A Retrospective Study to Compare the Surgical Outcomes of Robotic-assisted Laparoscopic, Laparoscopic, and Abdominal Myomectomies in a Hong Kong Community Hospital

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Objective: To compare the short-term operative and postoperative outcome of patients who underwent robotic-assisted laparoscopic (RALM), laparoscopic (LM), and abdominal (AM) myomectomies.
Methods: Patients who underwent RALM, LM and AM at Pamela Youde Nethersole Eastern Hospital from January 2007 to August 2014 were retrospectively reviewed.
Results: A total of 17 cases of RALM (9 with conventional technique, 8 with hybrid technique), 20 cases of LM, and 58 cases of AM were included. Patients were similar in age and body weight. The median weight of the fibroids removed in the AM group (286 g) was heavier than the LM group (205 g) and the RALM group (214 g) [p=0.002]. The median operating time of the RALM group was 240 minutes, and was significantly longer than that in the LM group (187.5 mins) and the AM group (69 mins) [p<0.001]. The median length of hospital stay (RALM 4 days, LM 3 days, AM 4 days; p=0.002) was shorter in the laparoscopic group. No significant differences were noted among the three groups for estimated blood loss, and operative and postoperative complications. Significantly more patient-controlled analgesia was used in AM (88%) than RALM (18%) and LM (5%) groups (p<0.001).
Conclusion: AM was more efficient to remove fibroids of heavier weight in a shorter operating time when compared with LM and RALM. Nonetheless patients who underwent RALM and LM had less postoperative pain when compared with AM. LM was associated with least postoperative pain and shortest postoperative hospital stay. RALM was not superior to LM but was at least as safe as other routes of myomectomy.
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Introduction

Uterine fibroid is the most commonly seen benign pelvic tumour in women of reproductive age. It is estimated that 20% to 40% of women of reproductive age have uterine fibroids[1]. Myomectomy is the standard surgical treatment for symptomatic women who wish to avoid hysterectomy, and thereby preserve fertility. Approximately 1800 myomectomies are carried out each year in Hong Kong[1]. The surgical techniques for myomectomy include laparotomy, laparoscopy, and recently robotic technique. The minimally invasive laparoscopic myomectomy offers less blood loss[2-4], minimal postoperative pain[4,5], shorter hospital stay[2], rapid convalescence[4], and reduced adhesion formation when compared with traditional open abdominal myomectomy. Nonetheless it may be limited by the size and number of fibroids reasonably removed[6]. It requires advanced laparoscopic skills to manoeuvre the rigid laparoscopic instruments that are fixed at the skin level by trocars, resulting in an overall reduction in degrees of freedom for dissection and suturing when compared with open surgery. The use of a remotely controlled robot has the potential to facilitate laparoscopic procedures and allows the surgeon to be seated comfortably while visualising the surgical field in a three-dimensional view. It also allows for increased dexterity and precision as it scales the surgeon's movements by varying increments and filters out unintentional tremors[7]. The primary disadvantages of robotics are increased cost[8-10], longer operating time[2,8,11-14], and lack of haptic feedback[7].

The optimal surgical technique for myomectomy remains debatable. There is currently no local study to compare the pros and cons of different routes of myomectomy. Pamela Youde Nethersole Eastern Hospital (PYNEH) is the local main public community hospital that offers robotic-assisted laparoscopic myomectomy (RALM).

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This study aimed to compare the operative and immediate postoperative outcomes of RALM, standard laparoscopic myomectomy (LM), and abdominal myomectomy (AM) performed at PYNEH, in order to provide local information about these three different routes of myomectomy.

