



Comparison between transumbilical and transvaginal morcellation of a large uterus during single-port-access total laparoscopic hysterectomy

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Objective

To compare the perioperative outcomes of transumbilical morcellation (TUM) and transvaginal morcellation (TVM) of a large uterus (≥ 500 g) during single-port-access total laparoscopic hysterectomy (SPA-TLH).

Methods

A total of 57 patients who underwent SPA-TLH for a large uterine myoma and/or adenomyosis (uterine weight ≥ 500 g) between March 2013 and July 2017 were included. For specimen retrieval, TUM was performed for 30 patients and TVM for 27 patients.

Results

Perioperative outcomes, including total operative time, tissue extraction time, extension of skin incision length, estimated volume of blood loss, changes in postoperative hemoglobin level, length of postoperative hospital stay, postoperative pain, and uterine weight, were compared between the 2 groups. No significant differences were observed in the baseline characteristics except for a history of cesarean section (TUM vs. TVM: 83.3% vs. 14.8%, $P=0.002$) and history of vaginal delivery (TUM vs. TVM: 6.7% vs. 88.8%, $P=0.001$). The total operative time, tissue extraction time, extension of skin incision length, estimated volume of blood loss, changes in postoperative hemoglobin level, length of postoperative hospital stay, and postoperative pain did not significantly differ between the two groups. The uterine weight was significantly higher for patients who underwent TUM than for those who had TVM (median [range]: 735 g [520–1,380 g] vs. 622 g [514–975 g]; $P=0.042$).

Conclusion

TUM during SPA-TLH is a feasible technique for extracting large uteri weighing ≥ 500 g. This procedure is suitable for patients without a history of vaginal delivery or a narrow vaginal cavity.

Keyword: Adenomyosis; Hysterectomy; Laparoscopy; Minimally invasive surgical procedures; Myoma

Introduction

Since laparoscopic hysterectomy was first performed [1], a series of studies have shown the superiority of laparoscopic hysterectomy over open hysterectomy in terms of better view of the surgical field, low volume of blood loss, faster recovery, and decreased wound complications [2]. Furthermore, to maximize the advantages of laparoscopic surgery and reduce the incision size and number of trocars [3], single-port laparoscopy was carried out.

Received: 2019.07.16. Revised: 2019.10.28. Accepted: 2019.11.07.

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After single-port-access total laparoscopic hysterectomy (SPA-TLH) was first performed in 1991 [4], the universalization of single-port laparoscopy has been slow. However, single-port laparoscopy has been more commonly used in the gynecologic field after the latest developments in laparoscopic instrumentation and the accumulation of surgical experience [5].

In SPA-TLH, specimen retrieval is one of the most critical factors affecting operative time, and the length of the procedure is positively correlated with uterine weight [6]. Efforts have been made to reduce specimen retrieval time in SPA-TLH, which include performing procedures, such as intra-abdominal morcellation, transvaginal morcellation (TVM), and combined laparoscopic morcellation and TVM [7,8]. Specimen retrieval during umbilicus and manual morcellation of a large specimen in a gynecological laparoscopic operation is considered feasible and safe [9]. Furthermore, in some cases, the transumbilical morcellation (TUM) of a large uterus had a shorter operative time [10].

The current study aimed to compare the surgical outcomes between TUM and TVM for retrieving a large uterus (≥ 500 g) during SPA-TLH.

Materials and methods

This retrospective study included all patients who underwent SPA-TLH between March 2013 and July 2017 at two institutions (National Health Insurance Service Ilsan Hospital, Goyang; Wonju Severance Christian Hospital, Wonju). During the study period, 386 patients underwent SPA-TLH for benign diseases, and a single surgeon performed all procedures. Among the patients, those with uterine weights over 500 g based on the pathology report were selected. Thus, 57 patients were included in this study. The data of 30 and 27 patients who underwent SPA-TLH with TUM and TVM, respectively, for tissue extraction were compared. All patients underwent transvaginal and/or transabdominal ultrasonography within 30 days before surgery, during which the size of the uterus was assessed and recorded. If the diagnosis and evaluation of the uterine mass via ultrasonographic examination were not sufficient, additional abdominopelvic computed tomography scan or magnetic resonance imaging was performed.

