Best practices in minimally invasive gynecology: making sense of the evidence

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Chapter 9

Analysis of risk factors for intraoperative conversion of laparoscopic myomectomy

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Abstract

Objectives: To report the surgical outcomes of laparoscopic myomectomy (LM) and abdominal myomectomy (AM) at a high-volume tertiary care hospital, to evaluate the risk of conversion during LM, and to analyze the associated risk factors.

Design: Retrospective cohort study (Canadian Task Force classification II).

Patients: All patients who underwent LM and AM in a tertiary academic center in Boston, Massachusetts between 2009 and 2012.

Intervention: Medical records were reviewed for baseline characteristics and perioperative outcomes. Robot-assisted laparoscopy was considered a subtype of LM.

Results: A total of 966 patients underwent myomectomy during the study period, including 731 LM cases (75.67%) and 235 AM cases (24.33%). Compared with patients undergoing LM, those undergoing AM had more myomas removed and heavier specimens (mean number of myomas, 12.60 vs 3.54, $p<.001$; mean weight, 592.75 g vs 263.4 g, $p<.001$). Conversion was necessary in 8 LM cases (1.09%). All conversions were reactive in nature and were associated with greater blood loss (mean, 1381.25 vs 167.95 mL; $p<.001$) and longer hospital stay (mean days 3.13 vs 0.55, $p<.001$) compared with cases without conversion. Factors associated with conversion included both the number and the weight of myomas removed (mean number, 9.75 vs 3.48, $p=.003$; mean weight, 667.9 vs 259.25 g, $p=.015$), especially with myomas weighing more than 500 grams (odds ratio: 8.551, $p=.005$).

Conclusion: The risk of conversion for LM was low (1.09%) in this cohort, and was associated both with the number and the weight of myomas removed. LM is a feasible approach for surgical management of myomas in the majority of cases; however, when myomas are expected to weigh more than 500 grams, it may be prudent to consider referring those cases to specialized centers with highly experienced teams.

Introduction

An estimated 20% to 40% of reproductive-aged women have symptomatic uterine myomas.[1] For women who desire uterine conservation, laparoscopic myomectomy (LM) is a safe and feasible option.[2-4] This minimally invasive procedure is associated with better postoperative outcomes, including less postoperative pain, quicker recovery, and fewer overall complications, compared with abdominal myomectomy (AM).[5;6] However, it is a technically challenging and potentially complicated procedure. As such, the selection criteria for patients who are candidates for a laparoscopic approach to myomectomy remain a matter of debate.[7-9]

The main complications seen during LM are excessive blood loss and conversion to an abdominal approach, which is especially closely associated with worse postoperative outcomes.[10;11] Depending on the reason for conversion, the procedure may be considered as strategic or reactive (owing to complications).[12] The incidence of conversion may reflect the preoperative indications for LM and/or intra-operative complications, and can be considered a quality indicator. Compared with laparoscopic hysterectomy, little has been published on the conversion rate of LM. The frequency of conversion has been historically cited as ranging from 0 to 41.4% at the time of LM,[3;7;13] and in more recent studies, rates have varied from 1% to 3% for high-volume surgeons.[9;14;15]

The objectives of the present study were to report the surgical outcomes of LM and AM at a high-volume tertiary care hospital, to evaluate the incidence of conversion during LM, and to analyze the risk factors associated with the need to convert to laparotomy.

Methods

The retrospective cohort study included all consecutive cases of myomectomy performed between January 2009 and December 2012 at Brigham and Women's Hospital, a tertiary care academic center in Boston, Massachusetts. The study was reviewed and approved by Partners Institutional Review Board. The cases were identified through a centralized hospital database.

Data abstracted from the medical record included age, parity, race, body mass index, history of previous surgeries, mode of myomectomy (laparoscopic, robotic, or abdominal), operative findings, type of conversion (reactive vs strategic), intra-operative and postoperative complications, readmission, reoperation, operative time (defined as time from first incision to closure of last incision), length of hospital stay (same day discharges coded as 0 days), estimated blood loss, and type of surgeon. Whether or not the surgeon entered the endometrial cavity during surgery could not be reliably determined from the clinical record. Conversion was defined according to the recent consensus definition.[12]

Intraoperative complications included injuries to the urinary tract, nerves, vessels, or bowel; estimated blood loss of more than 1000 mL; and major anesthesia-related issues. Postoperative complications were ranked according to the Clavien-Dindo classification system and included injuries to the urinary tract, nerves, vessels, or bowel diagnosed postoperatively, as well as hemorrhage requiring blood transfusion, pulmonary embolus, deep vein thrombosis, infection, fever, and other mild complications requiring treatment.

