Preoperative Factors Associated with the Need for the Morcellation in Total Laparoscopic Hysterectomy

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ABSTRACT

Removal of uterus during laparoscopic hysterectomy (LH) is occasionally challenging and therefore sometimes requires morcellation. Morcellation techniques for hysterectomy can spread the cancer cells which were presumed benign preoperatively in to the abdomen or pelvis. Probability of an undetected malignity should not be disregarded and accordingly must be shared with the patient prior to LH. The present study aimed to identify the demographic and the clinical factors associated with the need for morcellation in patients undergoing LH.

A total of 153 patients who underwent LH for presumed benign causes were enrolled in this retrospective study. Subjects were divided into two groups according to the need for the morcellation during the LH: Morcellation group and intact vaginal removal (IVR) group (it was possible to deliver the uterine specimen vaginally). The two groups were compared with respect to demographic and clinical characteristics, indications for LH, preoperative ultrasonographic findings and postoperative complications.

The frequency of the postmenopausal women was significantly higher in the morcellation group than the IVR group (p = 0.005). Preoperative uterus width (p < 0.001) and postoperative Uterus weight (p < 0.001) were significantly higher in the morcellation group compared to that of the IVR group. There were no significant differences between the groups regarding the complication rate. Uterine weight (OR: 1.020, 95 % CI: 1.008-1.031, p = 0.001) and menopause (OR: 2.571, 95 % CI: 1.328-4.980, p < 0.001) were predictive for the need of morcellation. A cut-off value of 287.5 gram was able to predict the need for morcellation with 87% sensitivity and 71 % specificity.

The present study demonstrates that uterine weight and presence of the menopause are predictive for the need of morcellation at the time of the total LH. These factors should be considered in preoperative planning and used to further guide surgeons in providing LH.

Key Words: Total laparoscopic hysterectomy, Morcellation, uterine weight

Introduction

The annual rates of the hysterectomies performed laparoscopically are increasing worldwide since the introduction of laparoscopic hysterectomy (LH) in 1989 (1). Recently, the rate of the LH surpassed the rate of vaginal hysterectomy for the first time (2). Increased exposure to less invasive techniques during the training period and the resultant improvement in skills of the surgeons, advances in technology and the preferences of the patients and the surgeons are the potential causes of the recent popularity of the LH (3). Moreover, shorter length of hospital stay and faster recovery has been reported in patients undergoing LH (4).

Since the approval by the Food and Drug Administration (FDA) in 2000, laparoscopic power morcellation has been widely used to facilitate removal of tissue specimen through small incisions in total laparoscopic hysterectomy (LH) (5). Actually, during total LH, the uterus may be removed intact vaginally or with the use of morcellation techniques. However, power morcellation brings some drawbacks about such as inoculation of benign or malignant tissue fragments within the peritoneal cavity or direct trauma to the neighboring organs, including

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bladder and the bowel. Morcellation of malignant tissue is contraindicated. However, some of the uterine pathologies such as the uterine fibroids may not always be diagnosed prior to surgery. According to the FDA reports the prevalence of unsuspected uterine sarcoma and unsuspected leiomyosarcoma were 1/352 and 1/498, respectively, in women undergoing hysterectomy or myomectomy for presumed benign causes (6). Therefore, women with presumed leiomyoma may have a malignancy which can spread with the use of the power morcellation. An FDA statement was published recently against the implementation of power morcellation in hysterectomy and in the treatment of the uterine fibroids as the procedure may lead to tumor spread in the case of an undetected early-stage cancer (6). Although FDA reported their concern particularly for power morcellation, all of the morcellation techniques dedicated for hysterectomy or myomectomy can spread the cancer cells into the abdomen or pelvis (7, 8). Spillage of dye or tissue may occur during power morcellation despite the use of contained tissue extraction (9). Therefore, we consider that the probability of an undetected malignity should not be disregarded and accordingly must be shared with the patient prior to LH or myomectomy.