The following patients met the inclusion criteria of this

study: women with a benign gynecological disease, such as uterine myoma and adenomyosis, who underwent total laparoscopic hysterectomy, had a uterus weighing ≥ 500 g were classified as American Society of Anesthesiologists class I and II, and were aged under 60 years.

Due to a high risk of undergoing complex surgical procedures, such as adhesiolysis or resection of severe endometriosis, patients with more than 4 previous abdominopelvic surgeries via laparotomy or those with clinical evidence of deep infiltrating endometriosis were excluded from the study. Moreover, patients diagnosed with malignancy via pathological examinations were excluded.

TUM or TVM was performed based on manual pelvic examination. Patients with a narrow vagina (< 2 finger breadths) were subjected to specimen retrieval via TUM [11].

A specific type was designed to retrospectively collect data about the characteristics of the patients, intraoperative details, surgical outcomes, and perioperative complications. The total operative time was defined as the time from skin incision to skin closure. The tissue extraction time was defined as the time spent on tissue extraction. The data were collected from the electronic medical records. In the anesthesiology unit, the estimated volume of blood loss was calculated as the difference between the total amount of suction and irrigation plus the difference between total gauze weight before and after surgery. To determine the extent of skin incision before and after surgery, the length of the skin incision was measured before inserting the single-port channel system and after skin closure (Fig. 1).

Changes in hemoglobin level was defined as the difference

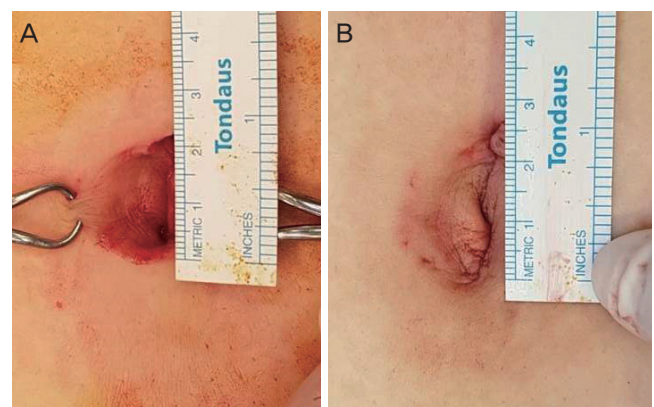


Fig. 1. Umbilicus wound (A) before starting laparoscopy, (B) after the end of operation.



Fig. 2. Single-port channel system.

between preoperative hemoglobin level and hemoglobin level on postoperative day 1. Patients were discharged from the hospital after the return of bowel activity and a successful ambulation and if fever was not observed after surgery and narcotic analgesics were no longer required. Length of hospital stay was defined as the time from the operative day to the day of discharge. Several assessors who were not associated with the investigators performed postoperative pain assessments with a visual analog scale 12, 24, and 48 hours after surgery. The scale was presented as a 10-cm line with the verbal descriptors “no pain” and “pain as bad as it could be” as the final outcome [12]. All intraoperative and postoperative complications arising within 30 days of surgery were recorded. All patients were scheduled for follow-up examinations at 1 week and 1 month after surgery.

