

## GYNECOLOGY

# Uterine artery embolization vs hysterectomy in the treatment of symptomatic uterine fibroids: 10-year outcomes from the randomized EMMY trial



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**BACKGROUND:** Since 1995 uterine artery embolization has been described as an alternative for hysterectomy in patients with symptomatic fibroids. Many studies including several randomized controlled trials established uterine artery embolization as a valuable treatment. These randomized controlled trials reported outcomes in terms of health-related quality of life, clinical outcomes, efficacy, and cost-effectiveness after 1, 2, and 5 years of follow-up.

**OBJECTIVE:** The purpose of this study was to compare clinical outcome and health-related quality of life 10 years after uterine artery embolization or hysterectomy in the treatment of heavy menstrual bleeding caused by uterine fibroids in a randomized controlled trial.

**STUDY DESIGN:** In all, 28 Dutch hospitals recruited patients with symptomatic uterine fibroids who were eligible for hysterectomy. Patients were 1:1 randomly assigned to uterine artery embolization or hysterectomy. The outcomes assessed at 10 years postintervention were reoperation rates, health-related quality of life, and patient satisfaction, which were obtained through validated questionnaires. Study outcomes were analyzed according to original treatment assignment (intention to treat).

**RESULTS:** A total of 177 patients were randomized from 2002 through 2004. Eventually 81 uterine artery embolization and 75 hysterectomy patients underwent the allocated treatment shortly after randomization. The remaining patients withdrew from the trial. The 10-year questionnaire was mailed when the last included patient had been treated 10 years earlier. The mean duration of follow-up was 133 months (SD 8.58)

accompanied by a mean age of 57 years (SD 4.53). Questionnaires were received from 131 of 156 patients (84%). Ten years after treatment, 5 patients underwent secondary hysterectomy resulting in a total of 28 of 81 (35%) (24/77 [31%] after successful uterine artery embolization). Secondary hysterectomies were performed for persisting symptoms in all cases but 1 (for prolapse). After the initial treatment health-related quality of life improved significantly. After 10 years, generic health-related quality of life remained stable, without differences between both groups. The urogenital distress inventory and the defecation distress inventory showed a decrease in both groups, probably related to increasing age, without significant differences between study arms. Satisfaction in both groups remained comparable. The majority of patients declared being (very) satisfied about the received treatment: 78% of the uterine artery embolization group vs 87% in the hysterectomy group.

**CONCLUSION:** In about two thirds of uterine artery embolization—treated patients with symptomatic uterine fibroids a hysterectomy can be avoided. Health-related quality of life 10 years after uterine artery embolization or hysterectomy remained comparably stable. Uterine artery embolization is a well-documented and less invasive alternative to hysterectomy for symptomatic uterine fibroids on which eligible patients should be counseled.

**Key words:** hysterectomy, long-term follow-up, myoma, quality of life, randomized trial, uterine artery embolization, uterine fibroids

## Introduction

Uterine artery embolization (UAE) was first described for the treatment of symptomatic uterine fibroids in 1995.<sup>1</sup> Since then UAE was established as being a valuable treatment alternative for hysterectomy in many studies including several randomized controlled trials. These randomized controlled trials compared hysterectomy or myomectomy with UAE and found similar results

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## EDITORS' CHOICE

in terms of health-related quality of life (HRQOL) after 1, 2, and 5 years of follow-up.<sup>2-9</sup>

Earlier we reported on the results from the randomized EMMY (Embolization vs Hysterectomy) trial. These results contained data through 5 years after index procedure.<sup>3,6-16</sup> We compared clinical results,<sup>8</sup> HRQOL outcomes,<sup>9</sup> and menopausal symptoms<sup>13</sup> between embolization and hysterectomy.

In the present study, we analyzed these results again, now 10 years after treatment.

