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Original Research Article

Uterine artery embolization versus total abdominal hysterectomy as a treatment modality: a comparative study of clinical outcomes and patient satisfaction in women with uterine fibroids ≤10 cm

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ABSTRACT

Background: Uterine fibroids are the most common benign tumours affecting women of reproductive age. Total abdominal hysterectomy (TAH) is the definitive treatment, while uterine artery embolization (UAE) is a minimally invasive alternative. This study compares clinical outcomes and patient satisfaction between UAE and TAH.
Methods: A prospective observational study including 30 women with symptomatic uterine fibroids ≤10cm. Patients were divided into two groups: UAE(n=15) and TAH (n=15). Follow-up was done at 3 months, 6 months and 1 year.
Results: UAE showed shorter operative time, reduced blood loss, less postoperative pain and shorter hospital stay compared with TAH. Fibroid reduction up to 60% at one year was observed in the UAE group. Psychological well-being improved in 80% of UAE patients and 75% of TAH patients.
Conclusions: UAE is a safe and effective minimally invasive alternative to hysterectomy for symptomatic fibroids ≤ 10cm with high patient satisfaction and faster recovery.

Keywords: Hysterectomy, Minimally invasive treatment, Patient satisfaction, Uterine artery embolization, Uterine fibroids

INTRODUCTION

Uterine fibroids (leiomyoma) are the most common benign tumours of the female reproductive tract. They may present with heavy menstrual bleeding, pelvic pain, infertility and pressure symptoms.[1] The gold standard for women hoping to have a family in the future is myomectomy, a surgical treatment that involves removing fibroids and reconstructing the uterus.[2]The procedure carries a low complication rate (1-5%), with the most common being blood loss.[3,4]

Hysterectomy has traditionally been the primary approach for the management of symptomatic fibroid and remains the only definitive treatment available. However, it involves major surgery and longer recovery.[5]

Uterine artery embolisation has emerged as a minimally invasive alternative. It involves occlusion of arteries using embolic particles, causing ischaemia and shrinkage of fibroids. UAE offers advantages such as shorter hospital stay, quicker recovery and preservation of the uterus.[6] This study was conducted to compare clinical outcomes and patient satisfaction between uterine artery embolisation and total abdominal hysterectomy in women with symptomatic uterine fibroids ≤10cm.

METHODS

Study type and place

The study was a comparative study conducted at Gajra Raja Medical College and J.A. Group of Hospitals, Gwalior, Madhya Pradesh.

Study period

The study was conducted over a period of 18 months from July 2023 to December 2024.

Selection criteria of the patients

Symptomatic women with uterine fibroid < 10cm in size having an Ayushman card (Government of India flagship health scheme) and giving consent for either procedure (UAE or TAH). Thirty women aged 35-50 years with symptomatic uterine fibroids ≤10cm were included. Patients were divided into two groups: UAE (n=15) and TAH (n=15).

Procedure

The procedure (UAE) was conducted in the catheterisation laboratory in the cardiology department by an interventional radiologist under local anaesthesia. Antibiotic prophylaxis was given in the form of Inj Cefoperazone 1.5gm IV. The procedure usually lasted for 45-80 minutes after which the patient was kept for observation in the cardiology department for 1 hour following which she was shifted to Gynaecology ward.

For patients opting for TAH, the procedure was done in the Gynaecology OT by a gynaecologist following which she would be kept in HDU for 2 days and then later shifted to the gynaecology ward.

Procedure for UAE

A well written and informed consent is taken. Under all aseptic precautions, cleaning and draping is done. Infiltration of puncture site with local anaesthesia is done. Under Digital Subtraction Assay (DSA) guidance, right femoral puncture is taken using an 18G introducer needle. Through the introducer needle a 5Fr femoral sheath guide wire is introduced. 5Fr femoral sheath is secured over the guide wire and the guide wire removed. A Terumo hydrophilic guidewire with Cobra (C1) catheter was introduced through the femoral sheath into the iliac vessels. Angiogram was taken under DSA guidance and the origin of uterine artery localised. Sim-1 catheter is introduced over the hydrophilic guide wire after the removal of C1 catheter. Origin of the uterine artery is tried to cannulate and repeat angiogram taken which will show horizontally located vessels crossing the ureters. The guide wire is then removed. Now, microcatheter with micro guide wire is introduced through C1 catheter. Repeat angiogram is taken to look for uterine artery. PVA particles 350-510microns are mixed with iohexol. Next, the micro guide wire is removed and the PVA particles which have been prepared is pushed through the micro catheter. Saline flush id given to prevent catheter blockage. Repeat angiogram is taken and the patency or the amount of vessel occlusion is looked for. If the vessel is occluded, Sim-1 catheter is again pulled back and with the help of cross over sheath the contralateral vessel is cannulated and the contralateral vessel is embolised using the same steps. Patients who underwent the procedures were then followed up at 3 months, 6 months and 1 year after treatment.