1. Surgical technique

A single surgeon performed all surgeries at the two institutions. A single-port channel system with surgical glove and Alexis wound protectors/retractors (Applied Medical, Rancho Santa Margarita, CA, USA) was inserted through the umbili-

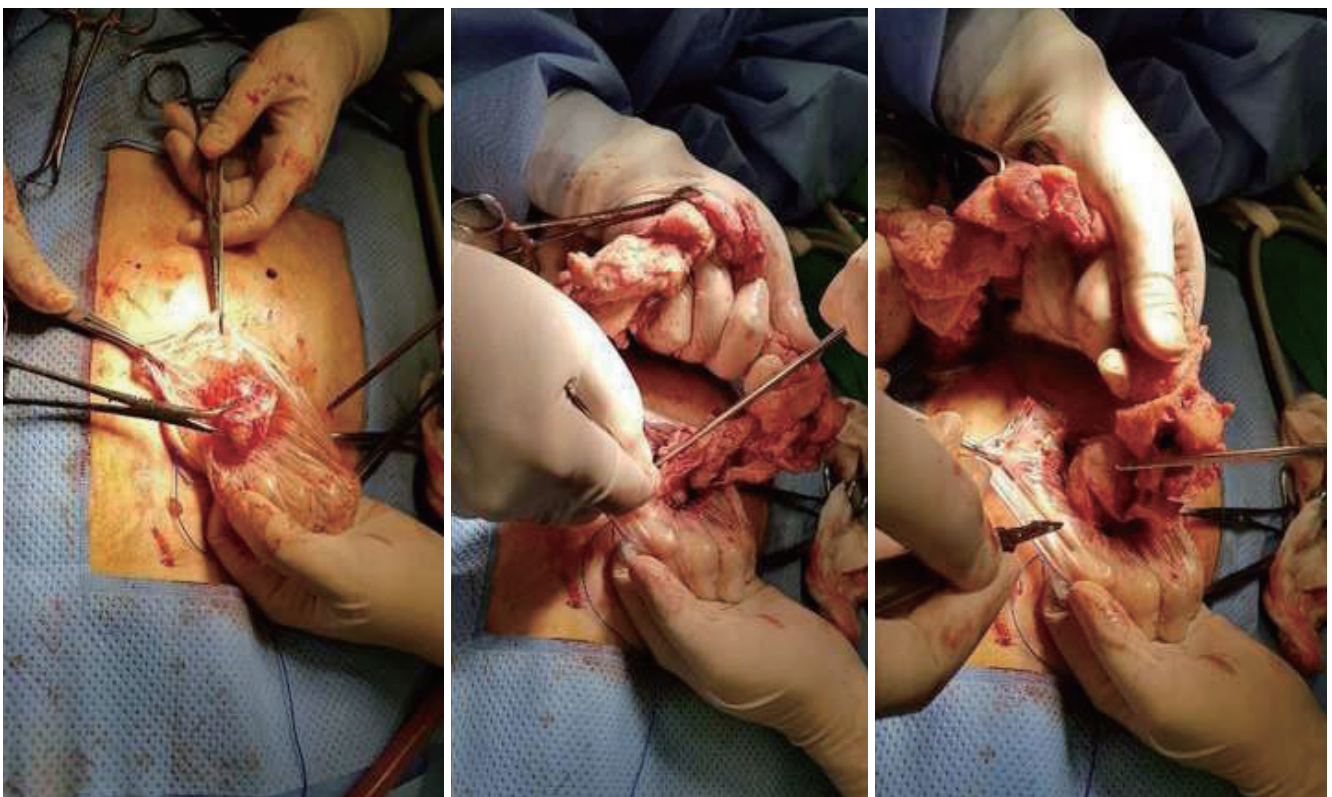


Fig. 3. Tissue extraction through umbilicus.

cus (Fig. 2). Hysterectomy was performed with conventional straight laparoscopic instruments and advanced bipolar instruments, such as LigaSure™ (Covidien, Dublin, Ireland) and THUNDERBEAT (Olympus Medical, Tokyo, Japan). In both TVM and TUM cases, the uterus was placed in an endo-pouch (Lap Bag™ metal type; Meditech Infrared, Seoul, Korea) before morcellation.

In TVM cases, tissue extraction was performed before vault closure. After placing the right-angle retractors at the 12 and 6 o'clock positions to retract the anterior and posterior vaginal walls and to protect the urethra, urinary bladder, and rectum, the uterine cervix was grasped with towel clips or Lahey clamps for pulling. Starting from the cervix, the uterus was circumferentially incised with scalpels or with Mayo scissors.

