

# Effect of Direct Marketing for Uterine Artery Embolization on Rates of Leiomyomas, Incidental Findings, and Management After Pelvic MRI

Sheena Gurwara, MD<sup>a</sup>, Brian C. Allen, MD<sup>b</sup>, Brian Kouri, MD<sup>c</sup>, M. Jennings Clingan, MD<sup>d</sup>, Melissa Picard, MD<sup>e</sup>, John R. Leyendecker, MD<sup>f</sup>

## Abstract

**Purpose:** The aim of this study was to determine whether a self-referred population screened by an interventional radiology (IR) clinic and a non-IR, physician-referred population differed with regard to suitability for uterine artery embolization (UAE) for symptomatic leiomyomas on the basis of preprocedure MRI.

**Methods:** This was an institutional review board–approved, HIPAA-compliant retrospective study of 301 women evaluated in an IR clinic for possible UAE from January 2009 to September 2012. Subjects were retrospectively divided into two groups: self-referred via direct marketing (group A, n = 203; mean age, 41.8 years; range, 22–58 years) and physician referred (group B, n = 98; mean age, 42.9 years; range, 30–65 years).

**Results:** There was no significant difference between groups in presenting symptoms (multiple symptoms, bleeding, bulk-related symptoms, pain). After initial screening, 73.4% of group A (149 of 203) and 79.6% of group B (78 of 98) underwent MRI ( $P = .242$ ). On the basis of MRI findings, 91.3% of group A (136 of 149) and 94.9% of group B (74 of 78) had uterine leiomyomas ( $P = .328$ ). Adenomyosis without leiomyoma was present in 4.0% of group A (6 of 149) and 3.8% of group B (3 of 78) ( $P = .947$ ). Incidental findings requiring further clinical or imaging evaluation were found in 20.8% of group A (31 of 149) and 24.4% of group B (19 of 78) ( $P = .539$ ). After MRI, 41.6% of group A (62 of 149) and 48.7% of group B (38 of 78) proceeded to UAE ( $P = .306$ ).

**Conclusions:** After initial screening, similar proportions of self-referred and physician-referred patients were candidates for UAE. The rates of confirmed leiomyomas and incidental findings on MRI were similar between groups.

**Key Words:** Leiomyoma, uterine artery embolization, fibroid embolization, marketing, MRI

*J Am Coll Radiol* 2016;■:■-■. © 2016 Published by Elsevier on behalf of American College of Radiology

## INTRODUCTION

Uterine artery embolization (UAE) was introduced in 1995 as a treatment option for symptomatic leiomyomas [1]. Over the past two decades, arterial embolization has had a marked impact on the treatment of

leiomyomas, and it is now a first-line treatment option for symptomatic leiomyomas [2]. Compared with hysterectomy, UAE is minimally invasive, can be performed with conscious sedation, allows a shorter recovery period, and is thus cost-effective [3–5].

Preprocedure MRI is important for treatment planning and has been shown to alter diagnoses and treatment plans in approximately 20% of women initially thought to have uterine leiomyomas [6]. MRI is used to evaluate leiomyoma burden and can assess the locations, morphology, sizes, and vascularity of uterine leiomyomas. In addition, potential contraindications to UAE are often recognized, including severe adenomyosis, large pedunculated subserosal or submucosal leiomyomas, and vascular anomalies.

Over the past decade, there has been growing interest in expanding the role of interventional radiology (IR) in

<sup>a</sup>Department of Radiology, Stanford University, Stanford, California.

<sup>b</sup>Department of Radiology, Duke University Medical Center, Durham, North Carolina.

<sup>c</sup>Department of Radiology, Wake Forest Baptist Medical Center, Winston-Salem, North Carolina.

<sup>d</sup>Portsmouth Naval Medical Center, Portsmouth, Virginia.

<sup>e</sup>Department of Radiology, Medical University of South Carolina, Charleston, South Carolina.

<sup>f</sup>Department of Radiology, University of Texas Southwestern Medical Center, Dallas, Texas.

Corresponding author and reprints: Brian C. Allen, MD, Duke University Medical Center, Department of Radiology, 2301 Erwin Road, Box 3808, Durham, NC 27710; e-mail: [brian.allen@duke.edu](mailto:brian.allen@duke.edu).

the evaluation and treatment of patients with uterine leiomyomas. Most previous reports have focused on assessing the impact of direct marketing on procedure volumes and generated revenue without comparing this population with a physician-referred population [7-9]. One prior investigation compared a self-referred population with a gynecologist-referred cohort [10]. In this study, the reported percentage of candidates not suitable for UAE was higher and the percentage of patients actually undergoing UAE was lower in the self-referred population, although the statistical significance of this difference was not assessed.