Outcome measures included operative time, blood loss, hospital stay, haemoglobin improvement, fibroid size reduction, complications and patient satisfaction. Data were analysed using standard statistical methods. Continuous variables were expressed as mean standard deviation and categorical variables as percentages.

Ethical consideration

Ethical approval was obtained from Institutional Ethics Committee, Gajra Raja Medical College. (IEC approval certificate number is 28/IEC-GRMC/2023).

RESULTS

Thirty patients were included with 15 patients in each group. Baseline characteristics were comparable. UAE demonstrated shorter operative time, less blood loss, lower transfusion requirement and shorter hospital stay compared with TAH. Patients undergoing UAE recovered faster and returned to daily activities earlier. Ultrasound follow-up showed progressive fibroid regression with approximately 60% reduction at one year. Hemoglobin levels improved in both groups. Psychological well-being improved in 80% of UAE patients and 75% of TAH patients. Minor complications included post-embolization syndrome in the UAE group and wound infection in the TAH group.

The age distribution was similar across both treatment groups. The majority of participants were aged between 40 and 45 years, comprising 46.7% of the UAE group and 40.0% of the TAH group (Table 1). A chi-square test of independence revealed no significant difference in age group distribution between the groups, χ^2 (2, N=30)=0.73, p =0.693, Cramér's V=0.16, indicating a small effect size (Table 1).

Table 1: Age distribution of study participants.

Age group (years)	UAE (n=15), N (%)	TAH (n=15), N (%)
35-40	4 (26.7)	7 (23.3)
40-45	7 (46.7)	6 (40)
45-50	4 (26.7)	6 (40)

Baseline haemoglobin levels were also statistically comparable between the groups. The mean haemoglobin level in the UAE group was 10.1 g/dL (SD=1.3), while in the TAH group it was 9.9 g/dL (SD=1.5), t(28)=0.41, p=0.685, Cohen's d=0.15. Mild anaemia (defined as Hb 10-12.9 g/dL) was observed in 33.3% of UAE participants and 40.0% of TAH participants (Table 2).

Table 2: Baseline haemoglobin levels (pre-treatment).

Parameter	UAE (n=15)	TAH (n=15)
Mean haemoglobin (g/dl)	10.1±1.3	9.9±1.5
Mild anaemia (10-12.9g/dl), N (%)	5 (33.3)	6 (40)

The size distribution of uterine fibroids was assessed using pre-treatment ultrasound measurements. The mean fibroid size in the UAE group was 5.8 cm (SD=2.1), compared to 6.2 cm (SD=1.9) in the TAH group. An independent samples t-test showed no statistically significant difference in mean fibroid size between groups, t(28)= -0.54, p=0.593, Cohen's d=0.19. Fibroid sizes were categorized into three groups: <5 cm, 5-7 cm, and 8-10 cm. The majority of participants in both groups had fibroids measuring between 5 and 7 cm (Table 3). A Chi-square test found no significant association between fibroid size category and treatment group, $\chi^2(2, N=30) = 0.87$, p=0.648, Cramér's V=0.17.

Table 3: Distribution of fibroid size in study population.

