Clinical Long-term Outcome after Uterine Artery Embolization: Sustained Symptom Control and Improvement of Quality of Life

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ABSTRACT

Purpose: To evaluate long-term clinical efficacy of uterine artery embolization (UAE) for uterine fibroids with respect to symptom control and improvement in quality of life.

Materials and Methods: Between October 2000 and October 2007, 380 consecutive women underwent UAE. To determine long-term efficacy, the rate of reinterventions (ie, repeat UAE, hysterectomy, myomectomy) and the clinical response regarding symptoms related to bleeding and bulk were documented. Persistence, worsening, or recurrence of symptoms and reinterventions were classified as treatment failure (TF). The cumulative rate of freedom from TF was determined by Kaplan-Meier analysis. Cox regression was used to identify possible clinical or morphologic predictors of outcome. Secondary outcome measures were changes in disease-specific quality of life and onset of menopause.

Results: Follow-up was available for a median of 5.7 years (range, 3.1–10.1 y) after treatment in 304 of 380 (80%) patients. There were 54 TFs with subsequent reintervention in 46 women. Kaplan-Meier analysis revealed a cumulative TF rate of 23.3% after 10 years. Cox regression demonstrated a significantly higher likelihood of TF in patients < 40 years old compared with patients > 45 years old (hazard ratio, 2.28; $P = .049$). Women without TF showed sustained normalization of disease-specific quality of life ($P < .001$). Cessation of menstruation at a median age of 51 years was reported by 57 (22.8%) of 250 women.

Conclusions: UAE leads to long-term control of fibroid-related symptoms and normalization of quality of life in approximately 75% of patients. Younger women seem to have a higher risk of TF than older women closer to menopause.

ABBREVIATIONS

HRQOL = health-related quality of life, PVA = polyvinyl alcohol, QR = quartile range, TF = treatment failure, TGM = trisacryl gelatin microsphere, UAE = uterine artery embolization, UFS-QOL = Uterine Fibroid Symptom and Quality of Life

Since its first description by Ravina et al (1) in 1995, uterine artery embolization (UAE) has been increasingly used as a treatment alternative for women with symptomatic uterine fibroids who would have otherwise been treated with surgery (2). Available long-term observations after UAE suggest that symptom control is achieved in 70%–90% of patients (3–7), with most of these studies reporting at a median follow-up of 3–5 years after treatment. Only a few studies present longer term follow-up data, reporting symptom control in 75%–81% of all women evaluated for up to 9.6 years after UAE (8,9). More long-term observations in large cohorts are needed to confirm the long-term benefits of UAE in the treatment of symptomatic fibroids. In this article, we present the long-term follow-up analysis of 380 consecutive patients who underwent UAE at a single institution.

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METHODS AND MATERIALS

Study Setting and Patient Population

Between October 2000 and October 2007, 380 consecutive patients with a median age of 44 years (quartile range [QR], 41–47 y; range, 33–64 y) were enrolled in a

prospective clinical study of UAE. Inclusion criteria were symptomatic uterine fibroid disease confirmed clinically (bleeding-related symptoms, such as hypermenorrhea or dysmenorrhea, and bulk-related symptoms, such as feeling of abdominal distention, increased urinary frequency, or constipation) and by magnetic resonance (MR) imaging or ultrasound with a recommendation for surgery and age > 18 years. Exclusion criteria were the wish to conceive, suspicion of malignancy, evident uterine adenomyosis, urogenital infections, contraindications for invasive angiography, and gonadotropin-releasing hormone therapy within 3 months before UAE. The last-mentioned is an exclusion criterion because this treatment increases the risk of vascular spasm during catheterization. All patients were seen by a gynecologist and interventional radiologist before study enrollment, and UAE was chosen as an alternative to surgical therapy. All patients gave written informed consent to undergo UAE and volunteered to participate in the follow-up examinations. Patients who withdrew consent to be followed further were not contacted again. The study was approved by the institutional review board, and permission to use the Uterine Fibroid Symptom and Quality of Life (UFS-QOL) questionnaire in an official German translation was granted by its authors and the Society of Interventional Radiology (SIR).

Primary outcome measures were absence of treatment failure (TF) after UAE as indicated by freedom from symptom recurrence at long-term follow-up with a follow-up period of at least 3 years and influence of clinical and morphologic imaging factors at baseline on clinical outcome. Secondary endpoints were changes in disease-specific quality of life as assessed by the validated UFS-QOL questionnaire and menstrual status over the follow-up period.

