diabetes Mellitus	5 (13%)
Hypothyroidism	2 (5%)
Other malignancy*	1 (3%)
COPD	1 (3%)
Hepatitis C	1 (3%)

*Stage IIB infiltrating ductal carcinoma of the breast.
COPD = chronic obstructive pulmonary disease.

Dallas County that serves a largely indigent population, and Clements University Hospital, which is affiliated with University of Texas Southwestern Medical Center, between June 2012 and January 2016 were included for review. Each case was performed by a surgical team that included a gynecologic oncology faculty physician, a gynecologic oncology fellow, and a resident physician, in line with the teaching hospital model at these institutions. Data collected included patient BMI, type of gynecologic malignancy, pathologic variables, stage of malignancy, operating room time, estimated blood loss, hospitalization length, length of bladder catheterization and intra- and postoperative complications. Pathology reports were reviewed to determine pathologic variables. Comparison among groups was performed using Analysis of Variance (ANOVA) or Fisher's Exact Test with P values < 0.05.

Operative procedure for radical hysterectomy

After laparoscopic entry and inspection of the abdomen and pelvis for gross intraperitoneal disease, the retroperitoneal spaces are entered bilaterally and carefully dissected to allow identification of the external and internal iliac vessels and ureter. The pararectal and paravesical spaces are opened bilaterally (**Figure 1**). The bladder is then mobilized off the cervix and upper vagina. With the medial leaf of the peritoneum retracted medially, the course of the hypogastric artery is followed caudally to identify the uterine artery and the superior vesical artery (**Figure 2**). The uterine artery is coagulated and ligated at its origin. Ventral traction on the uterine artery allows identification of the uterine vein, which is coagulated and divided. The ureter is then mobilized off the medial leaf of the peritoneum, and the cut medial end of the uterine artery is used to identify the entrance to the ureteric tunnel. Vascular branches from the uterine vessels to the ureter are coagulated and transected to allow development of the ureteric tunnel (**Figure 3**). This allows the lateral parametrium to be safely divided to unroof the ureter. The vesicouterine ligament (VUL) (anterior parametrium) is subsequently isolated and divided, unroofing the distal ureter (**Figure 4**). The avascular portion of the dorsal VUL in between the ureter and the vagina is cut to mobilize the ureter laterally. The rectovaginal space is then developed. After this, the uterosacral ligaments are coagulated and divided at the level of the rectum. The cardinal ligaments are divided at the pelvic sidewall. A colpotomy is made, and the entire specimen is removed vaginally (**Figure 5**).

Results

We identified 37 women who underwent a TLRH during the specified time (demographics shown in **Table 1**). Thirty-five underwent radical hysterectomy and pelvic lymphadenectomy for early-stage cervical cancer. One patient underwent radical hysterectomy and lymphadenectomy for FIGO stage II endometrioid endometrial cancer, and another patient for presumed adenoma malignum. The mean age of the women who underwent surgery was 44.8 years (range 27-

Table 3. Operative findings

	BMI < 25 (n = 7)	BMI 25-30 (n = 17)	BMI > 30 (n = 13)	*P* value
Estimated blood loss (mL)	146.4	140	140.1	0.98
Operative time (mins)	363.9	353.8	387.3	0.29
Length of Foley placement (days)	13.3	14.4	10.8	0.24
Length of postoperative stay (days)	1.3	1.8	1.2	0.02

Table 4. Pathologic findings

	BMI < 25 (n = 7)	BMI 25-30 (n = 17)	BMI > 30 (n = 11)	*P* value
Tumor size (cm)	1.8	1.7	2	0.79
Number of lymph nodes resected	22.9	19	21.2	0.61
Nodal metastasis (%)	28.6%	11.8%	8%	0.43
LVSI (%)	42.9%	23.5%	53.8%	0.24
Positive parametria (%)	14%	0%	0.0%	0.12
Positive vaginal margins (%)	0%	0%	0%	--
Require adjuvant therapy (%)	57.1%	35.3%	23.1%	0.33
Recurrence (%)	14.3%	11.8%	9.1%	0.9

LVSI = lymphovascular space invasion.