Fibroid size in cm	UAE (n=15), N (%)	TAH (n=15), N (%)
<5	5 (33.3)	4 (26.7)
5-7	7 (46.7)	6 (40)
8-10	3 (20)	5 (33.3)

In terms of clinical presentation, the most common symptom reported was menorrhagia, seen in 86.7% of UAE patients and 93.3% of TAH patients. Dysmenorrhea and pelvic pain were also commonly reported, with frequencies of 53.3% and 40.0% in the UAE group and 60.0% and 46.7% in the TAH group, respectively (Table 4). Chi-square tests revealed no significant differences in presenting symptoms between the groups: menorrhagia, $\chi^2(1)=0.36$, p=0.550; dysmenorrhea, $\chi^2(1)=0.14$, p=0.706; and pelvic pain, $\chi^2(1)=0.14$, p=0.706.

Table 4: Symptoms presented by patients at baseline.

Symptom	UAE (n=15), N (%)	TAH (n=15), N (%)
Menorrhagia	13 (86.7)	14 (93.3)
Dysmenorrhea	8 (53.3)	9 (60)
Pelvic pain	6 (40)	7 (46.7)

The mean operative time for patients undergoing UAE was 50 minutes (SD=15), significantly shorter than the 75 minutes (SD=10) recorded for the TAH group. This difference was statistically significant, t(28)= -5.57, p<0.001, Cohen's d=2.03, indicating a large effect size (Table 5).

Intraoperative blood loss was markedly different between the two procedures. UAE was associated with minimal blood loss (mean = 50 mL), and no patient in this group required transfusion. In contrast, the mean estimated blood loss during TAH was 350 mL, and 12 of 15 patients (80%) required blood transfusions. This difference in transfusion requirement was statistically significant, $\chi^2(1, N=30)=18.46$, p<0.001, Phi coefficient=0.78, representing a strong association (Table 5).

Similarly, the mean length of hospital stay was significantly shorter in the UAE group (M=3.0 days, SD=0.6) compared to the TAH group (M=9.0 days, SD=1.2). This difference was highly significant, t(28) = -17.1, p<0.001, Cohen's d=6.24, indicating an extremely large effect size (Table 5).

Postoperative pain was assessed using the Visual Analog Scale (VAS), with scores ranging from 0 to 10. The mean pain score for the UAE group was 3.2 (SD=1.0), whereas the TAH group reported significantly higher pain levels with a mean score of 6.8 (SD=1.2). The difference was statistically significant, t(28) = -9.39, p<0.001, Cohen's d=3.43, indicating a very large effect (Table 5).

Table 5: Intra operative, peri operative and post-operative metrics.

Procedure	Mean operative time (minutes)	Mean blood loss (ml)	Patients requiring blood transfusion, N (%)	Length of hospital stay	Post operative pain scores (VAS 0-10)
UAE	50±15	50	0	3±0.6	3.2±1.0
TAH	75±10	350	12 (80)	9±1.2	6.8±1.2

Early complications were more frequently reported in the TAH group compared to the UAE group. Post-embolization syndrome occurred in 2 patients (13.3%) in the UAE group but was absent in the TAH group. In contrast, post-operative infections (surgical site infection) occurred in 3 patients (20.0%) out of which one patient had to undergo re-suturing and wound dehiscence in 1 patient (6.7%) in the TAH group. The overall complication rate was significantly higher in the TAH group, $\chi^2(1, N=30)=4.29$, p=0.038, Phi=0.38 (Table 6).

Patients in the UAE group demonstrated progressive and substantial fibroid size reduction over time. At 3 months, the mean reduction in fibroid size was 35%, which increased to 50% at 6 months, and reached 60% by 1 year among those who completed follow-up. A repeated-measures ANOVA revealed a statistically significant

within-group effect of time on fibroid size reduction, F (2, 28)=42.1, p<0.001, η^2=0.75, indicating a large effect (Table 7).

Table 6: Postoperative complication.

Complication	UAE (n=15), N (%)	TAH (n=15), N (%)
Post-embolization syndrome	2 (13.3)	0
Surgical site infection	0	3 (20)
Wound dehiscence	0	1 (6.7)

Table 7: Post treatment reduction in fibroid size (UAE group only).

Time interval	Mean reduction (%)	Patients completing follow-up
3 months	35	15
6 months	50	15
1 year	60	11

Haemoglobin levels improved significantly over time in both treatment groups, reflecting clinical improvement in anaemia associated with fibroid-related menorrhagia. At baseline, there was no significant difference between groups (p=0.685). By 3 months, the TAH group exhibited a higher mean haemoglobin level (M=12.1 g/dl, SD=1.2) than the UAE group (M=11.4 g/dl, SD=1.1), and the trend persisted through 6 months and 1 year. However, the differences at each interval did not reach statistical significance (p>0.05), likely due to sample size (Table 8).