Methods

All cases of RALM (n=19), LM (n=49), and AM (n=127) performed at PYNEH from 1 January 2007 to 31 August 2014 were identified by searching the operative record listing of the hospital clinical medical system. The details of the cases were studied via the electronic patient record on the clinical medical system and the handwritten medical record notes. Cases of myomectomy with only single or two small fibroids of <4 cm removed, adenomyoma requiring wedge resection, and those that required concurrent adnexal surgery were excluded from analysis. Cases of AM with uterine size ≥18 weeks were excluded in order to have a group with uterine size comparable with that of RALM and LM cases. One case of RALM and four cases of LM required conversion to laparotomy and were excluded. These cases needed to be converted to laparotomy due to intraoperative findings of a large stuck posterior fibroid, which itself explained the limited access of the minimally invasive approach for myomectomy. One case of LM for torsion of a pedunculated fibroid in a 22-week pregnant patient was also excluded.

The data abstracted comprised patient demographics and clinical characteristics including age, body weight, history of abdominal surgery, and symptoms arising from the fibroids. Peri-operative preparation including prophylactic antibiotics, bowel preparation and pitressin use were recorded. Operative details included uterine size, fibroid characteristics (number, size and location of fibroid), weight of fibroids removed, operating time, docking and console time for RALM, estimated blood loss, need for intraoperative blood transfusion, morcellator use, and need for minilaparotomy in LM and RALM, entry of uterine cavity and intraoperative complications. Immediate postoperative outcomes including length of hospital stay, patient controlled analgesia (intravenous morphine) use, haemoglobin drop, postoperative blood transfusion, and complications were also recorded.

The practice of RALM was commenced at PYNEH in June 2010 and was performed using the da Vinci robotic surgical system (Intuitive Surgical Inc., Sunnyvale [CA], US). Patients were placed in the dorsal lithotomy position and a Foley catheter was inserted. A uterine manipulator was used if necessary. Depending on the surgeon's preference, either a 3 or 4 arm robotic setup with two assistant ports was used. A midline or right-sided docking technique was used. Docking time was the time used to fasten the robotic arms to the inserted trocars and introduce the camera and the robotic endowrist instruments (Intuitive Surgical Inc., Sunnyvale [CA], US). Console time was defined as the total time on the console for robotic surgery. The left lower quadrant undocked 12-mm assistant port was used by the assistant as a conventional laparoscopic port for irrigation and suction, passage of needles, tissue retraction and morcellation. In standard robotic myomectomy, the serosa of the fibroid is infiltrated with a diluted pitressin (vasopressin) solution prior to uterine incision with ultrasonic or monopolar energy. The fibroid is enucleated and the uterine defect, based on the surgeon's preference, is closed in multiple layers with barbed delayed absorbable suture (polyglactin 910 vicryl) to the myometrium and unbarbed delayed absorbable suture (polydioxanone) or fine vicryl to the serosa. An adhesion barrier (Interceed; Ethicon, US, LLC) may be placed onto the closed uterine wound to prevent adhesion formation. At the end of the robotic part of the procedure, traditional laparoscopy is used for morcellation by laparoscopic power morcellators and extraction of the removed fibroids. In the hybrid robotic myomectomy technique, a conventional laparoscopic technique is used for fibroid enucleation and the robot is swiftly docked to accomplish the uterine repair. The advantages of hybrid technique are the preservation of tactile sensation that helps in dissection of the fibroid and the use of a rigid tenaculum that can exert significant effective pull without risk of equipment damage. Fibroids of >10 cm and are beyond the pelvis, deep intramural fibroids or highly vascular fibroids are therefore best approached by the hybrid method[15]. Nonetheless this technique entails a time lag used for docking before the operator can sit at the console to control the uterine bleeding and should be used only after the robotic team are familiar with the docking procedure. For LM, a 10-mm trocar is placed through the umbilicus for the camera and two to three extra trocars are placed in the lower abdomen. The uterus is infiltrated with pitressin and an incision made using the Harmonic scalpel or monopolar scissors. The fibroid is then dissected out with generous traction with a tenaculum. The uterine defect is closed in multilayers and suturing done with laparoscopic needle holders. A morcellator is used to remove the fibroid from the abdominal cavity. Traditional AM is performed by a standard procedure with a suprapubic transverse skin incision or subumbilical midline skin incision.