The present study aimed to compare the demographic and clinical features of the subjects with a large uterus in whom transvaginal morcellation was required and subjects in whom intact vaginal removal was achieved despite a large uterus. We also aimed to identify the demographic and the clinical factors associated with the need for morcellation in patients undergoing LH.

Materials and Methods

Subjects: All women who underwent LH for presumed benign causes between February 2013 and June 2016 in the gynecology department of the Kanuni Sultan Suleyman Education and Research Hospital were recruited in this retrospective study. Those with a preoperative diagnosis of gynecologic malignancy and prior gynecologic surgery were excluded (patients with normal endometrial biopsy and pap test results). Written informed consent was obtained from all subjects included in the study. The study was approved by the Institutional Ethical Committee and was performed in accordance with the recent version of the Helsinki Declaration. Demographic and clinical features, preoperative ultrasonographic findings, and intra-and postoperative data of the study population were retrieved from the institutional electronic database.

Measurements and Operative Technique: Physical examination and transvaginal ultrasound evaluation were done preoperatively to all patients. Uterine size was determined with bimanual examination according to the appropriate pregnancy week. Uterus width was determined in coronal plane at fundus level with ultrasound. Genital hiatus size (distance between the lower end of the urethra and the lower end of the hymen) was measured preoperatively in all subjects to assess whether it was associated with the need for morcellation or not.

All surgical procedures were carried out under general anesthesia, by the same surgical team. The uterus was removed intact vaginally unless failure has been encountered during the removal. In case of failure to remove the uterus intact, vaginal morcellation was carried out to remove the uterus. For this purpose, the cervix was grasped with a tenaculum under camera visualization and was brought into the vagina. Vaginal surgical retractors were used to provide exposure and protect the vaginal walls, rectum, and bladder. The morcellation procedure was performed within the vagina with a no. 10 scalpel and a wedge resection technique. Myomectomy was performed as indicated. Once the specimen was removed vaginally, the vaginal apex was reapproximated using laparoscopic approach.

Subjects were divided into two groups according to the need for the morcellation during the LH: Morcellation group and intact vaginal removal (IVR) group (it was possible to deliver the uterine specimen vaginally despite the presence of a large uterus in bimanual examination). The two groups were compared with respect to demographic and clinical characteristics, indications for LH, preoperative ultrasonographic findings, and postoperative complications.

Statistical Analysis: All analyses were performed on SPSS v21. For the normality check, Kolmogorov-Smirnov test was used. Data are presented as mean ± standard deviation for continuous variables and frequency (percentage) for categorical variables. Continuous variableswere analyzed with independent samples t-test. Categorical variables were evaluated by using the Chi-square test or Fisher's exact test. Binary logistic regression was performed to identify the demographic, clinical and imaging features of the subjects which contribute to the need for morcellation during the LH. ROC curve analysis was performed to determine the sensitivity and

specificity of the uterus weight in predicting the morcellation need. P-value < 0.05 was accepted statistically significant.

Results

A total of 153 patients (mean age 47.6±5.2 years) were recruited in this study. Seventy-five patients required morcellation during the LH, and intact vaginal removal was obtained in 78 subjects. Morcellation group and IVR group were similar with respect to age, body mass index, gravid, parity, and route of the previous delivery, comorbid diseases, and indications for the LH. However, while the myomas in the morcellation group were predominantly located along the horizontal axis of the uterus, those in the IVR group were frequently located along the vertical axis of the uterus. The frequency of the postmenopausal women was significantly higher in the morcellation group than the IVR group (53 % vs. 30 %, p = 0.005). Preoperative uterus width (10.8±1.5 cm vs. 9.8±1.3 cm, p < 0.001) and uterus weight (342±156 gram vs. 279±53 gram, p < 0.001) were significantly higher in the morcellation group compared to that of the IVR group (Table 1).

