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Total laparoscopic hysterectomy for oncological indications with outcomes stratified by age☆

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Abstract

Objective. We hypothesize that there is no difference in surgical outcomes of patients undergoing total laparoscopic hysterectomy (TLH) for various oncological indications when stratified by age categories.

Methods. Data were analyzed by ANOVA and chi-square test with significance of $P < 0.05$, stratified by age (young: <50 years, middle: 50–64, senior age 65+).

Results. There were 208 patients, age 26–86 years: 85 young, 82 middle, and 41 senior women. Preoperative diagnoses included 13 cases of cervical dysplasia, 10 cervical or upper vaginal carcinoma, 60 endometrial neoplasias, 22 prophylaxes of familial ovarian carcinoma, 95 with complex pelvic mass, and 8 with early ovarian carcinoma. Mean body mass index (BMI) was 27.2 kg/m^2 for all groups. Parity increased with age (1.0, 1.3, and 2.0; $P = 0.001$). Surgical duration was longer for young than middle or senior (168, 147, and 140 min, $P = 0.0095$). All groups had a similar mean blood loss (133 cc, ns) and similar mean length of hospital stay (1.8 days, ns). Overall complication rate was 7.7% with no variance by age: one seroma, one hematoma, one diverticulitis, one incisional hernia, one vaginal nonhealing, one adhesive bowel obstruction, and five urologic complications (two bladder, three ureteral; four treated with catheter or stent, one reimplant. Reoperation was required in 2.8%.

Conclusions. Null hypothesis accepted: TLH appears feasible and safe for oncological practice indications throughout the life span. This pilot data can facilitate guidelines for a randomized controlled trial of TLH with TAH and laparoscopic assisted vaginal hysterectomy (LAVH).

Keywords: Total laparoscopic hysterectomy; Age; Laparoscopic assisted vaginal hysterectomy

Introduction

Traditional therapy for persistent complex pelvic mass, endometrial pathology, and cervical and vaginal neoplasia most often includes hysterectomy and most often by open laparotomy. Laparoscopic assisted vaginal hysterectomy (LAVH) has been described as an alternative to laparotomy in oncological practice because the laparoscopic approach confers similar overall complication rates, less blood loss, slightly longer operating times, fewer transfusions, less pain, and shorter hospital stay and disability [1–7]. However, LAVH is predicated upon the ability to resect the cervix and lower uterine segment and close the vaginal incision through the vagina from below. Nulliparous, senior, and obese women who are at increased risk for ovarian and uterine cancer may thus not qualify for LAVH due to insufficient uterine prolapse or small vaginal

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capacity. Thus, since 1996, we have employed a total laparoscopic hysterectomy (TLH) technique because it is quicker and associated with less blood loss than LAVH [8,9] and is more available to senior, nulliparous, and obese women [10,11].

Senior patients undergoing hysterectomy have typically received an open laparotomy with an acceptably higher rate of complications such as wound infection, pelvic abscess, and dehiscence than observed in younger patients [12]. A recent retrospective report of laparoscopic gastric bypass experience showed no increase in morbidity for patients over age 50 with the laparoscopic approach in comparison with an open technique [13]. It would be important to record surgicopathologic data from a series of senior patients undergoing laparoscopic hysterectomy to confirm safety issues and to facilitate planning a prospective trial. While a randomized clinical trial would be the standard for comparing the safety, efficacy, and complication rates of open hysterectomy versus laparoscopic hysterectomy for senior women, there are, as yet, no large cohort reviews to serve as pilot data focusing on safety and feasibility outcomes as they relate to age.

In this retrospective report, the office charts of oncological patients undergoing TLH as part of their care plan were abstracted for demographics, preoperative indications, surgical and pathological data, and complications and are analyzed with outcomes stratified by age categories. We hypothesize that there is no difference in surgical outcomes of patients undergoing total laparoscopic hysterectomy (TLH) for oncological indications when they are stratified by age categories.