## Materials and Methods

### Study design

The full methods of this trial have been described earlier.<sup>6,8,9</sup> Here we describe

the condensed methods. The EMMY study is a multicenter, randomized controlled trial, conducted in The Netherlands from 2002 through 2004. Five university hospitals and 29 general hospitals recruited patients. Patients with symptomatic uterine fibroids who visited the gynecological outpatient clinic were asked to participate in the trial. The following inclusion criteria had to be met: (1) premenopausal status, (2) diagnosis of uterine fibroids by ultrasonography, (3) heavy menstrual bleeding as the predominant symptom, (4) no other treatment option than hysterectomy, and (5) no wish to conceive in the future. The study was approved by the Central Committee Involving Human Subjects followed by approval from local ethics committees

**TABLE 1**  
**Baseline and procedural characteristics**

	UAE N = 88	Hysterectomy N = 89
Age, y		
Mean (SD)	44.6 (4.8)	45.4 (4.2)
Body mass index, weight [kg]/length [m <sup>2</sup> ]		
Mean (SD)	26.7 (5.6)	25.4 (4.0)
Parity		
0	30 (34.1)	20 (22.5)
≥1	58 (65.9)	69 (77.5)
Ethnicity		
Black	24 (27.3)	20 (22.5)
Caucasian	54 (61.4)	57 (64.0)
Other	10 (11.4)	12 (13.5)
Marital status		
Single	16 (18.2)	13 (14.8)
Married	55 (62.5)	54 (61.4)
Together but living apart	5 (5.7)	4 (4.5)
Divorced	12 (13.6)	15 (17.0)
Widow	0 (0)	2 (2.3)
Employment status		
Employed	68 (77.3)	69 (78.4)
Unemployed	20 (22.7)	19 (21.6)
Smoking status		
Current smoker	21 (23.9)	23 (25.8)
Former smoker	11 (12.5)	14 (15.7)
Nonsmoker	56 (63.6)	52 (58.4)
Highest educational level		
Elementary school	3 (3.4)	6 (6.9)
Lower vocational, lower secondary school	29 (33.0)	32 (36.8)
Intermediate and higher vocational, higher secondary school	26 (29.5)	27 (31.0)
College/university	28 (31.8)	22 (25.3)
Other	2 (2.3)	0 (0)
Previous treatment		
None	11 (12.5)	15 (16.9)
Hormonal	59 (67.0)	59 (66.3)
Nonsteroidal antiinflammatory drugs/tranexamic acid	45 (51.1)	41 (46.1)
Iron supplement/blood transfusion	50 (56.8)	52 (58.4)
Surgical procedures	17 (19.3)	11 (12.4)

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of the participating hospitals. After informed consent had been obtained, patients were randomly (1:1) allocated to UAE or hysterectomy.

### Procedures

As described earlier UAE and hysterectomy were performed according to protocol and professional standards. See Table 1 for type of hysterectomy and UAE.<sup>8,9</sup>

### Sample size and endpoints of the study

The primary endpoint of the 2-year EMMY trial was elimination of heavy/abnormal menstrual bleeding in at least 75% of patients who were therefore spared a hysterectomy.<sup>8</sup> To reject the null hypothesis that UAE and hysterectomy are not clinically equivalent, at least 2 × 60 (= 120) analyzable patients had to be included. Endpoints after 10 years were reinterventions, quality of life, urinary and defecation function, menopausal symptoms, menstrual characteristics, and satisfaction with the received treatment.

### Study measures

During the first 2-year follow-up patients received a total of 6 questionnaires. After 5 and 10 years, an additional questionnaire was sent to all participants of the trial. The 10-year questionnaire was mailed when the last included patient had reached 10 years of follow-up. As a result, the questionnaire was returned after a median of 11 years of follow-up (133 months; SD 8.58). Non-responders were contacted by telephone. All questionnaires were similar except for the 5- and 10-year follow-up questionnaires, which were condensed versions of the original 6 questionnaires to optimize the response rate. The 10-year questionnaire evaluated the following subjects: additional interventions between 5-10 years of follow-up, HRQOL, urinary and defecation function, menopausal symptoms, menstrual characteristics (bleeding symptoms since UAE or no symptoms due to successful UAE or menopause), and satisfaction.

