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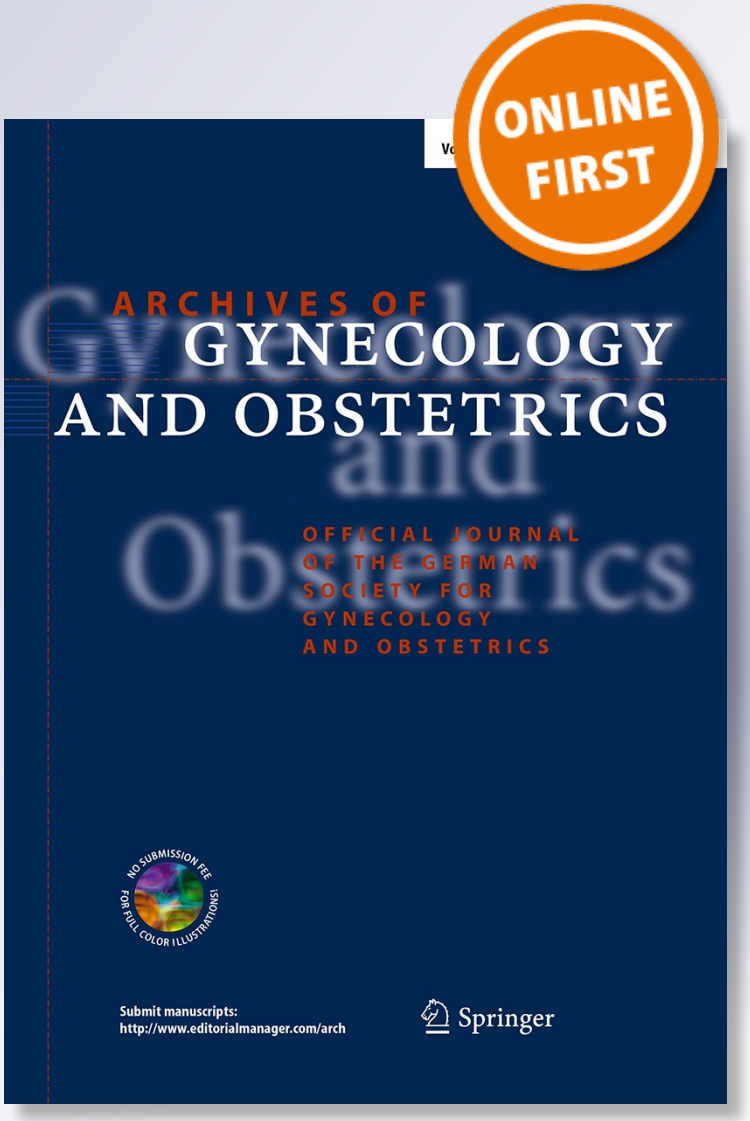

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Laparoscopic treatment of uterine fibroids: a comparison of peri-operative outcomes in laparoscopic hysterectomy and myomectomy

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Abstract
Purpose To compare peri-operative outcomes between laparoscopic myomectomy (LM) and laparoscopic hysterectomy (LH) for the treatment of uterine fibroids.
Methods Retrospective cohort study including 400 women who underwent LH or LM for the management of uterine fibroids.
Results LH patients were older, with higher BMI and larger uterine size but LH was associated with shorter operative duration (80.2 vs. 115.7 min, $p < 0.0001$), lower blood loss (215 vs. 316 ml, $p < 0.0001$), and shorter hospital stay (1.81 vs. 2.12 days, $p = 0.0003$). Seven LM patients (3.2 %) had blood loss >1000 ml compared with no LH patients and five LM patients (2.3 %) required blood transfusion compared to 1 (0.5 %) LH patient. Three LM patients (1.9 %) and no LH patients required conversion to laparotomy. Bladder injury occurred in three LH cases (1.6 %) and no LM cases. When the data was restricted only to women aged 44 years or over, LH was again associated with significantly lower operative duration and estimated blood loss.
Conclusions Particularly in perimenopausal women, the decision to perform myomectomy can be controversial. These data suggest that there are potential advantages to LH over LM, including reduced operation length, blood loss and hospital stay but increased risk of urinary tract injury.

