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Uterine artery embolization immediately preceding laparoscopic myomectomy

Kara N. Goldman^a, Jennifer E. Hirshfeld-Cytron^a, Mary-Ellen Pavone^a, Andrew P. Thomas^a, Robert L. Vogelzang^b, and Magdy P. Milad^{a,*}

^aDepartment of Obstetrics and Gynecology, Division of Reproductive Endocrinology and Infertility, Northwestern University Feinberg School of Medicine, Chicago, USA

^bDepartment of Radiology, Division of Interventional Radiology, Northwestern University Feinberg School of Medicine, Chicago, USA

Abstract

Objective—To determine whether performing uterine artery embolization (UAE) immediately before laparoscopic myomectomy can facilitate a minimally invasive surgical approach for larger uterine fibroids.

Methods—In a retrospective case–control study, laparoscopic myomectomy with and without preoperative UAE was examined. Data were analyzed from 26 laparoscopic myomectomies performed by a single surgeon at Northwestern University Feinberg School of Medicine between 2004 and 2010. Controls were matched for age, calendar year, surgeon, and number of fibroids removed. Surgical outcomes included preoperative clinical uterine size, operative time, operative blood loss, and postoperative myoma specimen weight. Data were analyzed via 2-tailed Student *t* test.

Results—Twelve women underwent laparoscopic myomectomy within 169±16 minutes (mean ±SEM) of preoperative UAE. Fourteen control patients underwent laparoscopic myomectomy alone. The UAE group had a greater mean preoperative clinical uterine size (19.7 versus 12.4 weeks, *P*<0.001) and a greater mean myoma specimen weight measured postoperatively (595.3 versus 153.6 grams, *P*<0.05). There were no significant differences in operative time or blood loss, and there were no intra-operative complications.

Conclusion—UAE performed immediately before laparoscopic myomectomy facilitated minimally invasive surgery for larger uteri and larger uterine myomas, with no differences in operative time or blood loss.

Keywords

Laparoscopy; Uterine artery embolization; Uterine leiomyomata

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*Corresponding author at: Department of Obstetrics and Gynecology, Northwestern University Feinberg School of Medicine, 250 East Superior Street, Suite 05–2177, Chicago, IL 60611, USA. Tel.: +1 312 472 4673; fax: +1 312 472 4687. mmilad@nmh.org (M.P. Milad).

Conflict of interest

The authors have no conflicts of interest.

1. Introduction

Uterine leiomyomata remain the most common neoplasm in women of reproductive age and the most frequent indication for hysterectomy [1,2]. Women with uterine fibroids report a significantly lower health-related quality of life [3], and leiomyomata contribute to increased healthcare costs and decreased work productivity [4].

Myomectomy is an effective technique for the treatment of symptomatic fibroids in patients desiring uterine preservation. Surgical approaches include laparotomy, laparoscopy, and robotic-assisted laparoscopy, and studies suggest that there is significantly less operative blood loss, postoperative pain, and overall morbidity with minimally invasive approaches [5–8].

Uterine artery embolization (UAE) is a minimally invasive alternative to the management of symptomatic fibroids that uses particulate emboli to occlude the uterine arteries and devascularize the blood supply to fibroids [9]. UAE is relatively contraindicated in patients with pedunculated fibroids because of possible fibroid degeneration and infection [10].

Therapeutic infarction of uterine leiomyomata begins immediately after embolization [11]. Uterine artery ligation has been attempted before laparoscopic myomectomy to disrupt fibroid vascularization [12,13]. In 2 distinct case series, Butori et al. [14] and Dumousset et al. [15] suggested that preoperative UAE devascularized fibroids before myomectomy and facilitated “easier” dissection of fibroids without complications. Patients underwent both abdominal and laparoscopic myomectomy, but no controls were available to compare operative outcomes. Butori et al. [14] performed the myomectomy procedure within 23.7 ± 18.5 hours (range 2–48 hours) of UAE, and Dumousset et al. [15] performed the myomectomy either on the same day as preoperative UAE (15 cases) or on the following day (7 cases).

Patients with large fibroids who do not qualify for minimally invasive myomectomy, and those with pedunculated fibroids who may not qualify for UAE, might require morbid and costly procedures including abdominal myomectomy or hysterectomy. To our knowledge, few studies have compared the outcomes of laparoscopic myomectomy immediately after UAE with those of laparoscopic myomectomy alone. Therefore, the aim of the present study was to test the hypothesis that pre-treating women with UAE to devascularize leiomyomata immediately before laparoscopic myomectomy may facilitate a minimally invasive approach for larger fibroids.

2. Materials and methods

In a retrospective case–control analysis, data were examined from women who underwent either laparoscopic myomectomy immediately after UAE or laparoscopic myomectomy alone at Northwestern University Feinberg School of Medicine between January 1, 2004, and June 30, 2010. The study was approved by Northwestern University’s Institutional Review Board. Participants were identified through Northwestern University’s Enterprise Data Warehouse and the participating surgeon’s records. Women aged between 18 and 50

years who underwent laparoscopic myomectomy performed by a single surgeon (M.P.M.) were included. Exclusion criteria included prior myomectomy, UAE before the study date, and lengthy concomitant procedures at the time of laparoscopic myomectomy including thyroid surgery, breast surgery, and hysteroscopic myomectomy.