**TABLE 1**  
**Baseline and procedural characteristics** (continued)

	UAE N = 88	Hysterectomy N = 89
<b>Symptoms</b>		
Menorrhagia	88 (100)	89 (100)
Dysmenorrhea	47 (53.4)	50 (56.2)
Pain (not during menstruation)	15 (17.0)	14 (15.7)
Anemia	43 (48.9)	42 (47.2)
Pressure symptoms	23 (26.1)	25 (28.1)
Other symptoms	6 (6.8)	11 (12.4)
<b>Duration of symptoms, mo</b>		
Median (range)	24 (3–250)	24 (4–240)
<b>No. of fibroids</b>		
Median (range)	2 (1–20)	2 (1–9)
<b>Uterine volume, cm<sup>3</sup></b>		
Median (range)	321 (31–3005)	313 (58–3617)
<b>Fibroid volume—dominant fibroid, cm<sup>3</sup></b>		
Median (range)	59 (1–673)	87 (4–1641)
<b>Type of UAE</b>		
<b>Target embolization</b>		
Left uterine artery	65	—
Right uterine artery	59	—
<b>Selective embolization</b>		
Left uterine artery	8	—
Right uterine artery	12	—
<b>Type of hysterectomy (N = 4)</b>		
Abdominal hysterectomy	2	63
Vaginal hysterectomy	1	8
Vaginal hysterectomy with morcellation	1	1
LH with morcellation	—	2
LAVH	—	1

Values are N (%) unless otherwise noted.

LAVH, laparoscopic-assisted vaginal hysterectomy; LH, laparoscopic hysterectomy; UAE, uterine artery embolization.

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### Generic HRQOL

Health status and HRQOL was evaluated using the Medical Outcome Study Short Form (SF)-36.<sup>17,18</sup> The SF-36 generates 2 summary scores: The physical component summary (PCS) and the mental component summary (MCS).<sup>19</sup> The scores range from 0-100 and were validated for the Dutch population. Higher scores represent better physical or mental functioning.

### Urinary function and defecation

Urinary and defecation functioning was evaluated using the validated urogenital distress inventory (UDI) and the defecation distress inventory (DDI).<sup>20-22</sup>

The UDI was used to investigate urinary symptoms. The UDI score ranges from 1-100. Higher scores represent worse functioning. The same applies to the DDI, which was used to score defecation symptoms. Patients were asked to

rate the overall quality of urinary and stool function: very good, good, not good, nor bad, fairly bad, bad, or very bad. Furthermore, an inquiry was made if patients used pads for urinary incontinence or laxatives.

### Menopause

Menopausal symptoms were evaluated by the Kupperman score as modified by Wiklund et al.<sup>23</sup> Scores range from 0-51, where higher scores represent more serious menopausal symptoms.

### Satisfaction

We inquired whether the patients would recommend the primary treatment to a friend and whether or not they would indeed have chosen the assigned treatment again if they would have the opportunity to do so. Finally, patients were asked to indicate how satisfied they were with the received treatment on a 7-point Likert scale: very satisfied, satisfied, fairly satisfied, not satisfied/not unsatisfied, fairly unsatisfied, unsatisfied, or very unsatisfied.

### Statistical analysis

Statistical software (SPSS, Version 20.0; IBM Corp, Armonk, NY) was used for analyses. Study outcomes were analyzed according to original treatment assignment (intention to treat). Comparison of differences in categorical data was assessed with the  $\chi^2$  test (or Fisher exact test, if appropriate). Differences in numeric data were assessed by the unpaired Student *t* test. Predictors for secondary hysterectomy were analyzed by binary logistic regression. Whenever univariate analyses within baseline characteristics (Appendix) yielded a *P* value < .1 these were included for binary logistic regression.

Differences in HRQOL between the groups were assessed with the unpaired Student *t* tests. Repeated measurement analysis was used to evaluate longitudinal differences (MCS, PCS, UDI, DDI, and Wiklund scores) between the treatment strategies with time as a repeated factor (covariance structure: unstructured).

Multiple linear regression analyses were performed for baseline characteristics (Appendix) that yielded *P* values

< .1 in univariate analyses to evaluate the impact of these characteristics on the MCS, PCS, UDI, and DDI change scores at 10 years compared to baseline.

$P < .05$  (2-sided) was considered statistically significant in all analyses.