In our unit, we selected cases with uterine size <20 weeks and with small number of fibroids for myomectomy using a minimally invasive technique. We did not apply strict selection criteria for robotic over laparoscopic approach. We initially allocated cases to RALM if they were considered difficult to dissect or suture laparoscopically, such as big intramural, lower pole, cervical or broad ligament fibroids, but the number of fibroids was restricted to three to four. The choice of hybrid robotic myomectomy technique was partly the surgeons' preference and was mostly adopted by surgeons more experienced with robotic surgery. Patients did not need to pay for the extra cost of robotic myomectomy but the use of this technique was also dependent on the availability of the robot system in the operating theatre.

All statistical analysis of data was done by PASW Statistics 18, release version 18.0.0 (SPSS, Inc., Chicago [IL], US). Concerning categorical data, the Chi-square test and Fisher's exact test were used according to the data pattern. For continuous data with a highly skewed distribution, non-parametric tests were used. Kruskal-Wallis *H* test and Mann-Whitney *U* test were adopted to analyse the continuous data of three groups and two groups, respectively. Bonferroni correction adjustment was applied when the comparison of two groups had been analysed. The critical level of statistical significance was set at 0.05.

The study protocol was approved by the Ethics Committee of the Hong Kong East Cluster. The requirement for informed consent was waived because of the retrospective nature of the study.

Results

After exclusion, a total of 95 cases, with 17 cases (18%) of RALM, 20 cases (21%) of LM, and 58 cases (61%) of AM, were included in the study (Figure). Patient demographics, clinical characteristics, and preoperative preparation for myomectomy are summarised in Table 1. The median age of the patients was 36 years in the RALM group, 38 years in the LM group and 37 years in the AM group, and was not statistically different (p=0.73). There was no significant difference among the three groups in body weight, previous abdominal surgery and symptoms arising from the fibroids, although the LM group (25%) and the AM group (19%) appeared to have a higher proportion of patients who had undergone previous abdominal surgery compared with the RALM group (6%). There was no routine protocol for the preoperative use of prophylactic antibiotics or bowel preparation for different routes of

