

Uterine Artery Embolization for Pedunculated Subserosal Fibroids

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OBJECTIVE. The objective of our study was to assess the outcomes of uterine artery embolization as a treatment for pedunculated subserosal fibroids, which we defined as those in which the diameter of the stalk was 50% narrower than the diameter of the fibroid.

MATERIALS AND METHODS. During a 72-month period, 196 consecutive women underwent embolization for treatment of symptomatic uterine fibroids that were confirmed on baseline sagittal and axial MR images. We identified those women with pedunculated subserosal fibroids treated with embolization and retrospectively assessed complications and outcomes of embolization using a serial questionnaire and MRI.

RESULTS. Of the 196 women, 12 (age range, 34–48 years; mean age, 42.3 years) had one or more pedunculated subserosal fibroids. Fifteen pedunculated subserosal fibroids were identified on baseline MR images in the 12 patients. The mean tumor diameter was 8.3 cm (range, 4.0–15.5 cm; 95% confidence interval [CI], 6.7–9.9 cm). The mean stalk diameter was 3.1 cm (range, 2.0–5.5 cm; 95% CI, 2.5–3.7 cm). The follow-up period ranged from 5 to 51 months (mean, 18.1 months). No serious complications such as separation of the tumors from the uterus, torsion of the tumors, or infection occurred after embolization. Enhanced MR images obtained 1 week after embolization showed that complete devascularization of the tumors had been achieved in 73% (11/15) of the tumors. The rates of mean tumor volume reduction were 41% (range, 12–73%) 4 months and 53% (range, 31–85%) 1 year after embolization. The mean stalk diameter was 3.2 cm (range, 1.7–5.4 cm; 95% CI, 2.5–3.9 cm) 4 months and 2.9 cm (range, 1.1–4.2 cm; 95% CI, 1.8–3.9 cm) 1 year after embolization. No significant difference in stalk diameters was noted 4 months ($p = 0.617$) or 1 year ($p = 0.963$) after embolization compared with the diameters before the treatment. The rates of mean uterus volume reduction were 35% (range, 15–47%) 4 months and 47% (range, 35–60%) 1 year after embolization. Marked or moderate improvement in bulk-related symptoms was achieved in 100% (10/10) of the women at 4-month follow-up, 100% (5/5) at 1-year follow-up, and 100% (2/2) at 2-year follow-up.

CONCLUSION. We found no serious complications after embolization for pedunculated subserosal fibroids with stalk diameters of 2 cm or larger. Successful outcomes can be obtained in such tumors.

Uterine artery embolization has increasingly been offered as a safe and efficient alternative to surgery for symptomatic uterine fibroids [1–8]. Appropriate patient selection before the procedure is important for obtaining improvement in fibroid-related symptoms and for avoiding unnecessary complications. Pedunculated subserosal fibroids have been generally recognized as a relative contraindication for uterine artery embolization [9–12] mainly because of the risk of separation from the uterus after embolization, which leads to serious complications [9–11]. However, to our knowledge, the frequency with which

complications occur and the outcomes that can be achieved in pedunculated subserosal fibroids after embolization are unknown. The objective of our study was to assess the complications and outcomes of uterine artery embolization as a treatment for pedunculated subserosal fibroids.

Materials and Methods

Ours was a retrospective study based on prospectively acquired data drawn from a database of cases of 196 consecutive women (age range, 31–53 years; mean age, 42.6 years) who underwent uterine artery embolization as the primary therapy for symptomatic uterine fibroids at our hospital during

