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Influence of Previous Abdominal and Pelvic Surgeries on Uterine Artery Embolization

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Abstract

Objective: To assess the influence of previous abdominal and pelvic surgeries on uterine artery embolization (UAE). We hypothesize that the formation of postoperative adhesions can impose technical difficulties for UAE, resulting in longer fluoroscopy time and less reduction of uterus and largest tumor volumes after the procedure. Methods: We retrospectively reviewed the medical records of 122 consecutive patients who underwent uterine artery embolization for the treatment of uterine fibroids in our department. Patients were divided into two groups according to the presence or absence of previous abdominal or pelvic surgery. Fluoroscopy time, change in symptoms, and volume variation of uterus and largest tumor were compared between groups. Results: Forty-seven patients underwent abdominopelvic surgery before UAE (Group 1) and 75 did not (Group 2). Median (IQR) fluoroscopy time was 22 minutes (IQR: 18 - 26.4) for Group 1, and 23.3 minutes (IQR: 19.05 - 28.25) for Group 2. No difference was found between the groups (P = 0.17). Regarding the results after UAE, neither the change in symptoms (P = 0.30) nor the volume variation for uterus (P = 0.41) and largest fibroid (P = 0.18) showed significant difference. Conclusions: In this study, previous abdominopelvic surgeries had no significant influence on fluoroscopy time, and overall outcomes of uterine artery embolization.

Keywords

Female, Uterine Artery Embolization, Leiomyoma, Uterus, Fluoroscopy

1. Introduction

Adhesions develop in 79% to 90% of patients who undergo open abdominal or pelvic surgery, and they represent a well-known cause of long-term morbidity. The formation of bands between tissues and organs may lead to important anatomical distortions, increasing the difficulty of future surgeries [1] [2] [3] [4]. When adhesions occur in the pelvic cavity, not only adhesions of pelvic organs but also of the vasculature can be expected to occur. If the uterine artery is bent, tortuous, or narrowed due to adhesions, catheter insertion into the uterine artery is expected to be difficult. Furthermore, the uterine artery may be injured by the catheter, or the catheter may not be inserted into the ascending branch of the uterine artery.

Despite the importance of these occurrences, to our knowledge there has been no report on the influence of previous abdominopelvic surgeries on uterine artery embolization (UAE).

When the uterine vasculature is treated, it is essential to be familiar with the pelvic anatomy; the origin of the uterine arteries must be delineated and their three-dimensional configuration comprehended [5] [6]. This is important for correctly selecting the target vessels, progressing the catheter, properly delivering the embolic particles, and thus assuring effective embolization not only the patients who receive UAE for symptomatic fibroids, but also the patients who receive UAE for submucosal pedunculated fibroid before myomectomy to reduce the bleeding during operation [7]. Forced insertion of the catheter into uterine artery can result in arterial spasm, dissection, or perforation, thus increasing the chances of technical and clinical failure [6] [8] [9]. In our experience in performing UAE for symptomatic fibroids, it seems that selective catheterization and progression of the catheter within the uterine arteries tend to be complex in patients who have had previous abdominal or pelvic surgery. We hypothesized that the formation of postoperative adhesions could impose technical difficulties for UAE, resulting in a longer procedure time and less therapeutic effect after the procedure.

To test our hypothesis, we compared fluoroscopy time, variation in tumor and uterine volume, and changes in symptoms between before and 6 months after UAE in patients who had a history of abdominal or pelvic surgery and those who did not.

2. Methods

The reporting of this study conforms to STROBE guidelines [10]. This retrospectivestudy was approved by the Institutional Review Board of Juntendo University Hospital, and the need for informed consent was waived. From December 2016 to June 2021, 122 patients (mean age 45 years; range 36 - 52 years) underwent UAE in the department of radiology to treat symptomatic uterine leiomyomas. The most common symptoms were dysmenorrhea, hypermenorrhea, and bulk-related symptoms such as pelvic pressure or pain and urinary tract or

bowel issues. Clinical information and previous surgical history data were collected from the hospital's electronic medical records system. Patients were then allocated to two groups according to the presence or absence of a history of previous abdominal or pelvic surgery. MRI (magnetic resonance imaging) and MRA (magnetic resonance angiography) images were retrieved from the radiological reporting system. Fluoroscopy time, change in symptoms, and volume variation of the uterus and the largest tumor between before and after the procedure were compared between groups (**Figure 1**).