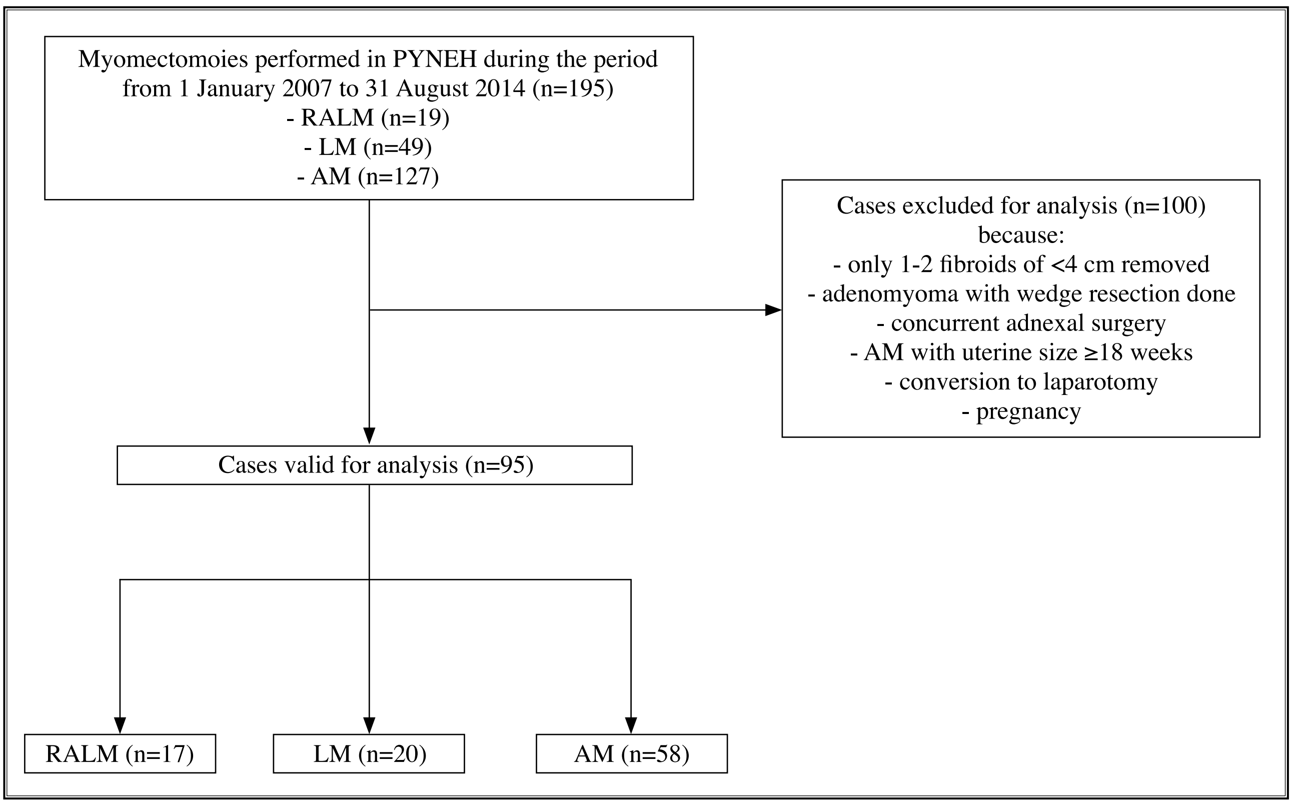

Figure. Recruitment of subjects in this study

Abbreviations: AM = abdominal myomectomy; LM = laparoscopic myomectomy; PYNEH = Pamela Youde Nethersole Eastern Hospital; RALM = robotic-assisted laparoscopic myomectomy

myomectomy and their use was totally dependent on the individual surgeon's practice. The use of prophylactic antibiotics before skin incision was statistically higher in the AM group (95%) than the RALM (82%) and LM (55%) groups ($p<0.001$). We specifically looked at the two techniques of robotic myomectomy and compared their demographics, clinical characteristics, and preoperative preparation (Table 1). Among the 17 cases of RALM, nine (53%) were performed with a conventional robotic technique while eight (47%) were performed using a hybrid robotic technique. The number, size, and location of fibroids did not differ significantly between the three types of myomectomy and the two techniques of robotic myomectomy (Table 2). The median uterine size of the patients in the RALM, LM, and AM groups was 12, 12 and 14 weeks gravid size, respectively ($p=0.12$). The median weight of the fibroids removed in the AM group (286 g) was heavier than the LM group (205 g) and the RALM group (214 g) [$p=0.002$]. The hybrid robotic technique apparently removed larger size and heavier fibroids than conventional robotic myomectomy. More fibroids and intramural fibroids were removed with the hybrid robotic technique when compared with the conventional technique, although none of these findings was statistically significant.

Table 3 shows the operative details of the three routes of myomectomy. The median operating time of the RALM group was 240 minutes, significantly longer than that of the LM group (187.5 mins) and the AM group (69 mins) [$p<0.001$]. The operating time for robotic surgery comprised the docking time and ranged from 3 to 20 minutes (median, 6 mins). The median console time was 131 minutes. The median estimated blood loss and the pitressin use were similar among the three groups. No intraoperative complications such as injury to the bowel, urinary bladder or ureter occurred. One case of RALM and one case of LM, but none of AM, required blood transfusion during operation. Fewer cases of RALM (6%) had the uterine cavity entered during operation when compared with LM (15%) and AM (26%) groups but the difference was not statistically significant ($p=0.20$). Conventional and hybrid robotic myomectomy techniques were comparable intraoperatively except for a significantly longer median operating time in the hybrid robotic group (275 mins vs. 205 mins, $p=0.02$).

