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Laparoscopic myomectomy: Enucleation of the myoma by morcellation while it is attached to the uterus

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KEYWORDS:
Morcellation;
Enucleation;
Myomas;
Laparoscopic
myomectomy

Abstract

STUDY OBJECTIVE: To evaluate the feasibility, blood loss, length of surgery, mean hospital stay, and complications of enucleation of a myoma by morcellation while it is still attached to the uterus and to compare the technique with the standard technique of laparoscopic myomectomy.

DESIGN: Randomized study (Canadian Task Force classification II-2).

SETTING: Private endoscopy center.

PATIENTS: Forty-four patients with symptomatic myomas confirmed by ultrasound examination were included in the study from January 2000 through December 2001 and were randomized into two groups—A and B. The inclusion criteria were the presence of a uterus larger than 12 weeks (on bimanual examination), ultrasound confirmation of the presence of at least one myoma 7 cm or greater in size, and/or presence of three or more myomas greater than 5 cm in size.

INTERVENTION: The technique of laparoscopic myomectomy by enucleation of a myoma by morcellation while it is still attached to the uterus was performed in all patients in Group A. The patients in Group B underwent laparoscopic myomectomy by the conventional technique of complete enucleation of the myoma followed by morcellation.

MEASUREMENTS AND MAIN RESULTS: Forty-nine myomas were removed in group A and 35 in group B. The mean weight of the myomas removed in each patient was 600.5 ± 369.1 g in group A (95% CI 452.83-748.17 g) and 584.2 ± 411.1 g in group B (95% CI 404.05-764.45 g) ($p = .706$). The mean blood loss was 283.9 ± 229.3 mL in group A (95% CI 192.20-375.72 mL) and 218.5 ± 110.7 mL in group B (95% CI 169.96-267.04 mL) ($p = .739$), the mean hospital stay was 37.91 ± 5.44 hours in group A (95% CI 35.74-40.10 hours) and 39.5 ± 3.634 hours in group B (95% CI 37.91-41.09 hours) ($p = .236$). The mean length of surgery was significantly shorter in group A (97.7 ± 27.06 min, 95% CI 86.88-108.54 minutes) as compared with that in group B (123 ± 38.8 min 95% CI 106.93-140.57 minutes), ($p = .013$).

CONCLUSION: Preliminary results suggest that laparoscopic myomectomy employing the technique of enucleation of a myoma by morcellation while it is still attached to the uterus is safe and efficient. It helps to overcome certain technical difficulties inherent in the standard technique of laparoscopic myomectomy. It may help to relax the inclusion criteria of patients with myoma for laparoscopic myomectomy based on the size of the myoma.

The standard technique of laparoscopic myomectomy has some inherent problems when dealing with very large myomas.[1] As laparoscopic myomectomy is based on a set of "tractions" (push/pull) in a limited space, the large dimensions of the myoma make the enucleation far more difficult.[2] Also, degenerative changes may cause softening of the myoma. It is difficult to insert a myoma screw into the softened tissue and hence the usual traction and counter-traction method of enucleation cannot be per-

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Table 1 Patient characteristics and indications for surgery

Parameter	Group A n = 24	Group B n = 20	p*
Mean age (yrs)	32.95 ± 4.648	33.8 ± 6.35	.644
Mean patient weight (kg)	63.41 ± 12.22	65.95 ± 14.22	.293
Symptom			
Menorrhagia	14	11	
Infertility	9	8	
Pain in abdomen	3	4	
Mass in abdomen	7	2	
Mean weight of myomas (g)	600.5 ± 361.33	584.25 ± 411.17	.706
Mean number of myomas	2.04 ± 1.54	1.75 ± 1.33	.562
Mean size of myomas (cm)	7.612 ± 4.295	7.629 ± 4.570	.895

*Computed by Wilcoxon rank-sum test.

formed efficiently, especially in the case of very large myomas.