Table 5. Postoperative complications

	BMI < 25 (n = 7)	BMI 25-30 (n = 17)	BMI > 30 (n = 13)
Urinary retention	2	3	2
Cuff cellulitis	1	1	0
Infected lymphocele	1	0	1
Postoperative pain*	0	1	0

*Requiring readmission for pain control.

70). Median patient follow up was 9.4 months (range 0.5-36.7 months). All patients had an Eastern Cooperative Oncology Group (ECOG) performance status of 0-2. The average weight overall was 72.5 kg (range 45.9-97.5 kg). The average BMI overall, was 29.2 (range 20.5-39.7). Within our group, 7 patients were normal weight, 17 patients were overweight, and 13 women were obese. Fifty-nine percent of patients did not have medical comorbidities. Significant medical comorbidities in the total cohort are recorded in **Table 2**.

The mean operating room times among ideal body weight, overweight, and obese patients did not differ (**Table 3**; $P = 0.29$). Moreover, estimated blood losses were comparable (**Table 3**; $P = 0.98$). The mean length of hospitalization was 1.5 days for all patients (range 1-3 days). There was a statistically significant difference ($P = 0.02$) in the length of postoperative stay across the three cohorts, with a longer length of stay in the overweight patients (1.8 days) vs normal-weight (1.3 days) and obese women (1.2 days). No significant intraoperative complications were encountered, and none of the cases required conversion to laparotomy.

The mean cervical tumor diameter did not vary among the BMI groups (**Table 4**). Among patients with cervical cancer, 2 normal-weight patients had microscopically tumor-positive parametria. However, all patients had negative surgical margins. The mean number of lymph nodes reported among the three groups did not differ ($P = 0.61$).

The mean duration of bladder catheterization was 14.1 days and did not differ among the three BMI groups. Of the total 39 patients, 7 (17.9%) required re-insertion of a Foley catheter at their 10-14-day postoperative visit. However, all patients were eventually able to void spontaneously. Four patients were re-admitted postoperatively. Reasons for re-admission included cuff cellulitis, pain control, infected lymphocele, and altered mental status secondary to urinary tract infection. The complication rate (**Table 5**) for the normal, overweight, and obese cohorts were 28%, 24%, and 15%, respectively ($P = 0.78$). Cancer recurred in 4 women, and 11 patients required postoperative adjuvant therapy.

Discussion

Abdominal surgery in obese patients can be complicated by greater operating time, blood loss, need for blood transfusion, and rates of postoperative infections and wound dehiscence [13-15]. Moreover, the increased postoperative recovery time associated with laparotomy can raise the chance for thromboembolism, particularly in obese patients [15, 16]. Hence, radical hysterectomies in obese women portend higher than average risks. Reports of transfusion in patients undergoing radical hysterectomy performed via laparotomy range from 49-81% [17-22]. Rates of major organ and

vascular injury during abdominal radical hysterectomy have been reported as high as 13% [23]. Rates of postoperative wound infection and lymphocyst formation range from 0.63-10.4% and 0.8-21.4%, respectively [24]. In a large study of radical hysterectomies performed at several cancer centers, the operative mortality rate was 0.72% [25]. These risks are amplified in obese patient. Purported reasons include poor anatomic visualization, impaired surgical maneuverability within a deep, narrow pelvis, and protracted healing due to obesity and associated comorbidities [6, 26].

Minimally invasive surgery has been shown to reduce or avoid the risks of postoperative complications seen with abdominal surgery for gynecologic cancers [27]. Minimally invasive approaches are well-accepted surgical treatment for endometrial cancer, with the most common complication being conversion to laparotomy [5]. This is attributed to laparoscopic surgery among obese women being associated with challenging laparoscopic abdominal entry, limited Trendelenburg positioning, inability to establish or maintain pneumoperitoneum, and difficulty with performing adequate lymphadenectomy [7, 8, 29]. In a study by Eltabbakh et al comparing laparoscopic versus open hysterectomy in obese women with endometrial cancer, patients undergoing laparoscopic hysterectomy required less IV pain medication, had shorter hospital stays, had lower incidences of postoperative ileus, and returned to baseline activity sooner than those who underwent laparotomy [6]. Overall, comparing laparoscopic with open hysterectomy in this patient population, the study by Eltabbakh and others have shown similar surgical outcomes, with the exception of increased operative time [6, 28-30]. Thus, investigations that seek to demonstrate similar outcomes for obese women with early-stage cervical cancer using minimally invasive techniques have merit.

