INITIAL RESULTS FROM UTERINE FIBROID EMBOLIZATION FOR SYMPTOMATIC LEIOMYOMATA

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ABSTRACT

Background: Uterine fibroids and uterine artery embolization (UAE) are closely linked in the management of benign gynecological conditions, particularly in women of reproductive age. Uterine fibroids can result in heavy menstrual bleeding, pelvic pain and pressure symptoms. Uterine artery embolization (UAE) is a new minimally invasive uterus preserving technique of fibroid treatment and alternative to hysterectomy. In 90% of the patients; it controls heavy vaginal bleeding within 24 hrs after the procedure. MRI is the modality of choice for to assess fibroid changes after UAE.

Objective: To assess the initial results of uterine artery embolization (UAE) for symptomatic leiomyomas.

Material and Methods: This prospective cohort study was performed in the Radiology Department of Kuwait Teaching Hospital, from 1 August 2022 to 31st July 2023, on 204 consecutively registered patients. Patients 20 yrs and above with symptomatic leiomyomata were included in the study. No upper limit for uterus or fibroid volume was kept. Patients with gynaecological malignancy, undiagnosed pelvic mass, acute pelvic infection, pregnancy, menopause, contraindication to MRI and allergy to contrast agents were excluded from the study. Follow-up evaluation was performed 3 months after the procedure to assess volume reduction, infarction rates, and symptom improvement.

Results: The ages of the patient were grouped in clusters of 10 yrs. 45.1% of the patients were found in 31-40 yrs age group. Majority of the fibroids were found in intramural location comprising 69.1%. 47.1% of the patients had single fibroid. Bleeding was resolved in 185 among 192 patients (96.3%) which means that only 7 patients were still having menorrhagia; bulk/pressure symptoms and pelvic pain was resolved in all of the patients.

Conclusion: UAE is an effective, minimally invasive, uterus-preserving treatment for symptomatic fibroids, providing significant symptom relief and improved outcomes.

Keywords: Uterine Fibroid Embolization, Leiomyoma, Radiologists, Hysterectomy, Symptomatic Relief, Magnetic Resonance Imaging, Uterine Artery Embolization.

INTRODUCTION

Uterine leiomyomas also known as uterine fibroids are the most common benign gynaecological neoplasm which primarily affects women of reproductive age group(1). Its prevalence increases with age until menopause affecting women more than hypertension or breast cancer. Racial difference is also noted with higher age specific incidence and prevalence among black females at all ages. Life time prevalence exceed 80% in African American women and about 70% in Caucasian women(2). Uterine fibroids are symptomatic in 25% of females and in 25% the symptoms are so severe that it requires treatment.

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Fibroids can result in heavy menstrual bleeding, dysmenorrhea, dyspareunia, pressure symptoms, pelvic pain, bladder and bowl dysfunction and can also impair infertility. It can affect quality of life more than other chronic conditions like irritable bowel syndrome, asthma or gastroesophageal reflux disease(3). Myomectomy and hysterectomy are the traditional means of treatment of symptomatic fibroids. Uterus preserving techniques are preferred with increase rate of later marriages and pregnancies. Myomectomy is a uterus preserving technique with removal of only fibroid, although it controls heavy bleeding but it is associated with myometrial trauma (4).

UAE is a new minimally invasive uterus preserving technique of fibroid treatment and alternative to hysterectomy. UAE is performed under local anesthesia, temporary occluding the arterial supply of fibroids with biocompatible particles which results in ischemic infarction of fibroids. In 90% of the patients; it controls heavy vaginal bleeding within 24 hrs after the procedure. It does not result in adhesions after the procedure and treat all fibroids simultaneously. Initially, uterine artery embolization (UAE) was performed to control bleeding prior to myomectomy or for the management of postpartum hemorrhage.