Types of surgeons included general and specialized gynecologists. The specialized gynecologists, defined as having completed fellowship training, were further subdivided into subspecialty: reproductive endocrinology and infertility (REI), oncology, and minimally invasive gynecologic surgery (MIGS). Instead of preoperative ultrasound measurements and/or clinical examination information, operative findings were used to account for the number and size of myomas, assuming that the surgeons had roughly this information before starting the procedure.

Statistical analyses were performed using SPSS version 20 for Windows (IBM, Armonk, NY). Data were summarized, and extreme values were verified to be correct. The AM procedures were compared with LM, and the converted LM cases were compared with nonconverted cases. To assess the significance of individual parameters, univariate logistic regression analysis was performed. For descriptive data with an empty category, the chi square or Fisher's exact test was used as appropriate. To investigate the combination of predictors for the route of myomectomy, multiple regression analysis was performed. A p-value <.05 was considered significant for all variables.

Results

We identified a total of 966 patients who underwent AM or LM between 2009 and 2012. These included 235 AMs (24.33%) and 731 LMs (75.67%), of which 343 cases (46.92%) were robot-assisted. The decision was made to treat the conventional laparoscopic cases and the robot-assisted laparoscopic cases as a single category, defined as LM. Overall, baseline characteristics were similar in these two subgroups (data not shown). One notable difference in perioperative outcomes was the weight of the removed myomas; specimen weight was significantly greater in the conventional laparoscopic group than in the robot-assisted group (mean grams, 396.87 vs 217.05; p<.001).

Baseline and operative characteristics of the LM and AM groups are displayed in Table 9.1. The demographic characteristics did not differ significantly between the two groups. With regard to the indications for myomectomy, the AM group had higher rates of menorrhagia (59.57% vs 50.71%; p=.037) and infertility (19.57% vs 14.35%; p=.021), whereas the incidence of pelvic pain was higher in the LM group (66.90% vs 58.59%; p=.004). Regarding operative characteristics, patients who underwent AM had more myomas removed with greater specimen weights (mean number, 12.60±14.80 vs 3.54±4.10, p<.001; mean weight, 592.75±884 vs. 263.4±286.2, p<.001). In addition, AM patients experienced greater intraoperative blood loss (mean, 267.16±274.04 mL vs 181.54±342.02 mL; p=.002) and had a longer length of hospital stay (mean, 2.15±1.1 days vs 0.581.0 days; p<.001).

Regarding the location of the myomas treated, submucosal myomas and subserosal myomas were encountered with equal frequency in the two groups. Significantly more women with intramural myomas underwent LM compared with AM (62.7% vs 53.8%; p=.004).

A total of 28 surgeons performed procedures on patients of the cohort, of whom 17 had completed a fellowship. Gynecologists specializing in REI performed 89.3% of AMs and 54.8% of LMs, whereas those specializing in MIGS performed 42.87% of LMs (Table 9.1). General gynecologists performed 7.9% of all cases. Specific for LM, 98.5% of the cases were performed by a gynecologist who had completed a fellowship.

Table 9.2 compares characteristics of the LM cases complicated by conversion and those of cases without conversion. Eight LM cases (including 1 robotic case) were converted to an open procedure (1.09%). In each instance, this was a reactive conversion in response to an adverse event. In one case, subsequent abdominal hysterectomy was performed owing to major bleeding. The other 7 cases were converted to an AM because of excessive blood loss (n=2), prolonged operating time (n=1), large number or size of myomas to be removed (n=3), and a tear of the ileum (n=1). Intraoperative blood transfusion was necessary in three of those cases. Five of the converted cases were performed by MIGS specialists in minimally invasive gynecology, two cases were performed by REI specialists, and one case was performed by a general gynecologist.