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Keywords Fibroids · Leiomyoma · Laparoscopy · Hysterectomy · Myomectomy · Complications

Introduction

Uterine fibroids are one of the most commonly encountered benign gynaecological conditions, affecting 40–70 % of women [1]. Although often asymptomatic, symptoms such as dysmenorrhoea, menorrhagia, pelvic pain and subfertility occur in approximately 30–50 % of women with fibroids [2–4]. Fibroids frequently require surgical management, and are the leading indication for hysterectomy in the United States [5].

Traditionally, abdominal hysterectomy was the treatment of choice for symptomatic fibroids, however, surgical advances coupled with increased demand to retain reproductive potential has led to increasing use of myomectomy [6]. Open myomectomy was developed as a conservative surgical alternative to hysterectomy. Studies showed that abdominal myomectomy is a lengthier procedure but is associated with significantly less blood loss and shorter hospital stay, with no overall difference in perioperative morbidity [7]. Particular concern regarding the risk of fibroid recurrence meant that myomectomy has traditionally been reserved for younger women who wish to retain fertility. However, cultural beliefs and perceptions about the effect of hysterectomy on sexuality, femininity, and bowel or bladder function have led to an increasing demand for conservative surgical management, even in peri- or post-menopausal women.

Subsequent developments in minimally invasive surgery have now enabled both these procedures to be performed laparoscopically. The laparoscopic route has been shown to have several advantages over the open route including a

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quicker return to normal activities, less post-operative pain, fewer wound infections, a smaller drop in haemoglobin, shorter hospital stay, and improved quality of life [8].

There is currently very limited data comparing operative outcomes between laparoscopic myomectomy (LM) and laparoscopic hysterectomy (LH) for the treatment of fibroids. Evidence to aid operative choice and patient counselling is frequently extrapolated from the older open studies which are associated with high rates of morbidity of up to 40 % [7].

In the present study, we aim to assess peri-operative morbidity in women undergoing laparoscopic myomectomy or hysterectomy for uterine fibroids.

Methods

The data of patients who underwent laparoscopic myomectomy or hysterectomy at the laparoscopic unit of Whipps Cross University Hospital, London, between January 2005 and December 2013 were included in this retrospective cohort study. Data were collected prospectively in a Microsoft Excel™ spreadsheet in accordance with Caldicott guidelines as part of an ongoing database designed to evaluate clinical practice. Formal ethical approval was not necessary as there was no deviation from normal clinical practice.

All patients were assessed preoperatively when baseline characteristics and presenting symptoms were recorded. Data recorded included age, parity, body mass index (BMI), prior abdominal surgery, uterine size and primary symptom (classified as bleeding, pain, subfertility or pressure). Uterine size was assessed clinically on pelvic examination and equated to number of weeks gestation. Patients also underwent preoperative imaging in the form of pelvic ultrasound (US) or magnetic resonance imaging (MRI) and details regarding the uterine size and number and location of fibroids were recorded.

Choice of operation was decided by the patient and surgeon at the initial clinic visit, following assessment and appropriate counselling. Exclusion criteria for both groups of patients include confirmed or suspected malignant disease of any part of the genital tract or second- or third-degree uterine prolapse. Exclusions for LM include uterine size above 28 weeks or the presence of more than 10 fibroids on pelvic imaging. In the hysterectomy group there was no upper limit of uterine size as an exclusion criterion. For taller patients with large uteri, if there was space to insert the primary port at palmers point and insert an ancillary port in the contralateral abdominal fossa, and if the uterus could be moved from side to side to visualise the pedicles, the hysterectomy was carried out laparoscopically [9].