Patients and methods

Retrospective study design

Of 451 recorded cases of total laparoscopic hysterectomy performed over an 84-month period, there were 211 cases performed for management of cervical dysplasia, cervical or upper vaginal carcinoma, endometrial hyperplasia, carcinoma and sarcoma, complex pelvic mass, early ovarian carcinoma, and prophylaxis of familial ovarian carcinoma. The cases were stratified into three age categories (young: <50 years, middle 50–64, senior age 65+) to correlate with increasing likelihood of cardiac morbidity due to the negative impact on cardiac output and systemic vascular resistance by pneumoperitoneum [14]. All surgeries were assisted by a categorical obstetrics and gynecology resident or, less often, by an attending specialized in obstetrics and gynecology who was also actively learning the technique.

In this practice, every patient needing hysterectomy was scheduled for a laparoscopic approach unless she had prior surgical reports documenting severe abdominal or intestinal adhesions, clinical or radiographic evidence of metastatic carcinoma, or documented severe pulmonary disease, contraindicating prolonged steep Trendelenburg position.

TLH means all surgery was performed entirely through the laparoscopic ports, including the closure of the vagina [15]. Simple total laparoscopic hysterectomy was performed for all cases of cervical dysplasia, cervical carcinoma with invasion less than 3.0 mm, endometrial hyperplasia, carcinoma, and ovarian neoplasia. A radical hysterectomy was performed for cases with invasive cervical carcinoma with invasion deeper than 3.0 mm. All pelvic masses were removed without intraperitoneal spillage in a 5 × 8 or 8 × 15 in. ripstop nylon sack with a purse string (Lapsac, Cook Surgical, Chicago, IL). The opening of the elongate sack was delivered out of the vagina by the purse string, allowing a speculum to be passed into the bag as it exits the introitus. Under direct visualization through the speculum, the mass was incised allowing any cystic material to pour out of the bag into a basin, collapsing the mass within the bag and permitting removal without intraperitoneal spillage. The nodes and omentum were delivered through the vagina. Staging was performed for all invasive cervical, uterine, and ovarian malignancies and included hysterectomy, pelvic, and aortic lymph node dissections, with omentectomy, appendectomy, and peritoneal washings and biopsies as appropriate. The hysterectomy procedure is described in detail elsewhere [10]. Many additional procedures were then performed for pelvic prolapse, incontinence, and other diagnoses such as cholelithiasis. Then the vaginal apex was closed, fixing the lateral vaginal angle to the uterosacral and round ligaments for suspension.

All patients were given printed information about their surgery: bowel prep, inpatient care, postoperative instructions, and home recovery. Discharge instructions encouraged early resumption of all general activities as soon as tolerated, including floor exercises, and return to unrestricted work at 2 weeks. Patients were seen for an abdominal incision check at 10 days after discharge and for vaginal check at 6 weeks. Patients were instructed not to engage in any vaginal penetration until after they received clearance at their 6-week vaginal check-up.

This data set has been reviewed with reports published earlier on 330 patients with data stratified by body mass index [10] and on 90 patients who had a pelvic mass [16].

Data management and analysis

Charts were reviewed for anonymous compilation of patient data regarding age, height, weight, parity, preoperative diagnosis, procedure(s), estimated blood loss (EBL), duration of surgery, duration of hospital stay, pathologic data including uterine dimensions, weight, cancer characteristics such as depth of invasion, grade, pelvic cytologic washings, number of nodes dissected, and complications. The data were analyzed on an SPSS statistical analysis package, using ANOVA and *t* test for comparison of continuous data, and chi-square analyses including Fisher's

Table 1
Patient demographics stratified by age category*

	Young (n = 85) M (SD)	Middle (n = 82) M (SD)	Senior (n = 41) M(SD)	P value
Age (years)	42.5 (5.1)	55.3 (4.5)	72.1 (5.9)	0.0001[a]
Parity	1.0 (1.3)	1.3 (1.1)	2.0 (1.5)	0.001[b]
Body mass index	27.2 (6.7)	27.0 (6.5)	28.0 (7.2)	0.7846

[a] All three categories significantly different from each other by post hoc analysis.
[b] Only young vs. senior and middle vs. senior significantly different by post hoc analysis.
* ANOVA.

exact test for nominal data. A value of $P < 0.05$ was accepted as significant.