Therefore, in the present study, we hypothesized that self-referred patients undergoing MRI for suspected leiomyomas might have a lower incidence of leiomyomas, a higher incidence of alternative etiologies for their symptoms, and/or a higher incidence of potentially important incidental findings, which may lead to a higher proportion of patients presenting to an IR clinic who are not suitable for UAE than a population referred for UAE by gynecologists or primary care physicians.

## METHODS

Our institutional review board approved this HIPAA-compliant retrospective study. A waiver of the requirement to obtain informed consent was obtained.

### Patient Population

The IR clinic database was searched for all patients evaluated for possible UAE from January 1, 2009 to July 17, 2012. Using clinic notes and intake questionnaires, subjects seen for UAE were divided into two groups: a self-referred population (group A,  $n = 203$ ; mean age, 41.8 years; range, 22-58 years) and a physician-referred population (group B,  $n = 98$ ; mean age, 42.9 years; range, 30-65 years). During the time frame of our study, our hospital-based IR department engaged in direct marketing of UAE for treatment of symptomatic leiomyomas, including television interviews and radio advertisements, seminars, and fliers. As a result of direct marketing, patients directly contacted the IR clinic without physician referrals. During these telephone calls, patients were screened by nurses for potential contraindications to UAE, including known gynecologic malignancy, current pregnancy or desire to maintain fertility, active pelvic inflammatory disease, severe iodinated contrast allergy, and stages 4 and 5 chronic kidney disease [11]. After this initial screening, patients were scheduled for appointments with interventional radiologists to

discuss different treatment strategies for symptomatic uterine leiomyomas and to help patients determine if they should proceed with UAE. During the same time period, our IR department accepted referrals from gynecologists and primary care physicians who, on the basis of clinical assessment and/or prior imaging, believed that their patients would benefit from UAE.

### Chart Review

The clinic charts and hospital electronic medical records were reviewed for presenting symptoms and to see whether patients underwent UAE. In addition, the MRI reports were reviewed for incidental MRI findings and recommendations.

The majority of subjects in both groups presented with multiple symptoms: 77.8% (158 of 203) of group A and 75.5% (74 of 98) of group B, with at least one symptom being bleeding, bulk related, or pain. A single presenting symptom of bleeding (group A, 13.8% [28 of 203]; group B, 14.3% [14 of 98]), pain (group A, 3.4% [7 of 203]; group B, 5.1% [5 of 98]), or bulk-related symptoms (group A, 3.9% [8 of 203]; group B, 2.0% [2 of 98]) was also similar between groups. One subject in group A and two subjects in group B were asymptomatic, and one subject in each group presented with a symptom other than the three major symptoms discussed above.

### MRI Technique

Imaging was performed on either a 1.5-T or a 3-T MRI system (GE Healthcare, Milwaukee, Wisconsin; Siemens Medical Solutions, Erlangen, Germany). Imaging was performed with the patient supine, using a phased-array body coil centered over the pelvis. A single-shot turbo/fast spin-echo sequence was obtained in the coronal plane, followed by axial dual gradient-echo T1-weighted (in-phase and opposed-phase) imaging. High-resolution T2-weighted images were obtained in the sagittal and axial planes. Fat-suppressed T2-weighted images were obtained in the axial plane. After the intravenous administration of a gadolinium-based contrast agent, dynamic contrast-enhanced T1-weighted imaging was performed in the coronal plane, and delayed axial and sagittal T1-weighted images were obtained.

### Image Analysis

Two radiologists (one with three years postfellowship training and one fourth-year radiology resident) reviewed the MR images of all 227 subjects and measured uterine size in three planes to calculate uterine volume using the

formula for a prolate ellipse ( $L \times W \times D \times 0.5233$ ) [12]. Endometrial thickness and the largest leiomyoma and largest submucosal leiomyoma diameters were also measured.