Table 1. Comparison of demographics, clinical characteristics, and preoperative preparation among the study groups*

	RALM			LM (n=20)	AM (n=58)	p Value (A, B, C)‡
	Conventional (n=9)†	Hybrid (n=8)†	Total (n=17)			
Age (years)	38 (35-39)	34.5 (29.3-37.5)	36 (34-38)	38 (32.5-39)	37 (34.75-40)	0.73 (0.46, 0.47, 0.97)
Body weight (kg)	56.8 (51.4-66.8)	52.3 (50.7-56.9)	54.8 (50.9-58.8)	50.2 (44.6-57.4)	52.9 (48.7-56.6)	0.21 (0.12, 0.31, 0.20)
Previous abdominal surgery	1 (11)	0	1 (6)	5 (25)	11 (19)	0.31
Symptom						
Menorrhagia	4 (44)	5 (63)	9 (53)	12 (60)	34 (59)	0.90
Pressure symptoms/ pain/AROU	5 (56)	4 (50)	9 (53)	7 (35)	32 (55)	0.29
Subfertility	2 (22)	0	2 (12)	2 (10)	5 (9)	0.89
Asymptomatic	0	0	0	2 (10)	1 (2)	0.19
Others	0	0	0	1 (5)	2 (3)	1
Prophylactic antibiotic	6 (67)	8 (100)	14 (82)	11 (55)	55 (95)	<0.001
Bowel preparation	8 (89)	7 (88)	15 (88)	18 (90)	57 (98)	0.09

Abbreviations: AM = abdominal myomectomy; AROU = acute retention of urine; LM = laparoscopic myomectomy; RALM = robotic-assisted laparoscopic myomectomy

* Age and body weight are shown as median (interquartile range) and analysed by Kruskal-Wallis *H* test and Mann-Whitney *U* test. Categorical variables are expressed by No. (%) and analysed by Pearson Chi-square test or Fisher's exact test

† No statistically significant differences were found between conventional and hybrid technique for listed parameters

‡ A = RALM vs. LM; B = RALM vs. AM; C = LM vs. AM

Table 2. Comparison of fibroid characteristics among the study groups*

	RALM			LM (n=20)	AM (n=58)	p Value (A, B, C)‡
	Conventional (n=9)†	Hybrid (n=8)†	Total (n=17)			
Uterine size (weeks gravid size)	12 (10-14)	14 (12-16)	12 (12-15)	12 (10-14)	14 (12-16)	0.12 (0.37, 0.32, 0.05)
Size of largest fibroid (cm)	8 (6-10)	10 (8.5-11.5)	10 (7-10)	8 (6-9.75)	8 (6-9)	0.09 (0.09, 0.04, 0.80)
Specimen weight (g) [n=81]	(n=7) 192 (163-270)	(n=8) 287 (177.25-320.5)	(n=15) 214 (164-313)	(n=17) 205 (72.5-352.5)	(n=49) 286 (204-388)	0.002 (0.47, 0.11, 0.07)
No. of fibroid(s)						0.81
1	6 (67)	3 (38)	9 (53)	11 (55)	24 (41)	
2	1 (11)	0	1 (6)	2 (10)	8 (14)	
≥3	2 (22)	5 (62)	7 (41)	7 (35)	26 (45)	
Location of largest fibroid						0.09
Subserosal	6 (67)	3 (38)	9 (53)	5 (25)	18 (31)	
Intramural	2 (22)	4 (50)	6 (35)	10 (50)	34 (59)	
Submucosal	0	0	0	1 (5)	2 (3)	
Pedunculated	0	0	0	3 (15)	3 (5)	
Broad ligament	1 (11)	1 (13)	2 (12)	1 (5)	0	
Cervical	0	0	0	0	1 (2)	
Uterine wall largest fibroid originated						0.77
Anterior	2 (22)	3 (38)	5 (29)	5 (25)	22 (38)	
Posterior	5 (56)	3 (38)	8 (47)	10 (50)	20 (34)	
Fundal	2 (22)	1 (13)	3 (18)	5 (25)	12 (21)	
Lateral	0	1 (13)	1 (6)	0	4 (7)	

