Retrospective Study of the Impact of Fellowship Training on Two Quality and Safety Measures in Uterine Artery Embolization

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Rationale and Objectives: To measure the impact of 1-year interventional fellowship training on fluoroscopic time and contrast media utilization in uterine artery embolization (UAE).

Materials and Methods: Retrospective single institution analysis of 323 consecutive UAEs performed by 12 interventional fellows using a standardized protocol. Fluoroscopy time and contrast media volume were recorded for each patient and correlated with stage of fellowship training. Preprocedure uterine volume (using MRI or ultrasound) was used as a measure of procedural complexity. Regression analysis was conducted per trainee factoring in duration of training, procedure number, supervising radiologist, uterine volume, and outcome variables of fluoroscopy time and contrast media volume.

Results: Median number of patients treated per trainee was 27 (range, 16-43) with mean fluoroscopic time 24.5 minutes (range, 4-90 min) and mean contrast volume 190 mL (range, 50-320 mL). Increasing uterine volume had no significant effect ($P > .05$) on fluoroscopic time but significantly increased ($P < .001$) contrast media volume. Significant training effect was identified with decrease in fluoroscopic time ($P < .001$) and decrease in contrast volume ($P = .02$) over training. Over the course of a 1-year fellowship, these summed to a decrease of 12 minutes in UAE fluoroscopy time and 17 mL less contrast.

Conclusion: A significant ($P < .05$) training effect that is clinically relevant was demonstrated over the course of a yearlong interventional radiology fellowship program in performance of a standardized protocol for UAE. This data supports fellowship training as a basis for UAE credentialing and privileging.

Key Words: Credentialing, training, interventional, radiation, uterine artery embolization

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INTRODUCTION

Since its description in 1995 [1], uterine artery embolization (UAE) has become an accepted alternative to medical and surgical treatment of uterine leiomyomata (uterine fibroids) [1,2]. A number of large multinational, multi-institutional, prospective, and retrospective studies have shown efficacy and safety for improving clinical outcome variables of pain, bleeding, and symptoms relating to the mass effect of the fibroids in approximately 85% of patients [3-8].

UAE is diagnostically and technically challenging because of difficulties in recognizing the abnormal contrast enhancement pattern of uterine leiomyomata on pelvic angiography and, when identified, safely and completely occluding the abnormal vascular bed. In our experience, 2 clinically relevant easily measured metrics—fluoroscopy time and contrast media volume—can be used as safety metrics that are related to the diagnostic and technical skill level of the operator. Reduction in these 2 measures has been associated with a reduction in procedural risk [9].

We conducted this retrospective study to determine if a training effect could be measured in these 2 metrics within a standardized UAE procedure during a 1-year interventional radiology (IR) fellowship program.

MATERIALS AND METHODS

We performed a retrospective (July 2009 to July 2012) single-center study in 323 consecutive women (median age, 45; range, 26-56) treated with UAE for symptomatic uterine leiomyomas. The UAE performance of the 12 clinical IR trainees under the supervision of 7 experienced staff radiologists was the focus of the

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study. We obtained expedited institutional research board ethical approval for this study.

Pre-embolization Evaluation

All patients received formal UAE preprocedural consultation by both the referring gynecologist, as well as the IR service, and were deemed appropriate candidates. Standard hematologic panels and coagulation profiles were documented before the procedure. Baseline uterine volume determination was made using MRI (314 of 323, 97%) or ultrasound (9 of 323, 3%). Maximal anterior-posterior, right-left, and cephalad-caudad measurements of the uterus were performed and converted to a volume using the equation for a prolate ellipsoid (d1 × d2 × d3 × .5233) [10].