However, it was later identified as an effective treatment option for uterine fibroids in patients with dysfunctional uterine bleeding (5).
No recurrence is noted in the fibroids which are necrotized and completely infarcted during long term follow up period (6). In routine patients are hospitalized overnight for observation and pain management, however patient can be discharged same day if pain is properly managed and the patient is educated (7). UAE improves symptoms and thus quality of life in most patients with symptomatic leiomyomata. MRI is the modality of choice to assess fibroid changes after UAE. Fibroid volume reduction is the imaging criteria used. Fibroid volume and vascularity is assessed by CE MRI. MRI will also exclude other uterine pathologies(8).
Uterine artery embolization (UAE) is performed by interventional radiologists in a limited number of countries, yet it remains largely underrecognized and underutilized as a treatment option for uterine fibroids (9). Despite its growing demand, particularly among patients seeking minimally invasive alternatives to surgery, there is a paucity of research evaluating the response of fibroids following UAE. Limited studies have explored factors such as fibroid size, location, and vascularity, which may influence treatment outcomes (10). This gap in evidence underscores the need for further research to establish standardized protocols and improve the adoption of UAE in clinical practice. (11). Therefore, this study aims to assess the initial results of UAE for symptomatic leiomyomas, focusing on volume reduction, infarction rates, and symptom improvement.

MATERIAL AND METHODS

This prospective cohort study was performed in the Radiology Department of Kuwait Teaching Hospital, from 1 August 2022 to 31st July 2023, on 204 consecutively registered patients. Patients 20 yrs and above with symptomatic leiomyomata were included in the study. No upper limit for uterus or fibroid volume was kept. Patients with gynaecological malignancy, undiagnosed pelvic mass, acute pelvic infection, pregnancy, menopause, contraindication to MRI and allergy to contrast agents were excluded from the study. Initial results were assessed immediately after the uterine artery embolization (UAE) procedure and during the overnight inpatient stay, focusing on technical success (defined as successful embolization of both uterine arteries with achievement of stasis), immediate complications (e.g., hematoma, allergic reactions, or vascular injury), patient tolerance (monitoring for pain, fever, or other symptoms), and baseline MRI findings (used to confirm the diagnosis of uterine leiomyomas and document the initial volume of the uterus and largest fibroid). Follow-up evaluation was performed 3 months after the procedure to assess volume reduction, infarction rates, and symptom improvement.

Data Collection Procedure

Prior to the commencement of the study, ethical approval was obtained from the Institutional Review Board of Kuwait Teaching Hospital Peshawar, under reference # 389-2. The study population consisted of patients with symptomatic leiomyomata attending the Radiology Department of KTH for pelvic MRI and who fulfilled the inclusion criteria. Patients underwent a thorough medical history and were made aware of the purpose, importance, and procedures of the study. Informed written consent was obtained from all participants.

All UAE procedures were conducted by one interventional radiologist, solely with the unilateral Common Femoral Artery (CFA) approach. We performed the procedures with a GE Advantax UNV MX 150 angiography system. Informed consent was obtained and a 5F sheath was inserted into the right femoral artery. Selectively catheterizing the bilateral internal iliac arteries with a 4F C2 catheter, the uterine arteries are visualized on angiography. Embolization was performed to stasis using 500 µm PVA particles. The procedure was well tolerated by the patients, and there were no immediate complications. After the procedure, patients were shifted to the inpatient department (IPD) for overnight observation and routine care. They were discharged in stable condition the following day.

MR Image Evaluation

Baseline unenhanced and contrast enhanced MR images were acquired before UAE and were used to confirm that the tumors were uterine leiomyomas. Unenhanced and contrast enhanced images were obtained 3 months after UAE. The volumes of the largest fibroid and uterus were calculated on MR images by using formula LxWxDx0.5233. Two blinded experienced radiologists independently estimated the infarction of all leiomyomas on contrast enhanced MR images. Any difference in assessment between the radiologists were resolved by the discussion and mutual consensus.

Data Analysis

All data were analyzed using SPSS version 23.0. We assessed infarction rates of all

leiomyoma tissues and the largest tumor, volume reduction rates of the largest tumor and uterus. We also assessed infarction rates of all leiomyoma tissue at contrast enhanced (CE) magnetic resonance images (MRI). Study variables were age, location of fibroid, number of fibroids, symptoms, total uterine volume, dominant fibroid volume, maximum diameter of largest fibroid and MRI characteristics which includes T1, T2 SI and contrast enhancement.

RESULTS

We analyzed the MRI scan of total of 204 patients with uterine fibroids before and 3 months after the uterine artery embolization. The ages of the patient were grouped in clusters of 10 yrs. Majority of the patients were found in 31-40 yrs age group comprising 92 patients which makes 45.1 %. The location of fibroids was categorized as submucosal, intramural and subserosal. Fibroids were also categorized by their number as single, 2-5 and more than 5. Majority of the patients had single fibroid constituting 96 patients which makes 47.1%. Table-1.