In TUM cases, the edge of the endo-pouch was elevated via an umbilical incision, and the specimen was visualized. The uterus was held and pulled with towel clips or Lahey clamps while it was circumferentially incised with a scalpel. The specimen was extracted in small fragments (Fig. 3).

The vaginal cuff was closed, and the peritoneum, fascia,

and subcutaneous tissue were then estimated and closed layer by layer using 2-0 Polysorb sutures (Covidien). Reinforced skin closures (Steri-Strip™; 3M Health Care, St. Paul, MN, USA) were used to close the incision.

2. Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences software version 23.0 (SPSS Inc., Chicago, IL, USA). Data were presented as means±standard deviations or medians (ranges) for continuous variables and frequencies (percentages) for categorical variables. The baseline clinical characteristics and study outcomes were compared between the two groups using the χ^2 test or Fisher's exact tests for categorical variables and the student's *t*-test or Mann-Whitney *U* test for continuous variables accordingly. A *P*-value <0.05 was considered statistically significant.

Table 1. Baseline characteristics (n=57)

	TUM (n=30)	TVM (n=27)	P-value
Age (yr)	45.2±5.8	46.8±7.2	0.892
Body mass index (kg/m ²)	24.2±4.2	24.9±4.1	0.341
Parity			>0.986
Nulliparous	2 (6.7)	1 (3.7)	
Parous	28 (93.3)	26 (96.3)	
History of cesarean section	25 (83.3)	4 (14.8)	0.002
1	11	1	
2	13	3	
≥3	1	0	
History of vaginal delivery	2 (6.7)	24 (88.8)	0.001
Hysterectomy indication			
Myoma	10 (33.3)	7 (25.9)	
Adenomyosis	3 (10.0)	2 (7.4)	
Myoma and adenomyosis	16 (53.3)	16 (59.2)	
Combined with cervical lesion	1 (3.4)	2 (7.5)	
Surgical procedure			0.812
Hysterectomy alone	22 (72.8)	18 (66.7)	
Hysterectomy with adnexal surgery ^{a)}	8 (27.2)	9 (33.3)	

Data are presented as mean±standard deviation or number (%).

TUM, transumbilical morcellation; TVM, transvaginal morcellation.

^{a)}Adnexal surgery includes ovarian cystectomy, salpingo-oophorectomy, and salpingectomy.

Results

Between March 2013 and July 2017, 386 patients underwent SPA-TLH. In total, 329 patients were excluded from the study according to the exclusion criteria. Meanwhile, 57 patients were enrolled, and 30 and 27 patients underwent SPA-TLH with TUM and TVM, respectively, for tissue extraction.

The baseline characteristics, except for a history of cesarean section and vaginal delivery, were similar between the TUM and TVM groups (Table 1). In the TUM group, 25 patients (83.3%) had a history of cesarean section. In the TVM group, four patients (14.8%) had a history of cesarean section ($P=0.002$). Moreover, only 2 patients (6.7%) had a history of vaginal delivery in the TUM group, and 24 (88.8%) had a history of vaginal delivery in the TVM group ($P=0.001$). In the TUM group, 22 patients underwent hysterectomy alone, and 8 had hysterectomy with adnexal surgery. Moreover, in the TVM group, 18 patients underwent hysterectomy, and 9 had hysterectomy with adnexal surgery.

The perioperative outcomes between the two study groups are depicted in Table 2. The mean total operative time was

135.3 min in the TUM group and 129.4 min in the TVM group ($P=0.724$). The mean total operative time was shorter in the TVM group than in the TUM group. However, the result was not significantly different. The mean tissue extraction time was 25.3 ± 12.5 minutes in the TUM group and 29.3 ± 11.5 minutes in the TVM group ($P=0.243$). The mean tissue extraction time was shorter in the TUM group than in the TVM group. However, no significant difference was observed. The extension of umbilical skin incision was noted in both groups. In the TUM group, the umbilical incision length was extended from 2.5 to 2.8 cm. Moreover, in the TVM group, the umbilical incision length was extended from 2.5 to 2.7 cm. No statistically significant difference was observed in both preoperative and postoperative skin incision lengths ($P=0.672$, $P=0.091$). In addition, the amount of blood loss, decrease in hemoglobin level, length of postoperative hospital stay (days), and postoperative pain between the two groups did not significantly differ.