Operative data recorded included duration of surgery, estimated blood loss, specimen weight, need for transfusions, intra-operative complications, additional surgical procedures performed and length of hospital stay. Operating time was defined as the duration from incision to wound closure.

Data gathered from all patients undergoing LH was reviewed but was only included for further analysis if there was clear documentation of fibroids or uterine size equivalent to 12 weeks gestation or above.

Surgical technique

All patients received prophylactic antibiotics at induction of anaesthesia.

The technique for LM has been described previously [10]. Initial entry was via an intraumbilical incision or Palmers point (in cases where the uterine size was more than 14 weeks) with two 5 mm ancillary lateral ports for operating, and a suprapubic port. Misoprostol (800 mcg per rectum) and Vasopressin™ (in 1:30–1:60 of saline) were used intraoperatively to reduce blood loss. Fibroid excision was predominantly carried out using the Harmonic™ scalpel (Ethicon) with two or three layer closure of the resulting defect using No. 1 polyglactin intracorporeal (Polysorb™, Covidien, UK) sutures and for the serosa, monofilament sutures (Biosyn™, Covidien, UK). Myomas were then removed via the suprapubic port following morcellation. Site-specific adhesion barriers (Sprayshield™, Covidien, UK) were used to minimise post-operative adhesions.

Laparoscopic hysterectomies were of two types, laparoscopic sub-total hysterectomy (LASH) or total laparoscopic hysterectomy (TLH), with or without removal of the ovaries. Entry was as described above. The technique for LH has been described previously [9, 11]. All procedures were performed in modified lithotomy position. A urinary catheter was inserted and a ClearView™ (Clinical Innovations) uterine manipulator was used for manipulation of the uterus. Bipolar diathermy forceps and Harmonic™ scalpel (Ethicon) were used for coagulation and cutting the pedicles. On both sides, the infundibulopelvic, or ovarian ligament with the tube and round ligaments, were coagulated and divided, the uterovesical fold was then opened and bladder resected downwards. On both sides, the uterine arteries were skeletonized, coagulated and divided.

Then, for LASH, the uterus was transected from the cervix using the Lap Loop™ (Roberts Surgical) and the endocervical canal was cored out to destroy any remnant endometrial tissue. A tissue morcellator was then used to remove the uterine specimen from the abdominal cavity.

For TLH a Koh cup™ (CooperSurgical, USA) was used to delineate the vaginal vault and a pneumo-occluder used

to prevent the leak of carbon dioxide once the vaginal vault was opened. After division of the uterus and cervix from the upper vagina, the specimens were then removed transvaginally while still attached to the uterine manipulator. The vaginal cuff was closed intra-corporeally using No. 1 polyglactin intracorporeal (Polysorb^{TM}, Covidien, UK) interrupted sutures.

Statistical analysis

Statistical analysis was performed using SPSS Statistics Version 19.0. Data are presented as mean ± standard deviation (SD) or as a percentage. Fisher's exact test was used for categorical data and the student's *t* test or Mann–Whitney *U* test was used for continuous data as appropriate after determination of the normality of the distribution of the data using the Kolmogorov–Smirnov test and normality plots (box plots). *p* values less than 0.05 were considered to be statistically significant.

Results

Baseline characteristics

Data from 481 patients were reviewed. Of these, 216 patients underwent LM and 265 underwent LH. Of the 265 LH cases, 81 were excluded as they were performed for reasons other than fibroids (including endometriosis, dysfunctional uterine bleeding, pelvic pain), leaving 184 LH patients to be included in further analysis (Fig. 1). No conversion from LM to LH occurred.