Table-1: Patient demographics & other characteristics

Characteristics	N(%)
Age groups in years	
21-30	77 (37.7%)
31-40	92 (45.1%)
41-50	35 (17.2%)
Location of Largest Fibroid	
Submuscosal	39 (19.1%)
Intramural	141(69.1%)
Subserosal	24 (11.8%)
Number of Fibroids	
1	96 (47.1%)
2-5	62 (30.4%)
More than 5	46 (22.5%)

The symptoms of patients with fibroids were assessed before and after uterine artery embolization (UAE). The findings are summarized in Table 2. Average total uterine volume pre-embolization was 1164.22 cm^3 and 610.54 cm^3 post UAE. Average dominant fibroid volume pre-UAE was 497.61cm^3 and post UAE it was 206.34 cm^3. Maximum diameter of the largest fibroid pre-UAE was 7.91 cm and post UAE was 5.46 cm. Table-2

Table-2: Symptoms with fibroid before and after UAE

Symptoms	Pre UAE	Post UAE
Bleeding	192 (94.1%)	185 (90.7%)
Bulk	60 (29.4%)	60 (29.4%)
Pelvic Pain	70 (34.3%)	70 (34.3%)
Mean total uterine volume (cm^3)	1164.22	610.54
Mean dominant fibroid volume (cm^3)	497.61	206.34
Mean maximum diameter of largest fibroid (cm)	7.91	5.46

Before embolization, the majority of fibroids were T1 hypointense (66.7%) and T2 heterogeneous (52.5%). Post-UAE, all fibroids became T1 hypointense, while most were T2 hypointense (97.1%). Contrast enhancement was significantly reduced, with 88.2% of fibroids showing no enhancement post-UAE. Detailed signal intensity changes are summarized in Table 3.

Table-3: T1, T2 signals & Contrast enhancement Pre & Post UAE

T1	Pre UAE	Post UAE
Isointense	64 (31.4%)	0 (0%)
Hypointense	136 (66.7%)	204 (100%)
Hyperintense	0 (0%)	0 (0%)
Heterogenous	4 (2%)	0 (0%)
T2		
Isointense	0 (0%)	0 (0%)
Hypointense	81 (39.7%)	198 (97.1%)
Hyperintense	16 (7.8%)	0 (0%)
Heterogenous	107 (52.5%)	6 (2.9%)
Contrast Enhancement		
Yes	178 (87.3%)	24 (11.8%)
No	26 (12.7%)	180 (88.2%)