There were no significant differences in baseline characteristics and the indication for myomectomy between the conversion group and the nonconverted LM group (Table 9.2). In terms of surgical outcomes, converted cases were associated with greater blood loss (mean, 1381.25±1645.85 mL vs 167.95±273.61 mL; p=.001) and a longer hospital stay (mean, 3.13±2.64 days vs 0.55±0.96 days; p=.001). The operative time was also longer in the converted cases, but the difference did not reach statistical significance (mean, 215±138.6 minutes vs 128.70±78.61 minutes; p=.232). The number and the weight of

Table 9.1: Baseline characteristics and surgical outcomes for laparoscopic and abdominal myomectomy cases

	Abdominal (n=235)	Laparoscopic (n=731)	Odds ratio (95% confidence interval)	p-value univariate	p-value multivariate
Age (years)	39.83±5.83	40.33±7.28	1.044 (0.998; 1.091)	--	.060
BMI (kg/m²)	27.50±6.12	26.75±5.84	0.999 (0.954; 1.046)	--	.970
Race					
White	103 (46.39)	411 (59.30)	1	--	.
Afro-Americans	88 (39.64)	162 (23.38)	0.820 (0.432; 1.558)		.545
Others	31 (13.97)	120 (17.32)	0.580 (0.285; 1.181)		.134
Prior laparotomy	68 (28.5)	154 (21.5)	0.737 (0.372; 1.460)	--	.381
Prior laparoscopy	20 (8.5)	109 (15.2)	1.928 (0.793; 4.687)	--	.147
Indication myomectomy					
Pressure/pain	135 (58.69)	471 (66.90)	2.473 (1.327; 4.607)	--	.004
Menorrhagia	137 (59.57)	357 (50.71)	0.507 (0.268; 0.959)		.037
Urologic/bowel problems	54 (23.48)	209 (29.69)	1.249 (0.653; 2.388)		.502
Infertility	45 (19.57)	101 (14.35)	0.415 (0.196; 0.878)		.021
Type of fibroids					
Submucosal	66 (36.3)	131 (20.9)	0.680 (0.365; 1.268)	--	.225
Intra/transmural	98 (53.8)	394 (62.7)	2.425 (1.376; 4.272)		.002
Subseroasal/pedunculated	125 (68.7)	373 (59.4)	1.436 (0.780; 2.644)		.245

	Abdominal (n=235)	Laparoscopic (n=731)	Odds ratio (95% confidence interval)	p-value univariate	p-value multivariate
Fibroids					
Number	12.60±14.80	3.54±4.10	0.845 (0.804; 0.888)	--	<.001
Weight (gram)	592.75±884	263.4±286.20	0.997 (0.996; 0.998)		<.001
EBL (mL)	267.16±274.04	181.54±342.02	0.999 (0.999;1.000)	.002	--
Length of stay (days)	2.15±1.10	0.58±1.00	4.439 (3.592;5.485)	<.001	--
Mode of myomectomy					
Abdominal	235 (100)	--	--	--	--
Laparoscopic	--	388 (53.08)			
Robotic	--	343 (46.92)			
Surgeon type					
MIGS	0	313 (42.87)	--	<.001	--
REI	208 (89.27)	400 (54.80)			
General gyn	15 (6.44)	11 (1.50)			
Oncology	10 (4.29)	6 (0.82)			

Data presented as mean (±SD) or as n (%).
Dependent variable for univariate and multivariate regression = laparoscopic myomectomy.

Table 9.2: Baseline characteristics and surgical outcomes for the laparoscopic myomectomy cases and the converted cases