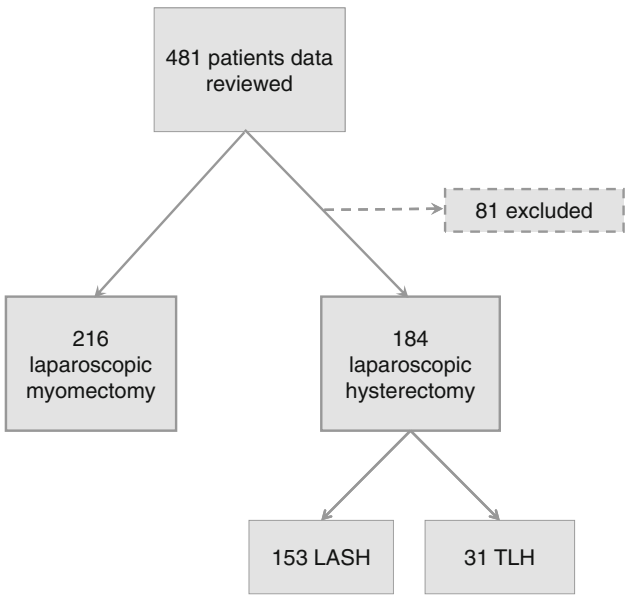

Fig. 1 Flow diagram showing distribution of patients. (*LASH* Laparoscopic sub-total hysterectomy, *TLH* Total laparoscopic hysterectomy)

Baseline characteristics can be seen in Table 1. LM patients were significantly younger (mean age 38.0 ± 5.4 vs. 46.5 ± 4.5 years, $p < 0.0001$) with lower BMI (26.7 ± 5.0 vs. 30.5 ± 6.3 kg/m^2, $p < 0.0001$) and lower parity (0.54 ± 0.97 vs. 1.9 ± 1.4, $p < 0.0001$) than LH patients.

Patients who underwent myomectomy were significantly more likely to present with subfertility or pain, whereas menorrhagia was the predominant symptom in 93 % of patients undergoing LH. Estimated uterine size preoperatively was significantly smaller in LM patients (14.1 ± 4.1 vs. 17.1 ± 5.9 weeks, $p < 0.0001$). There was no signifi-

Table 1 Baseline characteristics

	LM	LH	*p*
Age (years)	38.0 (5.40)	46.5 (4.52)	**<0.0001**
BMI (kg/m^2)	26.7 (5.0)	30.5 (6.27)	**<0.0001**
Parity	0.54 (0.97)	1.93 (1.37)	**<0.0001**
Indication for surgery (%)			
Menorrhagia	43.0	92.9	**<0.0001**
Pain	22.7	3.8	**<0.0001**
Infertility	29.2	0	**<0.0001**
Pressure	5.1	3.3	0.459
Estimated uterine size (weeks)	14.1 (4.1)	17.1 (5.9)	**<0.0001**
Previous CS, myomectomy or laparotomy (%)	13.9	13.0	0.8836

Bold values indicate statistical significant ($p < 0.05$)

Data presented as mean (SD) for continuous data or % for categorical data

LM laparoscopic myomectomy, *LH* laparoscopic hysterectomy, *BMI* body mass index, *CS* caesarean section

Table 2 Peri-operative outcomes for laparoscopic myomectomy and hysterectomy

	LM	LH	*p*
Operation length (min)	115.7 (43.6)	80.2(36.8)	<0.0001
Estimated blood loss (ml)	316.2 (232.9)	215.1(136.2)	<0.0001
Length of hospital stay (days)	2.12 (0.98)	1.81(0.64)	0.0003
Specimen weight (g)	218.8 (208.5)	403.6(310.0)	<0.0001

Data presented as mean (SD)

LM laparoscopic myomectomy, *LH* laparoscopic hysterectomy

cant difference between the rates of prior laparotomy in each group.

Myomectomy versus hysterectomy

Operative outcomes can be seen in Table 2. LH was associated with significantly shorter operative duration (80.2 ± 36.8 vs. 115.7 ± 43.6 min, $p < 0.0001$) and lower blood loss (215 ± 136 vs. 316 ± 232 ml, $p < 0.0001$), but increased weight of specimen (404 ± 310 vs. 219 ± 209 g, $p < 0.0001$). Length of hospital stay was significantly shorter following LH compared to LM (1.81 ± 0.64 vs. 2.12 ± 0.98 days, $p = 0.0003$).