Results

Among 211 patients identified with oncological indications for their hysterectomy (cervical dysplasia, cervical or upper vaginal carcinoma, endometrial hyperplasia, carcinoma, and sarcoma, complex pelvic mass, early ovarian carcinoma, mutation of BrCa 1 or 2, or family history of ovarian cancer), none was disqualified from a laparoscopic approach due to pulmonary disease or adhesions. There were three patients (1.4%) converted to open laparotomy early in the series. Two were converted at an outlying hospital because of equipment inadequacies (one young, one middle category of age). One was converted because of the unexpected finding of widespread intraperitoneal metastatic cancer (middle category). Of the remaining 208 cases, 85 were young with group average age of 42.5 years, 82 were in the middle category with group average of 55.3 years, and 41 were senior with mean age of 72.1 (Table 1). The mean parity was 1.0 for the young, 1.3 for the middle, and 2.0 for the senior women ($P = 0.001$), ranging from 0 to 9. Overall, 36% of the patients were nulliparous. The mean body mass index (BMI) was 27.3 for all three groups ($P = 0.785$), ranging from 17 to 54.1.

The preoperative indication for surgery varied significantly by age category with 23 cases of vaginal or cervical neoplasias, 125 cases with ovarian indications, and 60 cases with uterine neoplasia (Table 2). Senior women were more likely to have uterine neoplasia (14.1%, 30.5%, 56.1%; $P = 0.0001$) while younger women were more likely to have cervical or vaginal neoplasia (17.6%, 8.5%, 2.4%; $P = 0.0215$) or ovarian indications (68.2%, 61.0%, 41.4%; $P < 0.0163$).

The surgery durations decreased with increasing age category, with young category surgeries lasting 2.8 h, middle category surgeries lasting 2.5 h, and senior category surgeries lasting 2.3 h ($P = 0.0095$) (Table 3). The estimated blood loss did not vary by age, averaging 133 cc per case ($P = 0.1210$), ranging 0–1000, with 93 cases having less than 50 cc blood loss. While the mean hospital stay was 1.8 days for all age categories ($P = 0.2302$), 95 patients stayed only 1 day.

The mean uterine weight was 177 g in the young category, 128 g in the middle category, and 96 g in the senior category ($P = 0.0011$) (Table 4). Thirteen women had uteri weighing between 300 and 800 g. The mean size of the adnexal mass was 8.4 cm (range 3–19) in the 71 cases with a preoperative diagnosis of complex pelvic mass, with no significant difference between the three groups of patients ($P = 0.9877$). A radical lymphadenectomy was performed with radical hysterectomy in nine cases yielding a mean of 26 nodes without variance by age group ($P = 0.3844$) ranging from 16 to 55 nodes. Nodes were sampled in 21 cases with a mean of 17 obtained per case, ranging from 4 to 29, without variance by age category ($P = 0.4427$).

Ninety-eight patients had additional procedures including 27 appendectomies, 10 omentectomies, 30 lymph node