Table 2 shows the procedural features and postoperative complications in the two groups. The two groups were similar concerning the postoperative blood transfusion, and the blood parameters. There were no significant differences between the groups regarding the cuff infection (5 %vs. 5 %, p = 0.955) and cuff hematoma (0 % vs. 3 %, p = 0.239). Operation time was significantly longer in the morcellation group compared to the IVR group (160 ± 42 min vs. 143 ± 38, p = 0.011). Genital hiatus size was similar in the two groups. Patients in the morcellation group were more frequently inserted drains compared to the patients in the IVR group (16 % vs. 4 %, p = 0.014).

As shown in Table 3, the uterine weight (OR: 1.020, 95 % CI: 1.008-1.031, p = 0.001) and menopause (OR:2.571, 95 % CI: 1.328-4.980, p < 0.001) were predictive for the need of morcellation. ROC curve analysis revealed that a cut-off value of 287.5 gram was able to predict the need for morcellation with 87% sensitivity and 71 % specificity (AUC: 0.803, 95 % CI: 0.734-0.872, p < 0.001, Figure 1).

Discussion

The present study aimed to demonstrate the differences in demographic and clinical features of the subjects who required vaginal morcellation during the LH and in whom the uterus was removed intact from the vagina. Uterus size and weight were larger in the morcellation group than that of the IVR group. The frequency of the menopause was also higher in the morcellation group compared to the IVR group. Both groups were similar with respect to the complication rate. However, the operation time was longer in the morcellation group than the IVR group. Our findings indicate that menopause and preoperative uterus weight are significant predictors for the need of morcellation during the LH.

As hysterectomy is one of the most common major gynecologic operation, total LH, has become the standard of care as a consequence of the minimally invasive nature of the procedure. LH is often performed in cases for which vaginal route is not feasible due to the enlarged uterus (10-12). However, after completion of the hysterectomy in the laparoscopic route, intact extraction of the uterus from the abdominal cavity may not be possible in the presence of a grossly enlarged uterus (13). Therefore, several morcellation techniques have been introduced to overcome this issue by fragmenting uterus into small pieces and remove them from the abdominal cavity (14). However, the use of the morcellation techniques during the LH may significantly impact on the operation time and lead to a number of complications.

Morcellation may occasionally result in direct injury to the surrounding tissue, including ureteral injury, vascular injury, and injuries to the bowel or bladder (15). A recent analysis of the Manufacturer and User Facility Device Experience (MAUDE) Database reported that 215 events of patient injury and morcellation of 27 previously undiagnosed malignancies were recorded due to the use of the morcellators over a 10-year period (16). Of the nine deaths recorded in the database, one was related to the organ injury, and eight were associated with morcellation of cancer. Thus, tissue dissemination is a major issue for morcellation. While dissemination of the benign tissue fragments results in ectopic leiomyomas, dissemination of occult malignancy worsens prognosis and 5-year survival (5). Morcellation is contraindicated in known or suspected malignancies; however, occult malignancies may occur. A previous study has reported that occult

Table 1. Demographic characteristics and clinical features of the study group

	IVR Group n = 78	Morcellation Group n = 75	P-value
Age (years)	47.3 ± 5.1	47.9 ± 5.4	0.498
BMI (kg/m²)	31.3 ± 4.6	29.9 ± 5.2	0.138
Gravida (n)	4.6 ± 2.5	4.4 ± 2.3	0.610
Parity (n)	3.6 ± 1.9	3.5 ± 2.0	0.714
Previous delivery			
Vaginal delivery (n)	71 (91 %)	68 (90 %)	0.939
Cesarean section (n)	3 (4 %)	5 (7 %)	0.489
Both (n)	4 (5 %)	2 (3 %)	0.433
Comorbid diseases			
Diabetes (n)	6 (8 %)	11 (15 %)	0.204
Hypertension (n)	7 (9 %)	10 (13 %)	0.447
Hypothyroidism (n)	2 (3 %)	1 (1 %)	0.579
Anemia (n)	1 (1 %)	2 (3 %)	0.615
DVT (n)	0 (0 %)	1 (1 %)	0.842
COPD (n)	3 (4 %)	1 (1 %)	0.658
Post menopause (n)	24 (30 %)	40 (53 %)	0.005
Uterus width (cm)	9.8 ± 1.3	10.8 ± 1.5	<0.001
Uterus size on bimanual exam (weeks)	12.1 ± 1.2	12.2 ± 2.1	0.450
Uterus weight (gr)	279 ± 53	342 ± 156	<0.001
Indication for LH			
Myoma uteri (n)	47 (60 %)	48 (64 %)	0.739
Adenomyosis (n)	9 (12 %)	11 (15 %)	0.426
Endometrial hyperplasia (n)	13 (17 %)	6 (8 %)	0.141
Abnormal uterine bleeding (n)	9 (12 %)	10 (13 %)	0.925
Myoma location			
Along the horizontal axis (n)	11 (14 %)	24 (32 %)	0.005
Along the vertical axis (n)	19 (24 %)	7 (9 %)	0.009
Both (n)	16 (34 %)	18 (37 %)	0.346