Two abdominal radiologists with 15 and 3 years of postfellowship experience, respectively, reviewed the MR images of all 227 subjects in consensus for the presence of uterine leiomyomas, adenomyosis, and incidental findings. Incidental findings were categorized using the CT colonography categorization system, with category 3 and 4 findings considered potentially important findings requiring workup [13]. Category 1 findings include normal results and anatomic variants. Category 2 findings include clinically unimportant findings, such as simple renal cysts. Category 3 findings are likely unimportant, but workup may be indicated, such as a minimally complex renal cysts, and category 4 findings are potentially important findings, such as solid renal masses. The final radiology report was then reviewed to ensure concordance between the original report and the consensus read.

### Statistical Analysis

Results were initially analyzed using descriptive statistics. Two-sample *t* tests and *z* ratios for the significance between two independent proportions were calculated to compare groups A and B.

## RESULTS

A total of 301 subjects were referred to the IR clinic for potential UAE. The direct marketing campaign resulted in a self-referral population of 203 subjects (group A). Ninety-eight subjects were referred to the IR clinic by a gynecologist or primary care physician (group B). After appointments in the IR clinic, 73.4% of subjects from group A (149 of 203) and 79.6% of subjects from group

B (78 of 98) were referred for pretreatment planning MRI ( $P = .242$ ). A previous diagnosis of uterine leiomyoma (on the basis of prior ultrasound or CT imaging) was present in 87.9% of patients in group A (131 of 149) and in 92.3% of patients in group B (72 of 78) ( $P = .307$ ). In group B, 75.6% of subjects (59 of 78) were referred by a gynecologist, whereas the remaining were referred by primary care physicians.

Uterine leiomyomas were found in 91.3% of subjects from group A (136 of 149) and in 94.9% of subjects from group B (74 of 78) ( $P = .328$ ). Adenomyosis only, without leiomyoma, was found in only 4.0% of group A (6 of 149) and 3.8% of group B (3 of 78) ( $P = .947$ ). There was no significant difference between groups with respect to uterine volume, size of largest leiomyoma, or size of largest submucosal leiomyoma (Table 1).

Incidental findings were common, seen in 37.6% of group A (56 of 149) and 35.9% of group B (28 of 78). Category 3 and 4 incidental findings (potentially clinically significant and requiring workup) were found in 20.8% of group A subjects (31 of 149) and 24.4% of group B subjects (19 of 78) ( $P = .539$ ). Category 3 and 4 lesions included endometrial polyps or abnormal endometrial thickening requiring an endometrial biopsy ( $n = 14$ ), cervical lesions or stenosis ( $n = 5$ ), hydro- and hematosalpinx ( $n = 5$ ), solid ovarian masses, and complex cystic ovarian masses requiring surgical referral ( $n = 7$ ). Three urethral diverticula were identified, and four indeterminate lesions were identified in the liver, kidneys, and urinary bladder, including a renal cell carcinoma and a bladder neuroendocrine tumor. Other incidental findings included hydro-nephrosis ( $n = 3$ ), deep vein thrombosis ( $n = 3$ ), bowel abnormalities including acute diverticulitis ( $n = 1$ ), and a mucocele of the appendix ( $n = 1$ ). One patient each had cirrhosis and portal hypertension, a retrorectal cystic hamartoma, an indeterminate soft tissue mass in

Table 1. MRI results

Variable	Self-Referral (Group A) (n = 203)	Provider Referred (Group B) (n = 98)	p Value
Referred for MRI	73.4% (149/203)	79.6% (78/98)	.242
Uterine volume (mL)	563.9 (87.3-2964.3)	662.1 (113.2-2653.5)	.166
Largest leiomyoma (cm)	5.4 (0-13.4)	5.9 (0-13.4)	.281
Largest submucosal leiomyoma (cm)	0.9 (0-8.9)	0.6 (0-6.7)	.243
Leiomyomas present	91.3% (136/149)	94.9% (74/78)	.328
Adenomyosis only	4.0% (6/149)	3.8% (3/78)	.947
Incidental findings (category 3/4)	20.8% (31/149)	24.4% (19/78)	.539
Underwent UAE	41.6% (62/149)	48.7% (38/78)	.306

Note: For size measurements, mean is given with range in parentheses. UAE = uterine artery embolization.

the groin, and an indeterminate osseous lesion requiring further imaging.

After MRI, 41.6% of group A (62 of 149) and 48.7% of group B (38 of 78) underwent UAE ( $P = .306$ ).