Table 2
Preoperative demographics stratified by age category*

Preoperative Diagnosis	Young (n = 85) n (%)	Middle (n = 82) n (%)	Senior (n = 41) n (%)	P value
Vaginal or cervical neoplasia	15 (17.6)	7 (8.5)	1 (2.4)	0.0215
Vaginal carcinoma	1 (1.2)	0	0	
Cervical dysplasia	7 (8.2)	5 (6.1)	1 (2.4)	
Cervical carcinoma	7 (8.2)	2 (2.4)	0	
Uterine neoplasia	12 (14.1)	25 (30.5)	23 (56.1)	0.0001
Endometrial hyperplasia	3 (3.5)	5 (6.1)	4 (9.7)	
Endometrial carcinoma/sarcoma	9 (10.6)	20 (24.4)	19 (46.3)	
Ovarian pathology or risk	58 (68.2)	50 (61.0)	17 (41.4)	0.0163
Familial history breast/ovary cancer	8 (9.4)	9 (11.0)	5 (12.2)	
Pelvic mass	44 (51.8)	39 (47.6)	12 (29.3)	
Ovarian carcinoma	6 (9.4)	2 (2.4)	0	

* Chi-square test.

Table 3
Surgical data stratified by age category*

	Young (n = 85) M (SD)	Middle (n = 82) M (SD)	Senior (n = 41) M (SD)	P value
Duration of surgery (min)	167.5 (55.6)	146.8 (58.2)	139.9 (44.1)	0.0095[a]
Estimated blood loss (cc)	150.1 (165.4)	111.9 (130.7)	103.8 (121.0)	0.1210
Length of hospital stay (days)	1.8 (.9)	1.6 (.6)	2.0 (2.1)	0.2302

[a] The young category had significantly longer operating times than middle or senior in post hoc analysis.
* ANOVA.

Table 4
Pathologic data stratified by age category (Tukey–Kramer)

	Young (n = 85) M (SD)	Middle (n = 82) M (SD)	Senior (n = 41) M (SD)	P value
Pathology of uterus[a]				
Length (cm)	9.2 (1.9)	8.4 (2.2)	7.5 (1.6)	0.0001[b]
Width (cm)	6.3 (1.9)	5.7 (1.4)	4.9 (1.1)	0.0001[b]
Depth (cm)	4.4 (1.5)	3.9 (1.4)	3.4 (1.0)	0.0005[c]
Weight (g)	177 (145)	128 (86)	96 (51)	0.0011[c]
Ovarian mass (cm)[d]	8.3 (3.7)	8.3 (7.5)	8.6 (5.1)	0.9877
Radical node				
Dissect[e]	28.2 (15.2)	17.5 (2.1)		0.3844
Node sampling[e]	13.9 (7.7)	15.1 (8.5)	7.0 (4.2)	0.4427

[a] Uterine dimensions available for 206 cases. Uterine weight available for 175 cases.
[b] All three categories significantly different from each other by multiple specific comparisons.
[c] Young from middle and young from senior significantly different by multiple specific comparisons.
[d] Ovarian dimensions only included for 74 patients with neoplastic enlarged ovaries.
[e] Node counts are from 19 of the 21 patients sampled and from nine patients having radical dissection.

dissections (9 radical, 21 samplings), 9 ureterolyses, 6 Burch procedures, and 3 cholecystectomies (these by a general surgeon) (Table 5). However, the specific times required for these additional procedures were not recorded or subtracted from the duration of surgery.

The preceding analyses have included cases in which other gynecological, oncological, and nongynecological procedures were included, as needed by the patient. In order to analyze the data for simple hysterectomy only and to determine if the additional surgical procedures skewed the data on the laparoscopic hysterectomy and bilateral salpingo-oophorectomy per se, an analysis of surgical duration, blood loss, and length of hospital stay was performed on cases having only simple hysterectomy or adnexectomy and no additional procedures (Table 6). Among these 155 patients, there were no differences in surgicopathologic variables between the age groups. For the patients who had only simple hysterectomy or adnexectomy

Table 5
Additional procedures stratified by age category*

Additional procedures	Young (n = 85) n (%)	Middle (n = 82) n (%)	Senior (n = 41) n (%)	P value
Radical (not simple) hysterectomy	8 (8.4)	2 (2.4)	0	0.1105
Appendectomy	14 (16.4)	10 (12.2)	3 (7.3)	0.2878
Omentectomy	4 (4.7)	6 (7.3)	0	0.2018
Radical lymphadenectomy	7 (8.2)	2 (2.4)	0	0.3505
Lymph node sampling	9 (10.6)	10 (12.2)	2 (4.8)	0.4539
Ureterolysis	3 (3.5)	5 (6.1)	1 (2.4)	0.5851
Burch	1 (1.2)	4 (4.8)	1 (2.4)	0.5851
Cholecystectomy	2 (2.4)	0	1 (2.4)	0.2018

* Chi-square test.