Data are presented as mean ± standard deviation for continuous variables and as frequency for the categorical variables.
BMI = Body mass index, COPD = Chronic obstructive pulmonary disease, DVT = Deep vein thrombosis, IVR = Intact vaginal removal, LH = Laparoscopic hysterectomy

uterine carcinoma is encountered in 0.82% of the women undergoing vaginal hysterectomy with morcellation (17). To reduce the dissemination of the occult malignancies preexisting in uterine tissue, contained tissue extraction technique and equipment were introduced recently. However, tumor spread may even occur with the use of the contained tissue extraction technique. In a recent study conducted by Solima et al. the integrity of the endoscopic bag was investigated in twelve women undergoing vaginal morcellation during total laparoscopic hysterectomy (18). Although no gross ruptures came across after morcellation, minimal ruptures, which may potentially affect the spread of cancer cells into the abdominal cavity, were encountered in one-third of the endoscopic bags.

Given the presence of the occult malignancy in some of the presumed benign uterine lesions and this potentially lethal complication of the morcellation, identifying the preoperative predictors of the need for morcellation during the LH is critical. However, a limited number of researches have been carried out up to now to determine the factors that predict the need for morcellation in patients undergoing LH. Condous et al. performed the initial trial to seek the determinants of the morcellation in 112 women who were scheduled for total LH (19). The uterus was removed intact without the need of

Table 2. Comparison of the two groups with respect to the intra- and postoperative findings

	IVR Group n = 78	Morcellation Group n = 75	P value
Operation time (min)	143 ± 38	160 ± 42	0.011
Blood transfusion (n)	10 (13 %)	4 (5 %)	0.160
Drain insertion (n)	10 (13 %)	12 (16 %)	0.794
Complications			
Cuff infection/abscess (n)	4 (5 %)	4 (5 %)	0.955
Cuff hematoma (n)	0 (0 %)	2 (3 %)	0.239
Δ Hemoglobin (g/dl)	1.7 ± 0.9	1.4 ± 0.9	0.084
Δ Hematocrit (%)	4.9 ± 3.2	4.2 ± 2.9	0.151
Δ Platelet count (1000/mm3)	28 ± 5.1	43 ± 7.0	0.134
Genital hiatus size (cm)	3.9 ± 0.3	3.8 ± 0.4	0.861

Δ = Change in the variable from to preoperative measurement to the postoperative measurement

Table 3. Predictors of the need for morcellation

	Odds ratio	95 % CI	P value
Menopause	2.571	1.328-4.980	< 0.001
Uterus width	1.183	0.813-1.720	0.381
Uterus weight	1.020	1.008-1.031	0.001

morcellation in half of the subjects and morcellation was required in the other half of the study population. Findings of that study indicated that nulliparity and increasing uterine weight were associated with the need to perform uterine morcellation in total LH. In a recent retrospective study reported by Wolfe et al.,uterine cross-sectional area, the dimension of the largest leiomyoma, and uterine size on bimanual exam were found as predictors of the need for morcellation at the time of total LH (20).

