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The effects of uterine artery embolization on ovarian reserve

Chang-Woon Kim [a,1], Haeng Seon Shim [b,1], Hong Jang [c], Yun Gyu Song [c,*]

[a] Department of Obstetrics and Gynecology, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, South Korea
[b] Department of Anesthesiology and Pain Medicine, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, South Korea
[c] Department of Radiology, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, South Korea

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ABSTRACT

Objective: To evaluate the effects of UAE for symptomatic uterine fibroids on ovarian reserve based on AMH.

Study design: This was a retrospective study conducted between March 2011 and October 2014. All women underwent UAE. At baseline and at the 3-month and 12-month follow-up visits, serum anti-Müllerian hormone (AMH), follicle stimulating hormone (FSH), luteinizing hormone (LH), and estradiol (E2) levels were assessed, and ovarian volume and antral follicle count (AFC) were evaluated in each patient.

Results: There were no statistically significant differences in serum E2, LH, or FSH levels or in ovarian volume 3 or 12 months after UAE ($P = 0.8194$, $P = 0.3976$, $P = 0.4766$, and $P = 0.6822$, respectively). However, AMH and AFC were significantly different 3 and 12 months after the procedure ($P = 0.00$, $P = 0.029$ and $P = 0.00$, $P = 0.00$, respectively). AMH levels remained low after 12 months of follow-up compared to the expected AMH levels. A statistically significant recovery of serum AMH at 12 months compared to at 3 months in those <40 years of age ($P = 0.00$), but not in those ≥40 years ($P = 0.837$).

Conclusions: Ovarian reserve appears to be affected by UAE in premenopausal women. However, younger ovaries (according to biological ovarian age) exhibit a greater capacity for recovery after ovarian damage. Therefore, larger studies are needed for more conclusive results.

Introduction

Since its introduction in 1995, uterine artery embolization (UAE) has been established as a safe and effective alternative to the surgical treatment of symptomatic uterine fibroids [1–4]. However, amenorrhea has been reported after UAE [5,6] and the incidence of permanent ovarian failure occurred in more than 2% of patients overall and approximately 7% of those near menopause after UAE [7,8].

The effects of UAE on fertility remain understudied [9–11]. In fertility, the ovarian reserve is more important with respect to women's health-related wellbeing in related organs. Consequently, a number of studies have evaluated ovarian reserve after UAE for symptomatic fibroids using hormone markers and have suggested that ovarian reserve is subclinically affected in most women; however, the ovarian reserve of perimenopausal women 45 years of age and older was apparently affected [7,12–17].

There are many markers for evaluating ovarian reserve, including antral follicle count (AFC), anti-Müllerian hormone (AMH), follicle stimulating hormone (FSH), inhibin B, estradiol (E2), and luteinizing hormone (LH) [18]; however, AMH is superior to these other markers for evaluating ovarian reserve [19,20]. Few reports have evaluated ovarian reserve based on AMH level after UAE [21,22]. Therefore, the aim of the present study was to evaluate the effects of UAE on ovarian reserve, as determined by AMH, in premenopausal women.

Materials and methods

Patients

The institutional review board approved this retrospective study. We obtained verbal and written informed consent from each patient. Between March 2011 and October 2014, 32 women with

* Corresponding author at: Department of Radiology Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, 158 Changwon 630-723, South Korea, Tel.: +82 55 290 6092; fax: +82 55 290 6087.
E-mail address: yawoo114@naver.com (Y.G. Song).

[1] These authors equally contributed to this work.

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Table 1
Baseline patient characteristics.

Characteristic	Mean ± SD	Range
Age (years)	39.4 ± 4.8	27–45
≥40	11 (no.)	40–45
<40	21 (no.)	27–39
Body mass index (kg/m^2)	22.8 ± 2.9	18–30.4
Gravidity (no.)	2.7 ± 1.5	0–5
Parity (no.)	1.4 ± 0.8	0–3
No. of fibroids per patient	3.4 ± 2.4	1–11
Dominant fibroid volume (cm^3)	265.26 ± 339.0	28.4–1800
Total uterine volume (cm^3)	960.27 ± 548	146.4–2400.6

symptomatic fibroids underwent UAE using gelatin sponge particles. Patient age ranged from 27 to 44 years (mean age, 39.4 years). All patients had regular menstrual cycles and had no clinical findings of menopause. All patients underwent baseline transvaginal ultrasonography (US) and magnetic resonance imaging (MRI) to evaluate antral follicles and ovary and fibroid features (Table 1). Baseline hormone levels, including AMH, FSH, LH, and E2, were measured during the early follicular phase (days 3–7 of the menstrual cycle) before UAE. All follicles 2–10 mm in size were measured. The sum of the follicles in each ovary was designated as the AFC. Exclusion criteria included (i) age >45 years; (ii) basal serum FSH level >25 mIU/mL; (iii) a history of myomectomy, embolization, unilateral or bilateral oophorectomy, or hormone therapy of fibroids preceding the study; and/or (iv) a history of hysterectomy during follow-up.