For laparoscopic myomectomy to replace the laparotomy method, it must be able to deal with large myomas effectively. In this article, we describe our experience with a technique for laparoscopic myomectomy of very large myomas, which combines two principal steps of the standard technique of laparoscopic myomectomy, namely enucleation of the myoma and morcellation. We also evaluate the efficacy of this technique in comparison with the standard technique of laparoscopic myomectomy.

Materials and methods

A randomized study was performed in patients undergoing laparoscopic myomectomy from January 1, 2000, through December 31, 2001, at our center. The patients were selected consecutively based on physical and ultrasound characteristics. Inclusion criteria were symptomatic myomas confirmed by ultrasound examination with uterus larger than 12 weeks on bimanual examination, presence of at least one myoma measuring 7 cm or greater, and/or presence of three or more myomas greater than 5 cm in size as confirmed by ultrasound examination. Patients with submucosal myomas were excluded from the study. Similarly, patients who had associated ovarian lesions or any other pathology discovered by ultrasound examination and a history of surgery were excluded from the study to prevent the addition of any confounding extraneous factors that might skew the results. The 48 patients who fulfilled the inclusion criteria for the study and gave informed consent were randomized into two groups—A and B—using a computer-generated random number sequence.

In group A, laparoscopic myomectomy was performed by the technique of enucleation of a myoma by morcellation while it was still attached to the uterus. In group B, laparoscopic myomectomy was performed by the standard technique of laparoscopic myomectomy (complete enucleation of the myoma followed by morcellation) as described elsewhere.[3,4]

There were initially 24 patients in each group. However, in four patients in group B, the size and position of the myomas made enucleation by the standard technique very difficult. For ethical reasons, enucleation of the myomas in these patients had to be done by the technique of enucleation of the myoma by morcellation while it was still attached to the uterus; these patients had to be excluded from the study. Hence there were 24 patients in group A and 20 in group B. The main indications for surgery are described in Table 1.

Preoperative preparation

Forty-eight patients (24 in each group) underwent preoperative preparation, but 4 patients from group B were excluded post-surgery. No patient in either of the two groups underwent medical therapy preoperatively.[5] Blood transfusion was given preoperatively when the hemoglobin was less than 11 g/dL. The patients kept to a liquid diet for two days before the procedure to ensure that bowel loops were empty. Antibiotic prophylaxis was cefazolin 2 g administered intramuscularly. The patients also received prophylaxis against possible thromboembolic episodes with a sequential compression device and subcutaneous injection of low-molecular-weight heparin. Hysteroscopy was performed in all patients at the outset of the procedure.

Enucleation of the myoma by morcellation while it is still attached to the uterus

Under general anesthesia, the patient is placed in lithotomy position and the urinary bladder catheterized. The cervix is grasped with a tenaculum, and a uterine manipulator is inserted to manipulate the uterus. A Veres needle is inserted at Palmer's point, and the abdomen is insufflated with CO_2 at the preset pressure of 15 mm Hg. In patients with large myomas, placement of the 10-mm trocar at the usual intraumbilical site would cause the scope to be too close to the suture line.[6] The increased magnification would result in a constantly smaller operative field making precise manipulation of instruments difficult.[7] In such cases, we prefer to place the optical trocar at an appropriate supraumbilical site depending on the size of the uterus and myomas.[6] However, this 10-mm trocar must be inserted at the supraumbilical location under direct vision to avoid damaging major vessels that are directly beneath the insertion site.[6] To this end, a 5-mm trocar is inserted blindly in the abdomen in the left lateral upper quadrant lateral to the inferior epigastric vessels at the level of or above the upper limit of the uterus.[6] If the pathology extends beyond the umbilicus, the 5-mm trocar is inserted at Palmer's point. A 5-mm 30-degree foreoblique telescope is introduced through this port, and the abdominal cavity is surveyed and the myomas are assessed. A steep Trendelenburg tilt is given.

The 10-mm trocar is then inserted supraumbilically in the midline under vision of the 5-mm telescope at an appropriate distance from the umbilicus as decided by the intraoperative assessment of uterine size. We perform the surgery with the help of a 30-degree foreoblique telescope as it helps in viewing the uterus and the myomas from all angles.