Apart from the findings of the previous two studies, our results show that uterine weight, rather than uterus dimension or uterine size on the bimanual exam was predictive for the morcellation need at the time of the total LH. However, removal of a tall and thin uterus might be more feasible than a short, thick and sometimes heavy uterus. Our findings indicate that a uterine weight > 287.5 mg predicts morcellation need with high sensitivity and specificity.

Another predictor of the morcellation need at the time of the LH in our subjects was the presence of the menopause. To the best of our knowledge, the present study is the first to identify menopause condition of the subjects as a predictor for the need of morcellation during LH. Indeed, a significant reduction in uterine size and in the corpus-cervix ratio occurs after menopause (21, 22). Endometrial thickness is also reduced following the menopause. A number of morphological changes occur in the uterine tissue after menopause such as atrophy, fibrosis, and calcification. Moreover, these morphological changes are augmented over time from the last menstruation (23). Therefore, the viscoelastic properties of the uterine tissue might change with the menopause. Despite the lack of the evidence concerning the impairment in elastic properties of the postmenopausal women, we speculate that the predictive role of the menopause for the morcellation need that has been shown in our study might be related to the loss of the uterine elasticity after menopause. In spite of the atrophic changes in the genitals experienced after menopause, the need for morcellation increased in uteruses which remained relatively over-sized.

The use of morcellation during LH was associated with a longer operation time compared to the intact vaginal removal. The complication rate, however, were similar for the morcellation group and IVR group in the present study. The lack of any difference concerning the complication rate between the groups is likely to be related to the technical advancements and increased familiarity of the surgeons with the morcellation technique.

The present study demonstrates that uterine weight and presence of the menopause are predictive for the need of morcellation at the time
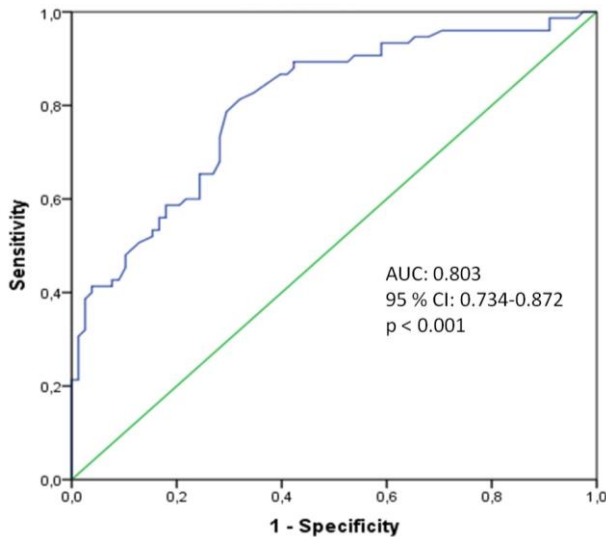
Fig. 1. ROC curve analysis demonstrating the sensitivity and specificity of uterine weight in predicting the need for morcellation at the time of total laparoscopic hysterectomy

of the total LH. Both morcellation and intact vaginal removal are associated with similar complication rate. Morcellation is associated with a smaller postoperative genital hiatus size. Presence of menopause and the uterine weight should be considered in preoperative planning and used to further guide surgeons in providing LH.

References

1. Reich H: Laparoscopic hysterectomy. Surgical laparoscopy & endoscopy 1992; 2: 85-88.

2. Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, Van Voorst S, Mol BWJ, Kluivers KB: Surgical approach to hysterectomy for benign gynaecological disease. Cochrane database of systematic reviews 2009(3).

3. Sandberg EM, Twijnstra AR, Driessen SR, Jansen FW: Total laparoscopic hysterectomy versus vaginal hysterectomy: a systematic review and meta-analysis. Journal of Minimally Invasive Gynecology 2017; 24: 206-217.

4. Johnson N, Barlow D, Lethaby A, Tavender E, Curr L, Garry R. Methods of hysterectomy: systematic review and meta-analysis of randomised controlled trials. Bmj 2005; 330: 1478.