The weight of the uterus was significantly different between the two study groups ($P=0.042$). The median uterine weight of the TUM group was 735 g, ranging from 520 to

Table 2. Perioperative outcomes (n=57)

	TUM (n=30)	TVM (n=27)	P-value
Total operation time (min)	135.3±32.4	129.4±33.6	0.724
Morcellation time (min)	25.3±12.5	29.3±11.5	0.243
Estimated blood loss (mL)	90 (15–300)	60 (20–380)	0.582
Hb decrease (mg/dL)	1.5±1.1	1.4±0.9	0.593
Postoperative hospital (days)	3 (2–5)	3 (2–4)	0.876
Postoperative pain			
Immediately after surgery	3.56±0.52	3.74±0.42	0.847
12 hr after surgery	3.14±0.67	3.11±0.78	0.773
24 hr after surgery	2.54±0.84	2.56±0.75	0.452
48 hr after surgery	2.10±0.79	2.13±0.58	0.574
Uterine weight (g)	735 (520–1380)	622 (514–975)	0.042
Length of skin incision (cm)			
Preoperative	2.5 (2.4–2.7)	2.5 (2.3–2.8)	0.672
Postoperative	2.8 (2.6–3.2)	2.7 (2.4–3.0)	0.091
Major postoperative complication			
Ureter injury	1	0	
Re-operation	0	0	
Re-admission	0	0	

Data are presented as mean±standard deviation or median (range).

TUM, transumbilical morcellation; TVM, transvaginal morcellation; Hb, hemoglobin.

1,380 g. The median uterine weight in the TVM group was 622 g, ranging from 514 to 975 g.

No surgery was converted to multi-port laparoscopy or laparotomy. In the TUM group, 1 patient presented with intraoperative ureter injury. Primary repair of the ureter and retrograde pyelography-guided ureter stent insertion were conducted. The ureter stent was removed 3 months after the operation, and no further treatment was required.

Discussion

No difference was observed in total operative time, tissue extraction time, or estimated amount of blood loss between the two study groups. Furthermore, postoperative decrease in hemoglobin level, length of hospital admission, and postoperative pain did not significantly differ. Uterine weight was significantly different between the two study groups (TUM: 735 g [520–1,380 g], TVM: 622 g [514–975 g]; $P=0.042$). However, no significant difference was observed in tissue extraction time between TUM and TVM (25.3 vs. 29.3 minutes; $P=0.243$). Thus, a larger specimen can be retrieved using the TUM procedure within the same duration.

In total, 24 patients (88.8%) in the TVM group and two patients (6.7%) in the TUM group had a history of vaginal delivery ($P=0.001$). The repeated stretching of vaginal tissues, such as that during vaginal delivery, leads to decreased collagenase in these tissues and enlargement of the vaginal cavity [13]. In patients with an enlarged vaginal cavity, TVM is a more competitive procedure. However, in patients with a history of cesarean section but without vaginal delivery, the vaginal cavity is relatively narrow, and TUM is more effective for specimen extraction.

According to a previous study, adhesiolysis of the posterior uterus, time to colpotomy completion, uterine extraction time, and uterine weight are the predictors of total operative time in performing SPA-TLH. Additionally, a positive correlation was observed between uterine weight and extraction time [6]. To reduce the overall operative time, the specimen extraction time must be decreased.