Baseline MR Imaging

MR imaging with a standardized imaging protocol, including axial and sagittal T2-weighted and non–contrast-enhanced and contrast-enhanced T1-weighted pulse sequences, was performed before the intervention to obtain baseline morphologic data related to the fibroid burden (ie, uterine and largest fibroid volume and number of fibroids and location of the largest fibroid).

Embolization Technique

After establishing a unilateral transfemoral access, the tip of either a 4-F/5-F end-hole catheter or a coaxially advanced microcatheter was directed into the horizontal segment of the uterine artery well beyond angiographically visualized cervicovaginal branches. In the first 75 patients, a microcatheter was used only in 9 patients because of difficult vascular anatomy. Subsequently, as a result of a change in the UAE protocol of our department, microcatheters were used in all cases. Free-flow particle embolization was accomplished using 500- to 900-μm-diameter trisacryl gelatin microsphere (TGM) particles (EmboSphere; Merit Medical, Paris, France) (n = 280), 500- to 1,000-μm-diameter nonspherical polyvinyl alcohol (PVA) particles (Contour; Boston Scientific, Natick, Massachusetts) (n = 31), or 500- to 900-μm-diameter spherical PVA particles (Bead Block; Biocompatibles UK Ltd, Farnham, United Kingdom) (n = 69). The angiographic endpoint for TGM particles was occlusion of the perifibroid plexus but preserved sluggish antegrade flow in the uterine arteries according to a limited embolization protocol; for PVA particles, a more radical angiographic endpoint, near stasis in the horizontal segment of the uterine artery, was chosen. Although the choice of embolic agent was to some extent at the discretion of the interventionalist, preferences also changed over the study period with a view to optimizing the UAE procedure and clinical outcome. Because TGM particles exhibited superior properties compared with PVA particles, while showing similar effectiveness in terms of devascularization of the fibroid load, they became the predominantly used embolic agent (10–13). UAE was performed as an inpatient procedure; all women were admitted for further observation and sufficient analgesia with intravenous narcotics on the day of the procedure. Nonsteroidal antiinflammatory drugs were prescribed for analgesia thereafter.

Clinical Follow-up

A self-administered nonvalidated questionnaire asking for bleeding-related (ie, hypermenorrhea, dysmenorrhea) and bulk-related (ie, pelvic pressure and feeling of distention, urinary urgency, constipation) symptoms on a yes-or-no basis was used to assess leiomyoma-related symptoms before enrollment. At 3, 6, and 12 months and once a year thereafter, all patients were asked to complete the questionnaire again and report any changes in these symptoms. The patients' self-assessment was classified as "resolved" or "improved," summarized as positive outcome or "unchanged" or "worsened" (ie, negative clinical outcome). Unchanged or worsened symptoms (negative outcome) or recurrence of previously improved complaints as well as intervening major reinterventions (ie, hysterectomy, myomectomy, repeat UAE) to control leiomyoma-related symptoms were classified as TF. At each follow-up time point, the questionnaires were sent by mail or fax to be completed by hand, completed by telephone interview, or completed as an individually keyed online survey. For the purpose of this study, the latest available follow-up or, in case of negative clinical outcome, the time of recurrence of symptoms was used for clinical outcome analysis.

From July 2002 on, the validated UFS-QOL questionnaire by Spies et al (14) was additionally integrated into the ongoing study along with the nonvalidated questionnaire. In the context of this study, the UFS-QOL data were used to evaluate the changes in patients' disease-specific quality of life in case of treatment success (ie, the absence of TF). The questionnaire was administered within 2 weeks before UAE to elicit baseline data and again at the times of follow-up.