## DISCUSSION

UAE has become a first-line treatment for symptomatic uterine leiomyomas. Direct patient marketing has been shown to increase a practice's volume, but it is unclear if direct marketing also leads to an increased volume of patients who are not suitable candidates for UAE by eliminating assessment by a clinician before the patient presents to the IR clinic [7,8]. The purpose of this investigation was to compare the rates of uterine leiomyomas, possible alternative explanations for symptoms, and incidental findings of patients who were self-referred through a direct marketing campaign to a group of patients who were referred by non-IR physicians using MRI findings as the outcomes measure. Our initial hypothesis was that the self-referred population would have a lower incidence of imaging findings favorable for UAE and a higher incidence of diagnoses other than leiomyomas (eg, adenomyosis) to explain their symptoms. The results of our investigation, however, support the null hypothesis.

Initial screening by the IR clinic, typically done over the telephone by a clinic nurse, can exclude many patients by asking a few questions, including if there is a desire to maintain fertility. Once patients were scheduled for IR clinic appointments, we found no significant difference between groups (self-referred via direct marketing [group A] versus physician referred [group B]) in terms of the numbers who underwent preprocedure MRI and eventual embolization, suggesting that initial telephone screening works to exclude many patients who are not candidates for UAE.

Pre-embolization MRI allows accurate determination of leiomyoma burden, location, morphology, and vascularity [14,15]. MRI has previously been shown to alter treatment plans in about 20% of patients who were initially thought to have leiomyomas [6]. For example, UAE may not be the best treatment for certain patients, particularly those with primarily large submucosal or subserosal leiomyomas and those with extensive adenomyosis [16]. On the basis of the preprocedure MRI results in our study population, we found no significant difference between referral groups in the proportion of patients who had leiomyomas or other abnormalities to account for symptoms, such as adenomyosis. We also

found that uterine volume, largest leiomyoma, and largest submucosal leiomyoma were similar between referral groups.

When patients are self-referred for UAE and are not referred by gynecologists or primary care physicians for their symptoms, it is also possible that more incidental findings or contraindications to UAE will be found on subsequent imaging. However, on the basis of MRI alone, we found that incidental findings overall (37% [84 of 227]) and potentially important incidental findings (22% [50 of 227]) occurred in similar percentages of patients between groups.

We did not specifically examine the potential role referring physicians play in counseling patients about treatment options, and we did not set out to establish self-referral as a superior workflow when all aspects of patient care are considered. Some investigators have contended that lack of a routine referral relationship between gynecologists and interventional radiologists results in women receiving treatment that might not be fully aligned with their treatment desires [10]. We agree that regardless of whether a patient is initially evaluated by a gynecologist, a primary care physician, or an interventional radiologist, the patient must be fully informed regarding the complete spectrum of surgical and nonsurgical treatment options available. Furthermore, having a direct marketing campaign resulting in a significant self-referred population does not necessarily preclude a healthy collaborative relationship between gynecologists and interventional radiologists for the treatment of patients with suspected symptomatic leiomyomas [10].

Given that similar proportions of patients from the self-referred population and the physician-referred population eventually underwent UAE, we can conclude that despite an increased volume of patients presenting to an IR clinic because of direct marketing [8], the increased volume of patients results in a proportionate increase in patients who are suitable candidates for UAE. The initial clinic visit is largely spent discussing the patient's symptoms, what the patient can expect from UAE, and the available treatment options. It is not surprising that fewer than half of patients from both the self-referred and physician-referred groups underwent UAE. Because self-referred patients are not referred by physicians, they may be largely unaware of their treatment options. In our population, most patients who were physician referred were referred by gynecologists, and patients may feel more comfortable being treated by physicians with whom they have prior relationships.

There were limitations to this study. Patients were categorized as having been self-referred only or referred by physicians only on the basis of an intake questionnaire, but it is possible that patients in both groups may have had discussions with physicians before presenting to the IR clinic. There was selection bias, in that nearly all patients had previously documented leiomyomas by imaging, before presenting to the IR clinic. However, it is unlikely that a significant proportion of patients would present to an IR clinic for UAE without a diagnosis of leiomyomatous uterus, particularly with the ubiquity of prenatal ultrasound and cross-sectional imaging for pelvic pain and bleeding, symptoms common in both cohorts. Furthermore, the mere presence of leiomyomas does not necessarily imply their suitability for UAE or exclude the possibility of contraindications and/or alternative diagnoses. Although incidental findings were commonly identified on MRI, we were unable to determine how many patients had the incidental findings previously documented, as many patients' primary care providers were not located at our institution. Finally, clinical follow-up was limited in patients who were not part of our health system, and we were reliant on clinic notes for purposes of this study.