## Results

### Patients

Enrollment took place from March 2002 through February 2004 in 28 of 34 hospitals in The Netherlands. A total of 75 women vs 81 women received hysterectomy or UAE, respectively. Baseline and procedural characteristics are listed in Table 1. The patient flow is described in Figure 1; 84% of the mailed 10-year questionnaires were returned, with a mean follow-up of 133 months (SD 8.58 for analytical purposes, the median time of 11 years is depicted as a fixed point in time and mentioned hereafter as “10 years”). The remaining 16% consisted of nonresponders due to emigration ( $n = 3$ ), unknown address ( $n = 10$ ), refusal to participate ( $n = 9$ ), or death ( $n = 3$ ). Of the nonresponders 10 patients underwent UAE without secondary hysterectomy. The median age of all patients responding to the 10-year questionnaire was 56 years (range 45-68).

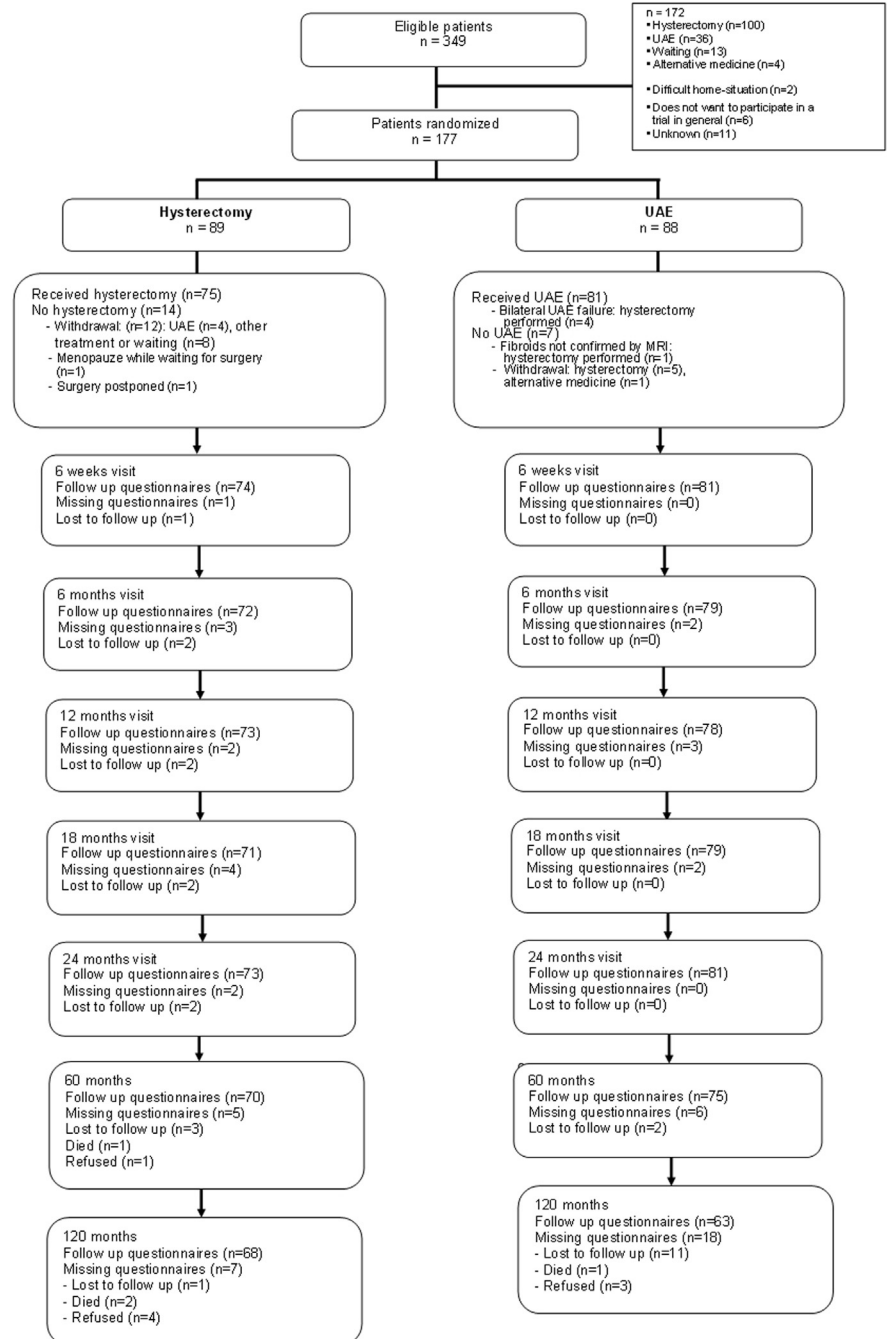
### Clinical outcome already reported

In the first 2 years of follow-up, 19 secondary hysterectomies were performed (23.5%): 4 because of bilateral UAE failure and another 15 because of clinical failure during follow-up.<sup>8</sup> At 2-5 years an additional 4 secondary hysterectomies were performed, because of insufficient improvement of menstrual bleeding symptoms, thus increasing the total secondary hysterectomy rate after 5 years to 28.4%.<sup>6</sup>