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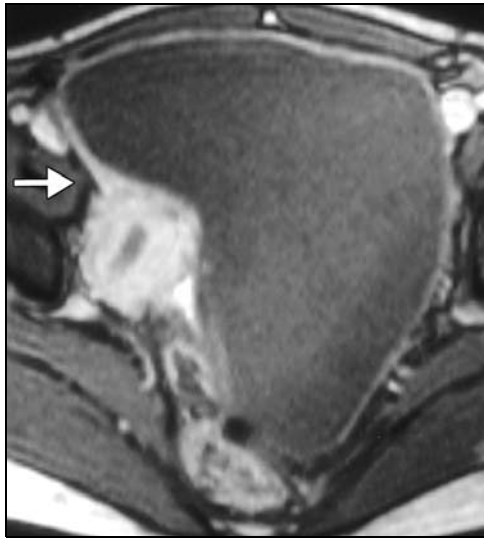
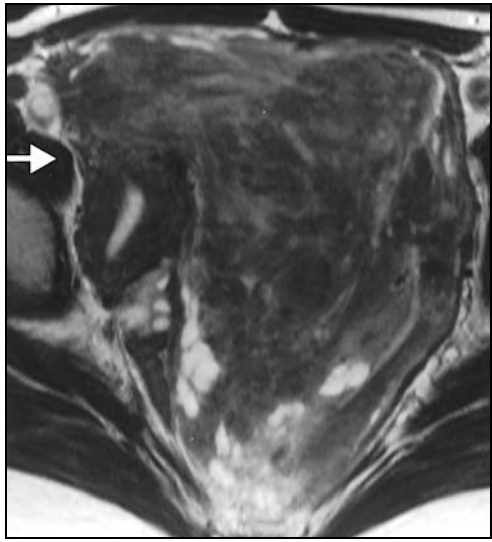


Fig. 1.—41-year-old woman with bulk-related symptoms caused by large uterine fibroid.

A, T2-weighted MR image obtained before embolization reveals large pedunculated subserosal fibroid that is 15.5 cm in maximal diameter. Diameter of stalk (*arrow*) is 4 cm.

B, Contrast-enhanced T1-weighted MR image obtained 1 year after embolization reveals that pedunculated subserosal fibroid, now 14.3 cm in maximal diameter, is not enhancing. Diameter of stalk (*arrow*) is 4.2 cm. Bulk-related symptoms markedly improved.

A

B

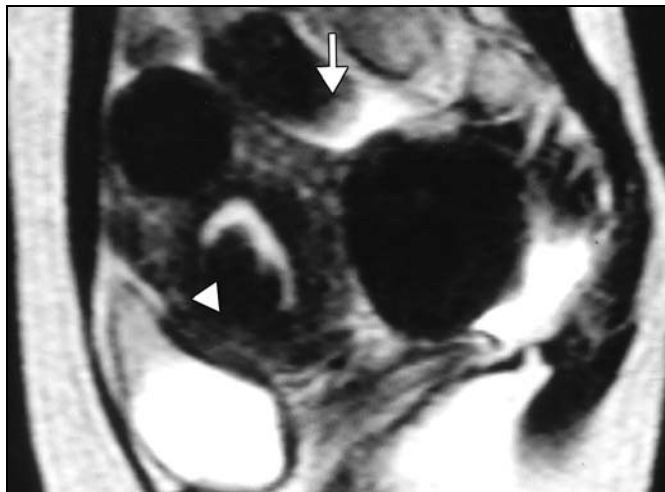
the 72-month period from December 1997 to November 2003. The data were gathered and assessed in December 2003. All patients had been informed of the potential benefits and risks of uterine artery embolization for uterine fibroids and had given oral and written informed consent. We instructed all the women to inform us of any adverse reactions, should they occur. The institutional ethics committee approved the procedure.

All women were premenopausal and had one or more symptoms associated with uterine fibroids that were difficult to control with medication, including menorrhagia, pain, or bulk-related symptoms. Gynecologists had diagnosed the tumors in

all the women as uterine fibroids. Before uterine artery embolization, we confirmed that all women had negative results on Pap smears and that all women with abnormal uterine bleeding had negative results at endometrial biopsy. Baseline sagittal and axial MR images obtained in all women before uterine artery embolization confirmed that the tumors were uterine fibroids. The baseline clinical symptoms in all women were assessed with an oral questionnaire before the procedure. The routine hospital stay for these patients was 3–4 days, which is our protocol for postprocedural care.