We perform this technique with the help of three 5-mm accessory ports. The 5-mm trocar inserted earlier serves as the first trocar for the subsequent surgery. Another 5-mm trocar is introduced in the contralateral midquadrant of the abdomen or higher depending on the uterine size. The third accessory port is inserted in the left lateral mid or lower quadrant of the abdomen. Occasionally, we may need a fourth 5-mm trocar, which is inserted in the right lateral mid or lower quadrant of the abdomen.

Before myomectomy, the abdominal cavity is inspected. The number, size, and location of myomas are noted. The course of the ureter, especially in the case of broad ligament myomas, is traced. Twenty to 30 mL of vasopressin at a concentration of 10 IU/100 mL saline solution is infiltrated below the pseudocapsule of the myoma at several points. A longitudinal incision is then made on the most distended part of the myometrium down to the pseudocapsule with bipolar coagulation and scissors until the characteristic pearl-white appearance of the tumor is seen. The cleavage plane is identified and is further dissected by coagulating or cutting connective tissue bridges, depending on vascular content.[5]

The myoma is separated from its capsule to the extent possible with ease in the limited space available. Generally it is possible to enucleate the myoma up to half its circumference. The 5-mm port in the upper left lateral region is then converted into a 15-mm port for the insertion of the 15-mm serrated-edge electromechanical macromorcellator (Gynecare, Mumbai, Maharashtra, India). The myoma is held by means of the traumatic claw forceps of the morcellator, and thin strips of the myoma are progressively morcellated. The direction of the morcellation should be away from the base of the myoma, and both the entry and exit points should be under vision to prevent any damage to the uterine wall. When the bulk of the myoma is removed, the traction maintained on the myoma by the claw forceps of the morcellator during the procedure causes progressive enucleation of the myoma from its base in the uterine wall. Counter-traction is provided by the pull exerted on the cervix with the help of the tenaculum held by the assistant. A 5-mm bipolar forceps inserted through the contralateral port helps in the coagulation of any major bleeding vessels. In certain cases, when the pseudocapsule is very thinned out as can happen in very large myomas, a part of the pseudocapsule also can be morcellated off along with the myoma. This excess capsule has to be sacrificed anyway later on during reconstruction of the uterine wall.

The myometrial wound is repaired in two layers by intracorporeal suturing. Interrupted sutures are placed with No. 1 polyglactin on a 40-mm round-bodied needle.

The peritoneal cavity is irrigated with saline and hydroflotation leaving at least 250 mL of Ringer's lactate solution. The 15-mm port is closed with a Granee needle (Reza Ribe) under vision. The remaining ports are closed with 3-0 polypropylene subcuticular sutures.

Data analysis

We monitored the operating time (from the skin incision for the Veres needle insertion to the skin closure), blood loss, patient age, weight, chief symptoms, and postoperative hospital stay in both groups. Blood loss was measured by consistently sucking the blood into the suction bottle without any irrigation until the intracorporeal suturing was completed and the hemostasis confirmed. Discrete data were analyzed by Fisher's exact test and Binomial test wherever applicable. Continuous data were evaluated by Wilcoxon rank-sum test. Results are presented as mean $\pm$ SD (95% CI). A difference was considered significant at $p < .05$.

Results

The two groups were comparable with respect to patient age and weight as well as the mean weight and number of myomas removed (Table 1). A total of 49 myomas were removed in group A and 35 in group B. The mean size of the myomas removed in each patient was also comparable in the two groups (Table 1). The size of the myomas removed ranged from 1 to 20 cm in group A and from 3 to 19.5 cm in group B. Table 2 shows the positions of the myomas removed in the two groups. There were 26 subserous myomas in group A and 21 in group B ($p = .796$). There were 23 intramural myomas in group A and 14 in group B ($p = .273$). Thus the two groups were comparable with regard to the size, type, number, and location of the myomas ($p > .05$). This was essential in order to remove confounding factors that could distort the results with respect to the blood loss, length of surgery, weight of the myomas, and mean hospital stay.

