Effects of Selective Blockage of Utero-ovarian Anastomoses on Clinical Results of Uterine Artery Occlusion
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ABSTRACT

Background: We assessed the results and impact of blockage of utero-ovarian anastomoses (UOA) on clinical outcome in women treated by laparoscopic uterine artery occlusion for uterine fibroids.

Methods: Between 2004 and 2005, we prospectively analyzed the clinical data for 23 laparoscopic uterine artery occlusion cases combined with blockage of utero-ovarian anastomoses (Group A) and 67 laparoscopic uterine artery occlusion cases alone (Group B).

Results: Of these 23 patients with UOA (mean age, 36.7±2.8 years), 10 patients (43.4%) had anastomoses bilaterally and 13 patients (56.6%) had unilateral anastomoses. Mean fibroid size reduction after LUAO and anastomoses blockage was 32.5% from baseline (P<0.001). In patients with LUAO, the mean DF size after surgery was estimated at 38.7±19.2 mm, which translated to a mean fibroid size reduction of 30.6% from baseline (P<0.001). No case of clinical failure or recurrence was found in Group A patients with UOA (mean follow-up, 15.6 months), who were treated with combined surgery. At a mean clinical follow-up of 18.2 months (Group B), 6 patients (8.9%) elected to undergo further surgical intervention for clinical failure and recurrence, including 4 myomectomies and 2 hysterectomies. The statistical difference between groups was not significant (P=0.33).

Conclusion: Laparoscopic blockage of utero-ovarian anastomoses combined with uterine artery occlusion is a safe, feasible surgical procedure in women with symptomatic fibroids. Combining the uterine artery occlusion and blockage of UO anastomoses may be a useful procedure for the decreasing rate of clinical failure and recurrence. This premise should be confirmed in a larger prospective multicenter study.

Key Words: Uterine fibroid, Utero-ovarian anastomoses, Uterine artery occlusion, Laparoscopy.

INTRODUCTION

Uterine artery embolization (UAE) and surgical uterine artery occlusion are emerging as effective treatment alternatives for symptomatic uterine fibroids.1–5 Sound evidence exists for shorter hospital stay, quicker return to work, and a similar major complication rate compared with these things with hysterectomy.6 Although the reports have shown great promise for uterine fibroid embolization and laparoscopic uterine artery occlusion (LUAO), clinical failures for these procedures range from 4% to 39%.7–11 Among that group, there have been women having arterial supply to their fibroids from sources other than the uterine artery. Although anastomoses between the ovarian and uterine arteries have been studied extensively in cadavers, postmortem or fresh postoperative specimens, the frequency and importance of such anastomoses in this patient population have not been well described. In the September 2002 issue of Radiology, Dr Razavi and colleagues8 analyzed and classified 3 main angiographic patterns of utero-ovarian anastomoses (UOA). The presence of such arterial communications can play an important role not only in avoiding nontarget ovarian embolization, but also in the clinical failure rate of UAE and LUAO.

We prospectively assessed the frequency of laparoscopically detectable anastomoses between uterine and ovarian arteries. The effect of blockage of such arterial communications on clinical results, safety, and recurrence in women with symptomatic fibroids treated by LUAO was studied. The study is part of the prospective Czech multicenter study of fibroid surgery alternatives treatment (FSAT).
METHODS

This study carried out in the Department of Obstetrics and Gynecology, Baby Friendly Hospital Kladno, Czech Republic, was a prospective, non-randomized, cohort, clinical investigation designed to evaluate the frequency, safety, and effectiveness of blockage of utero-ovarian anastomoses when used in combination with LUAO for symptomatic fibroids. This particular study represented an extension of a previously reported prospective cohort study that analyzed clinical results, complications, and fibroid recurrence after laparoscopic uterine artery occlusion for symptomatic fibroids. Patients with symptomatic fibroids, confirmed by ultrasound (US) or magnetic resonance imaging (MRI), were invited to participate in the study. A total of 90 women were included in this part of the study over a 12-month period (2004 to 2005), with 67 women undergoing LUAO and 23 women undergoing LUAO combined with UOA blockage.