Table 6
Surgical data for cases of simple hysterectomy only,[a] stratified by age category*

	Young (n = 57) M (SD)	Middle (n = 62) M (SD)	Senior (n = 36) M (SD)
Duration of surgery (min)	149.3 (46.6)	136.3 (46.4)	140.2 (42.6)
Estimated blood loss (cc)	156.6 (179.7)	115.3 (144.0)	91.1 (103.5)
Length of hospital stay (days)	1.8 (.9)	1.5 (.6)	1.8 (2.0)

[a] Cases eliminated if included lymphadenectomy, omentectomy, appendectomy, cholecystectomy, posterior repair, or Burch.
* ANOVA.

and no other procedure, the mean operating time was 134 min, with 21 completed in 90 min.

Final pathology diagnoses (Table 7) confirmed 1 vaginal carcinoma, 12 cervical dysplasias, 10 cervical carcinomas, 13 endometrial hyperplasias, 43 endometrial carcinomas or sarcomas, 10 ovarian carcinomas, 1 breast cancer recurrence, and 117 with benign ovarian neoplasias and findings. Lower tract neoplasia (P = 0.0250) and ovarian neoplasia or indications (P = 0.0268) were associated with younger age category, while endometrial neoplasia (P = 0.0001) was associated with senior age category.

The overall complication rate for the series was 7.7% without variance by age category (P = 0.3778) (Table 8). These include one case of diverticulitis, one seroma, one hematoma evacuated, one bowel obstruction from adhesions, one vaginal perforation during sex at 6 weeks, and five urologic injuries: two cystotomies with immediate intraoperative repair, one bladder fistula catheterized, one stented ureteral fistula, and one reimplanted ureteral fistula among three patients in the young and two patients in the middle categories for age, with no senior category patients having urologic complications.

One patient developed postoperative herniation of the small bowel into a lateral 10-mm trochar incision. Our

Table 7
Final diagnosis stratified by age category*

	Young (n = 85) n (%)	Middle (n = 82) n (%)	Senior (n = 41) n (%)	P value
Vaginal cervical neoplasia	15 (17.6)	7 (8.5)	1 (2.4)	0.0250
Vaginal carcinoma	1 (1.2)	0	0	
Cervical dysplasia	7 (8.3)	4 (4.9)	1 (2.4)	
Cervical carcinoma (2 IA2, 8 IB1)	7 (8.2)	3 (3.7)	0	
Uterine neoplasia	11 (12.9)	23 (28.0)	22 (53.7)	0.0001
Endometrial hyperplasia	3 (3.5)	5 (6.1)	5 (12.2)	
Endometrial carcinoma/sarcoma (18 IA, 13 IB, 5 IC, 3 IIB, 2 IIIA, 2 IIIB)	8 (9.4)	18 (22.0)	17 (41.5)	
Ovarian neoplasia/indications	59 (69.4)	52 (63.4)	18 (43.9)	0.0268
Benign	53 (62.4)	46 (56.1)	18 (43.9)	
Ovarian carcinoma (4 IA, 2 IB, 2 IC, 2 IIC, 1 IIIB)	5 (5.9)	6 (7.3)	0	
Metastatic breast carcinoma	1 (1.2)	0	0	

* Chi-square test.