Abbreviations: AM = abdominal myomectomy; LM = laparoscopic myomectomy; RALM = robotic-assisted laparoscopic myomectomy

* Continuous variables are shown as median (interquartile range) and analysed by Kruskal-Wallis *H* test and Mann-Whitney *U* test. Categorical variables are shown as No. (%) and analysed by Pearson Chi-square test or Fisher's exact test

† No statistically significant differences were found between conventional and hybrid techniques for listed parameters

‡ A = RALM vs. LM; B = RALM vs. AM; C = LM vs. AM

The postoperative outcomes of the three different types of myomectomy are shown in Table 4. The median length of postoperative hospital stay was shorter in the LM group (RALM 4 days, LM 3 days, AM 4 days, p=0.002). The median haemoglobin drop was also similar. The use of patient-controlled analgesia that released intravenous morphine was significantly more in the AM group (88%) than the RALM (18%) and LM (5%) groups (p<0.001). There was no significant difference in terms of postoperative complications among the three groups. The RALM group appeared to have more minor febrile morbidity that was managed with antibiotics. Two cases of AM were complicated by shock and haemoperitoneum, one of whom required repeat laparotomy for haemostasis. More cases of AM (10%) required postoperative blood transfusion than LM (5%) and RALM (6%) but the difference was not statistically significant (p=0.82). Conventional robotic myomectomy required a shorter median length of postoperative hospital stay than hybrid robotic myomectomy (2 days vs. 4 days, p=0.01). The two subgroups were otherwise not significantly different postoperatively (Table 4).

Discussion

Robotic-assisted surgery has become a worldwide trend recently. Since the da Vinci robotic surgical system

Table 3. Comparison of operative details among the study groups*

	RALM			LM (n=20)	AM (n=58)	p Value (A, B, C)†
	Conventional (n=9)	Hybrid (n=8)	Total (n=17)			
Operating time (mins)	205 (179.5-252.2)‡	275 (246.3-301.8)‡	240 (205-286)	187.5 (131.3-253.8)	69 (55-93.5)	<0.001 (0.03, <0.001, <0.001)
Docking time (mins)	5 (4-9.5)	6.5 (5-9.75)	6 (5-9.5)	-	-	-
Console time (mins)	127 (100-162.5)	135 (122.5-143.3)	131 (114.5-147.5)	-	-	-
Estimated blood loss (ml)	200 (100-325)	250 (62.5-375)	200 (100-350)	200 (50-525)	150 (77.5-300)	0.58 (0.52, 0.28, 0.92)
Pitressin	8 (89)	8 (100)	16 (94)	18 (90)	54 (93)	0.86
Morcellation (RALM and LM)	8 (89)	7 (88)	15 (88)	17 (85)	-	1
Minilaparotomy for fibroid removal (RALM and LM)	1 (11)	1 (13)	2 (12)	2 (10)	-	1
Intraoperative complications	0	0	0	0	0	-
Intraoperative transfusion	1 (11)	0	1 (6)	1 (5)	0	0.15
Enter uterine cavity	0	1 (13)	1 (6)	3 (15)	15 (26)	0.20

Abbreviations: AM = abdominal myomectomy; LM = laparoscopic myomectomy; RALM = robotic-assisted laparoscopic myomectomy

* Continuous variables are shown as median (interquartile range) and analysed by Kruskal-Wallis *H* test and Mann-Whitney *U* test. Categorical variables are shown as No. (%) and analysed by Pearson Chi-square test or Fisher's exact test

† A = RALM vs. LM; B = RALM vs. AM; C = LM vs. AM

‡ The p value was 0.02 for comparison of operating time between conventional and hybrid techniques

(Intuitive Surgical Inc., Sunnyvale [CA], US) was first approved by the US Food and Drug Administration for gynaecological application in April 2005[16], a robotic system has been applied for benign and malignant gynaecological conditions including hysterectomy, pelvic and para-aortic lymphadenectomy, myomectomy, sacrocolpopexy, tubal ligation or re-anastomosis, salpingo-oophorectomy, and ovarian cystectomy[7,8]. Myomectomy is a particularly challenging procedure to be performed via a conventional laparoscopic approach due to the difficulties associated with the rigid instruments for dissecting the fibroid and suturing the fibroid bed. It was believed that robotic technology can overcome the limitations of conventional laparoscopy and enable myomectomy, which would otherwise require an open surgical approach, to be performed as a minimally invasive procedure.