Myomectomy was associated with significantly higher blood loss. Seven patients (3.2 %) had blood loss greater than 1000 ml (range 50–1500 ml) compared to no patients in the LH group (range of blood loss 50–800 ml) and 5 patients (2.3 %) required blood transfusion compared to 1 (0.5 %) in the LH group.

Complications are presented in Table 3. Four of the patients in the LM group (1.9 %) required conversion to laparotomy, whereas all hysterectomies were completed laparoscopically. Bladder injury occurred in three of the LH cases (1.6 %) compared to none of the LM cases. There were also 4 (1.9 %) port site hernias and 2 (0.9 %) cases of urinary retention post op, all in the LM group.

Table 3 Peri-operative complications

	LM	LH
Conversion to laparotomy	4 (1.9)	0 (0)
Blood loss >1000 ml	7 (3.2)	0 (0)
Blood transfusion	5 (2.3)	1 (0.5)
Bladder injury	0 (0)	3 (1.6)
Port site hernia	4 (1.9)	0 (0)
Urinary retention	2 (0.9)	0 (0)

Data presented as *n* (%)

LM laparoscopic myomectomy, *LH* laparoscopic hysterectomy

Table 4 Peri-operative outcomes for laparoscopic myomectomy and hysterectomy in women 44 years and over

	LM	LH	*p*
Operation length (min)	111.6 (38.1)	79.2 (36.7)	**0.0002**
Estimated blood loss (ml)	292.0 (279.0)	209.9 (131.9)	**0.02**
Size of specimen (g)	164.3 (207.3)	417.3 (326.2)	**0.0006**
Length of hospital stay (days)	1.96 (0.87)	1.78 (0.59)	0.18

Bold values indicate statistical significant ($p < 0.05$)

Data presented as mean (SD)

LM laparoscopic myomectomy, *LH* laparoscopic hysterectomy

LM versus LH in older women

When the data was restricted only to women aged 44 years or over, in whom the decision to perform myomectomy may be more difficult, the findings were as shown in Table 4.

Similar to the findings across all age groups, LH was associated with significantly lower operative duration 111.6 vs. 79.2 min, $p = 0.0002$) and estimated blood loss (292 vs. 209.9 ml, $p = 0.02$), but with increased specimen size. There was no significant difference in day of discharge (1.96 vs. 1.78 days).

Discussion

There is currently a paucity of data in the literature comparing outcomes between LH and LM. This observational study has shown that despite the LH patient group having demographics which would suggest higher surgical risk (older age [12], higher BMI [13] and larger uterine size [14]), LH was associated with shorter operative duration, lower blood loss, less risk of transfusion and shorter hospital stay compared to LM. Overall, the rates of peri-operative morbidity were low in both groups. Conversion to mini-laparotomy was required in 4 myomectomy cases (1.9 %), all of who had estimated uterine size of 14–16 weeks. In one case, the patient was desaturating and so the procedure could not be completed in the trendelenberg position. The other conversions to mini-laparotomy were required due to technical difficulty in closing the myometrium, and suspicion of malignancy. LH was associated with higher risk of bladder injury. The bladder injuries occurred in women with large uteri and low BMI restricting vision to the lower part of the uterus, anteriorly. Although length of hospital stay was significantly shorter for LH compared to LM, mean duration of stay was 1–2 days for both procedures, as in our unit these operations have not yet been done commonly as day case procedures. There have been studies reporting on the feasibility of same day discharge for these procedures [15, 16] and so this may become increasingly common.