### Clinical outcome at 10 years

In addition to these 23 secondary hysterectomies, another 5 hysterectomies were required between 5-10 years (Figure 2). This totals 28 (35%) secondary hysterectomies after 10 years. Secondary hysterectomies were performed because of persistent menstrual problems or pain in all cases but 1, which was carried out for prolapse. Per protocol analysis showed that 24 of 77 (31%)

**FIGURE 1**  
Patient flow through trial and follow-up period



Patient flow through trial and follow-up period.

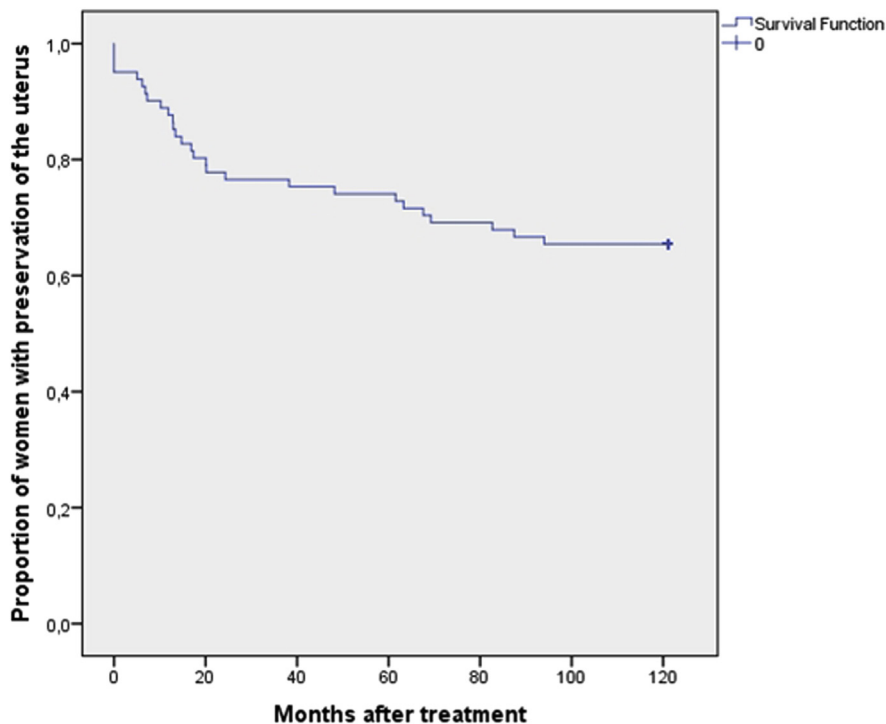
UAE, uterine artery embolization.

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patients underwent a secondary hysterectomy after a technically successful UAE, while another 4 patients in the UAE group had a bilateral embolization failure and subsequently had a

hysterectomy. Three of the patients who underwent unilateral embolization (30%) had a secondary hysterectomy, all within the first 2 years of follow-up. A total of 10 of 81 (12%) patients

**FIGURE 2**  
Kaplan-Meier curve for preservation of the uterus after uterine artery embolization



Hysterectomy-free survival for uterine artery embolization patients.

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underwent unilateral embolization. Of these 10 patients, 3 of 28 (10.7% received a secondary hysterectomy) and 8 of 53 (13.2%) did not.

UAE failure within 10 years of follow-up was associated with a body mass index  $>25$  (odds ratio, 3.29; 95% confidence interval [CI], 1.14–9.55;  $P = .028$ ) and smoking (odds ratio, 3.24; 95% CI, 1.08–9.68;  $P = .036$ ) in the multivariate analysis.