The questionnaire comprises 8 questions pertaining to the type and severity of symptoms, summarized in the symptom severity score, and 29 questions pertaining to how the disease affects different aspects of the patient's health-related quality of life (HRQOL), subdivided into six subscale scores pertaining to concern, activities, energy/mood, control, self-consciousness, and sexual function. Response options are presented as 5-point Likert scales ranging from "not at all" (1 point) to "a very great deal" (5 points) in response to "how distressed were you by …?" for the symptom severity items (questions 1–8) and from "none of the time" (1 point) to "all of the time" (5 points) in response to the questions about HRQOL (questions 9–37). As recommended by the authors, a subscale score was excluded from further analysis if > 50% of the respective questions were not answered. Otherwise, the missing value was imputed by the mean of the other subscale values. The UFS-QOL scores were normalized to a scale ranging from 0–100, with lower symptom scores indicating improvement in fibroid-related symptoms and higher HRQOL scores indicating improvement in QOL. Worsened symptom severity and HRQOL scores were classified as TF. The menstrual status was documented, in case of permanent amenorrhea with the date of the last menstrual period.

Statistical Analysis

All metric demographic data (ie, age and volumes of the uterus and largest leiomyoma) are given as median and range or QR. For nominal variables (ie, clinical symptoms, number and location of leiomyomas), absolute counts and percentages are documented. Kaplan-Meier analysis was used to determine the cumulative rate of TF and the mean freedom from TF during the follow-up period for the entire cohort. Cox proportional hazard regression analysis was used to identify possible clinical and morphologic imaging predictors of TF. The following variables were included: (*i*) age at time of UAE in three groups—< 40 years, 40–45 years, and > 45 years; (*ii*) baseline uterine volume; (*iii*) baseline volume of the largest leiomyoma (dominant leiomyoma); (*iv*) number of leiomyomas, distinguishing three categories—single leiomyoma, two to five leiomyomas, and more than five leiomyomas; (*v*) location of the dominant leiomyoma—subserosal, intramural, or submucosal; (*vi*) clinical symptoms at baseline, grouped as predominantly bleeding-related, predominantly bulk-related, or mixed bleeding-related and bulk-related symptoms; and (*vii*) type of embolization particles used. The results of the UFS-QOL questionnaire and its eight subscales before and after UAE are given as median and QR (25th and 75th percentile). Changes within each score were tested for significance using Wilcoxon test for paired samples. Statistical significance was defined as $P < .05$. Statistical analysis was performed using the SPSS software package (SPSS 19.0; IBM Corporation, New York, New York).

Table 1. Demographic Characteristics

	N = 304
Age (y), median (range)	44 (33–64)
Volume of uterus before UAE (mL), median (QR)*	367 (237–546)
Volume of largest leiomyoma before UAE (mL), median (QR)*	96 (38–190)
No. leiomyomas*	
1	79 (26%)
2–5	98 (32%)
> 5	121 (40%)
Location of largest leiomyoma*	
Subserosal	70 (23%)
Intramural	173 (57%)
Submucosal	55 (18%)
Clinical symptoms	
Predominantly bleeding-related	61 (20%)
Predominantly bulk-related	53 (17%)
Mixed bleeding-related and bulk-related	186 (61%)
Undetermined	4 (3%)

QR = quartile range, UAE = uterine artery embolization.
* Six patients without magnetic resonance imaging before intervention and missing baseline information.

RESULTS

Of 380 patients initially included in the study, 74 (19.5%) patients were lost to follow-up. Two patients were additionally classified as dropouts. One woman died of another cause, and the other underwent hysterectomy for endometrial cancer 6 years after UAE at the age of 51. There were 304 women who completed clinical long-term follow-up after a median of 5.7 years (range, 3.1–10.1 y). The demographic characteristics and baseline clinical presentations and objective disease burden of these patients are summarized in **Table 1**. All but six patients underwent MR imaging before the intervention. These six women did not wish to undergo MR imaging because of claustrophobia, and diagnosis relied on ultrasound.

Technical Success

Bilateral UAE was technically successful in 296 (97.4%) of 304 patients. The remaining eight women underwent unilateral embolization because of absence or hypoplasia of one uterine artery (n = 3), difficult branching pattern (n = 3), tortuous anatomy leading to irreversible spasm (n = 1), or previous surgical ligation on one side (n = 1). In seven other cases, initial bilateral UAE was combined with ovarian artery embolization because of relevant collateral blood supply via one ovarian artery. UAE was performed using TGM particles in 227 (74.7%) of 304 cases, non-spherical PVA particles in 31 (10.2%) of 304 cases, and spherical PVA particles in 46 (15.1%) of 304 cases.

Clinical Outcome and Survival Analysis

On the basis of the nonvalidated questionnaire, clinical improvement of symptoms was achieved in 250 of 304 women.