We based our definition of pedunculated subserosal fibroids on a previously published description

[13] as fibroids in which the diameter of the stalk was 50% narrower than the diameter of the fibroid (Figs. 1 and 2). Women with pedunculated subserosal fibroids were not excluded from uterine artery embolization if the diameter of the stalk was 2 cm or larger and if, in the judgment of the gynecologists, the only other treatment option was a hysterectomy or difficult myomectomy or if the women absolutely refused major surgery. Pedunculated subserosal fibroids with stalk diameters smaller than 2 cm were not considered indications for embolization. Unenhanced and contrast-enhanced axial and sagittal MRI was performed 1 week, 4 months, and 1 year after the procedure. After 1



A

B

Fig. 2.—44-year-old woman with menorrhagia and bulk-related symptoms caused by multiple uterine fibroids.

A, T2-weighted MR image obtained before embolization reveals submucosal fibroid (*arrowhead*) and pedunculated subserosal fibroid 6 cm in maximal diameter. Diameter of stalk (*arrow*) is 2 cm.

B, Contrast-enhanced T1-weighted MR image obtained 1 year after embolization reveals pedunculated subserosal fibroid, now 4.5 cm in maximal diameter, is not enhancing. Diameter of stalk (*arrow*) is now 1.1 cm. Rate of volume reduction in pedunculated subserosal fibroid is 61%. Menorrhagia and bulk-related symptoms markedly improved.

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year, patients with residual problems related to fibroids and embolization were contacted and underwent unenhanced and contrast-enhanced MRI as necessary. A written questionnaire was administered 4 months, 1 year, and then annually after embolization. The symptomatic outcomes compared with preprocedural symptoms, obtained by the written questionnaire, were classified as markedly improved, moderately improved, slightly improved, unchanged, or worsened. Patient satisfaction with the procedure and the outcomes, also obtained with the questionnaire, was classified as markedly satisfied, slightly satisfied, neither satisfied nor dissatisfied, slightly dissatisfied, or markedly dissatisfied.

All uterine artery embolization was performed using a unilateral femoral approach. We routinely used a coaxial microcatheter system. The embolic agent used was gelatin sponge particles of approximately 500 to 1,000 μm , which was made by the operators from gelatin sponge sheets (Spongel, Yamanouchi). The agent mixed in saline, contrast media (iopamidol, Iopamiro, Bracco), and antibiotics (cefazolin sodium, Cefamezin, 1 g, Fujisawa Pharmaceuticals) were infused in uterine arteries, as we previously have described [6, 14]. The end point of embolization was near stasis in the ascending uterine artery. We did not use intraarterial antispasmodics routinely. Postprocedural cramping was managed mainly with morphine hydrochloride (Morphine Hydrochloride Injection, Takeda Pharmaceuticals) and naproxen (Naixan, Tanabe Seiyaku), as we previously have described [6, 14].

We assessed the diameter of the stalk, the maximal diameter and volume of pedunculated subserosal fibroid, and the uterine volume using baseline MRI. The infarction rates of the fibroids were assessed 1 week after embolization on contrast-enhanced sagittal MRI performed at the level of the maximal diameter of the tumor. We considered complete devascularization to have been achieved if the signal intensity of the tumor on enhanced MRI was the same as that on unenhanced MRI [14]. The diameter of the stalk and the rates of tumor and uterine volume reduction were assessed on serial MRI 4 months and 1 year after embolization. The volumes of the tumor and the uterus were calculated using the formula of a prolate ellipse (length \times depth \times width \times 0.5233). We also evaluated cystic change within the tumor after embolization on serial MRI. Complications were assessed using information collected at the time of the hospital stay or an unanticipated hospital visit, on serial questionnaires, or on MRI. Symptomatic outcome and patient satisfaction were assessed with serial questionnaires. We also analyzed the dose of morphine hydrochloride related to postprocedural cramping, the time required for the complete disappearance of post-

procedural pain, and the time required for full recovery, which we defined as the time required before the patient subjectively felt back to normal and which we assessed with a questionnaire administered 4 months after embolization. Statistical analysis was performed using a paired *t*-test. A probability value of less than 5% ($p < 0.05$) was considered significant.