5. Noel NL, Isaacson KB. Morcellation complications: From direct trauma to inoculation. Best Practice & Research Clinical Obstetrics & Gynaecology 2016; 35: 37-43.

6. Wallis L: FDA warns against power morcellation for hysterectomy and fibroids.

7. Pritts EA, Parker WH, Brown J, Olive DL: Outcome of occult uterine leiomyosarcoma after surgery for presumed uterine fibroids: a systematic review. Journal of minimally invasive gynecology 2015; 22: 26-33.

8. Oduyebo T, Rauh-Hain AJ, Meserve EE, et al. The value of re-exploration in patients with inadvertently morcellated uterine sarcoma. Gynecologic oncology 2014; 132: 360-365.

9. Cohen S, Morris S, Brown D, et al. Contained Tissue Extraction Using Power Morcellation: Prospective Evaluation of Leakage Parameters. Journal of minimally invasive gynecology 2015; 22: 83.

10. Cianci S, Gueli Alletti S, Rumolo V, et al. Total laparoscopic hysterectomy for enlarged uteri: factors associated with the rate of conversion to open surgery. Journal of obstetrics and gynaecology: the journal of the Institute of Obstetrics and Gynaecology 2019; 39: 805-810.

11. Pedroso J, Taylor C, Gutierrez M, Volker KW: Total Laparoscopic Hysterectomy for Enlarged Fibroid Uterus. J Minim Invasive Gynecol 2015; 22: 129.

12. Terzi H, Hasdemir PS, Biler A, Kale A, Sendag F. Evaluation of the surgical outcome and complications of total laparoscopic hysterectomy in patients with enlarged uteruses. International journal of surgery (London, England) 2016; 36: 90-95.

13. Hurd WW. On the Road to Safer Morcellation. Obstetrics and gynecology 2017; 129: 976-978.

14. Miller CE. Morcellation equipment: past, present, and future. Current opinion in obstetrics & gynecology 2018; 30: 69-74.

15. Kho KA, Nezhat CH. Evaluating the risks of electric uterine morcellation. Jama 2014; 311: 905-906.

16. Naumann RW, Brown J. Complications of Electromechanical Morcellation Reported in the Manufacturer and User Facility Device Experience (MAUDE) Database. J Minim Invasive Gynecol 2015; 22: 1018-1021.

17. Wasson M, Magtibay P, 2nd, Magtibay P, 3rd, Magrina J. Incidence of Occult Uterine Malignancy Following Vaginal Hysterectomy With Morcellation. J Minim Invasive Gynecol 2017; 24: 665-669.

18. Solima E, Scagnelli G, Austoni V, et al. Vaginal Uterine Morcellation Within a Specimen Containment System: A Study of Bag Integrity. J Minim Invasive Gynecol 2015, 22: 1244-1246.

19. Condous G, Bignardi T, Alhamdan D, et al. What determines the need to morcellate the

AJN The American Journal of Nursing 2014, 114(7): 16.

uterus during total laparoscopic hysterectomy? J Minim Invasive Gynecol 2009; 16: 52-55.

20. Wolfe M, Biest S, Tutlam N, Woolfolk C, Winner B. Preoperative Factors That Predict the Need to Morcellate in Total Laparoscopic Hysterectomy. J Minim Invasive Gynecol 2018, 25: 158-162.

21. Merz E, Miric-Tesanic D, Bahlmann F, Weber G, Wellek S. Sonographic size of uterus and ovaries in pre- and postmenopausal women. Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology 1996; 7: 38-42.

22. Sokalska A, Valentin L. Changes in ultrasound morphology of the uterus and ovaries during the menopausal transition and early postmenopause: a 4-year longitudinal study. Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology 2008; 31: 210-217.

23. Teresinski L, Sipak O, Ryl A, et al. Assessment of morphological changes and steroid receptors in the uteri of postmenopausal women. Histology and histopathology 2019; 34: 631-644.