Several technical attempts have been made in removing a large uterus using procedures, including intra-abdominal morcellation with a power morcellator, mini-laparotomy, TVM, and TUM [7,8,10]. Intra-abdominal morcellation with a laparoscopic power morcellator was widely performed

before the release of the November 2014 Food and Drug Administration safety communication statement about the risk of using morcellators for uterine fibroid morcellation due to the risk of specimen spillage and tumor dissemination [14]. In addition to the risk of specimen spillage, laparoscopic morcellation has been associated with bowel or vessel injury caused by the morcellator blade as well as prolonged operative time [10,15].

Transvaginal specimen extraction is generally performed using bisection, morcellation, wedge resection, and vaginal myomectomy. However, this procedure is challenging to perform, and the total operative time is higher in patients with a narrow vaginal cavity and obesity [16]. During transvaginal tissue extraction, injury in the vaginal wall, vaginal stump, bladder, and ureter may occur [17].

Transumbilical tissue extraction was first performed to remove huge pelvic masses, including ovarian masses. Recently, transumbilical tissue extraction in laparoscopic hysterectomy was found to be safe and effective. In addition, as TUM is performed with the specimen in an endoscopic bag, the risk of bowel injury, vessel injury, and tumor dissemination is reduced [18]. Moreover, our study showed the feasibility of TUM, without complications and extension of operative time.

In 2008, Ghezzi et al. [9] have reported that the transumbilical approach was feasible for adnexal masses. Furthermore, in 2012, they showed that the use of the vaginal approach in colpotomy might be more effective for the removal of adnexal masses [19]. However, the results of these studies differ from those of the current study because the target was an adnexal mass. This type of mass can be easily resected via a small incision because it is rarely firm. However, the uterus with total hysterectomy is solid and greater in size on which the procedure was performed were different in nature. A solid and larger uterus is more difficult to remove via the vaginal cavity and particularly through a narrow vaginal cavity.

A recent study has compared TVM and TUM during multi-port laparoscopic hysterectomy, and results showed no difference between the 2 morcellation methods. Between January 2010 and December 2014, patients with a uterus weighing ≥ 500 g were included in the study, and all manual morcellation procedures were performed in an endoscopic bag. The abdominal approach was used in 58.7% of the patients and the vaginal approach in 41.3%. Results showed no gross spillage, rupture of the endoscopic bag, or other complica-

tions correlated to the morcellation procedure [18].

Our study performed single-port-access laparoscopy, and no difference was observed between the TUM and TVM groups in terms of extension of the skin incision. Previous studies have shown that postoperative pain after laparoscopy significantly decreases with the reduction in incision size [20]. Therefore, in this study, no difference was observed in postoperative pain between the two groups because the umbilical incision sizes were similar. In addition to reducing postoperative pain, smaller umbilical incision sizes are beneficial in terms of cosmetic aspects.

An objective guideline for selecting morcellation method is not available. Thus, this might have caused selection bias as the selection of procedure was not blinded or randomized. Moreover, since this was a retrospective study with a small sample size, a randomized prospective analysis should be performed to increase the power of the study. In this study, all patients were Koreans, and they had a relatively low BMI. Therefore, there is a limitation for the generalization and application of the results. In addition, there might be errors in the measurement of skin incisions. To evaluate the exact extension, the length of the incision in the fascia before and after the operation must be compared. The stability of the tissue extraction method and the use of an endo-pouch has not been well established. Thus, further prospective studies must be conducted.

Future large-scale prospective randomized controlled trials about specimen extraction methods may provide more reliable results and objective guidelines for selecting the morcellation method.

In conclusion, when performing SPA-TLH in a patient with a large uterus, TUM is considered safe and effective. In particular, in patients with a narrow vaginal cavity, TUM may be a more suitable procedure for specimen retrieval.

Acknowledgements

This work was supported by the Yonsei University Wonju Campus Future-Leading Research Initiative of 2018 (2018-62-0040) and by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (NRF-2017R1D1A3B03032983).

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

The study was approved by the Institutional Review Board of Wonju Severance Christian Hospital (IRB No. CR318116) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consents were obtained.

Patient consent

The patients provided written informed consent for the publication and the use of their images.

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