UAE procedure

The same interventional radiologist performed all patient preparation and embolization procedures, as described previously [23]. A coaxial 3-F microcatheter (Stride Hi-flow; Asahi Intecc, Osaka, Japan) through a 5.0-F RUC catheter (Cook, Bloomington, IN, USA) was placed first in the left uterine artery, followed by the right uterine artery. Embolization was performed using gelatin sponge particles (SPONGOSTAN, Johnson & Johnson, Skipton, UK). The particle sizes were 500–710 μm initially and then changed to 710–1000 μm. Complete cessation of blood flow in the proximal ascending uterine artery after 10 cardiac beats was considered the embolization end point. Post-procedural pain was managed with an intravenous patient-controlled analgesia pump containing 1500 μg fentanyl sulfate and 150 mg ketorolac tromethamine, and additional nonsteroidal anti-inflammatory drugs were given by intravenous injection.

Clinical follow-up

Serum levels of AMH, FSH, LH, and E2 and ovarian volume with AFC were evaluated during the early follicular phase at the 3-month and 12-month follow-up visits. Ovarian volume and AFC were assessed via transvaginal ultrasound. Ovarian volume was calculated according to the prolate ellipse formula (length × depth × width × 0.5233).

Statistical analysis

Statistical analysis was performed with SPSS version 10.1 software for Windows (SAS Institute, Cary, NC, USA). Continuous variables were expressed as the mean ± SD. Comparisons were performed with repeated measures ANOVA. A P value <0.05 was considered statistically significant.

Results

We observed an increasing trend in FSH and LH levels after UAE; however, no statistically significant differences in serum FSH or LH level was found at baseline, 3 months, or 12 months after UAE. Also, there were no statistically significant differences in E2 or ovarian volume at baseline, 3 months, or 12 months.

AFC and AMH levels in UAE patients had decreased at the 3-month follow-up (5.34 ± 0.43 [P = 0.00], 1.46 ± 1.23 [P = 0.00], respectively). These levels recovered somewhat by the 12-month follow-up visit (7.69 ± 0.65, 1.66 ± 1.13, respectively), but were still significantly lower than at baseline (P = 0.00, P = 0.029, respectively).

Statistically significant differences were found in AFC and serum AMH at 12 months compared to baseline in patients <40 years of age (P = 0.00, P = 0.00) and ≥40 years of age (P = 0.00, P = 0.26). Also, serum AMH recovered significantly between 3 and 12 months in those <40 years of age (P = 0.00). However, no statistically significant differences were found in serum AMH at 3 and 12 months (P = 0.837) in those ≥40 years (Figs. 1A and B and 2). The changes in AMH, AFC, FSH, LH, and E2 levels and ovarian volume are shown in Table 2.

AMH levels following UAE are presented in Fig. 3 and compared to reference data from Seifer et al. [24]. Amenorrhea occurred in

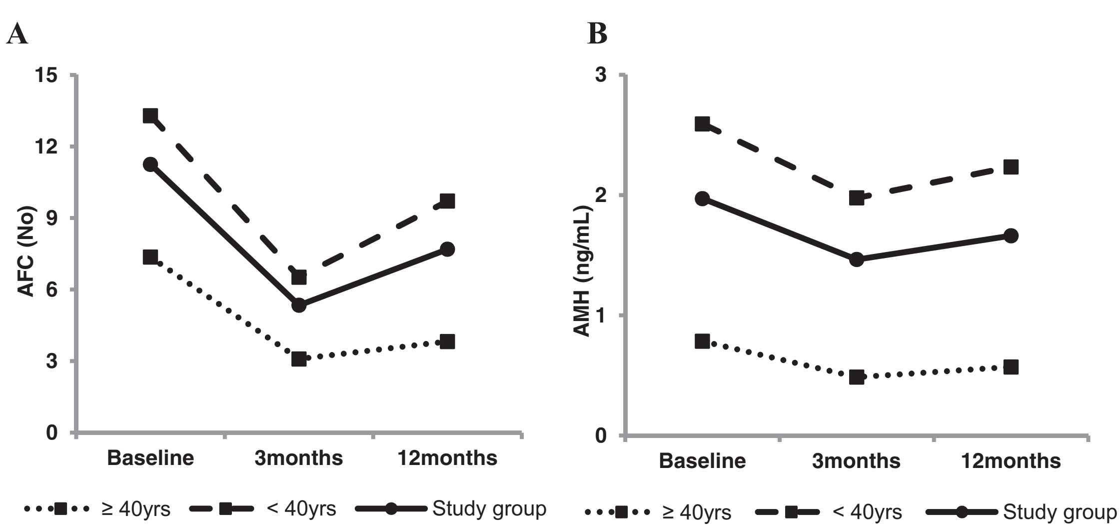

Fig. 1. Results of (A) AFC and (B) AMH levels (pre- and post-UAE).