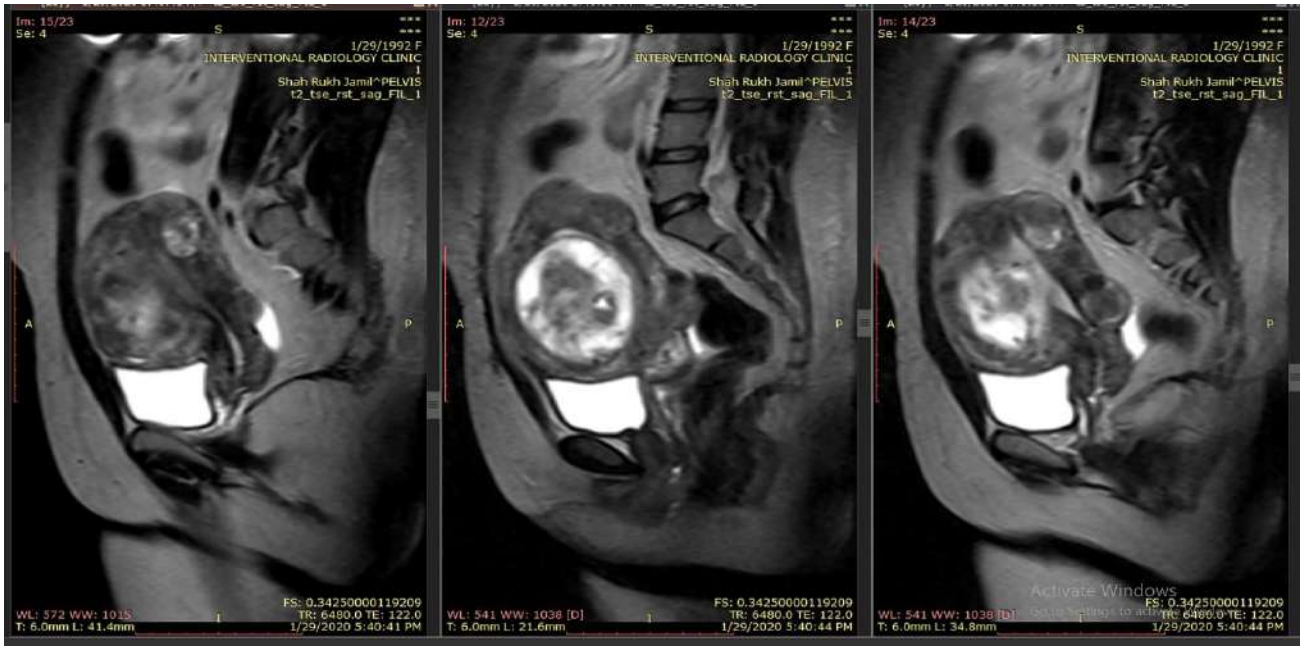

Fig1a: T2 sagittal MRI showing multiple variable size intramural fibroids giving heterogenous signals.

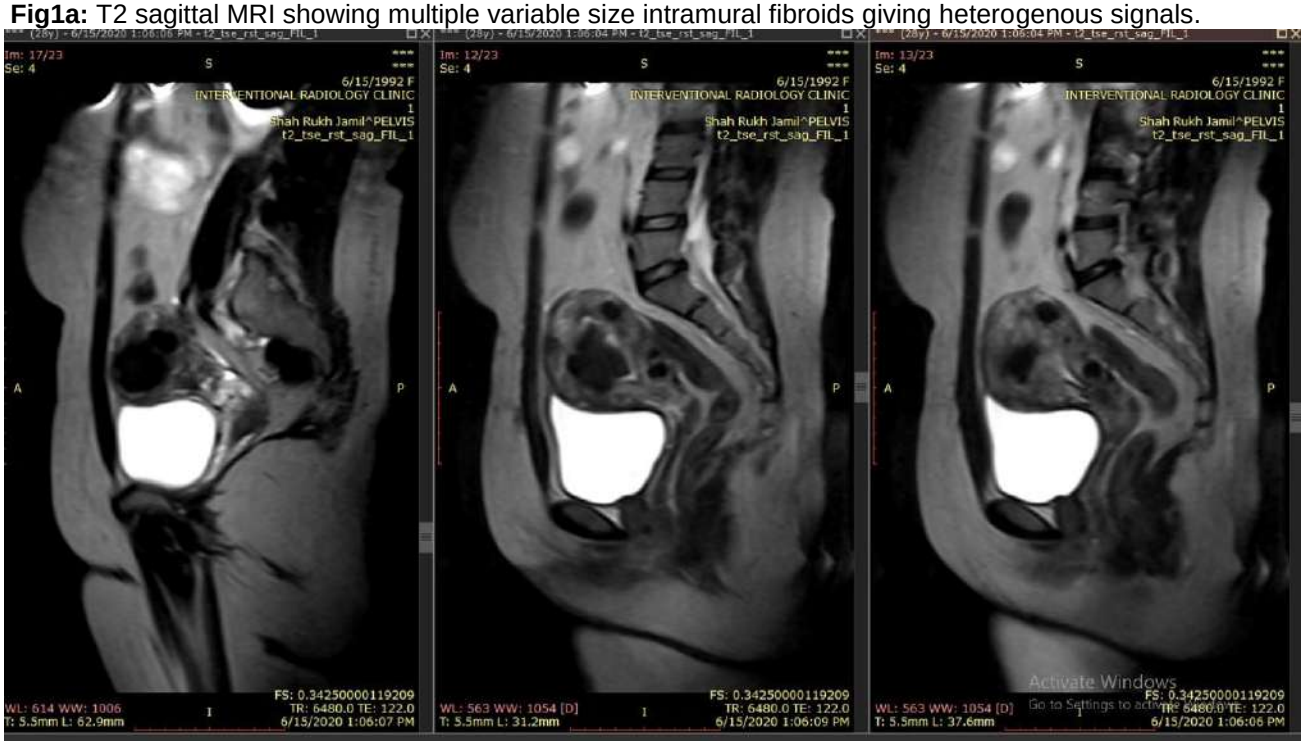

Fig 1 b: T 2 sagittal MRI 3 months after embolization shows complete necrosis of all fibroids which are replaced fluid filled cavities.