	Non converted laparoscopic cases (n=722)	Converted cases (n=8)	Odds ratio (95% confidence interval)	p-value
Age (years)	40.33±7.30	40.88±5.08	1.010 (0.919; 1.110)	.832
BMI (kg/m^2)	26.78±5.85	23.23±1.94	0.853 (0.671; 1.085)	.195
Race*				
White	407 (59.33)	4 (57.14)	--	.320
Afro-Americans	159 (23.18)	3 (42.86)		
Others	120 (17.49)	0		
Prior laparotomy	151 (21.33)	3 (37.50)	2.213 (0.523; 9.336)	.280
Prior laparoscopy*	109 (15.40)	0	--	.373
Indication myomectomy				
Pressure/pain	464 (66.67)	7 (87.5)	0.188 (0.19; 1.815)	.149
Menorrhagia	353 (50.72)	4 (50.0)	0.790 (0.184; 3.389)	.751
Urologic/bowel	208 (29.89)	1 (12.50)	3.893 (4.69; 32.316)	.208
Infertility	100 (44.25)	1 (12.50)	0.624 (0.061; 6.404)	.691
Suspicion of malignancy*	4 (0.57)	0	--	1.000
Type of fibroids*				
Submucosal	131 (21.12)	0	--	.215
Intra/transmural	389 (62.74)	5 (62.5)	0.990 (0.234;4.180)	.989
Subseroasal/pedunculated	368 (59.35)	5 (62.5)	1.141 (0.270;4.819)	.857
Fibroids				
Number	3.48±3.84	9.75±12.59	1.117 (1.039; 1.201)	.003
Weight (gram)	259.25±281.56	667.79±448.67	1.002 (1.000; 1.003)	.015
Converted cases of >500g	--	4 (4.16)	8.551 (1.883; 38.822)	.005
EBL (mL)	167.95±273.61	1381.25±1645.85	1.002 (1.001; 1.002)	<.001
Length of stay (days)	0.55±0.96	3.13±2.64	1.732 (1.307; 2.296)	<.001
Mode of myomectomy				
Laparoscopic	381 (52.77)	7 (87.50)	1	.086
Robotic	342 (47.37)	1 (12.50)	0.159 (0.19; 1.300)	.086
Surgeon type*				
MIGS	308 (42.66)	5 (62.5)	--	.096
REI	398 (55.12)	2 (25.0)		
General gyn	10 (1.39)	1 (12.5)		
Oncology	6 (0.83)	0		
OR time (min)	128.70±78.61	215±138.6	1.005 (0.998; 1.011)	.197

Data presented as mean (±SD) or as n (%).
Dependent variable for univariate regression = conversion.
* Chi square/Fisher exact performed, due to empty categories.

the removed myomas were associated with an increased risk of conversion (mean number of myomas removed: 9.75±12.59 in the converted subgroup vs 3.48±3.84 in the non-converted group; p=.003; mean specimen weight: 667.79±448.67 g vs 259.27±281.55 g; p=.015), especially when the specimen weight exceeded 500 grams, (conversion risk, 4.16% vs 0.47%; OR=8.551; p=.005).

The converted LM cases and AM cases are compared in Table 9.3. There were no significant between-group differences in baseline characteristics or indications for myomectomy. Similarly, no differences were found in the number of removed myomas or specimen weight (mean number of myomas removed: 9.75±12.59 vs 12.60±14.80; p=.694; mean specimen weight: 667.79±448.67 g vs 592.75±884 g; p=.549). The converted LM group had significantly greater intraoperative blood loss (mean, 1381.25±1645.85 mL vs 267.16±274.04 mL; p<.001) and longer postoperative hospital stay (mean, 3.13±2.64 days vs 2.15±1.10 days; p=.036).

Table 9.3: Baseline characteristics and surgical outcomes for the abdominal myomectomy cases and the converted cases

	Abdominal cases (n=235)	Converted cases (n=8)	Odds ratio (95% confidence interval)	p-value
Age (years)	39.83±5.83	40.88±5.08	1.032 (0.913; 1.166)	.617
BMI (kg/m^2)	27.50±6.12	23.23±1.94	0.829 (0.654; 1.051)	.122
Race*				
White	103 (46.39)	4 (57.14)	--	.559
Afro-Americans	88 (39.64)	3 (42.86)		
Others	31 (13.97)	0		
Prior laparotomy	68 (28.5)	3 (37.50)	1.474 (0.343; 6.338)	.302
Prior laparoscopy*	20 (8.5)	0	--	1.000
Indication myomectomy				
Pressure/pain	135 (58.69)	7 (87.5)	5.900 (0.614; 56.645)	.124
Menorrhagia	137 (59.57)	4 (50.0)	0.883 (.207; 3.772)	.867
Urologic/bowel	54 (23.48)	1 (12.50)	0.325 (0.38; 2.763)	.303
Infertility	45 (19.57)	1 (12.50)	1.051 (0.109; 10.169)	.965
Suspicion of malignancy*	4 (1.74)	0	--	1.000
Type of fibroids				
Submucosal*	66 (36.3)	0	--	.052
Intra/transmural	98 (53.8)	5 (62.5)	1.429 (0.332; 6.156)	.632
Subserosal/pedunculated	125 (68.7)	5 (62.5)	0.760 (0.176; 3.290)	.714
Fibroids				
Number	12.60±14.80	9.75±12.59	0.988 (0.931; 1.049)	.694
Weight (gram)	592.75±884	667.79±448.67	1.00 (0.99; 1.002)	.549
EBL (mL)	267.16±274.04	1381.25±1645.85	1.002 (1.001; 1.003)	.001
Length of stay (days)	2.15±1.10	3.13±2.64	1.459 (1.025; 2.075)	.036
Surgeon type*				
MIGS	0	5 (62.5)	--	<.001
REI	208 (89.27)	2 (25.0)		
General gyn	15 (6.44)	1 (12.5)		
Oncology	10 (4.29)	0		