There were no intraoperative complications in either group. The postoperative course was uneventful in both

Table 2 Site of myomas

		Group A		Group B			
	No. of myomas	No. of patients	No. of myomas	No. of patients	No. of myomas	Total no. of myomas in Group A and B	p*
Fundal	1	9	9	9	9	18	
	2	2	4	0	0	4	
	3	0	0	2	6	6	
Subtotal (No. of fundal myomas)			13		15	28	.85
Anterior	1	10	10	2	2	12	
	2	0	0	3	6	6	
Subtotal (No. of anterior myomas)			10		8	18	.815
Posterior	1	5	5	7	7	12	
	2	5	10	0	0	10	
Subtotal (No. of posterior myomas)			15		7	22	.134
Lateral	1	6	6	4	4	10	
Anterior cervical	1	2	2	0	0	2	
Posterior cervical	1	1	1	0	0	1	
Fundal pedunculated	1	1	1	1	1	2	
Posterior pedunculated	1	1	1	0	0	1	
Total			49		35	84	

*Computed by binomial test applied to the subtotals of the fundal, anterior, and posterior myomas in groups A and B.

groups. The mean blood loss was 283.9 ± 229.3 mL in group A (95% CI 192.20-375.72 mL) and 218.5 ± 110.7 mL in group B (95% CI 169.96-267.04 mL) ($p = .739$). The mean hospital stay was 37.91 ± 5.44 hours in group A (95% CI 35.74-40.10 hours) and 39.5 ± 3.634 hours in group B (95% CI 37.91-41.09 hours) ($p = .236$). Length of surgery was significantly shorter in group A (97.7 ± 27.06 min, 95% CI 86.88-108.54 minutes) as compared with that in group B (123 ± 38.8 min, 95% CI 106.93-140.57 minutes) ($p = .13$).

Four patients required postoperative blood transfusion in both the groups. The mean weight of the myomas was larger in the group A. The total number of myomas and the mean number of myomas removed in each patient was also greater in group A. The patients in both the groups were followed up at 7 days, 1 month, 6 months, and then yearly for a 2-year follow-up period. The patients in both the groups with symptoms of menorrhagia, pain in abdomen, and mass in abdomen reported resolution of their symptoms and were satisfied with the results of the surgery at the end of the 3-year follow-up period. An extended follow up of the patients with history of infertility is being conducted at present.

Discussion

The standard technique of laparoscopic myomectomy requires us to separate the myoma completely from the uterus before morcellation.[3] However, in very large myomas, there is limited space available for the push-pull maneuvers required for the complete enucleation of the myoma.[8] The myoma screw and bipolar forceps cannot be manipulated with ease, thus increasing the technical difficulty. Also, traction accorded by a 5-mm or even a 10-mm myoma screw or grasper in standard myomectomy may not be adequate to maneuver a very large myoma efficiently.[8] This is especially the case when dealing with large, softened, degenerated myomas that do not allow adequate grip. Repeated repositioning of the screw is required, which might be very cumbersome. The concerns posed by the technical difficulty of laparoscopic myomectomy have led to various exclusion criteria based on myoma size and number.[9,10]

Our technique offers certain advantages that help to overcome these problems. First, it combines two major steps of standard laparoscopic myomectomy: enucleation and morcellation. As the myoma is progressively morcellated and the uterine size reduced, additional space is created for the optimum movement of instruments, especially bipolar forceps.[8] Second, the 15-mm claw forceps of the morcellator offers better grip and steady traction even in the case of degenerated myomas. In addition, the electromechanical force exerted by the morcellator causes progressive enucleation of the myoma from its bed even as it is being morcellated, thus completing the process of enucleation (Figures 1 to 3). Thus the use of the morcellator to both enucleate the myoma as well as remove it from the abdomen reduces operating time in addition to reducing the technical difficulty of the procedure.