Our case series exclusively focuses on patients undergoing TLRH to study the effects of BMI on procedure outcome. First, we demonstrated the feasibility of TLRH in obese patients. Second, we showed in all three weight classes, ideal bodyweight, overweight, and obesity, that TLRH yields similar outcomes with respect to blood loss, operative time, number of resected lymph nodes, and surgical margin status. Other reports have found that, despite longer operating times, the laparoscopic approach to radical hysterectomy was associated with a lower average blood loss compared with laparotomy [3, 10, 12, 31]. This difference is likely due to improved visualization, focused isolation of blood vessels, and decreased incisional bleeding. The latter advantages persist even among obese women, as can be evidenced by the similarity in operative blood loss and surgico-pathologic features seen in this study. Our findings are supported by a previous report that demonstrated no significant difference in parametrial length, maximum vaginal cuff length, or number of lymph nodes extracted among obese women undergoing laparoscopic radical hysterectomy [12]. All surgical procedures in our case series were performed at a training institution, which may in part attribute toward longer operative times.

In radical pelvic surgery, the risk of postoperative bladder dysfunction leading to urinary retention is increased [32, 33]. However, studies have shown no significant differences in the duration of postoperative Foley catheterization following TLRH vs abdominal radical hysterectomy [1, 3, 34]. In our case series, the mean length of catheterization (14.1 days) across all BMI categories was similar. These values were also comparable to values from other studies, and a range of 7 to 21 days was reported in one meta-analysis of 11 studies [3]. Across our three cohorts, the length of postoperative stay did not vary. The longest stays were seen in overweight patients. This finding is likely due to the limited number of patients and the narrow range of variance for length of postoperative stay, given that most of patients were hospitalized for only 1 day.

The main limitation of this study is the limited sample size of our study population. Increasing the number of reviewed cases would allow stronger comparisons among weight classifications. However, our review of 37 TLRH cases for early-stage cervical cancer is comparable to the patient populations studied in other published data. Frumovitz et al at MD Anderson also compared TLRH and abdominal radical hysterectomy in similar cases. Their study included 35 patients who underwent TLRH [12]. The outcomes across all three groups from our institution were comparable to the comprehensive data from the Frumovitz study. In a study performed on a cohort of 166 patients under-

going radical hysterectomy (54 laparoscopic versus 116 open) in Seoul, Korea, TLRH was found to be a preferred alternative to abdominal radical hysterectomy due to comparable surgical outcomes and favorable measures of postoperative recovery [11].

The laparoscopic platform to radical hysterectomy is comparable to that of the minimally invasive robotic approach. One study comparing robotic and laparoscopic approaches to radical hysterectomy showed no differences in estimated blood loss, operative time, length of hospital stay, number of lymph nodes resected, and rates of postoperative complications. The three-dimensional magnified field, improved surgeon ergonomics, surgeon flexibility, and decreased surgeon fatigue are largely touted as advantages of robotic compared with straight-stick laparoscopy. However, the added operative time and costs may be prohibitive depending on the facility, case load, and surgeon training. Although the learning curve to perform TLRH is steep, we demonstrate that it is a teachable technique that can be acquired through hands-on training [34].

Our data suggest that TLRH is a feasible approach in the management of early-stage cervical cancer with no difference in adequacy or efficacy of the procedure between normal-weight, overweight, and obese patients. Future randomized studies are needed to further investigate the effects of BMI on the long-term outcomes for these women.

Disclosure of conflict of interest

None.

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