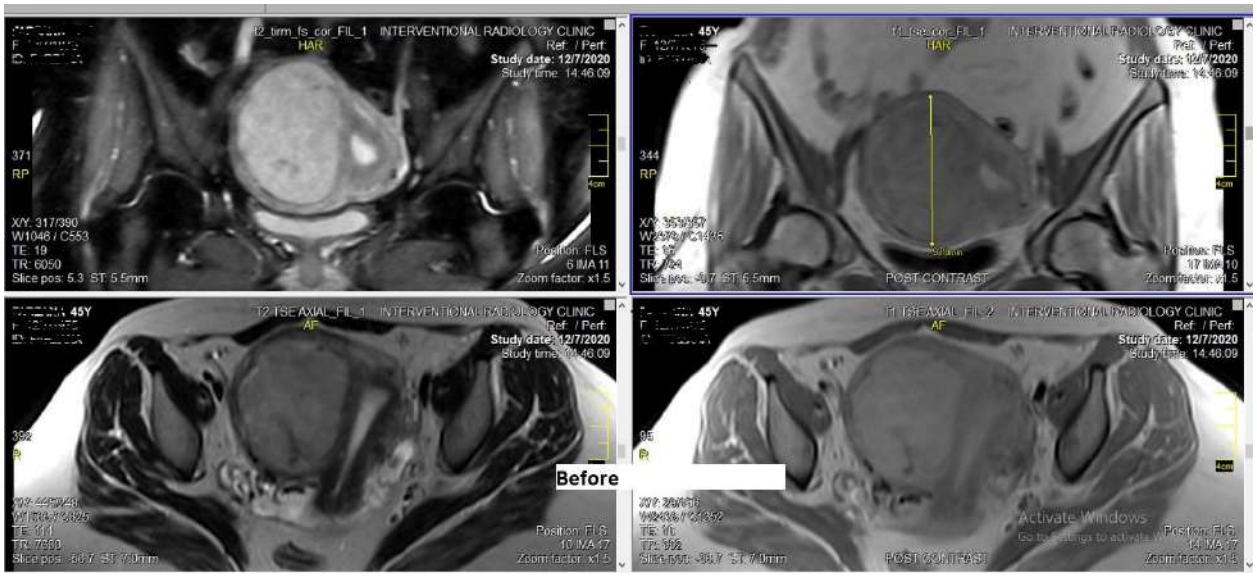

Fig 2 a: MR images showing a solitary large right lateral wall fibroid.