Data presented as mean (±SD) or as n (%).
Dependent variable for univariate regression = conversion.
* Chi square/Fisher exact performed, due to empty categories.

Discussion

To our knowledge, this retrospective study is the largest cohort of patients undergoing LM analyzed to date, with 98.5% of the laparoscopic cases performed by a gynecologist who had completed a fellowship. We found that risk of conversion at time of LM was low (1.09%) and in line with recent reports.[9;15;16] In addition, our data show that converted cases were associated with more intraoperative blood loss and a longer hospital stay compared with LM or planned AM.

The low incidence of conversion at the time of LM in our cohort may be attributable to surgeon experience (with 17 of 28 surgeons having completed a fellowship, performing 98.5% of the LM cases), as well as appropriate patient selection for this complex procedure.[7] Various selection criteria for LM have been proposed in previous studies based on the size and number of myomas, location of myomas, and surgical history of the patient.[7;9] In addition, infertility as indication for surgery has been a consideration when choosing the mode of myomectomy.[17] With technical advances in minimally invasive surgery, increasingly complex cases are being considered for the laparoscopic approach.[16] Indeed, the majority of the LM cases at our hospital are now managed in a minimally invasive fashion. Recent studies have suggested that after surgeons overcome the learning curve of LM, limiting factors may disappear provided the availability of optimal instrumentation, a trained and dedicated operating room team, and an experienced surgeon who feels at ease with the case.[9;14;16]

Regarding the risk factors for conversion during LM, the number of removed myomas and their weight were associated with conversion in our cohort. The number of myomas removed varied widely in the converted group, ranging from one up to 31 myomas. Therefore, we could not define a clear cutoff, in contrast to a previous study, where attempted removal of more than four myomas was associated with a greater risk of conversion.[7] We also noted that specimen weight of more than 500 grams, corresponding approximately to a uterus of 16 weeks gestation was associated with a greater risk of conversion (4.16% vs 0.47%; OR=8.551; p=.005).[18;19] This finding is in accordance with several other studies of LM.[7;9] Similarly, for cases of laparoscopic hysterectomy, a uterus weighing more than 500 gram was also found to be a predictor for conversion.[20] This may be clinically relevant, given that estimated myoma volume can be calculated preoperatively based on imaging findings.[21] For patients with a preoperative estimated myoma volume of more than 500 gram, we suggest that surgeons should consider the case carefully and counsel the patient about the increased risk of conversion.[9] In this respect, in cases of myomas weighing more than 500 grams, low-volume providers might consider referral to a specialized center.

Of note, minimally invasive gynecologic surgery has been confronted recently with a complex problem regarding the use of power morcellation during laparoscopic surgeries, and this might influence the general approach to LM. We have generally recommended the use of contained tissue extraction and have demonstrated the feasibility of this approach in recent publications.[22-26]

Limitations of this study include its retrospective design and inherent propensity for misclassification, although the latter is presumed to be nondifferential in nature. In addition, the missing values seen in retrospective studies could potentially affect the results of our analysis. Moreover, our findings are based on a single outcome (risk of conversion) and did not include such outcomes as pregnancy rate or patient satisfaction. We combined the robotic and the conventional laparoscopic cases because of the small number of converted cases, precluding more detailed analysis of these groups. Strengths of the study include the large number of patients included and the widely varying case mix.

In conclusion, LM is a safe and effective minimally invasive option for the removal of uterine myomas. A minimally invasive approach to myomectomy confers many benefits to patients compared with AM. Our data suggest however that myomas weighing more than 500 grams predict potential surgical difficulties and a significantly greater risk of conversion. Therefore, in an effort to optimize patient outcomes, it may be prudent to evaluate estimated myoma number and size pre-operatively, and to take this information into consideration during operative planning.

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