Controls were matched for age, calendar year, surgeon, and number of fibroids removed. Twelve patients underwent laparoscopic myomectomy immediately after UAE, and 14 control patients underwent laparoscopic myomectomy alone.

Demographic data were extracted for both groups, including age, body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters), parity, and race (Table 1). The following operative characteristics were extracted: clinical uterine size measured by examination under anesthesia, postoperative fibroid weight (grams), estimated blood loss (mL), total operative time (minutes), intra-operative vasopressin use, pre- and postoperative hemoglobin, and number of hours in hospital (Table 2).

Twelve patients scheduled for laparoscopic myomectomy underwent same-day UAE. After anesthesia was administered, transfemoral diagnostic arteriography revealed hypervascular changes consistent with uterine fibroids. The uterine arteries were super-selectively catheterized with a microcatheter and embolized with a 500–700- μ m diameter embolic agent (Embospheres, Biosphere Medical, Rockland, MA, USA) to a point of near-stasis (Fig. 1). All radiation parameters were optimized for minimizing radiation dose, including the use of enhanced low-dose settings on all angiographic equipment and minimizing angiographic runs. After an appropriate recovery period, participants were transferred to the gynecology operating room for subsequent laparoscopic myomectomy.

A single surgeon (M.P.M.) performed all laparoscopic myomectomy procedures. Port placement varied slightly depending on the size and location of uterine fibroids. Pedunculated fibroids were grasped and the base was divided with a bipolar electrosurgical device. Subserosal and intramural fibroids were removed by sharp and blunt dissection after the pseudocapsule was scored in a transverse manner with a monopolar spatula. All specimens were removed by morcellation. When appropriate, the uterine defect was closed by a delayed absorbable suture with a minimum of 2 layers.

Data were analyzed retrospectively by 2-tailed Student *t* test, and sample size was determined by the number of patients fitting the enrollment criteria. To account for the small sample size, data were also compared by 2-tailed Mann–Whitney U and χ^2 tests. Estimates of exact *P* value were determined for the χ^2 and Mann–Whitney tests by using a Monte Carlo method with 10 000 samples and confidence limits of 99%.

Data were analyzed via PASW Statistics version 18.0.2 (SPSS, Chicago, IL, USA), and a post-hoc power analysis was performed via STATA version 11.0 (Stata Corporation, College Station, TX, USA). An α error of less than 0.05 was considered statistically significant. Findings were consistent between Student *t* test and Mann–Whitney U test, and data are reported as the mean $\pm$ standard error of the mean (SEM) via Student *t* test.

3. Results

From the database, 12 patients who underwent UAE followed immediately by laparoscopic myomectomy between January 2004 and June 2010 were identified. Fourteen patients who underwent laparoscopic myomectomy alone were selected as controls.

The mean duration between UAE and laparoscopic myomectomy was 169 ± 16 minutes. Participants were sedated in the interventional radiology suite for an average of 55.5 ± 4.6 minutes, and approximately $150 \pm 20.6 \pm \text{mL}$ of Omnipaque (GE Healthcare, Princeton, NJ, USA) was injected. The fluoroscopic exposure time was 17.5 ± 1.9 minutes, and there were no complications.

Both groups were overweight with a mean BMI of 27 ± 2.3 in the control group and 28.5 ± 1.2 in the UAE group. Most participants in the control group were White European, while the majority in the UAE group were African-American. The mean age was 43.3 ± 1.4 years in the UAE group and 40.3 ± 1.2 years in the control group ($P > 0.05$). Most participants were nulliparous.

The mean clinical uterine size, measured in “obstetric weeks”, was 12.4 ± 0.8 weeks in the control group, and 19.7 ± 1.7 weeks in the UAE group ($P < 0.001$). The mean fibroid weight was 153.6 ± 29.0 grams in the control group, and 595.3 ± 187.1 grams in the UAE group ($P < 0.05$) (Table 2).

There was no difference in operative time between the control group (122.7 minutes) and the UAE group (121.6 minutes). Despite a trend toward less operative blood loss in the UAE group, there was no statistical difference between the 2 groups. However, intra-operative vasopressin was used more often in the control group (64%) than in the UAE group (8%). There was no difference between pre- and postoperative hemoglobin among the 2 groups; however, only 12 patients had a postoperative hemoglobin value for analysis. The control group spent 12.5 ± 2.2 hours in hospital, as compared with 36.3 ± 2.8 hours for the UAE group ($P < 0.05$) (Table 2).

There were no intra-operative complications in either group. One postoperative urinary tract infection occurred in the UAE group, and 1 postoperative pelvic hematoma required inpatient hospitalization and interventional drainage in the control group. There were no complications specific to the UAE procedure.