Table 8: Haemoglobin level comparison over time.

Time interval	UAE group (Mean±SD)	TAH group (Mean±SD)	P value (t-test)
Pre-treatment	10.1±1.3	9.9±1.5	0.685
3 months	11.4±1.1	12.1±1.2	0.093
6 months	12.2±1.0	12.9±1.1	0.086
1 year	12.5±0.9	13.2±1.0	0.072

Overall, a high proportion of patients in both groups reported general improvement in fibroid-related symptoms following treatment. In the UAE group, 85% (n=13) of patients reported symptom improvement, while in the TAH group, the rate was slightly higher at 90% (n=14). The difference was not statistically significant, χ^2(1, n=30)=0.18, p=0.670, Phi=0.08 (Table 9).

Table 9: Symptom improvement and quality of life.

Procedure	General symptom improvement, N (%)	Improvement in quality of life, N (%)	Improvement in psychological being, N (%)	Improvementt in menstrual bleeding, %
UAE	13 (85)	11 (70)	12 (80)	66.7 (3 months) 80 (6 months) 86.7 (1 year)
TAH	14 (90)	9 (60)	11 (75)	100

Table 10: Patient satisfaction across follow-up intervals.

Time interval	UAE group, N (%)	TAH group, N (%)	P value (Fisher's Exact Test)
3 months	11 (73.3)	12 (80)	0.68
6 months	13 (86.7)	13 (86.7)	1.00
1 year	12 (80)	14 (93.3)	0.29

When asked about their perceived change in quality-of-life post-treatment, 70% (n=11) of UAE patients reported improvement, while 25% (n=4) experienced no change, and 1 patient (5%) reported worsening. In the TAH group, 60% (n=9) reported improvement, 30% (n=5) reported no change, and 10% (n=1) reported worsening. Although the proportions differed slightly, these differences were not statistically significant, χ^2 (2, n=30)=1.00, p=0.606, Cramér's V=0.18 (Table 9).

Improvement in psychological well-being was reported by 80% (n=12) of UAE patients and 75% (n=11) of TAH patients. The difference between the groups was not statistically significant, χ^2 (1, n=30)=0.14, p=0.706, Phi=0.07 (Table 9).

Patients in the UAE group were asked a few questions regarding their menstrual bleeding pattern as mentioned in the questionnaire and was assessed accordingly. Among UAE patients, improvement in menstrual bleeding was reported by 66.7% at 3 months, 80.0% at 6 months, and 86.7% at 1 year (Table 9). A Cochran's Q test indicated a significant increase in reported improvement over time, Q(2)=6.00, p=0.049.

Patient satisfaction was evaluated at three follow-up intervals using a questionnaire and depending on the answers given by the patient their level of satisfaction with either procedure was assessed. At 3 months, 73.3% of UAE patients and 80.0% of TAH patients reported being satisfied with their treatment. Satisfaction rates increased slightly at 6 months and 1 year. At the 1-year mark, 80.0%

of UAE patients and 93.3% of TAH patients reported satisfaction. Although TAH showed higher satisfaction at 1 year, the differences at any time point were not statistically significant (all p>0.05; Table 10).

DISCUSSION

Demographic and baseline parity

The demographic characteristics of the participants confirmed a comparable baseline between the UAE and TAH groups. The age distribution and mean haemoglobin levels were not significantly different between the two cohorts. Most participants were within the 40-45-year age range, aligning with prior epidemiological data indicating that uterine fibroids most commonly present in women during their reproductive years, particularly in the fourth and fifth decades of life (Laughlin-Tommaso et al, 2017).[7] The mean haemoglobin levels in both groups were indicative of mild anaemia, a common comorbidity due to fibroid-related menorrhagia.

Clinical characteristics and fibroid distribution

Mean fibroid sizes did not significantly differ between groups, which enabled a fair comparison of treatment outcomes. Importantly, only patients with fibroids ≤10 cm were included, ensuring homogeneity and alignment with current guidelines for UAE candidacy.