All imaging examinations were conducted with either a 1.5-T MR unit (Excelart Vantage powered by Atlas; Canon Medical Systems, Otawara, Japan) or a 3-T MR unit (Vantage Galan 3T/ZGO; Canon Medical Systems, Otawara, Japan) by using a pair of phased-array coils (Canon Medical Systems, Otawara, Japan) placed at the front and back of the abdomen. Our protocol for patients undergoing UAE has been described previously [11]. After the procedure, patients were asked to return for follow-up MRI and MRA at 3, 6, and 12 months.

2.1. Volume Measurement

For each patient, preprocedural and 6-month postprocedural sagittal T2-weighted images were imported into the volume analyzer of the Synapse Vincent system (FUJIFILM Medical Co., Ltd., Tokyo, Japan). After a radiologist had delineated the margins of the uterus and the largest tumor in sequential sagittal slices, the program automatically calculated the total volume of each.

2.2. UAE Technique

All procedures were performed by the same interventional radiologist (R.K., who has 37 years of experience in the field). A 4-French (Fr) vascular sheath (Medikit Supersheath; Medikit Co., Ltd., Tokyo, Japan) was placed into the right common femoral artery under local anesthesia. The tip of a PIG-S4 catheter

Figure 1. Aortogram obtained before uterine artery embolization in a 44-year-old woman with no history of abdominopelvic surgery. (The same patient is shown in **Figure 3** and **Figure 5**).

(Medikit Angiography Catheter MH; Medikit Co., Ltd., Tokyo, Japan) was placed in the abdominal aorta at the L2 level by using an angled guide wire (Radiofocus Guide Wire M; Terumo Co., Ltd., Tokyo, Japan), and aortography (Figure 1 and Figure 2) was performed by using a digital subtraction angiography unit (INFX-8000C/JL; Canon Medical Systems, Otawara, Japan) to assess the bifurcation of internal iliac arteries, identify both uterine arteries, check the tumor staining, and detect possible additional tumor feeder vessels such as the ovarian artery. The catheter was then exchanged for a 4-Fr MOHRI-1 catheter (Medikit Angiography Catheter; Medikit Co., Ltd., Tokyo, Japan), which was advanced through the left internal iliac branch and its posterior division until the beginning of the left uterine artery. From this point, superselective catheterization to the proximal ascending segment of the left uterine artery was performed by using a microcatheter (2.6-Fr tip Masters HF; AsahiIntecc, Aichi,

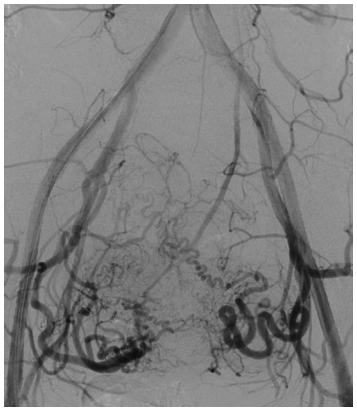

Figure 2. Aortogram obtained before uterine artery embolizationin a 44-year-old woman with no history of abdominopelvic surgery (The same patient is shown in Figure 4 and Figure 6).

Figure 3. Aortogram obtained before uterine artery embolization in a 44-year-old woman with a history of abdominopelvic surgery (laparoscopic ovarian cyst removal). Dilated uterine arteries and multiple tortuous collateral vessels are apparent (The same patient is shown in Figure 5).

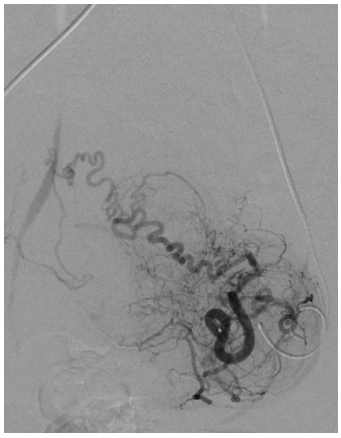

Figure 4. Selective catheterization of the left uterine artery. Image obtained before uterine artery embolizationin a 44-year-old woman with no history of abdominopelvic surgery.