The remaining 54 patients reported unchanged or worsened symptoms and were classified as TFs. Of these patients, 46 subsequently underwent a second intervention. Hysterectomy was performed in 33 patients, myomectomy in 4 patients, and repeat UAE in 9 patients at a median of 1.3 years (QR, 0.9–3.3 y) after initial UAE. Eight additional patients failed clinically at a median of 65 months (range, 10–92 mo) after UAE with no relevant symptom alleviation but did not undergo another surgical or endovascular approach. At the time of follow-up, two women had entered menopause, one woman improved under hormone replacement therapy, and the remaining five women tolerated their symptoms. The cumulative rate of freedom from TF according to Kaplan-Meier analysis was 76.7% (standard error, 3.4%) 10 years after UAE. The mean duration of freedom from TF for the observed period reached 8.5 years (95% confidence interval, 8.2–8.9) (Fig 1). Cox regression analysis revealed no relevant effect of clinical or morphologic imaging parameters or the type of embolization particles used on outcome measured as TF. Only the age group (< 40 y, 40–45 y, and > 45 y at UAE) was significantly related to outcome. The risk of TF was twice as high in women < 40 years old compared with women > 45 years old ($P = .049$). The data are presented in **Table 2**. **Fig 2** presents freedom from TF by age group.

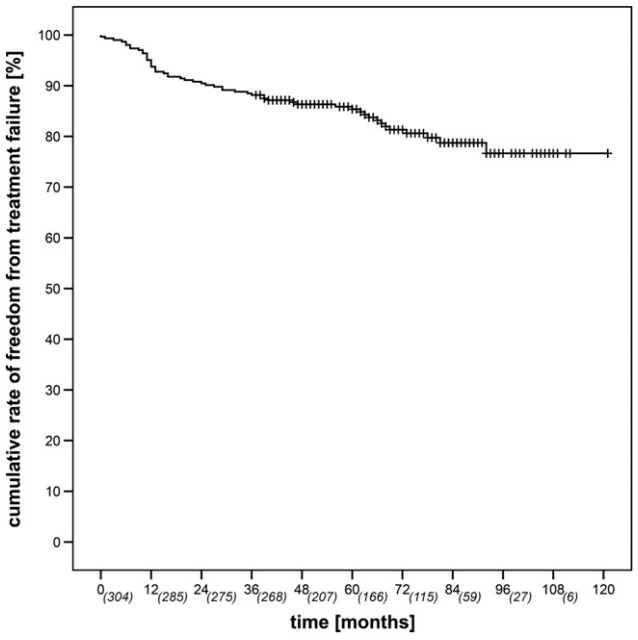

Figure 1. Cumulative rate of freedom from TF (ie, persistence or recurrence of symptoms or major reintervention, such as hysterectomy, myomectomy, or repeat UAE) according to Kaplan-Meier analysis for all patients eligible for follow-up analysis (N = 304). The numbers in parentheses along the x-axis are the patients at risk after each year. The black crosses along the graph correspond to censored data (patient's last available follow-up without evidence of TF). The cumulative rate of freedom from TF reaches 76.7% after 92 months (7.7 y) and remains stable until the end of the follow-up period of 10 years.

Outcome of UFS-QOL Questionnaire

Of the 250 women with reported long-term success of treatment, 47 were treated before July 2002 and did not complete the UFS-QOL questionnaire at baseline. Baseline questionnaires were completed by 186 of 203 women, and follow-up questionnaires were completed by 221 of 250 women. Wilcoxon test for paired samples could be conducted for 165 patients with sufficient baseline and follow-up data. The remaining women did not complete the questionnaire or left too many questions unanswered, and no scores could be calculated. All scores of the UFS-QOL questionnaire improved significantly during the observation period (**Table 3**). The symptom severity score decreased from a median of 46.88 (QR, 34.38–62.50) to 3.13 (QR, 0.00–15.63) ($P < .001$), the overall HRQOL score increased from a median of 58.62 (QR, 43.10–74.14) to 100.00 (QR, 95.69–100) ($P < .001$).