The following inclusion criteria were used: age up to 45 years, dominant symptomatic intramural fibroid of at least 4 cm (in the case of more fibroids, the largest being at least 4 cm), and serum concentration of FSH under 30 IU/L. Elimination criteria: submucous fibroids, size of largest fibroids >12 cm in greatest diameter (by ultrasound or MRI), history of amenorrhoea, previous medical therapy with GnRH agonists, and suspected uterine sarcoma.

Two experienced laparoscopic surgeons (ZH, JL) performed all the operations. Central and local ethics committee approval was obtained. Presence of utero-ovarian anastomosis on laparoscopy, peri-operative outcome, size of dominant fibroid (DF) before and after surgery, clinical improvement, the rates of clinical failure, and symptom recurrence were recorded prospectively and analyzed. Serum concentration of hemoglobin and FSH were taken preoperatively and 3 months after surgery. The patients underwent evaluation of symptom status and size of dominant fibroid at 3 to 6 months and yearly after the procedure. In addition, the women were interviewed regarding changes in bleeding and bulk-related symptoms using a scale described by Yen et al.12

Anatomical, Angiographic, and Laparoscopic Description of Utero-ovarian Anastomoses and Uterus Supply

The ovarian (infundibulopelvic) vessels course medially through the broad ligament toward the uterine cornu and consistently give off a branch to the ovary on its lateral border (Figure 1). The uterine fundus derives its rich blood supply from the uterine artery and the tubal branch of the ovarian artery as they anastomose just lateral and inferior to the junction of the uterine body and the fallopian tube. Therefore, selective vessel occlusion of both these branches (ie, the tubal branch of the ovarian artery and the uterine artery) will provide a significant reduction in blood supply to the uterine fibroid.

Three types of utero-ovarian angiographic anastomoses in women undergoing uterine fibroid embolization have been described by Razavi et al.8 In type I, flow from the ovarian artery to the uterus is through anastomoses with the main uterine artery. In type II, the ovarian artery supplies the fibroids directly. In type III, the major blood supply to the ovary is from the uterine artery.

The above-mentioned classification of Razavi et al8 was simplified and modified for surgical purposes. Type III was deleted for an impossibility to laparoscopically assess the direction of blood flow. Utero-ovarian arterial communications were classified into the following 2 surgical types:

Type I: the ovarian artery connects to the intramural uterine artery before the fibroid supply through the tubo-ovarian segment. The tubal artery is hypertrophic and runs toward the uterus, or multiple unnamed small vessels run between leaves of broad ligament toward the uterus wall (Figures 2 and 3). Type II: the ovarian artery supplies the fibroid directly.
Operative Procedure

Operative procedures for laparoscopic uterine artery dissection, coagulation, and transsection have been previously described in more detail.10 Briefly, laparoscopy is performed with the patient in the lithotomy position by using video-monitoring equipment. Lateral peritoneum dissection using ultrasonically activated shears (LCS-K5 or ACE-S, UltraCision, Ethicon EndoSurgery, Johnson & Johnson Ltd, Cincinnati, OH) is initiated. The peritoneum is opened, and the paravesical and pararectal space is developed by blunt dissection. Subsequently, distancing uterine vessels from the ureter with a safe ultrasonic coagulation of the uterine artery and cutting just medial to their origin from the unobliterated umbilical artery or hypogastric artery is performed. In some cases, only coagulation of the uterine artery is carried out (Figure 3). Coagulation of utero-ovarian anastomoses vessels using UltraCision is performed in cases of surgical classifications type I and type II.

Definition of Clinical Failure and Recurrence

Clinical failure was defined as persistence of symptoms at 3-month follow-up, and recurrence was defined as the return of symptoms or the regrowth of more than 10% of fibroids. The main outcome measures were the rates of hysterectomy and myomectomy. Other factors included in the data analysis were time interval of symptom recurrence and operative and pathologic findings.

Statistical Analysis

Statistical analysis was performed with Fisher’s exact test when comparing categorical variables with results presented as mean±SD, range, or percentage. The paired Student t test was used for continuous variables. All tests were 2-sided, and P<0.05 was considered statistically significant.

