

Leiomyoma Infarction after Uterine Artery Embolization: Influence of Embolic Agent and Leiomyoma Size and Location on Outcome

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ABSTRACT

Purpose: To study the factors that might impact infarction of individual uterine leiomyomas and total tumor burden after uterine artery embolization (UAE).

Materials and Methods: This retrospective study included 91 patients (mean age, 44 y [range, 34–54 y]) who underwent UAE with tris-acryl gelatin microspheres (TAGMs) or nonspherical polyvinyl alcohol (PVA) particles. Twenty-one patients were treated with PVA (23%) and 70 were treated with TAGMs (77%). A total of 356 uterine leiomyomas were assessed, with a median uterine volume of 533 cm³ (range, 321–848 cm³). A reader masked to demographic and technical details reviewed contrast-enhanced magnetic resonance images before and 3 months after UAE to estimate the extent of tumor infarction.

Results: There was no significant difference in global or individual tumor infarction rate between embolizations with TAGMs and PVA particles ($P = .73$ and $P = .3$, respectively). Global infarction was not affected by age ($P = .53$), race ($P = .12$), number of leiomyomas ($P = .72$), or uterine volume ($P = .74$). Leiomyoma size did not influence individual tumor infarction ($P = .41$). Leiomyoma location was the sole factor that influenced individual tumor infarction rates, with pedunculated serosal tumors significantly less likely to show complete infarction than transmural tumors (odds ratio, 0.24; $P = .01$).

Conclusions: Nonspherical PVA particles and TAGMs produce similar rates of uterine leiomyoma infarction. Complete infarction of individual tumors is less likely in serosal and pedunculated serosal tumors.

ABBREVIATIONS

OR = odds ratio, PVA = polyvinyl alcohol, TAGM = tris-acryl gelatin microsphere, UAE = uterine artery embolization

Uterine artery embolization (UAE) has been extensively studied since its introduction for the treatment of symptomatic leiomyomas (1). Observational studies and randomized trials have demonstrated that UAE provides

symptomatic relief similar to hysterectomy (2–4). This procedure is accepted as an alternative to hysterectomy, and the American College of Obstetricians and Gynecologists has recognized the procedure as “safe and effective” (5).

Despite the procedure’s success, it does not always provide symptom control, and some women experience recurrence and require subsequent intervention (3,4). Among the factors that have been shown to affect the outcome of UAE, a large uterus and incomplete leiomyoma infarction have been associated with poorer outcomes (6–9). In contradistinction, other factors have been associated with positive outcomes after UAE, such as menorrhagia as a presenting symptom, multiple tumors, submucosal tumor location, and smaller tumor size (10).

Previous studies assessing the relative effectiveness of different embolic materials have suggested that these may also impact UAE outcomes. An early randomized trial (11)

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From the SIR 2012 Annual Meeting.

J.B.S. is a paid consultant for Boston Scientific (Marlborough, Massachusetts). None of the other authors have identified a conflict of interest.

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J Vasc Interv Radiol 2017; ■:1–8

<http://dx.doi.org/10.1016/j.jvir.2017.03.015>

comparing tris-acryl gelatin microspheres (TAGMs; Embosphere Microspheres; Merit Medical, South Jordan, Utah) and nonspherical polyvinyl alcohol (PVA) particles (Contour; Boston Scientific, Marlborough, Massachusetts) showed no difference in global infarction of leiomyomas. A second study (12) showed that spherical PVA particles (Contour SE; Boston Scientific) were significantly less likely to cause tumor infarction compared with TAGMs. However, these studies focused on the overall tumor infarction rate, assessing the entire group of tumors in any single patient.

As part of an overall evaluation of UAE outcomes, previous studies have assessed the impact of tumor volume and location on the degree of volume reduction in individual uterine leiomyomas (13). However, the outcome studied was purely volume reduction of tumors over 1 year, as opposed to tumor infarction. Given that infarction precedes the change in volume and may have a better correlation with long-term outcome after UAE, the infarction of individual leiomyomas may be more relevant to study than the amount of shrinkage (14–16). Kroencke et al (17) showed a correlation between greater infarction on magnetic resonance (MR) imaging and decreased symptoms and repeat interventions. Overall, however, there has been relatively little study of the factors that impact the infarction rate of individual leiomyomas, specifically their size and location.

The present study was designed to analyze factors that might impact the likelihood of tumor infarction after UAE, including a range of demographic and anatomic factors that might influence outcomes.

MATERIALS AND METHODS

The present study was a retrospective review of existing records and images, and was approved by the institutional review board. The study was in compliance with the Health Insurance Portability and Accountability Act.

Patient Selection

Patients were selected between 2002 and 2004 and supplemented with additional patients treated from 2009 to 2011. This included all patients who had pre- and postprocedural imaging. Patients were premenopausal women 34–54 years of age with symptomatic leiomyomas. Patients were eligible if they underwent UAE for symptomatic leiomyomas, had a baseline contrast-enhanced MR examination at our institution, were not interested in future pregnancy, and did not have ongoing pelvic infections or other conditions that would preclude participation. Patients were also required to have a 3-month follow-up post-UAE MR imaging study at our institution for technical uniformity to facilitate comparison. Patients were excluded from the study if they did not have complete pre- and postprocedural MR imaging studies. A total of 91 patients and 356 individual leiomyomas were evaluated. Baseline patient characteristics of the cohort are presented in [Table 1](#).

Table 1. Baseline Characteristics and Embolic Agent Choice (N = 91)

Characteristic	Value
Mean age (y) ± SD	44 ± 4
Race	
White	28 (30.8)
Black	47 (51.7)
Asian	2 (2.2)
Asian-American	2 (2.2)
Hispanic	2 (2.2)
Other	3 (3.3)
Unknown	7 (7.7)
Uterine volume (cm ³)	
Median	533
IQR	321–848
Embolic agent	
PVA	21 (23.1)
TAGMs	70 (76.9)
No. of leiomyomas	
1	13 (14.3)
2–5	35 (38.5)
6–10	20 (22.0)
> 10	23 (25.3)

Note—Values in parentheses are percentages.

IQR = interquartile range; PVA = polyvinyl alcohol; SD = standard deviation; TAGM = tris-acryl gelatin microsphere.

Procedure

UAE was performed with bilateral embolization and bilateral femoral access with 5-F catheters and coaxial 3-F microcatheters (Renegade Hi-Flow; Boston Scientific) in each case. The embolic material used was TAGMs or nonspherical PVA particles based on operator preference. TAGMs were used in patients with small uteri (smaller than 14-wk size), and nonspherical PVA particles were used in larger uteri (larger than 14-wk size), particularly in patients with high uterine artery flow rates.

All procedures were performed by one of two experienced interventional radiologists, each with greater than 5 years of experience. Regardless of type, embolic material was prepared by the same method. Each vial of embolic material was mixed to a final volume 20 mL, with 10 mL of normal saline solution and 10 mL of nonionic contrast material (various manufacturers). For TAGMs, 500–700- μ m sizes were initially used, and, after a total of two vials were used in any vessel (4 mL embolic agent), the particle size was increased to 700–900 μ m and embolization was continued until completion. For nonspherical PVA, 355–500- μ m particles were used in all cases, with no increase in embolic particle size.

The endpoint of embolization for TAGMs was sluggish forward flow, defined by contrast material still visible in the main transverse or ascending uterine artery for five cardiac beats after the injection of 2 mL of contrast material. This corresponds to an angiographic image of continued patency of the main uterine artery and the proximal portions of its main

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