Table 8
Complications stratified by age category*

	Young (n = 85) n(%)	Middle (n = 82) n(%)	Senior (n = 41) n(%)	P value
Diverticulitis	0	0	1 (2.4)	
SBO from vaginal adhesions	1 (1.2)	0	0	
Traumatic vaginal dehiscence	0	1 (1.2)	0	
Incisional hernia	1 (1.2)	0	0	
Seroma	1 (1.2)	0	0	
Hematoma	0	0	1 (2.4)	
Urologic subtotal	3 (3.5)	2 (2.4)	0	0.4797
Cystotomy repaired	1 (1.2)	1 (1.2)	0	
Bladder fistula catheterized	1 (1.2)	0	0	
Ureter fistula stented	1 (1.2)	0	0	
Ureter fistula reimplanted	0	1 (1.2)	0	
Total complications	9 (10.6)	5 (6.1)	2 (4.9)	0.3778
Required reoperation	3 (3.5)	2 (2.4)	1 (2.4)	0.8988

* Chi-square test.

suturing of the fascia may not have provided adequate closure despite our routine palpation subcutaneously to confirm closure of the fascia after suturing it. Also, we now use only 5 mm instruments at the lateral sites and place any 10 mm trochars, when needed, only in the suprapubic site.

One patient with a normal 6-week postoperative exam and no granulation tissue at the vaginal apex resumed sexual activity with vaginal penetration and ruptured a small site in the vaginal apex, experiencing acute pain and copious peritoneal fluid discharge for a few days. These symptoms resolved without treatment, but she was advised to not have any penetration for another 6 weeks and then to avoid very deep penetration for another 6 months. She has not had recurrence of the traumatic vaginal dehiscence and has returned to her usual sexual activity.

One patient developed a small bowel obstruction from adhesions of the distal ileum to the vaginal apex. She had simple lysis of adhesions by laparoscope with immediate resolution of symptoms. Prior to removing the instruments at the end of every case, we now attempt to place the redundant portion of the sigmoid colon immediately behind the raw vaginal apex, but this is not always possible.

Despite having unremarkable findings at both operations, the postoperative courses of two patients were complicated by pelvic hematoma and symptomatic seroma. The postoperative hematoma was evacuated laparoscopically for symptomatic relief. The other patient presented with pelvic pain postoperatively and had no leukocytosis or fever, but a CT scan revealed a small fluid collection in the pelvis. Needle aspiration of the fluid relieved her discomfort but did not reveal an abscess. The exacerbation of one patient's known diverticulitis was associated with a low-grade fever and familiar left lower quadrant pain. Her symptoms resolved with intravenous antibiotics and a low residue diet.

One patient with two prior cesarean deliveries had preoperative warning that uterine scarring may increase her risk of bladder injury during dissection of the bladder off of the lower uterine section. This injury occurred in an area of thinning of the bladder wall within the cesarean scar on the uterus. A second patient had cystotomy during dissection of the bladder pillars in a radical hysterectomy and was repaired intraoperatively. When the catheter was removed on postoperative day 14 for a voiding trial, the patient developed a vesicovaginal fistula and required two open attempts at closure by urologists. In the third case, a bladder fistula developed on postoperative day 5 and healed with catheterization. One patient's ureter was heat-injured during ligation of the uterine artery. In retrospect, her uterus was not optimally placed on "traction–countertraction" as has been described to give maximum separation from the uterine artery and the ureter. Her ureter healed with stenting. The second patient's ureter was injured due to misidentification of the cervicovaginal margin with dissection carried down too far in the parametrium. We now repeatedly check to see if the uterus is maximally pushed upward and frequently identify the cervicovaginal margin, anteriorly and posteriorly using both visual and haptic cues from the "palpation" of the lower cervix and upper vagina with laparoscopic instruments.

All of the urologic injuries but one occurred in the first one third of patients in the clinical series. The reoperation rate for complications was 2.8%, which did not vary by age category (P = 0.8988). All patients remain alive with no evidence of disease recurrence as of submission date.