RESULTS

Eighty-nine (98.9%) patients underwent a successful bilateral LUAO operative procedure with UltraCision with at least a 12-month follow-up after the operation. One woman had a unilateral uterine artery dissection. An absent uterine artery on the right side was later confirmed by angiography. Anastomoses between uterine and ovarian arteries were demonstrated by laparoscopy in 23 patients (25.5%) (Group A). Of these 23 patients with UO anastomoses (mean age, 36.7±2.8 years), 10 patients (43.4%) had anastomoses bilaterally and 13 patients (56.6%) had unilateral anastomoses. Type I of UOA surgical classification was found in 22 patients (95.6%). In one patient, the ovarian artery supplied the cornual fibroid directly. No significant differences existed in age, weight, incidence of symptoms, and previous myomectomy between Group A (23 patients with LUAO and blockage of anastomoses) and Group B (67 patients with LUAO) (Table 1). At a mean MRI or US imaging follow-up 16.4 months after surgery, significant improvement was noted in mean DF size in both groups (Table 2). Mean fibroid size reduction after LUAO and anastomoses blockage was 32.5% from baseline (P<0.001). In patients with LUAO, the mean DF

Figure 2. The parauterine collateral between leafs of broad ligament on the left side.

Figure 3. Anatomical situation after dissection of umbilical ligament and uterine artery on the left side: medially, the coagulated utero-ovarian collateral; caudally, the pressed ureter using irrigator instrument.
size after surgery was estimated at 38.7±19.2 mm, which translated to a mean fibroid size reduction of 30.6% from baseline (P<0.001).

The preoperative blood hemoglobin level and the amount of clinical improvement after surgery increased significantly (P<0.01) in both groups (Table 2). All patients had a normal level of FSH after 3-month follow-up. No case of amenorrhea or postmenopausal symptoms occurred. Only 2 women reported irregular bleeding. For the patients who underwent LUAO and UOA blockage, the mean surgery was 35.5 minutes (range, 20 to 50); for those who underwent only LUAO, it was 36.0 minutes (range, 23 to 55). The mean intraoperative blood loss was 35.2±14.7 mL in Group A and 28.1±18.2 mL in Group B. The hospital stay ranged from 1 day to 4 days, and no difference was found between the groups (mean, 2.1 days, Group A vs mean, 2.2 days, Group B). No immediate intraoperative complications occurred. Neuritis of the obturator nerve was observed in 1 patient, and febris in 3 patients, (Group B). No case of clinical failure or recurrence was found in Group A patients with UOA (mean follow-up, 15.6 months), who were treated using combined surgery. At a mean clinical follow-up of 18.2 months (Group B), 6 patients (8.9%) elected to undergo further surgical intervention for clinical failure and recurrence, including 4 myomectomies and 2 hysterectomies. Of these, hypertrophy of parauterine vessels was observed in 4 of the patients. The difference between groups was not statistically significant (P=0.33) Eight of the 18 women desiring pregnancy in both groups conceived spontaneously. One woman underwent a Caesarean delivery at week 39, and the second was at week 34 with no complications at the time of the writing of this paper (Group A). One spontaneous abortion was reported in the first trimester of pregnancy in a 41-year-old woman, and others delivered at full term (Group B). The infants delivered at full term were normal. Only one growth fetus retardation in a woman with alcohol and nicotine abuse was found.

### Table 1.
**Patient Characteristics**

|                   | Group A (n = 23) | Group B (n = 67) | P Value |
|-------------------|------------------|------------------|---------|
| Mean age ± SD (y) | 36.7 ± 2.8       | 36.4 ± 3.9       | NS      |
| Mean weight ± SD (kg) | 61.9 ± 8.9   | 59.6 ± 8.2       | NS      |
| Menorrhagia (%)   | 19 (82.6)        | 56 (83.5)        | NS      |
| Pain (%)          | 4 (12.4)         | 11 (16.5)        | NS      |
| Previous myomectomy | 1 (4.3)        | 2 (2.9)          | NS      |

NS = not significant.