The current study compared the outcome of the three different approaches of myomectomy. It suggests that AM is more efficient than LM and RALM when removal of a heavier weight fibroid in a shorter operating time is required. Barakat et al[2] reported a total of 575 myomectomies including the comparison of robotic-assisted (n=89, 15.5%), laparoscopic (n=93, 16.2%), and abdominal (n=393, 68.3%) myomectomies. The actual surgical time was significantly longer in the robotic-assisted group (181 mins) than the laparoscopic group (155 mins) and the abdominal group (126 mins, p<0.01), and is in agreement with our finding. The additional operating time of RALM may be attributed to the docking and undocking procedures of the robot. In addition, the learning curve associated with acquiring the skills to perform robot-assisted surgery is approximately 50 practice cases[7]. In our study the 17 cases of RALM were shared by five different surgeons who might not have reached the peak of the learning curve. The longer operating time required in the hybrid robotic myomectomy may be due to the possibly larger and deeper uterine wound following fibroid enucleation that required extensive multilayered suturing. Barakat et al[2] showed that the abdominal group had a longer median hospital stay of 3 days, compared with 1 day in the laparoscopic group and 1 day in the robotic-assisted group (p<0.001). The

Table 4. Comparison of postoperative outcomes among the study groups*

	RALM			LM (n=20)	AM (n=58)	p Value (A, B, C)†
	Conventional (n=9)	Hybrid (n=8)	Total (n=17)			
Length of hospital stay (days)	2 (2-3)‡	4 (4-4.75)‡	4 (2-4)	3 (3-4)	4 (4-5)	0.002 (0.81, 0.02, 0.001)
Haemoglobin drop (g/dL) [n=92]	(n=8) 1.3 (0.77-2.38)	(n=8) 2.1 (0.53-3.88)	(n=16) 1.6 (0.63-3)	(n=18) 1.65 (1.15-2.55)	1.65 (0.7-2.63)	0.71 (0.68, 0.83, 0.40)
PCA IV morphine use	1 (11)	2 (25)	3 (18)	1 (5)	51 (88)	<0.00
Complications						
Fever	1 (11)	2 (25)	3 (18)	0	6 (10)	0.16
Wound infection	0	0	0	0	1 (2)	1
Urinary tract infection	0	0	0	2 (10)	2 (3)	0.33
Gastro-intestinal (upper gastro-intestinal bleeding, ileus)	1 (11)	0	1 (6)	1 (5)	1 (2)	0.34
Myomectomy wound haematoma	1 (11)	0	1 (6)	0	5 (9)	0.43
Shock/subrectal haematoma/ haemoperitoneum	0	0	0	0	2 (3)	1
Fever	1 (11)	2 (25)	3 (18)	0	6 (10)	0.16
Wound infection	0	0	0	0	1 (2)	1
Urinary tract infection	0	0	0	2 (10)	2 (3)	0.33
Gastro-intestinal (upper gastro-intestinal bleeding, ileus)	1 (11)	0	1 (6)	1 (5)	1 (2)	0.34
Myomectomy wound haematoma	1 (11)	0	1 (6)	0	5 (9)	0.43
Shock/subrectal haematoma/ haemoperitoneum	0	0	0	0	2 (3)	1
Re-laparotomy	0	0	0	0	1 (2)	1
Blood transfusion	0	1 (13)	1 (6)	1 (5)	6 (10)	0.82

Abbreviations: AM = abdominal myomectomy; LM = laparoscopic myomectomy; PCA IV = intravenous patient-controlled analgesia; RALM = robotic-assisted laparoscopic myomectomy