An overview of all additional interventions performed within 10 years in the UAE group and hysterectomy group are listed in Table 2.

### Quality of life outcome

#### HRQOL already reported

As described before, a significant improvement in general HRQOL (SF-36 MCS and PCS) occurred during the first 6 months after treatment for both groups.<sup>6,8,9</sup> Thereafter the scores stabilized and remained comparable between the groups during the first 5 years of

follow-up. Also, the UDI score showed significant improvement in both the hysterectomy and UAE groups during the first 6 months. Hereafter, UDI scores stabilized from 6 months to 5 years in both groups at a significantly higher level compared to baseline values before treatment without significant differences between groups.<sup>9</sup>

For defecation functioning a significant improvement was found in the UAE group between 6 months and 5 years compared to baseline. In the hysterectomy group, this was not the case. Between the groups there was no significant difference.

#### Generic HRQOL at 10 years

At 10 years both groups had improved significantly compared to baseline (MCS and PCS;  $P$  value  $< .001$ ) with no differences between groups. Between 5-10 years of follow-up no differences for PCS and MCS change scores between the groups were found.

Table 3 shows the differences in PCS and MCS between and within groups over time.

Repeated measurements analyses of the 10-year follow-up general HRQOL scores remained stable, without differences between both groups (PCS:  $P = .77$ ; MCS:  $P = .95$ ) (Figure 3, A and B).

Multivariate analyses of baseline variables showed a high or intermediate educational level ( $\beta$ , 3.02; 95% CI, 1.14–4.91;  $P = .002$ ) and previous surgical treatment ( $\beta$ , 5.89; 95% CI, 2.25–9.53;  $P = .002$ ) to be associated with improvement in PCS scores after 10 years. The increase in MCS scores after 10 years was positively influenced by a higher number of fibroids at baseline ( $\beta$ , 4.96; 95% CI, 0.53–9.38;  $P = .028$ ).

### Urinary and defecation function at 10 years

At 10 years both groups remained stable without differences between the groups (UAE:  $P = .93$ ; hysterectomy:  $P = .59$ ) (Table 3). Similarly, repeated measurements analyses showed no differences in UDI scores between the groups during 10 years of follow-up ( $P = .308$ ) (Figure 3, C). Improvement in urinary functioning after 10 years of follow-up was associated with 1 baseline characteristic: a lower number of fibroids ( $\beta$ ,  $-22.02$ ; CI,  $-37.67$  to  $-6.36$ ;  $P = .007$ ).

Figure 3, D, depicts defecation function (DDI). The significant improvement of DDI scores in the UAE group was no longer present when the 10-year scores were added to the repeated measurement analysis ( $P = .253$ ).

Table 3 shows the differences in DDI change score between and within groups over time.

Table 3 illustrates that no systematic differences for DDI change scores were present between the groups from 5-10 years of follow-up (UAE:  $P = .23$ ; hysterectomy:  $P = .31$ ). Multivariate analysis showed none of the baseline characteristics to be associated with improvement of defecation functioning.

Urinary incontinence was present at baseline in 18.5% of UAE patients vs 14.7% of hysterectomy patients ( $P = .52$ ). After 10 years 26.9% of UAE group patients reported urine incontinence

**TABLE 2**  
**Reinterventions in uterine artery embolization and hysterectomy group through 10 years after initial treatment**