Repeat UAE

Of 46 patients who required reintervention, 9 (20%) chose to undergo repeat UAE. Eight interventions were performed within the first 13 months, and one intervention was performed 29 months after the initial treatment. In two of the eight women with early repeat embolization, insufficient fibroid infarction after the initial treatment was caused by relevant additional fibroid supply via hypertrophied ovarian arteries. Repeat UAE in these cases was supplemented by unilateral ovarian artery embolization. The reason for TF of the patient with repeat UAE after 29 months was insufficient devascularization of the fibroids with only about 60% infarction of her entire fibroid burden already seen on contrast-enhanced MR imaging 48 hours after her first UAE treatment. Follow-up was available in all nine patients who underwent repeat embolization at a median of 5.3 years (range, 4.3–7.8 y) after the second UAE. All patients experienced marked clinical improvement. The UFS-QOL questionnaire at baseline was available in all but one and at follow-up of all women. The symptom severity score decreased from a median of 25.00 (QR, 21.88–59.38) to 0.00 (QR, 0.00–21.10) ($P = .046$), and the HRQOL total score increased from a median of 74.14 (QR, 57.11–84.84) to 100.00 (QR, 94.40–100.00) ($P = .050$).

Menopause

In the subset of patients without TF during the observation period, 57 (22.8%) of 250 women experienced menopause. Four women were unable to specify the time of menopause; the remaining 53 had their last menstrual period at a median age of 51 years (QR, 48–53 y; range, 38–66 y) and at a median of 43 months (range, 0–108 mo) after embolization therapy. Early onset of menopause within the first year after UAE was seen in 9 (3.6%) of 250 women; 8 of these women were younger than the natural age of menopause (38 y, 40 y, 45 y, 46 y, 48 y, and three 49 y). More than 1 year after UAE, cessation of menstruation occurred almost exclusively in women at normal

Table 2. Results of Cox Proportional Hazards Regression

Variables	Hazard Ratio (95% CI)	*P* Value
Patient age > 45 y vs < 40 y	2.28 (1.01–5.18)	.049
Patient age > 45 y vs 40–45 y	1.53 (0.75–3.08)	.240
Uterine volume at baseline	1.00 (0.99–1.00)	.490
Largest leiomyoma volume at baseline	1.00 (0.99–1.00)	.863
> 5 vs 1 leiomyoma	0.93 (0.44–1.99)	.850
> 5 vs 2–5 leiomyomas	0.85 (0.42–1.74)	.655
Subserosal vs intramural location of largest leiomyoma	1.15 (0.55–2.39)	.708
Subserosal vs submucosal location of largest leiomyoma	1.06 (0.41–2.73)	.906
Bleeding- and bulk-related symptoms vs bleeding-related symptoms only	0.88 (0.39–1.99)	.758
Bleeding- and bulk-related symptoms vs bulk-related symptoms only	1.26 (0.60–2.64)	.541
TGM particles vs spherical PVA particles	1.60 (0.78–3.29)	.197
TGM particles vs nonspherical PVA particles	0.48 (0.11–2.09)	.329

The only significant hazard ratio was found for patient age. Women < 40 y had a 2.28-fold higher risk of TF. Fig 2 illustrates the cumulative rate of freedom from TF for the three age groups compared.
Grouping of categorical variables included in the analysis:

- Patient age: < 40 y, 40–45 y, > 45 y
- Number of uterine leiomyomas: 1, 2–5, > 5
- Location of largest leiomyoma at baseline: subserosal, intramural, submucosal
- Symptoms at baseline: predominantly bleeding-related, predominantly bulk-related, mixed bleeding-related and bulk-related symptoms
- Particles used for UAE: TGM particles (Embosphere), nonspherical PVA particles (Contour), spherical PVA particles (Bead Block)

CI = confidence interval, PVA = polyvinyl alcohol, TF = treatment failure, TGM = trisacryl gelatin microsphere, UAE = uterine artery embolization.