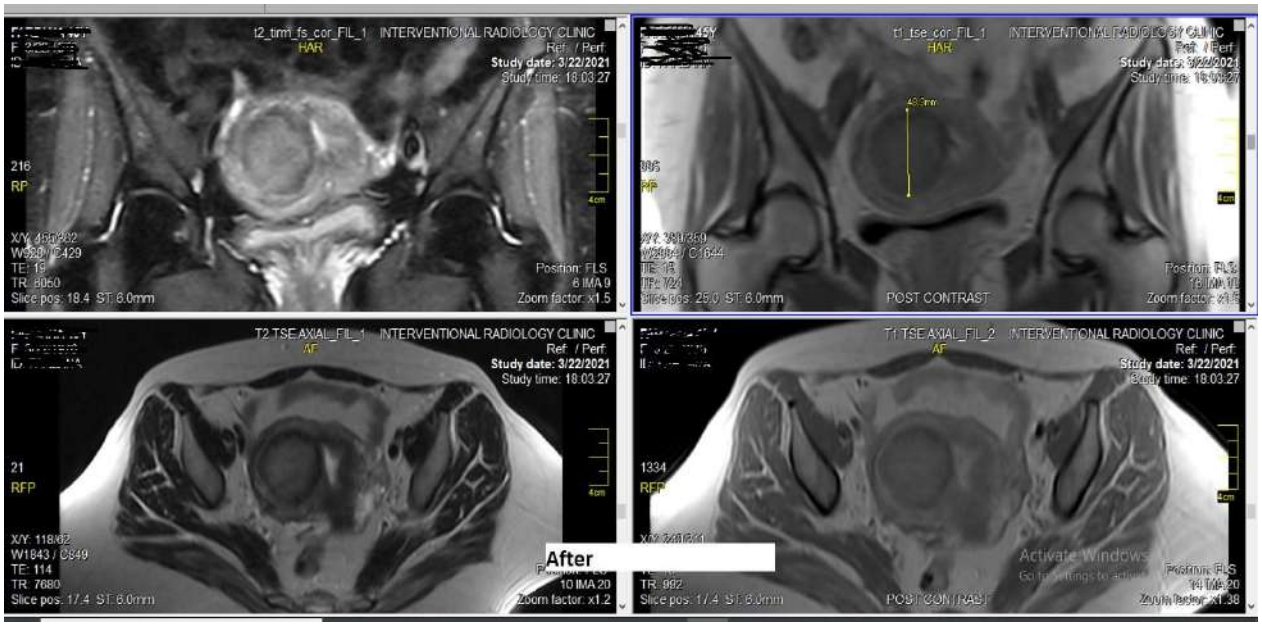

Fig 2 b: MR images following 3 months after embolization shows interval reduction in the size of fibroid and uterus.

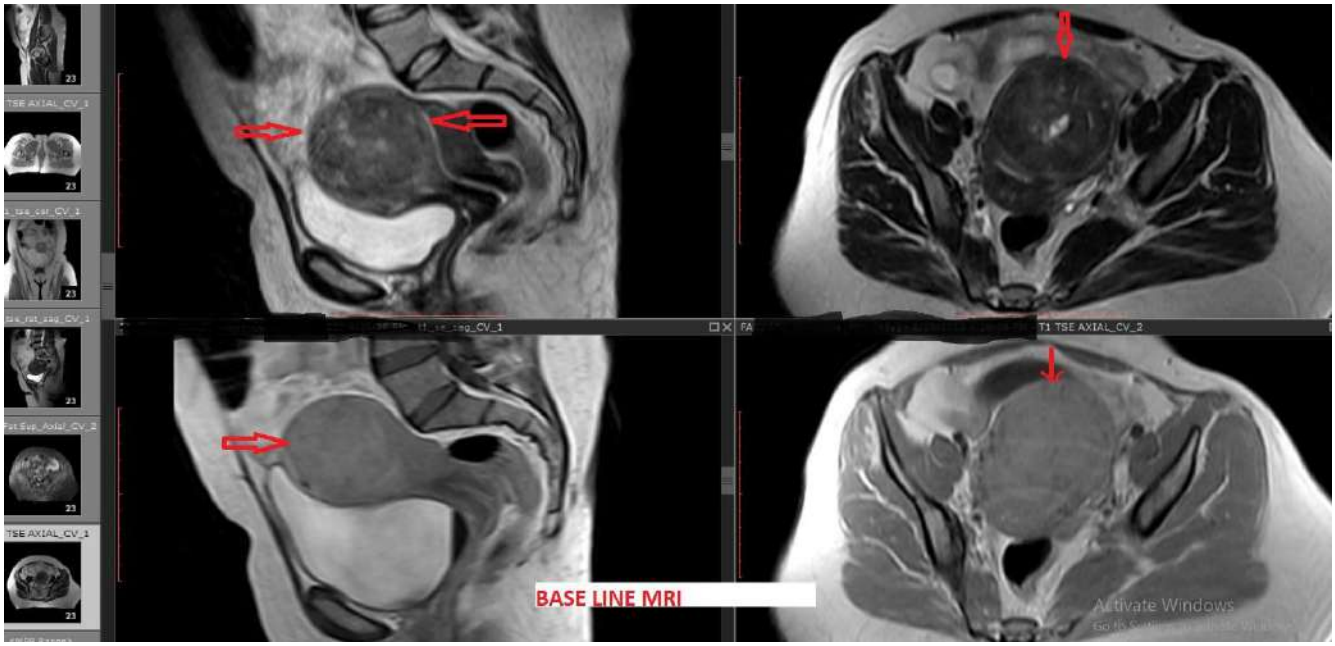

Fig 3 a: MR images showing a solitary large fundal fibroid.