4. Discussion

The present results suggest that women with clinically larger uteri successfully underwent laparoscopic myomectomy with no difference in operative time or operative blood loss compared with women with smaller uteri. The aggregate fibroid weight for participants in the UAE group was nearly 4 times that of the control group, indicating successful resection of considerably larger fibroids. There was a trend toward less operative blood loss in the UAE group. The greater operative blood loss observed in the control group—despite the use of vasopressin—supports preoperative UAE.

In a post-hoc power analysis, a power calculation with an α value of 0.05 and a power of 80 determined that a minimum of 267 patients in each group would be needed to detect a 20% difference in estimated blood loss. Therefore, the present pilot study was not appropriately powered to detect a difference in blood loss, and future studies will be needed to determine whether or not UAE affects blood loss at the time of laparoscopic myomectomy.

Scheurig-Muenkler et al. [11] reported that UAE induces immediate transient ischemia of the uterine body and fundus, supporting our hypothesis that UAE immediately preceding laparoscopic myomectomy can devascularize leiomyomata in preparation for surgery. Tixier et al. [16] reported that operative blood loss and changes in hemoglobin were lower when patients underwent preoperative UAE or selective uterine artery ligation before myomectomy as compared with controls.

In the present study, UAE was performed within 169 minutes of myomectomy and, to our knowledge, there are no reports of UAE and myomectomy occurring within this brief time interval. The Embospheres embolic agent was used because it has a greater degree of infarction as compared with other embolic materials [17]. The fluoroscopy time was appropriate for the procedure [18]. Bilateral instead of unilateral femoral access was obtained because of its association with reduced fluoroscopy and procedure times without an increase in complications [19].

The study has limitations, including the relatively small sample size and retrospective design. In addition, its external validity may be limited given the expertise of the laparoscopic surgeon (M.P.M.) performing the procedures.

Preoperative UAE requires a post-procedure observation period of 24 hours, and this additional hospital time may contribute to increased direct costs. However, UAE in combination with laparoscopic myomectomy may in fact be cost-effective given the tremendous global cost, increased work absenteeism, and morbidity associated with alternative procedures, such as open myomectomy or hysterectomy, and cost analysis should be considered in future studies.

Although successful pregnancies have been described after UAE, there are no data on the impact of UAE in conjunction with laparoscopic myomectomy on future fertility or pregnancy outcome [20,21]. Further research is necessary to understand the implications of UAE and laparoscopic myomectomy on fertility and pregnancy outcomes.

Performing UAE immediately before laparoscopic myomectomy may be a novel, feasible technique for uterine debulking, potentially expanding the indications for UAE and enabling surgeons to safely use a minimally invasive surgery to approach large uterine leiomyomata.

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Fig. 1.
Images from a single patient in the preoperative uterine artery embolization (UAE) group. Arrows indicate the patient's 16-cm myoma, visualized as follows: preoperative pelvic MRI with contrast (A); UAE fluoroscopy image (B); and intra-operative image (C).

Table 1Demographic data of the study participants.^a

Variable	Laparoscopic myomectomy (n=14)	UAE and laparoscopic myomectomy (n=12)	P value
Age, years	40.3±1.2	43.3±1.4	0.112 ^b
BMI	27±2.3	28.5±1.2	0.6 ^b
Race			
African-American	3 (21.4)	9 (75.0)	—
White European	9 (64.3)	2 (16.7)	—
Unknown	2 (14.3)	1 (8.3)	—
Living children			
Yes	3 (21.4)	2 (16.7)	—
No	9 (64.3)	8 (66.7)	—
Unknown	2 (14.3)	2 (16.7)	—

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters).

^aValues are given as mean±SEM or number (percentage).^bData were analyzed by Student *t* test. An α error of less than 0.05 was considered statistically significant.

Table 2Operative characteristics of the study participants.^a

Variable	Laparoscopic myomectomy (n=14)	UAE and laparoscopic myomectomy (n=12)	P value ^b
Uterine size, weeks	12.4±0.8	19.7±1.7	<0.05
Fibroid size, grams	153.6±29.0	595.3±187.1	<0.05
Fibroids resected, number	1.6±0.1	2.3±0.6	0.25
Pedunculated fibroids, number	0.9±0.3	1.4±0.3	0.17
Subserosal fibroids, number	0.8±0.4	0.8±0.6	1.0
Intramural fibroids, number	0.6±0.2	0.4±0.2	0.64
Time UAE before myomectomy, minutes	N/A	169±16	
Estimated blood loss, mL	129.3±31	103±21.5	0.51
Total operative time, minutes	122.7±10	121.6±17.3	0.96
Vasopressin use	9 (64)	1 (8)	N/A
Preoperative hemoglobin, g/dL	12.9±0.3	12.7±0.4	0.8
Postoperative hemoglobin, g/dL	10.6±0.3	10.9±0.5	0.8
Total hospital time, hours	12.5±2.2	36.3±2.8	<0.05

^aValues are given as mean±SEM or number percentage.^bData were analyzed by Student *t* test. An α error of less than 0.05 was considered statistically significant.