* Continuous variables are shown as median (interquartile range) and analysed by Kruskal-Wallis *H* test and Mann-Whitney *U* test. Categorical variables are shown as No. (%) and analysed by Pearson Chi-square test or Fisher's exact test

† A = RALM vs. LM; B = RALM vs. AM; C = LM vs. AM

‡ The p value was 0.01 for comparison of length of hospital stay between conventional and hybrid techniques

prolonged operating time and increased operative cost of robotic-assisted myomectomy may be offset by the shorter hospital stay. Gobern et al[17] showed similar findings in a retrospective study to evaluate the operative outcome of robotic (n=66, 21.4%), laparoscopic (n=73, 23.7%), and abdominal (n=169, 54.9%) myomectomies conducted at a community hospital. Median operating time of robotic surgery (140 mins) was significantly longer compared with laparoscopic (70 mins) and abdominal myomectomies (72 mins, $p<0.01$). Robotic and laparoscopic myomectomies required significantly shorter hospital stay compared with abdominal myomectomies. Our study did not show a shorter postoperative hospital stay in the robotic myomectomy group as a whole, but the conventional robotic myomectomy group had a shorter postoperative hospital stay than the hybrid robotic myomectomy group. We do not know whether this was due to the surgeon's preference or other reasons. Nonetheless patients who underwent

RALM and LM experienced less postoperative pain as reflected by the lower intravenous morphine use when compared with AM. Nash et al[13] compared RALM (n=27) and AM (n=106) stratified by uterine size. Intravenous hydromorphone use was significantly lower for RALM ($p<0.001$). A meta-analysis of randomised controlled trials to compare laparoscopic and open myomectomy that included six studies and 576 patients[4] found significantly lower postoperative pain intensity in the LM group.

RALM has been shown to be as safe as LM and AM in other studies[8,13,18,19]. The estimated blood loss, operative and postoperative complications of the three routes of myomectomy were similar in our study. Although our study did not show the advantages of RALM over LM, robotic surgery can be performed comfortably while sitting and endowrist of robotic surgery did offer the surgeon freedom of movement and make the extensive dissection and intensive suture of myomectomy easier. The learning curve for suturing for robotic surgery was noted to be less steep than that for laparoscopy, and may allow a less skilled or experienced laparoscopist to perform safe suturing in a shorter time period[8].

This study have several limitations. First, this study was based on a single community hospital with limited cases of RALM and LM to date. There may be a true difference in the re-bleeding complication between the abdominal and the robotic or laparoscopic routes but the sample size may not be big enough to make it statistically significant. We did not specifically analyse the relationship between the surgeon's experience and the surgical outcome. Surgeons performing different types of myomectomy varied in their level of experience and had their own technique for performing myomectomies. Generally we had more experience with laparoscopy than robotic surgery as robotic gynaecological surgery was only introduced at PYNEH in 2010. In addition, this was a retrospective study and long-term outcomes such as resolution of symptoms, recurrence, rates of pregnancy, uterine rupture and adhesion formation could not be determined. Whether the advantage of the meticulous suturing of robotic myomectomy can be transformed to a better outcome such as less uterine rupture in subsequent pregnancy will be a meaningful study question. Prospective and randomised trials can be considered in the future to compare the short-term outcomes as well as to determine the long-term outcomes of these three different approaches of myomectomy.

Conclusion

AM was more efficient for the removal of fibroids of heavier weight in a shorter operating time when compared with LM and RALM. Patients with RALM and LM on the other hand had less postoperative pain compared with AM patients, as reflected by less need for intravenous morphine. The estimated blood loss, operative and postoperative complications of the three routes of myomectomy were similar. Patients who underwent LM had least postoperative pain and shorter postoperative hospital stay. RALM was not shown to be superior to LM but was at least as safe as the other routes of myomectomy. We believe that RALM is feasible and safe and can overcome some of the surgical difficulties of conventional laparoscopy. Future studies when more experience and cases have accumulated are suggested to compare the short-term and long-term outcomes of these three different approaches of myomectomy.

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