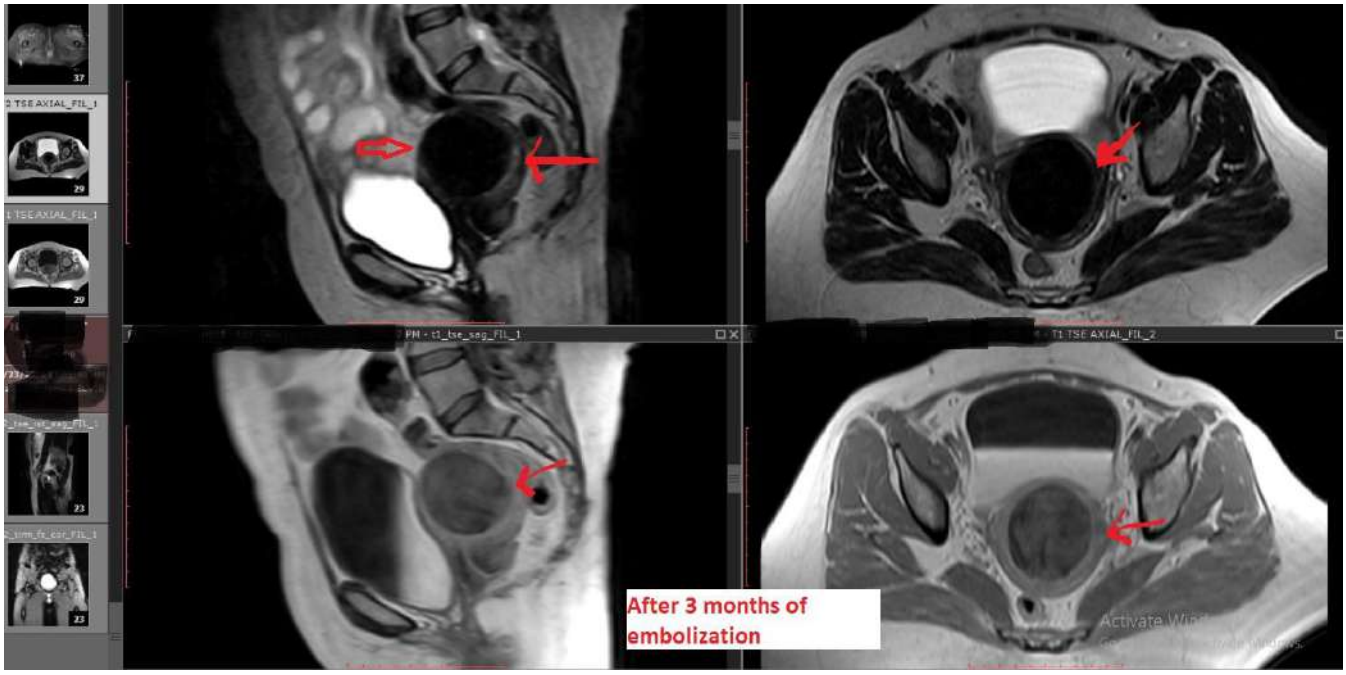

Fig 3 b: MR images 3 months after embolization shows complete necrosis of the fibroid and is replaced by fluid filled cavity.