Results

Of a total of 196 women, 12 (6.1%) had one or more pedunculated subserosal uterine fibroids. Mean age of the 12 women was 42.3 years (range, 34–48 years). Fifteen pedunculated subserosal fibroids were identified in 12 women on baseline MRI. Three women had a single pedunculated subserosal fibroid, and the remaining nine women had three or more uterine fibroids including pedunculated subserosal fibroids. The mean stalk diameter before embolization was 3.1 cm (range, 2.0–5.5 cm; 95% confidence [CI], 2.5–3.7 cm). The mean diameter of the baseline tumor was 8.3 cm (range, 4.0–15.5 cm; 95% CI, 6.7–9.9 cm), and the mean tumor volume was 279 mL (range, 26–1,424 mL; 95% CI, 87.7–469.3 mL). The mean baseline uterine volume was 976 mL (range, 328.0–2,333.0 mL; 95% CI, 627.5–1,325.0 mL). Eight women had menorrhagia, 10 women had bulk-related symptoms, and six women had dysmenorrhea.

All but one of the 12 women successfully underwent bilateral uterine artery embolization. One woman underwent unilateral uterine artery embolization because the other uterine artery was anatomically absent. The follow-up period ranged from 5 to 51 months (mean, 18.1 months). All women were followed up for more than 4 months; five women, for more than 12 months; and two women, for more than 24 months. During follow-up, we found no major complications such as separation of the tumors from the uterus; torsion of the tumors; infection requiring unanticipated, prolonged, or repeat hospitalization; major surgery; unplanned increase in the level of care; permanent adverse sequelae; or death. Moreover, no minor complications requiring nominal treatment were noted. The mean length of the hospital stay was 4.3 days (range, 3–6 days; 95% CI, 3.2–4.3 days). One patient had a 6-day hospital stay due to reasons unrelated to fibroids or the procedure.

Enhanced MRI performed 1 week after embolization showed that complete devascularization of the tumors was achieved in 73% (11/15) of the tumors. In one woman, MRI could not be performed 4 months after embolization. The

rates of mean tumor volume reduction were 41% (range, 12–73%; 95% CI, 29.7–53.0%) 4 months and 53% (range, 31–85%; 95% CI, 33.9–72.1%) 1 year after embolization. MRI performed 4 months and 1 year after the procedure showed that there had been no tumor regrowth. The mean stalk diameters were 3.2 cm (range, 1.7–5.4 cm; 95% CI, 2.5–3.9 cm) 4 months and 2.9 cm (range, 1.1–4.2 cm; 95% CI, 1.8–3.9 cm) 1 year after embolization. No significant difference was seen in the stalk diameters 4 months ($p = 0.617$) and 1 year ($p = 0.963$) after treatment compared with the stalk diameters before embolization. The rates of mean uterus volume reduction were 35% (range, 15–47%; 95% CI, 28.7–44.0%) 4 months and 47% (range, 35–60%; 95% CI, 34.9–59.5%) 1 year after embolization.

Cystic change in part of the tumor was observed in a single tumor on an MR image obtained 4 months after embolization, although the tumor size had decreased compared with the size at baseline. Marked or moderate improvement in bulk-related symptoms was achieved in 100% (10/10) of the women 4 months, 100% (5/5) 1 year, and 100% (2/2) 2 years after embolization. Marked or moderate improvement in menorrhagia was achieved in 88% (7/8) of the women 4 months and 100% (2/2) 1 year after embolization. This measure was not applicable to any woman 2 years after treatment. Marked or moderate improvement in pain was achieved in 83% (5/6) of the women 4 months, 100% (2/2) at 1 year, and 100% (1/1) 2 years after embolization. One hundred percent (12/12) of the women were markedly satisfied with the outcomes 4 months after embolization; 80% (4/5) were markedly satisfied 1 year and 100% (2/2) 2 years after embolization. The time required for a full recovery after the procedure was 5–60 days (mean, 28.3 days; 95% CI, 13.1–43.6 days). The time required for the complete disappearance of postprocedural pain was 0–50 days (mean, 13.6 days; 95% CI, 3.8–23.4 days). Of the 12 patients, 11 received morphine hydrochloride for cramping after the procedure. The dose of morphine hydrochloride administered ranged from 15.5 to 35 mg (mean, 23.8 mg; 95% CI, 19.9–27.7 mg).