Lemyre and colleagues [17] have published results from a prospective study also comparing morbidity associated with LM and LH for the treatment of uterine fibroids. This study, involving 61 women (40 LM and 21 LH), also found that women who underwent LH were older, with higher parity, but in contrast to our results found that LH was associated with longer operative time (223 min vs. 188 min, $p = 0.02$) and no significant difference in blood loss or other short-term complications. Small sample size, different selection criteria and different surgical techniques may have contributed to the conflicting results.

Often, particularly for younger women, the decision to preserve the uterus is relatively straightforward and our results confirm that LM is being used for younger patients of lower parity, in whom the need to retain fertility is a more frequent requirement. In peri- or post-menopausal women the decision to perform myomectomy rather than hysterectomy can be more controversial. Subgroup analysis in women of 44 years and older showed that LH was associated with shorter operative duration and lower blood loss but this did not affect duration of hospital stay. Given the increased risk of bladder injury with LH and overall low rate of complications in both groups, the data would support the use of LM in older women although the risks of fibroid recurrence would need to be considered. This is supported by a recent study that did not find any difference in complication rates between LM done in pre-menopausal women compared to peri-/postmenopausal [18]. In the same study, LM in peri-/post menopausal woman was associated with a high level of patient satisfaction and a symptomatic fibroid recurrence rate of 3.5 %.

An alternative to LH is vaginal hysterectomy (VH), which remains the recommended route for women with normal sized uteri or uterine prolapse [8]. However, a recent meta-analysis has shown that TLH was associated with decreased post-operative pain and earlier discharge than VH, with no difference in peri-operative complications [19]. Few studies have directly compared VH with TLH for enlarged uteri. In a recent randomised controlled trial comparing VH, TLH and laparoscopically assisted vaginal hysterectomy (LAVH) for treatment of women with uterine size above 12 weeks gestation, VH was the shortest procedure, with smaller blood loss and shorter time to discharge [20]. The removal of large uteri using a vaginal approach may be feasible using preoperative gonadotrophin-releasing hormone analogues (GnRHa) or the selective progesterone receptor modulator ulipristol acetate to reduce uterine size, however, these medications can have significant side effects. In the present series, we found that it was possible to operate on significantly enlarged uteri without the need for preoperative GnRHa. Therefore, although VH may have certain benefits over TLH, LH remains a valuable option in the case of significantly enlarged uteri or when VH is not feasible.

The limitations of the present study include the lack of randomization and the inherent biases of observational studies, particularly selection bias, which may occur due to differences in the two populations, as demonstrated by the variations in baseline characteristics. Furthermore, as this was a single centre study, with all cases operated on by one lead surgeon, the results may not necessarily be generally extrapolated to multiple centres. However, the fact that a single operator performed all cases could also be considered a strength of the study as it reduces differences due to surgical technique and operator experience. Surgical experience and workload are strong aetiological factors in peri-operative complications [21, 22] and so this should be taken into account when comparing our data to that of other units. Subgroup analysis of outcomes in older women was limited by sample size and further studies in this specific population are particularly needed.

Preoperative counselling for the surgical management of fibroids is often complex and treatment has to be individualised. Unfortunately, there is currently a lack of large-scale randomised data to help guide individual management decisions. Many patient and surgical factors can influence decision-making including symptomatology, fertility wishes, size and location of fibroids. Management decisions also need to take into account the risk of recurrence and subsequent need for treatment in women undergoing LM. In addition, there are many new treatment modalities, both medical and surgical, which may be appropriate depending on the size, number and location of fibroids [23]. This study provides further evidence to aid choice of treatment when laparoscopic management is being considered, but there remains a need for large-scale randomised studies, particularly investigating the surgical outcomes and risk of fibroid recurrence in peri-and post-menopausal women.

Conflict of interest There are no conflicts of interests, financial or otherwise, to declare. KM (data analysis, manuscript preparation), NA (data collection, manuscript preparation), FO (data collection, manuscript preparation). The authors have full control of all primary data and that they agree to allow the journal to review their data if requested.

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