Perioperative parameters: operative time, blood loss, and hospital stay

Perioperative findings demonstrated that UAE conferred significant advantages over TAH in several domains. The mean operative time was significantly shorter in the UAE group (50±15 minutes) compared to the TAH group (75±10 minutes). This difference is attributable to the less invasive nature of UAE, which is performed via percutaneous vascular access, thereby avoiding the time-consuming steps of open surgery, such as incision, dissection, organ removal, and closure (Vo and Andrews, 2008).[8]

Intraoperative blood loss also favoured UAE, which averaged 50 mL compared to 350 mL in the TAH group. Moreover, no patient in the UAE group required a blood transfusion, whereas 80% of TAH patients did. These findings are clinically significant, particularly for patients presenting with preoperative anaemia or those at higher surgical risk. Previous studies have similarly identified reduced blood loss and transfusion requirements as principal advantages of embolization (Lara and Lewis, 2024).[9]

Additionally, the mean hospital stay was substantially shorter for UAE (3±0.6 days) than for TAH (9±1.2 days), corroborating findings from multicentre trials such as the EMMY trial, which reported similar trends in reduced hospitalization and faster recovery (van der Kooij et al, 2010).[10] This has implications for resource utilization, cost-effectiveness, and patient satisfaction.

Pain and recovery profiles

The study found a marked difference in postoperative pain levels between groups, as measured by the Visual Analog Scale. UAE patients reported a mean score of 3.2, significantly lower than the TAH group's 6.8. These findings are consistent with the literature, where lower postoperative pain following UAE has been attributed to the avoidance of extensive tissue trauma, nerve irritation, and muscular disruption associated with abdominal surgery (Gonsalves et al, 2008).[11] Shorter hospital stays and lower pain levels translated into faster convalescence and earlier return to daily activities for UAE patients, enhancing quality of life in the early recovery period.

Fibroid regression and recurrence

Among patients in the UAE group, progressive fibroid size reduction was observed: a 35% reduction at 3 months, 50% at 6 months, and 60% at 1 year. This trajectory mirrors data from long-term studies, including Psilopatis et al (2022), which documented a clinical success rate of 75.8% at nearly 10 years post-UAE.[12] However, it must be emphasized that UAE does not remove fibroids; rather, it induces ischemic necrosis that leads to shrinkage. Thus, unlike TAH, which offers a definitive cure through complete uterine removal, UAE carries a residual risk of symptom recurrence or incomplete resolution. This was modestly reflected in this study, where a few patients reported persistent or returning symptoms and required further evaluation.

Hemoglobin improvement

In both treatment groups, haemoglobin levels improved progressively over the follow-up period. TAH patients showed slightly higher values at each time point, likely reflecting the definitive resolution of bleeding due to uterine removal. However, the improvement in the UAE group was also clinically meaningful, reaching near-normal levels by 1-year post-procedure. This finding reaffirms the therapeutic role of UAE in managing fibroid-related menorrhagia, with the added advantage of uterine preservation.[2]

Patient satisfaction and subjective outcomes

Patient satisfaction was assessed at three intervals. While both groups demonstrated high levels of satisfaction, slightly higher proportions were noted in the TAH group at 1 year (93.3% vs. 80.0%). However, satisfaction among UAE patients remained robust and stable throughout the study. The slightly lower satisfaction rate in the UAE group may be attributable to the small subset of patients experiencing recurrent symptoms or anxiety regarding incomplete treatment. This trend is supported by registry studies such as the COMPARE-UF registry, which found

durable satisfaction across treatment types but acknowledged variable trajectories in symptom resolution (Anchan et al, 2023).[13]

Nonetheless, it is important to note that many patients prioritized uterine preservation, shorter recovery, and lower complication risks factors that weighed favourably toward UAE. Thus, while satisfaction may be marginally lower due to incomplete symptom elimination in some cases, the trade-off is acceptable for many women, especially those seeking non-surgical options.