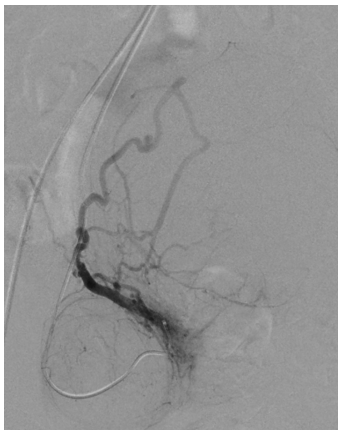

Figure 5. Selective catheterization of the left uterine artery. Image obtained before uterine artery embolizationin a 44-year-old woman with a history of abdominopelvic surgery. Multiple tortuous collateral vessels are apparent.

Japan) over a RUN & RUN micro-guidewire (0.016 inch; Piolax Medical Devices, Kanagawa, Japan). The territory supplied by the target vessel was confirmed (**Figure 3** and **Figure 4**), and embolic materials were delivered to the site.

Embolization was achieved by deploying Tris-acryl gelatin microspheres (Embosphere; Merit Medical, South Jordan, UT, USA) that were 500 to 700 μm or 700 to 900 μm in diameter. The microspheres were provided in a prefilled syringe containing 2 mL of these embolic particles and 9 mL of sterile physiological saline. To deliver the contents, 9 mL of contrast medium (Ultravist-300; Bayer AG; Leverkusen, Germany) was added to the syringe and the contents mixed thoroughly to suspend the microspheres in the solution. Embolization was terminated when 2 mL of the injected contrast media had disappeared from the proximal ascending segment of the uterine artery in three to five heartbeats.

Thereafter, the same sequence was performed on the right side (**Figure 5** and

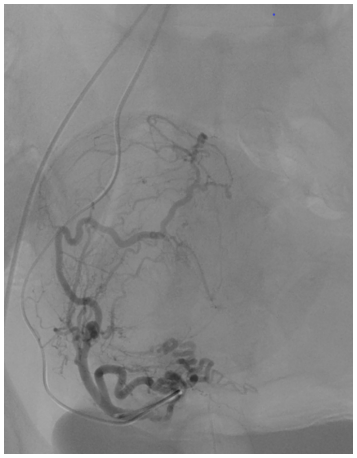

Figure 6. Selective catheterization of the right uterine artery. Image obtained before uterine artery embolizationin a 44-year-old woman with no history of abdominopelvic surgery.

Figure 6) through a unilateral approach. Finally, aortography was performed. Once the absence of peritumoral arterial plexus and the presence of slow antegrade flow in the main uterine arteries were confirmed, the procedure was considered finished.

2.3. Statistical Analysis

Statistical analysis was performed by using commercially available software (SPSS Statistics for Windows, version 26.0, IBM Corp., Armonk, NY). Normally distributed data are reported as mean values ± 1 standard deviation, and non-normally distributed data are given as medians with interquartile range (IQR). Fluoroscopy time and variation in the uterine and largest fibroid volumes between the two groups were compared by using the Mann-Whitney *U*-test. The threshold for significance was set to $P < 0.05$.

3. Results

3.1. Baseline Characteristics

According to the medical records, 47 patients had undergone abdominal or pelvic surgery before UAE (Group 1) and 75 patients had not (Group 2). Among the patients in Group 1, the previous procedures were mainly myomectomy, appendectomy, correction of inguinal hernia, C-section, colectomy, and ovarian cyst removal. Our analysis of the baseline characteristics of Group 1 and Group 2 revealed no significant differences between the groups for age ($P = 0.08$), body mass index ($P = 0.99$), or initial volumes of the uterus ($P = 0.10$) and dominant fibroid ($P = 0.07$). Further details are given in Table 1.

3.2. Procedure and Outcomes of UAE

Median fluoroscopy time was 22 min (IQR: 18 to 26.4) for Group 1, and 23.3 min (IQR: 19.05 to 28.25) for Group 2. No significant difference in these times

Table 1. Baseline characteristics.