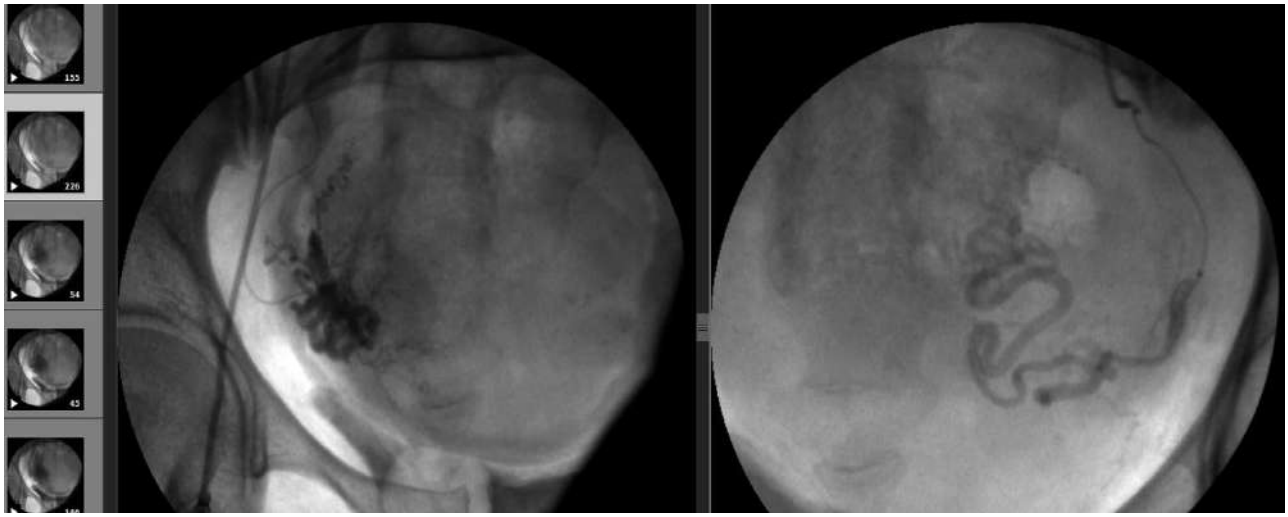

Fig 3 c: Digital subtraction angiographic images of the same case.

DISCUSSION

Uterine artery embolization (UAE) is a new minimally invasive, uterus preserving technique for symptomatic fibroid treatment and alternative to hysterectomy. Limited studies have been performed regarding factors affecting the outcomes of UAE. The purpose of our study was to assess the initial response of patients with symptomatic fibroid following embolization. Embolic agent used in our study was 500 um Polyvinyl Alcohol (PVA) (12).

Tumor infarction seen on T1, T2 and CE MRI after UAE has been identified as a good predictor for symptoms control. It is seen as T1, T2 hypointense with no enhancement seen on post contrast images. In our study menorrhagia was resolved in 185 out of 192 patients with only 7 patients still experiencing excessive bleeding three months following procedure. Bulk/pressure symptoms and pelvic pain remained unchanged pre- and post-UAE, however, significant improvement was observed in bleeding control and fibroid volume reduction, demonstrating the effectiveness of UAE in managing symptomatic fibroids. Our results are comparable to the study performed by Cao M et al (13) who compared the outcomes of 1st and 2nd UAE where better response was seen following 1st UAE then 2nd UAE. MRI findings indicate that UAE is a very effective technique in tumor infarction and thus symptoms control.

In our study majority of the patient's had solitary fibroid and the most common location was intramural followed by submucosal and then subserosal location. The results correspond well with the study performed by Kohli MP et al (14).

In our study total uterine volume was reduced by 52% following 3 months after the procedure. This result was in agreement with the study performed by Ludwig PE et al, where total uterine volume was reduced by 46.9%, however the follow up scan was performed 1 year after the intervention (15).

Mean volume of the dominant fibroid in our study was 497.61cm^3 which is different from the mean diameter of the largest fibroid in the study performed by Chung YJ et al**,** where mean volume is 341 cm^3 (16). In our study volume of the largest tumor was reduced by 41 %, this is in contrast to the results of study done by Sher A et al**,** where dominant fibroid volume was reduced by 59.4 %, possible explanation for his difference is that follow up was performed 1 year after the intervention (17). In our study mean diameter of the largest fibroid was 7.91cm while it was 8.7cm in the study performed by Katsumori T et al (18).

The current study had some limitations. First, it was a single- institution retrospective study. A multicenter prospective study is preferable. Second, short term imaging was performed to assess the technical, clinical and MRI outcomes. Further studies with long-term follow-up, including serial MRI assessments and symptom progression tracking, are required to evaluate sustained efficacy and fibroid regression. Third, there was lack of specific information about symptoms relief following UAE.

CONCLUSION

Uterine artery embolization (UAE) is a well-established, minimally invasive, and uterus-preserving treatment for symptomatic uterine fibroids. Advances in technique, patient selection, and periprocedural care have further improved clinical outcomes. Interventional radiologists should play a key role in counseling patients considering hysterectomy or myomectomy, providing them with UAE as an effective alternative treatment option.

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