Discussion

Our results suggest that uterine artery embolization can be a safe and effective treatment for pedunculated subserosal fibroids with a stalk diameter of 2 cm or larger. We have never encountered serious complications such as separation of septic necrosis of pedunculated subserosal fibroids from the

uterus, torsion of the tumor, infection, or increased tumor size caused by liquefied change after embolization and have obtained successful symptomatic outcomes in our patients. In one woman with a partially infarcted pedunculated subserosal fibroid after embolization, contrast-enhanced MRI performed 30 months after embolization showed regrowth of viable components within the tumor. However, because the patient has not reported any recurrent symptoms related to the fibroid, confirmed with a questionnaire administered 4 years after embolization, she has not undergone additional treatment to date.

Pedunculated subserosal uterine fibroids have been generally recognized as relative contraindication for use of uterine artery embolization [9–12]. This contraindication stems from the potential for pedunculated subserosal fibroids to separate from the uterus due to stalk necrosis, leading to serious complications, or the risk of liquefied change in the tumor, resulting in an increased tumor size after embolization. The literature contains two reports of cases in which separating septic necrosis of pedunculated subserosal fibroids from the uterus after embolization resulted in hysterectomy and resection of the bowel [9, 10]. Walker et al. [12] reported a case of liquefied change of pedunculated subserosal fibroids leading to an increased tumor size after embolization that was confirmed on MRI. However, these reports did not give detailed information on the diameter of the stalk and the size of the tumor before embolization. To our knowledge, the frequency with which complications occur and the outcomes that can be achieved in pedunculated subserosal fibroids treated with embolization are unknown. Therefore, we retrospectively assessed the complications and outcomes in this study.

We found it interesting that, although pedunculated subserosal fibroids carry a potential risk of stalk necrosis after embolization, serial MRI performed 4 months and 1 year after embolization showed that the stalk diameter after embolization did not significantly change from the diameter before the procedure, whereas the volume of pedunculated subserosal fibroids decreased in size. Myomectomy or combined treatments such as myomectomy performed before or after uterine artery embolization are safe and effective for the management of pedunculated subserosal fibroids. Nevertheless, we performed embolization for fibroids with a stalk diameter of 2 cm or larger because, in the judgment of the gynecologists, a hysterectomy or difficult myomectomy was the only treatment

option for patients with such fibroids or because the patients absolutely refused major surgery. With regard to a boundary of the stalk diameter for embolization, we regarded a stalk with a diameter of 2 cm or larger as a broad stalk. Therefore, we performed embolization and got good outcomes with no serious complications. In contrast, we regarded a stalk with a diameter of less than 2 cm as a thin stalk and excluded such cases from our indication for embolization.

The mean length of the hospital stay was 4.3 days (range, 3–6 days) in this study, which was much longer than that reported in the literature. However, in our previous series [6] involving 60 patients the mean length of the hospital stay was 4.3 days (range, 4–14 days), which was similar to that of the present study. In general, the hospital stay is much longer for Japanese patients than for patients in other countries because the medical and insurance systems in Japan differ from those of other countries [6].

The mean time required for full recovery after the procedure was 28.3 days. This result is certainly much longer than those reported in the literature [2, 5–7, 15]. Our previous article [6] suggested that the mean time required for full recovery after the procedure was 12 days (range, 3–50 days) and that the mean time required for the complete disappearance of postprocedural pain was 6.1 days (range, 2–50 days). However, we cannot identify the reason for the longer recovery time required by the patients in this present study or which factors (such as pedunculated subserosal fibroids or other factors) could have contributed to this delayed recovery.

We used gelatin sponge particles as embolic agents in this study because other embolic agents are not available commercially in Japan and our previous reports [6, 16] have suggested that the outcomes of uterine artery embolization using only gelatin sponge particles bear comparison with those previously reported in the literature in which other embolic agents were used [1–5, 7, 8].

In conclusion, we found no serious complications after uterine artery embolization for pedunculated subserosal fibroids with a stalk diameter of 2 cm or larger. Successful outcomes can be obtained for such tumors with uterine artery embolization. However, our study has some limitations. Because we excluded pedunculated subserosal fibroids with a stalk diameter of less than 2 cm, we cannot assess the outcomes for those lesions. Moreover, our study is a retrospective analysis involving a limited number of patients who underwent embolization at a single

institution during a limited follow-up period. Therefore, further investigation with a multicenter prospective study is warranted.

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