## CONCLUSIONS

A direct marketing campaign has been shown to increase IR clinic volume, but after an initial screening process, the incidence of leiomyomas, alternative diagnoses such as adenomyosis, and incidental findings is not significantly different between patients who are self-referred and those who are physician referred. Similar percentages of patients from both groups proceed to UAE.

## TAKE-HOME POINTS

- Direct patient marketing has been shown to increase an IR practice's volume.
- There are no differences between self-referred and physician-referred populations with respect to proportion of patients with leiomyomas and alternative diagnoses to explain patients' symptoms.
- The incidence of incidental findings between self-referred and physician-referred populations is similar.

- Compared with a physician-referred population, direct patient marketing leads to a proportionate number of patients who are candidates for UAE.

## REFERENCES

1. Ravina JH, Herbreteau D, Ciraru-Vigeneron N, et al. Arterial embolisation to treat uterine myomata. *Lancet* 1995;346:671-2.
2. Ganeshan A, Nazir SA, Hon LQ, et al. The role of interventional radiology in obstetric and gynaecology practice. *Eur J Radiol* 2010;73:404-11.
3. Bradley LD. Uterine fibroid embolization: a viable alternative to hysterectomy. *Am J Obstet Gynecol* 2009;201:127-35.
4. Beinfeld MT, Bosch JL, Isaacson KB, Gazelle GS. Cost-effectiveness of uterine artery embolization and hysterectomy for uterine fibroids. *Radiology* 2004;230:207-13.
5. Volkers NA, Hehenkamp WJ, Smit P, Ankum WM, Reekers JA, Birnie E. Economic evaluation of uterine artery embolization versus hysterectomy in the treatment of symptomatic uterine fibroids: results from the randomized EMMY trial. *J Vasc Interv Radiol* 2008;19:1007-16.
6. Omary RA, Vasireddy S, Chrisman HB, et al. The effect of pelvic MR imaging on the diagnosis and treatment of women with presumed symptomatic uterine fibroids. *J Vasc Interv Radiol* 2002;13:1149-53.
7. Chrisman HB, Smith SJ, Sterling KM, et al. VI. Uterine fibroid embolization: developing a clinical service. *Techn Vasc Interv Radiol* 2002;5:67-76.
8. Ciacci J, Taussig J, Kouri B, Bettmann M. A single institution's 1-year experience with uterine fibroid embolization marketing. *J Vasc Interv Radiol* 2011;22:1236-9.
9. Chrisman HB, Basu PA, Omary RA. The positive effect of targeted marketing on an existing uterine fibroid embolization practice. *J Vasc Interv Radiol* 2006;17:577-81.
10. Zurawin RK, Fischer JH II, Amir L. The effect of a gynecologist-interventional radiologist relationship on selection of treatment modality for the patient with uterine myoma. *J Minim Invasive Gynecol* 2010;17:214-21.
11. Dariushnia SR, Nikolic B, Stokes LS, Spies JB. Society of Interventional Radiology Standards of Practice Committee. Quality improvement guidelines for uterine artery embolization for symptomatic leiomyomata. *J Vasc Interv Radiol* 2014;25:1737-47.
12. Orsini LF, Salardi S, Pilu G, Bovicelli L, Cacciari E. Pelvic organs in premenarcheal girls: real-time ultrasonography. *Radiology* 1984;153:113-6.
13. Zalis ME, Barish MA, Choi JR, et al. CT colonography reporting and data system: a consensus proposal. *Radiology* 2005;236:3-9.
14. Spielmann AL, Keogh C, Forster BB, Martin ML, Machan LS. Comparison of MRI and sonography in the preliminary evaluation for fibroid embolization. *AJR Am J Roentgenol* 2006;187:1499-504.
15. Dueholm M, Lundorf E, Hansen ES, Ledertoug S, Olesen F. Accuracy of magnetic resonance imaging and transvaginal ultrasonography in the diagnosis, mapping, and measurement of uterine myomas. *Am J Obstet Gynecol* 2002;186:409-15.
16. Cura M, Cura A, Bugnone A. Role of magnetic resonance imaging in patient selection for uterine artery embolization. *Acta Radiol* 2006;47:1105-14.