Discussion

Uterine, ovarian, and cervical neoplasias constitute the common oncological indications for hysterectomy; however, patients may also prefer to have hysterectomy in association with any of these indications to reduce bothersome gynecologic symptomatology and reduce future cancer risk. While the cervical neoplasia rate remains constant with age [17], the rates of uterine and ovarian cancer increase with advancing age [18]. Among women with BrCa 1 or 2 mutation or a history of breast cancer, especially if they are taking Tamoxifen [19], both ovarian and uterine cancers have been observed at higher than expected rates, justifying that hysterectomy be offered at the time of prophylactic oophorectomy [17]. This also simplifies their future decisions about hormone replacement therapy, if needed, and ameliorates any menorrhagia or dysmenorrhea. While we and others have demonstrated the safety and feasibility of laparoscopic hysterectomy and staging procedures to prevent [20], diagnose [21], or stage [22–25] these early cancers, the current body of literature suffers from a paucity of data regarding the potential influence of age on outcomes and complication rates on total laparoscopic hysterectomy [26–28].

Three age categories were selected to reflect the incremental likelihood of cardiac comorbidities. Pneumoperitoneum decreases cardiac output and increases systemic vascular resistance [14], and both of these increase risk of

cardiac disease. These changes would have minimal effect on younger women but could be incrementally deleterious for women past age 50 when heart and lung diseases begin to present and potentially pose more significant threat past age 65, when heart and lung diseases are epidemic [12]. In addition, respiratory mechanics can be adversely affected by the pneumoperitoneum [29]. Higher than usual inspiratory pressures are often needed when ventilatory compliance is reduced, as in Trendelenburg position [30]. In this report, we have addressed the concerns about performing a hysterectomy as part of the laparoscopic management of women with cervical or vaginal neoplasia and cancer, endometrial hyperplasia and cancer, and pelvic mass as well as ovarian cancer, with particular focus on outcomes stratified by age.

Despite our standard of not offering the laparoscopic approach to women with severe adhesions or pulmonary disease, no patients were turned down for a TLH for these reasons. Additionally, there were no respiratory or cardiac complications in this series or in the series of 451 patients from which it was drawn.

Many are concerned that there are significantly longer operating times with a laparoscopic approach, especially as reported with the LAVH [31]. However, our data confirm reasonable operating times (about 2.5 h on average) and no deleterious changes with age. Operating times were significantly shorter in the senior group. The significantly smaller weight and dimensions of the uterus could account for this difference. The operating times for our patients included many younger patients having additional procedures, such as cholecystectomy, node dissection, Burch colpopexy, omentectomy, appendectomy, and fulgeration of endometriosis. Although inclusion of these cases with additional procedures certainly confounds interpretation of the operating times for hysterectomy, this retrospective clinical series reflects the spectrum of surgical procedures realistically performed concomitantly in gynecologic oncology practice.

There was no difference in blood loss by age category; however, blood loss decreased with experience as 23 of the last 40 patients in the series lost 0–50 cc of blood.

The durations of stay in the hospital showed a trend to increase with age, but hospital stays for all patients continue to decrease in the series, with 36 of the last 40 patients going home on postoperative day 1.

Our node dissections, both radical and sampling, yielded similar numbers of nodes as reported for other resections or samplings [32,33] with no attributable complications.

With open laparotomy, senior women have been shown to have a higher incidence of surgical and medical complications resulting in extended hospitalizations and additional procedures compared with younger women [12]. In a series of 471 patients undergoing abdominal hysterectomy for benign disease and with small uteri (<280 g), the complication rate was 13.3% [34]. Complications in our series occurred in 7.7% of patients with no variance by age category. Overall, five patients, or 2.4%, sustained a urologic injury, three bladder and two ureteral, and none occurring within the senior category. This rate is similar to recent laparoscopic reports ranging from 3.4% to 8.3% [35–37] and gives credence to the learning curve concept [38]. The lessons learned from these early complications have prevented further injuries in the latter two thirds of our series. Increased expertise has resulted in decreased blood loss, shorter hospitalizations, and fewer complications. Laparoscopic surgeons are urged to perform their initial series of total laparoscopic hysterectomies with trained colleagues.