Clinical Procedural Management

Informed written consent was obtained in all cases. Patients were admitted on the morning of the procedure and brought to the IR suite. Routine intravenous antibiotics were administered in all patients (1 g Cefazolin (Ancef; Smith-Kline Beecham Pharm, Oakville, Ontario or in penicillin allergic patients Clindamycin 300 mg IV; Sando Canada Inc. Qc, Canada). A Foley bladder catheter was inserted by a nurse before treatment. The procedure was performed using conscious/moderate sedation and analgesia with use of midazolam (Versed; Hoffman-LaRoche) and fentanyl narcotic (Sublimaze; Abbott Laboratories, St Laurent, Quebec, Canada) with morphine loaded postprocedural patient-controlled analgesia pump and on-demand antiemetic. All procedures were performed as short-stay procedures with patients initially recovering for 1 to 2 hours in the IR recovery area, then being transferred to the surgical short-stay ward and overnight admission. Nonionic contrast media was used in all cases (Optiray 320, Tyco Healthcare, Montreal, Canada).

At discharge, patients were given prescriptions for oral diclofenac (Apotex Inc. Ontario, Canada) and oxycodone with acetaminophen (Percocet; Du Pont Pharma, Mississuaga, Ontario, Canada). Follow-up was performed by the referring gynecologist at 6 weeks and all patients were seen at 3 months for clinical consultation and pelvic ultrasound examination.

Embolization Technique

Standard ultrasound-guided Seldinger technique via the right common femoral artery using a 4Fr or 5Fr C1 or C2 catheter and 5F sheath was conducted in all cases. Coaxial microcatheters were not used routinely but reserved for cases in which the operator deemed them necessary. Embolization was performed from a stable and safe position, ideally within the transverse portion in the uterine artery. Polyvinyl alcohol particles, 355 μm to 500 μm, packaged as 1 cc per vial (Contour, Target Therapeutics, Boston Scientific Corporation, Mississauga, Ontario, Canada) was the only embolic agent used. The embolization end point was defined as stasis of antegrade flow in the uterine artery for at least 5 cardiac cycles. A routine postembolization flush aortogram was performed in all cases. Protocol was maintained for all patients and all supervising staff radiologists.

The primary operator for each procedure was 1 of 12 IR fellows each undergoing a 1-year dedicated IR fellowship. All procedures were performed under the direct supervision of 1 of 7 senior staff IR. The fellows were the primary operator for all of the UAE procedures with the supervising physician available in a system of graduated responsibility. Radiation exposure was minimized by the use of pulsed fluoroscopy, collimation, and avoidance of magnification and oblique imaging planes [11]. The retrospective nature of this study blinded operators to interaction with either outcome metric.

Statistical Analysis

Analysis was performed on an intention-to-treat basis. Results are expressed as mean, median, and standard error to detail variation in patient and technical details and contrast medium volume and fluoroscopy time. Statistical analysis of the results was performed using the MLwiN multilevel model statistical analysis software program (University of Bristol, UK). Regression analysis was conducted factoring in the individual operator, the number of days of fellowship training, the number of procedures performed during the fellowship, the staff radiologist supervising the procedure, overall fluoroscopy time, contrast medium use, and uterine volume. P values were calculated by Z tests based on the estimated coefficient of regression and the estimated standard error of this coefficient. Statistical significance was determined by a P value $\geq .05$.

RESULTS

Three hundred and twenty three patients underwent UAE, with a mean age of 45 (range, 26-56) and mean uterine volume 642 cc (range, 66-4,828). The average number of patients treated per trainee over the 1-year training was 27 (range, 16-43). Total fluoroscopic time and contrast volume were recorded in 322 of 323 (99.6%) and 321 of 323 (99.3%) patients respectively. The mean total fluoroscopic time was 24.6 minutes per study (range, 3.6-90 minutes) for all fellows. The mean volume of contrast media per UAE was 190 mL, (range, 50-320 mL).

Technical Success

Technical success was achieved in 309 of the 323 patients. Failure of bilateral embolization occurred in 14 patients (4%); these patients had unilateral embolization performed.

In the cases of failed bilateral embolization, anatomical variation precluding bilateral embolization was the cause in 11 patients. In 9 patients, 1 uterine artery was unilaterally hypoplastic, absent, or too small or tortuous