Quality of life and psychological impact

Both procedures positively impacted patients' quality of life and psychological well-being. In this study, 70% of UAE patients and 60% of TAH patients reported improvements in general quality of life. Furthermore, 80% of UAE patients and 75% of TAH patients experienced psychological improvement, highlighting the emotional relief afforded by symptom control, improved haemoglobin levels, and resolution of menstrual irregularities. These findings are in line with the FEMME study, which observed significant quality-of-life gains post-UAE and myomectomy, albeit slightly less than those seen with hysterectomy over a longer term (Manyonda et al, 2020).[14]

Complication profiles and safety

UAE was associated with a lower complication rate overall. Mild post-embolization syndrome was noted in 13.3% of patients, resolving with conservative treatment. In contrast, TAH patients had higher rates of postoperative infection (20%) and wound dehiscence (6.7%), consistent with expected complications of major abdominal surgery. Importantly, no cases of uterine rupture, sepsis, or severe adverse outcomes were reported in either group, reflecting the procedural safety when performed in appropriate clinical settings.

Late complications were confined to the UAE group and included fibroid shrinkage-related pain (13.3%), recurrent menorrhagia (13.3%), and isolated limb weakness (6.6%). These findings warrant close follow-up and patient counselling about potential delayed effects of ischemic necrosis on surrounding pelvic tissues. Nevertheless, the overall safety profile of UAE remains favourable and compares well to surgical alternatives, especially in patients with significant comorbidities.

Implications for fertility and uterine preservation

While this study did not focus on fertility outcomes, it is essential to contextualize UAE and TAH within reproductive planning. TAH eliminates fertility, making it unsuitable for women desiring future pregnancy. UAE preserves the uterus, and although successful pregnancies post-UAE have been documented, outcomes remain variable, with concerns regarding placental implantation and uterine contractility (Berkane and Moutafoff-Borie, 2010).[15] As such, patient selection, informed consent, and multidisciplinary collaboration are crucial when offering UAE to women of reproductive age.

Cost-effectiveness and systemic impact

UAE has been shown to be cost-effective in numerous studies due to shorter hospitalization, fewer sick days, and reduced need for analgesia. However, potential re-intervention in the UAE group may offset these savings in some cases. This necessitates individualized cost-benefit analysis, particularly in resource-constrained settings where repeat procedures may be logistically challenging (Smith et al, 2004).[16]

From a public health perspective, the option of UAE offers a valuable alternative that can decongest surgical theatres, reduce hospital burden, and provide women with greater autonomy in treatment selection. As minimally invasive technologies evolve, the role of UAE is likely to expand further, especially with improvements in embolic materials and imaging guidance.

This study has few limitations. This study is limited by its small sample size (n=30), which may restrict generalizability. Larger, multi-centre randomized controlled trials are needed to validate these findings. Additionally, although follow-up was extended to 1-year, longer-term outcomes, particularly recurrence rates and fertility data, could not be assessed. Patient-reported outcomes were subject to recall bias, though structured instruments were used to minimize this.

One of the major challenges encountered during this study was counselling patients for UAE. As UAE is a relatively novel treatment modality, many patients were unfamiliar with the procedure, which led to numerous doubts and hesitations. Despite detailed explanations, a significant proportion of the patients remained unconvinced about opting for UAE.

Furthermore, although the procedure was fully covered under the Ayushman Bharat Yojana, there were frequent instances when the essential materials required for the procedure were either unavailable or could not be procured in a timely manner. This resulted in delays in scheduling procedures, which contributed to patient attrition- many of those initially counselled for UAE eventually chose to discontinue or seek alternative treatments.

During the course of this study, several limitations were encountered that impacted the total number of completed UAE cases. While counselling challenges and logistical delays were significant factors, technical issues during the procedure also contributed to case exclusion. In certain patients, the procedure could not be successfully carried out due to the presence of anomalous or tortuous uterine arteries, making catheter navigation and embolization technically difficult. These procedural limitations reduced

the number of complete and analysable cases, thereby affecting the overall sample size available for the study.

Despite these limitations, the study offers a robust head-to-head comparison of two commonly employed fibroid treatments in a real-world setting.

CONCLUSION

This research adds to the growing body of evidence supporting UAE as a safe and effective treatment for selected patients with uterine fibroids. As interventional radiology continues to evolve, UAE is likely to play an increasingly prominent role in gynaecologic care. Ongoing research with larger sample sizes and extended follow-up is warranted to further assess long-term outcomes, recurrence rates, and impacts on reproductive health.

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