We believe that the learning curve for TLH exists because the procedure is not yet being taught in residency training programs. Surgeons who have developed their own TLH techniques, well outside of their residency training, generate the many reports of complications describing "learning curves" [35–38]. If randomized trials confirm the utility of the TLH approach, learning curves will be avoided by meticulous residency training as is currently provided for abdominal and vaginal hysterectomy approaches.

Although all the patients operated on in this series remain alive without disease recurrence, no conclusions can be drawn as to the suitability of TLH in cancer management regarding survival because the series is too small. Our goal was to review the use of TLH as might be employed in a typical gynecologic oncology practice to highlight safety and feasibility issues that would facilitate planning of randomized trials.

In this series, 36% of the patients were nulliparous, 52% were overweight or obese, and 19% were both nulliparous and overweight or obese, rendering LAVH impractical for most [39,40]. In previous studies, we have confirmed that a total laparoscopic approach is facile and efficient for nulliparous women [38,41,42] and useful also for women with high BMI [11].

Even for women with descensus and vaginal capacity, we still plan and perform the entire surgery laparoscopically. This is in part because vaginal hysterectomies have been associated with higher risk of posthysterectomy urinary incontinence and vault prolapse [43–45]; but also because we prefer to prevent prolapse by suturing the lateral vaginal apices to the uterosacral ligaments. This provides visible elevation and support to the vaginal apex not achievable from below.

Interpretation of the data from this retrospective observational series carries many challenges regarding both validity and utility. First, the initial nonrandom, clinically based assignment of laparoscopic approach introduces selection bias with regard to comorbidities, even though no patients have been excluded from TLH due to their age, obesity, adhesions, or cardiopulmonary comorbidity. Every patient needing hysterectomy had a laparoscopic approach scheduled from the outset in the absence of prior surgeries documenting severe adhesions. While this standard introduces some degree of selection bias, it is likely that such

bias will not pose problem in the suggested randomized clinical trials. Additionally, our excluding patients with metastatic disease may confound interpretation of the applicability of TLH, but these are warnings for open surgeries as well. We have piloted these guidelines for assignment of approach to reflect the wisdom of current clinical laparoscopic surgical safety standards [14,46,47] and believe that they will be useful in randomized trials as well.

Second, this methodology is limited in terms of generalizability, as many other gynecologic surgeons may not have the laparoscopic experience to begin to perform this procedure, with a resultant higher complication rate. They may learn it on their own, with a resultant higher morbidity and steeper learning curve.

Third, there are many patient variables that were not abstracted or analyzed in this small observational series such as nutritional status and other significant medical comorbidities, which make broad conclusions in this retrospective study difficult.

Lastly, there were over 173 additional procedures performed concomitantly with the hysterectomy, contributing to complications, blood loss, durations of surgeries, and length of hospital stay. This reflects the standard practice of gynecologic oncologists to address pelvic floor dysfunction, adhesions, and anomalous findings at surgery. This report shows that total laparoscopic hysterectomy can be offered to select patients without significant increase in morbidity due to age. Future randomized study protocols should ideally control for patients' baseline health and allow for additional procedures, which are then accounted for in the analysis.

Conclusions

Total laparoscopic hysterectomy appears to be feasible and safe for women of all ages who require surgical management of gynecologic pathology. When patients are stratified by age, the duration of surgery, blood loss, length of hospital stay, and complication rates do not increase with increasing age. This report provides descriptive data regarding surgical and postoperative parameters, discusses complications, and highlights clinical considerations that are important to the safety and design of randomized, clinical trials. Based on this cohort of cases, randomized prospective studies of TLH are warranted to validate the utility of this approach, with attention to both short- and long-term complications in all ages of women.

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