Characteristic	Previous surgery (Group 1, n = 47)	No previous surgery (Group 2, n = 75)	P (Mann-Whitney *U*-test)
Age (years)	46.1 (±2.77)[a]	45 (44 - 47)[b]	0.08
Body mass index	22 (21 - 24)[b]	22 (21 - 24)[b]	0.99
Largest fibroid volume (cm^3)	206 (130 - 450)[b]	332 (201 - 551)[b]	0.07
Uterine volume (cm^3)	728 (511 - 1019)[b]	817 (593 - 1048)[b]	0.10

[a]Mean (±1 SD); [b]median (interquartile range).

was found between the groups (P = 0.17). Six months after UAE, the median reduction of tumor volume was −41% (IQR: −56% to −31%) for Group 1 and −51% (IQR: −62% to −35%) for Group 2. No significant difference was found between the groups (P = 0.18). The median reduction in uterine volume was −33% (IQR: −39% to −25%) for Group 1 and −33% (IQR: −45% to −23%) for Group 2. Again, these values did not differ between the two groups (P = 0.41).

Analysis of the change in symptoms showed that, in Group 1, 32 patients reported improvement after UAE, 6 reported no change, and 8 presented worsening of symptoms. One patient in Group 1 had no record of clinical information. In Group 2, 56 patients reported improvement of symptoms after UAE, 11 had no change, and 6 reported worsening of symptoms. Two patients in Group 2 had no record of clinical information. There was no significant difference between the outcomes in Group 1 and Group 2 (P = 0.30).

4. Discussion

Adhesions due to previous surgeries are well known to predispose patients to complications in future surgeries, such as unintentional injury to the bowel, bladder, or ureters [12]. One of the reasons is that the irregular bands of scar tissue that form between two surfaces of the body may lead to difficult abdominal or pelvic access owing to loss of tissue planes or distortion of the anatomy [13] [14]. Furthermore, because of the increased technical difficulty, postsurgical adhesions can extend the requisite duration of surgery during future procedures [15] [16].

These issues trigged our interest in the influence of post-surgical adhesions on UAE. In our practice, we have noticed that, in general, angiographic images obtained from patients who have undergone abdominopelvic surgery (**Figure 3**, **Figure 5**) tend to show more collaterals and tortuous pelvic vessels than those obtained from patients who have not (**Figure 2**, **Figure 4**, and **Figure 6**). Also, performing UAE in patients presenting with a history of abdominopelvic surgery is more challenging than usual, for 3 main reasons. First, in some cases, we have noticed that the uterine artery is too tortuous making selective catheterization difficult. Secondly, when we advance the catheter, there is a notable resis-

tance due to arterial stiffness, making it difficult to place the catheter in the best location to insert the embolic particles. Lastly, the usual mobility of the uterine arteries seems to be limited in such patients. All these points increase the risk of iatrogenic arterial injury and might lead to treatment failure. Despite the higher complexity of such cases, all procedures included in this study were performed successfully. Preprocedural imaging assessment was decisive for achieving this result. Preprocedural MRA images can provide relevant preliminary information about the uterine arteries, ovarian arteries, and pelvic vasculature, thus increasing technical success rates [6].

In our patient series, a history of abdominal or pelvic surgery did not have a significant influence on the following variables: fluoroscopy time, change in symptoms, or tumor or uterine volume variation after UAE. Our findings might help to reassure interventional radiologists with regard to the outcomes of UAE in patients with potential adhesions. However, we acknowledge that there were several limitations. First, this was a single-institution retrospective analysis. Second, because performing repeated surgery in all patients for no other reason than to assess postoperative adhesion formation is unethical, we could only assume the occurrence of adhesions in our patients. Finally, within the surgical group, we did not categorize our cases according to surgical technique (laparoscopic or open). Initially, we had planned to further compare the variables between gynecological and gastrointestinal surgeries. However, we found that the mean baseline largest tumor volume differed significantly between these two samples ($P < 0.05$), thus biasing further analysis. We plan to address more specific groups in a future study, once our number of cases increases.

5. Conclusion

In this comparison between UAE patients with a history of abdominopelvic surgical history versus those without such a history, there were no significant differences in fluoroscopy time, change in symptoms, and volume reduction of the uterus and largest fibroid. These preliminary findings suggest that previous gynecological or abdominal surgery does not influence the performance or the outcomes of UAE, if a preoperative MRA with good uterine branching morphology had been performed.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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