A major concern regarding the efficacy of this technique concerns hemostasis. Because the myoma is not completely enucleated before morcellation is begun, one would expect

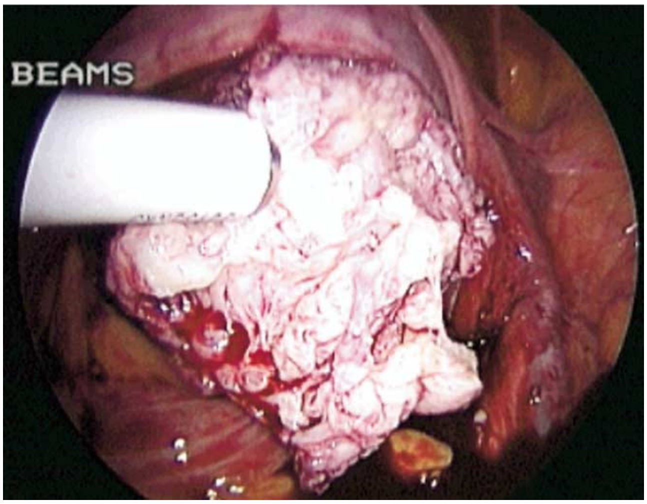

Figure 1 Enucleation of a large posterior wall myoma by morcellation while it is still attached to the uterus.

bleeding to be more pronounced because all the feeding vessels have not been coagulated before morcellation. However, our experience has been quite encouraging. In our study, the mean blood loss was only slightly higher in group A as compared with group B, and this difference did not reach statistical significance. Although total blood flow in a myomatous uterus is greater than total blood flow in a normal uterus, blood flow in a myomatous uterus, gram for gram, is less than that in a normal uterus.[11] Also, blood flow in the myomata is reduced as compared with the blood flow in normal myometrium in the same uterus.[11] Large myomas undergo degeneration because of diminishing blood supply and the morcellation of the degenerated areas does not result in excessive bleeding. In addition, no large blood vessels enter the myoma, and there is no vascular pedicle.[11] If the dissection is carried out between the myoma and the pseudocapsule, blood loss can be minimized.[11] In our technique, the cleavage plane is properly identified, and the dissection is carried out for almost half the circumference of the myoma in this plane. The morcellation done later continues the dissection in the same cleavage plane, thus keeping blood loss under control.

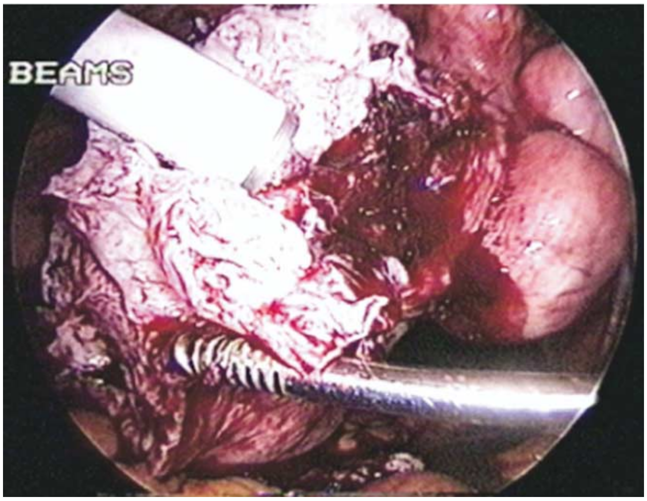

Figure 2 The morcellation of a posterior cervical myoma causes progressive enucleation of the myoma from its bed.