### Table 2.
**Comparison of Fibroid Sizes and Symptoms Before and After Procedure**

| Size and Outcome                  | Group A (n = 23) | Group B (n = 67) | P Value |
|-----------------------------------|------------------|------------------|---------|
| Mean DF size before surgery (mm)  | 55.2 ± 12.4      | 55.1 ± 13.8      | NS      |
| Mean DF size after surgery (mm)   | 38.2 ± 16.6      | 38.7 ± 19.2      | NS      |
| Hemoglobin before surgery (g/L)   | 120.1 ± 9.2      | 123.3 ± 14.3     | NS      |
| Hemoglobin after surgery (g/L)    | 135.9 ± 8.9      | 138.2 ± 15.6     | NS      |
| Clinical improvement              |                  |                  |         |
| Significantly improved (%)         | 22 (95.6)        | 61 (91.0)        | NS      |
| Slightly improved (%)              | 1 (4.4)          | 6 (9.0)          | NS      |
| Clinical failure and recurrence (%) | 0 (0)           | 6 (8.9)          | NS      |
DISCUSSION

The ovarian artery can provide significant collateral flow to the uterus, and the causes of clinical failure of uterine artery occlusion have not been well studied. Razavi et al prospectively evaluated uterine artery to ovarian artery anastomoses in 76 consecutive patients undergoing fibroid embolization and found that 46% of patients had connections. In that study, 7.9% of women had bilateral anastomoses of types that could potentially place them at high risk for ovarian embolization and therefore premature menopause. In a study by Kim et al, the anastomoses between the uterine artery and ovarian artery on angiography in 40.3% of 288 patients were demonstrated. The overall repeat intervention rate after initial UAE was 5.6%, but UAE in patients with anastomoses on angiography was associated with a significantly higher rate of treatment failure than UAE in patients without anastomoses. Laparoscopic occlusion of parauterine collaterals also has been successfully performed in a small group of 11 patients, who were treated by Park et al. Authors reported better clinical results in these patients at 12-month follow-up.

To better elucidate the frequency and importance of UOA, we prospectively studied the patterns of ovarian artery supply to the fibroids and the uterus in 90 consecutive patients. Two surgical types of UOA were found in 23 patients in this series, type I of patients. To better elucidate the frequency and importance of UOA, we prospectively studied the patterns of ovarian artery supply to the fibroids and the uterus in 90 consecutive patients. Two surgical types of UOA were found in 23 patients in this series, type I of patients. Two surgical types of UOA were found in 23 patients in this series, type I of patients. Two surgical types of UOA were found in 23 patients in this series, type I of patients.

The enthusiastic information of Park et al regarding patients who had better clinical outcomes after their parauterine collaterals were cauterized was not confirmed in our study. We found that the statistical difference between groups was not significant. Follow-up of these women was longer than in the Park et al study. With an error of 0.05 and a error of 0.10, we calculated that 60 subjects and 150 subjects, respectively, would be needed in each group to determine significance. Laparoscopy may help to identify collateral flow to the dominant fibroid by way of tubo-ovarian artery hypertrophy and the small caliber of the uterine artery. Type III of the angiographic classification with blood flow reversal to the ovarian artery is impossible to detect by laparoscopy. The present study revealed dilated tortuous parauterine vessels during a second look surgery in 4 patients with clinical failure and recurrence. Of the patients with recurrence, 2 underwent surgery due to the coexistence of adenomyomas and fibroids. Although the causes of uterine artery occlusion treatment failure were multifactorial and still need further investigation, the results indicate that utero-ovarian collaterals can be an important contributor to decreasing clinical failure leading to repeat surgical intervention.

This observational study has several limitations. First, is the potential inability to detect 3 types of anastomosis. The second is that we did not attempt to correlate the occurrence of these types of anastomosis with anatomic factors, such as dimension of the uterus or fibroids, location of fibroids, and duration of recent change in symptoms.

CONCLUSION

Laparoscopic blockage of utero-ovarian anastomoses combined with uterine artery occlusion is a feasible surgical procedure in women with symptomatic fibroids. We demonstrated anastomoses between the uterine artery and ovarian artery on laparoscopy in 25.5% of 90 women studied. Combining the uterine artery occlusion and blockage of UO anastomoses may be a useful procedure for decreasing the rate of clinical failure and recurrence. Of the patients with recurrence, 2 underwent surgery due to the coexistence of adenomyomas and fibroids. Although the causes of uterine artery occlusion treatment failure were multifactorial and still need further investigation, the results indicate that utero-ovarian collaterals can be an important contributor to decreasing clinical failure leading to repeat surgical intervention.

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