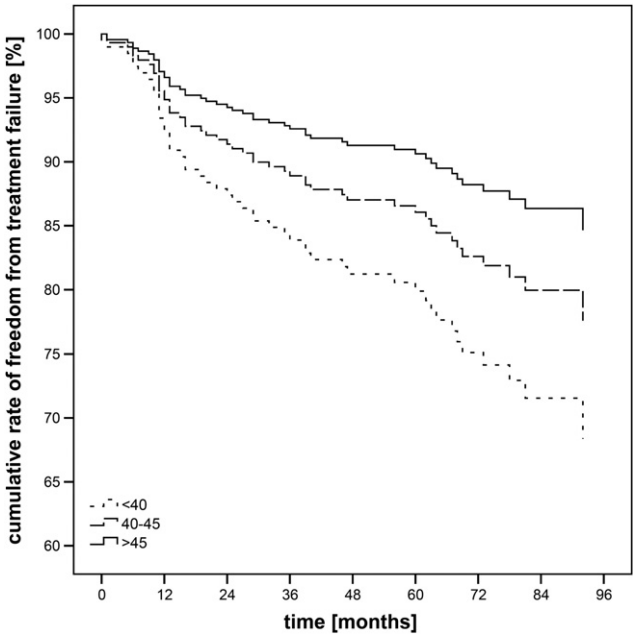

Figure 2. Cumulative rate of freedom from TF (ie, persistence or recurrence of symptoms or major reintervention, such as hysterectomy, myomectomy, or repeat UAE) according to Cox proportional hazards regression separately for patients < 40 years old, 40–45 years old, and > 45 years old. Corresponding curves reach cumulative rates of freedom from TF of 68% (< 40 years old), 78% (40–45 years old), and 85% (> 45 years old). The difference between women < 40 years old and > 45 years old reached significance ($P = .049$).

menopausal age. Another 6 (2.4%) of 250 women reported symptoms indicating the beginning of the climacteric period at a median age of 52.5 years (range, 47–57 y).

DISCUSSION

Introduced into clinical practice in the late 1990s as an alternative to hysterectomy, UAE has since proved to be an effective, minimally invasive, and low-risk treatment option for women with symptomatic uterine fibroids (3,7,15). Available retrospective analyses and prospective randomized trials comparing UAE with established surgical treatments (ie, hysterectomy, myomectomy) followed patients for up to 5 years (7,16–20). The results either are in favor of UAE in terms of observed complications, clinical effectiveness, and cost efficiency or at least show both procedures head to head. The major drawback of UAE compared with primary hysterectomy is a greater need for a repeat intervention. This drawback cancels out the initial cost advantage of UAE over surgery. Our study shows that the cumulative rate of TF approaches a steady state rather than increasing linearly over time. Data analysis revealed that most reinterventions occurred within the first 4 years of UAE, at a median of 1.3 years (QR, 0.9–3.3 y), mainly reflecting primary failure of the procedure with insufficient fibroid infarction (3,9,21). A further increase in costs owing to repeat interventions becoming necessary after

Table 3. Results of Uterine Fibroid Symptom and Quality of Life Questionnaire

	Before UAE		After UAE		
UFS-QOL subscale	**Median**	**QR**	**Median**	**QR**	***P* Value**
Symptom severity	46.88	34.38–62.50	3.13	0.00–15.63	< .001
Concern	55.00	30.00–80.00	100.00	97.50–100.00	< .001
Activities	53.57	35.71–75.00	100.00	98.22–100.00	< .001
Energy/mood	55.36	39.29–71.43	100.00	92.86–100.00	< .001
Control	60.00	45.00–75.00	100.00	95.00–100.00	< .001
Self-consciousness	75.00	41.67–91.67	100.00	100.00–100.00	< .001
Sexual function	50.00	25.00–75.00	100.00	96.88–100.00	< .001
HRQOL total	58.62	43.10–74.14	100.00	95.69–100.00	< .001

HRQOL = health-related quality of life, QR = quartile range, UAE = uterine artery embolization, UFS-QOL = Uterine Fibroid Symptom and Quality of Life.

this initial phase, such as described in the 5-year results of the REST (Randomized Trial of Embolization versus Surgical Treatment of Fibroids) trial, may not occur.

However, not only the need for reinterventions but also the choice of secondary treatment can affect cost efficiency. UAE may fail in the first attempt because of difficult anatomy, impairment of free-flow embolization by spasm, substantial collateral blood supply, or misinterpretation of the angiographic endpoint. This TF should not automatically prompt hysterectomy as the only and best choice for reintervention. A second minimally invasive endovascular approach, if necessary with refined technique or supplemented by embolization of relevant collaterals (22–24), can be successful despite initial failure, as could be shown in nine patients who did well after repeat UAE with a median follow-up period of 5.3 years. Similar results showing high clinical efficacy after repeat UAE were published by Yousefi et al (25) in a larger cohort of 24 women.