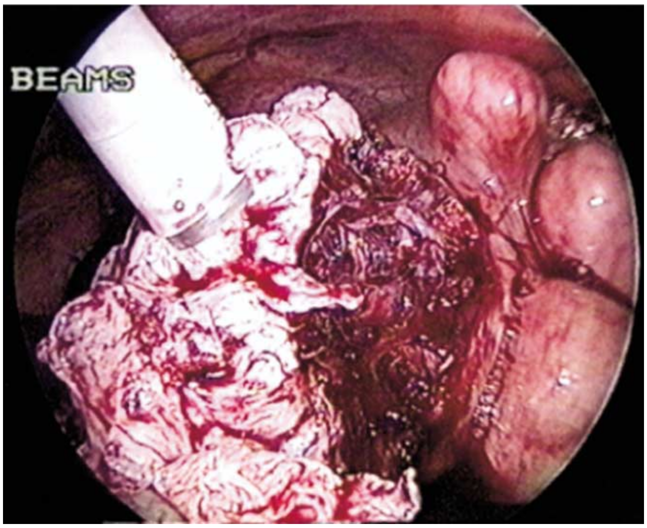

Figure 3 The progressive enucleation of the posterior cervical myoma from its bed.

The muscle fibers and blood vessels surrounding a myoma are compressed by its growth to form the pseudocapsule around a myoma. Some studies have stated that the biggest myomas will have a highly distended perimyomatous vascularization due to compression of the myoma thus increasing the risk of perioperative hemorrhage.[12] The injection of a vasoconstrictor agent like vasopressin subcapsularly and at the base of the myoma induces vasoconstriction of these vessels and reduces blood loss. Before this study, we had performed laparoscopic devascularization of large myomas by either ligation of the uterine vessels or laparoscopic bipolar coagulation of the uterine vessels at the outset of laparoscopic myomectomy.[8] However, devascularization is a relative contraindication in women who want to preserve their fertility. Also, in patients with lateral wall myomas, it might be difficult to delineate the uterine arteries.[8] The technique described in this study has no such limitations.

This technique compares very favorably with the standard technique. The mean blood loss and hospital stay were comparable in the two groups and the time of surgery was significantly less in the study group A.

The method, however, requires training and skilled use of the morcellator; otherwise, potentially catastrophic vascular or visceral injuries can occur. The camera assistant also needs to be well trained as this method is better performed with a 30-degree foreoblique telescope to view both the entry and the exit points of the serrated edge of the morcellator through the myoma. One might inadvertently damage the uterus, fallopian tubes, or ovaries if the exit point of the morcellator is not seen. In order to prevent this complication, it is necessary that the morcellator should never be advanced toward the uterus. The myoma should be pulled in steadily toward the serrated edge of the morcellator by means of the claw forceps. But as the myoma gets progressively enucleated, the junction between the myoma and the uterine wall can be demarcated easily.

One other problem that could arise is in the case of very deep intramural myomas extending up to the endometrium. The traction force exerted by the morcellator could cause the endometrium to be pulled up along with the myoma, and this could result in the inadvertent morcellation of the endometrium along with the myoma, if the surgeon is not alert. The endometrium can, however, easily be distinguished from the myoma, and when the endometrium gets pulled, it can be separated from the myoma. In the two patients in group A in whom the endometrium was pulled up, we easily discerned the same, and separated the endometrium from the myoma before any injury could occur. Also, after the bulk of a large, deep intramural myoma has been morcellated, a 5-mm myoma screw can be inserted in the remaining myoma, and the rest of the enucleation can be done according to the conventional method.

Since this study, we have routinely performed laparoscopic myomectomy of very large myomas employing this technique. It has helped us perform myomectomy via the laparoscopic route of very large myomas which would have been technically very difficult, in fact impossible, to attempt employing the conventional technique of laparoscopic myomectomy.

Conclusion

The technique of enucleation of the myoma by morcellation while it is still attached to the uterus is a promising method for laparoscopic myomectomy of very large myomas and degenerated myomas. The length of surgery is reduced significantly due to combination of the two major steps of the conventional method of laparoscopic myomectomy. The blood loss is not significantly greater than in the conventional method. This technique also can be adopted to reduce the bulk of the myoma so as to create enough space to complete the enucleation by the conventional method. It could thus help us relax the inclusion criteria based on the size of the myoma proposed by various experts for myomectomy of very large myomas by the laparoscopic route.

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