Primary intervention UAE	Secondary intervention	Reason for intervention	Time since primary intervention, mo Until 2 y
1	Abdominal hysterectomy	Bilateral failure UAE	<1
2	Abdominal hysterectomy	Bilateral failure UAE	<1
3	Abdominal hysterectomy	Bilateral failure UAE	<1
4	Vaginal hysterectomy with morcellation	Bilateral failure UAE	<1
5-1	Failed attempt to hysteroscopically remove myoma under general anesthesia	Persistent abdominal pain/myoma nascens	1
5-2	Attempt at hysteroscopic myoma resection: converted to vaginal hysterectomy	Return menorrhagia	20
6	Manual resection myoma under general anesthesia	Discharge, fever, and abdominal pain/myoma nascens	2
7	Abdominal hysterectomy	Menorrhagia and persistent abdominal pain	5
8	Abdominal hysterectomy	Menorrhagia	6
9	Abdominal hysterectomy	Menorrhagia, persistent pain, bulk symptoms	7
10	Abdominal hysterectomy	Menorrhagia	7
11	Abdominal hysterectomy	Persistent abdominal pain and irregular menstruation	10
12	Vaginal hysterectomy	Menorrhagia, persistent pain, and dyspareunia	12
13-1	Diagnostic hysteroscopy with curettage	Post menstrual blood loss	12
13-2	Abdominal hysterectomy	Irregular cycle, pain, and bulk symptoms	13
14	Abdominal hysterectomy	Menorrhagia and bulk symptoms	13
15	Abdominal hysterectomy	Return menorrhagia	13
16	Laparoscopic-assisted vaginal hysterectomy	Menorrhagia	15
17	Abdominal hysterectomy	Menorrhagia	17
18	Vaginal hysterectomy	Menorrhagia	17
19	Abdominal hysterectomy	Menorrhagia	20
20	Abdominal hysterectomy	Menorrhagia	24
<b>Until 5 y</b>			
21	Myomectomy	Menorrhagia	25
22	Abdominal hysterectomy	Menorrhagia	36

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compared to 29.4% of patients in the hysterectomy group ( $P = .76$ ).

### Menopause

The 10-year questionnaire contained the question: “do you feel that you are in or beyond menopause?” In all, 26 of 62 (42%) patients in the UAE group and 29 of 67 (43%) in the hysterectomy group answered “yes” ( $P = .88$ ).

Figure 4 shows the mean Wiklund score over time.

Within-group analyses showed a significant increase in menopausal symptoms score in the hysterectomy group (+5.06; 95% CI, 2.01–8.11;  $P = .002$ ) and UAE group (+3.28; 95% CI, 0.68–5.87;  $P = .014$ ) from baseline compared to 10 years later. Repeated measurements analyses revealed no differences between UAE and hysterectomy after 10 years.

### Menstrual/bleeding characteristics

Of the 53 women who had their uterus at 10 years of follow-up, 7 (13%) still reported menstrual blood loss, however only 3 reported a lot to a fair amount, 2 women reported very little to none, and 2 women reported not being sure about menstrual blood loss.

Among women who underwent a primary hysterectomy or a secondary hysterectomy after an initial UAE, 5 of 103 (5%) reported occasional vaginal blood loss.

### Satisfaction and preference

At 10 years after the intervention, the majority of patients declared being satisfied about the received treatment: 78% in the UAE group vs 87% in the hysterectomy group ( $P = .77$ ) (Table 4).

In the UAE group 81% (51/63) would advise a friend to undergo an embolization, while 84% (57/68) of patients in the hysterectomy group would recommend a hysterectomy to their friends ( $P = .48$ ). As published earlier<sup>14</sup>, most patients had a strong preference for their allocated treatment. This did not change over time: 74.2% (46/62) of patients from the UAE group preferred UAE, while 71.2% (47/66) women from the hysterectomy group preferred hysterectomy ( $P < .71$ ).

**TABLE 2**  
**Reinterventions in uterine artery embolization and hysterectomy group through 10 years after initial treatment** (continued)

			Until 5 y
23	Curettage	Menorrhagia	37
24	Abdominal hysterectomy	Menorrhagia	44
25	Endometrium ablation	Menorrhagia	47
26	Polypectomy	Menorrhagia	48
27	Abdominal hysterectomy	Menorrhagia	48
28	Abdominal hysterectomy	Menorrhagia	63
			Until 10 y
29	Hysterectomy	Menorrhagia	64
30	Hysterectomy	Menorrhagia	67
31	Hysterectomy	Menorrhagia	68
32	Hysterectomy	Menorrhagia	79
33	Hysterectomy	Prolapse	93
<b>Hysterectomy</b>			Until 2 y
1–1	Adhesiolysis via laparotomy	Persistent abdominal pain	4
1–2	Bilateral and extirpation	Persistent abdominal pain	11
2	Fistula repair using Latzko technique	Vesicovaginal fistula	7
3	Reconstruction surgery	Incisional hernia	9
4	Adhesiolysis and cystectomy via laparotomy	Persistent abdominal pain	23
5	Diagnostic laparoscopy	Persistent abdominal pain	24
			Until 5 y
7	Ovariectomy	Persistent abdominal pain	38
8	Suburethral sling procedure	Stress incontinence	50
9	Reconstruction surgery	Cosmetic	54
			Until 10 y
10	Suburethral sling procedure	Prolapse	64
11	Suburethral sling procedure	Prolapse	100
12	Suburethral sling procedure	Prolapse	Unknown

UAE, uterine artery embolization.