Because symptomatic fibroid disease usually ameliorates with menopause, clinical long-term analysis has to prove whether this period can be bridged successfully by UAE without further treatment. Throughout the current literature (3,4,6,7,19,25), mean patient age at the time of UAE varies only a little around 43 years, leaving 8 years until onset of menopause, which occurs at a mean age of 51 years (26). Poulsen et al (8) published the follow-up data of 83 patients who were evaluated for up to 9.4 years after UAE, documenting a 22% rate of hysterectomy owing to clinical failure of embolization. This rate matches the range known from shorter follow-up intervals and the cumulative rate of TF of 23.3% in this study (3). Menopausal age in the analysis of Poulsen et al (8) was 50.6 years. In our study, almost one-quarter of women reported cessation of menstruation or at least symptoms indicating the beginning of the climacteric period at a median age of 51 years or 52.5 years, respectively. These findings match the natural menopausal age, and there is no evidence that UAE may accelerate the onset of menopause (27). With a follow-up period ranging from 3.1–10.1 years, we found a mean freedom from TF of 8.5 years. UAE, which is usually performed in women in their early 40s, is able to alleviate fibroid-related symptoms until menopause, when symptomatic fibroid disease usually terminates. This finding suggests that the percentage of successfully treated patients would not decrease during longer observation periods. However, longer term studies with follow-up until the onset of menopause in all treated women may be needed to prove clinical and cost efficiency, particularly for younger patients. Women < 40 years old are much farther away from menopause and, in the present study, had a significantly higher risk of TF than women > 45 years old. Better outcome of UAE in older patients has been described in the literature before (28,29). This age effect may be even more pronounced in our study because of the longer follow-up period and the resulting higher proportion of menopausal women. No other influencing factors were identified. The particles used for embolization had no relevant effect on outcome, an observation that is in agreement with earlier reports (4,13).

For all women without TF, fibroid-specific quality of life improved and reached the highest possible scores, whereas the symptom severity score decreased, as expected, to a minimum. When effective, UAE successfully eliminates a woman's symptoms and symptom-related impairments in different areas of daily activities, and quality of life normalizes. The scores in our study exceed scores of the long-term follow-up data of the FIBROID Registry, with a mean symptom severity score of 16.54 and a mean HRQOL score of 89.55 after 3 years (2), and scores of the normal population in the validation study of the questionnaire with a mean symptom severity score of 22.5 and a mean HRQOL score of 86.4 (14). Causes might be the previous exclusion of all women with TF regardless of any secondary intervention and the longer follow-up period, during which more women entered menopause. In a comparative study of different leiomyoma therapies by Spies et al (15), women after hysterectomy also showed a markedly lower symptom severity score with 7.6 than women after UAE with 24.9 1 year after treatment or the normal control group with 15.2. Along with a decrease in symptom severity, the patients in the hysterectomy group experienced an improvement in quality

of life comparable to that of normal individuals (score of 92.3 vs 94.1 in controls). Patients who underwent UAE or myomectomy showed mean scores after treatment slightly > 80. The fact that all patients with clinical failure of UAE were eliminated may explain the fact that satisfaction scores in our patient population were closer to the range otherwise seen for women treated by complete removal of the organ causing their symptoms.

A limitation of this study is the rate of patients lost to follow-up. Although we had a response rate of 80%, this means that one-fifth of patients were lost to follow-up. The results have to be interpreted with some caution. However, our response rate is in the range of 72%–93% reported by earlier studies investigating the long-term outcome after UAE (4–6,11,30). Another limitation is the wide variation in follow-up periods, which ranged from 3–10 years. We addressed this problem by applying adequate statistical methods (Kaplan-Meier analysis, Cox proportional hazard regression). Finally, the clinical information available for analysis is limited by the fact that we followed our patients solely by clinical questionnaire. There were no office visits or follow-up imaging examinations. Some factors possibly relevant to outcome may have been missed.

In conclusion, this study demonstrates that a sustained positive clinical effect of UAE can be observed in about three-quarters of patients 10 years after treatment. Younger women have a slightly higher risk of TF compared with patients > 45 years old. Quality-of-life analysis revealed that UAE leads to normalization of HRQOL in women with fibroid disease. The median freedom from TF of 8.5 years, in conjunction with the expected rate of reported menopause at natural age, indicates that UAE is able to bridge most women to menopause.

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