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## Comment

This 10-year follow-up study describes the long-term outcomes of a large randomized trial that compared UAE with hysterectomy. We conclude that UAE is a well-documented valuable treatment alternative for surgery in the treatment of patients with symptomatic fibroids in

terms of quality of life. This view is supported by a recent Cochrane review.<sup>24</sup>

## Most important clinical findings

The necessity to perform a secondary hysterectomy after a median follow-up of approximately 11 years occurred in

35% (27) of UAE patients. This results in a success rate of 69% after an initially successful UAE (excluding 4 initial technical failures of UAE). The continuous increase of women undergoing hysterectomy beyond a follow-up of 5 years underlines the importance of studying long-term outcomes. A longer follow-up provides important insights for counselling patients and prediction of quality of life. This article reports the longest follow-up so far from a randomized comparison between UAE and hysterectomy. Other publications concerning shorter ( $\leq 5$  years) follow-up time frames show higher success rates.<sup>5,25</sup> Lower success rates, as reported in our study, may be explained by: (1) our initial selection criteria, where we selected the worst group of patients with no option other than a hysterectomy; (2) the fact that reem-bolizations were not performed in the study, which also may have resulted in higher hysterectomy rates; (3) the multicenter design of our trial: our results were not derived from a single high-volume center that, arguably, may have better UAE results; and (4) a longer follow-up than any other study in which we demonstrated that even between 5-10 years secondary hysterectomies are performed. Our finding that secondary hysterectomy within 5-10 years of follow-up was associated with a body mass index  $>25$  and smoking at baseline might be of importance in counselling patients. The same finding was reported between 2-5 years of follow-up.<sup>6</sup>

The most striking increase in HRQOL in both study arms occurred in the first 6 months after treatment and remained stable for 10 years without differences between both groups.<sup>9</sup> However, after 5 years of follow-up a decrease in PCS scores occurred in both groups, which seems to be explained best by increasing age and (befitting) consequential physical decline.

The 10-year multivariate analysis for baseline variables showed previous surgical treatment and high or intermediate educational level to be associated with improvement of PCS scores. Previous gynecological surgical

**TABLE 3**  
Quality of life change scores through 10 years after uterine artery embolization and hysterectomy

	12 months change score			24 months change score			60 months change score			120 months change score		
	UAE (N=81)	Hyst. (N=75)	Change score difference (95%CI)	UAE (N=81)	Hyst. (N=75)	Change score difference (95%CI)	UAE (N=81)	Hyst. (N=75)	Change score difference (95%CI)	UAE (N=81)	Hyst. (N=75)	Change score difference (95%CI)
MOS	6.33 <sup>a</sup>	7.67 <sup>a</sup>	1.34 (-2.63 to 5.32)	5.80 <sup>a</sup>	7.26 <sup>a</sup>	1.47 (-2.78 to 5.71)	6.31 <sup>a</sup>	6.87 <sup>a</sup>	-0.56 (-5.07 to 3.95)	4.41 <sup>a</sup>	4.54 <sup>a</sup>	0.13 (-4.08 to 3.82)
SF-36												
MCS												
MOS	7.32 <sup>a</sup>	10.13 <sup>a</sup>	2.81 (-0.59 to 6.21)	9.42 <sup>a</sup>	9.32 <sup>a</sup>	-0.096 (-2.98 to 2.79)	8.47 <sup>a</sup>	7.20 <sup>a</sup>	1.26 (-2.16 to 4.70)	7.31 <sup>a</sup>	7.04 <sup>a</sup>	0.26 (-3.93 to 4.46)
SF-36												
PCS												
UDI	-17.16 <sup>a</sup>	-17.88 <sup>a</sup>	-0.72 (-9.74 to 8.30)	-17.03 <sup>a</sup>	-14.66 <sup>a</sup>	2.37 (-8.13 to 12.87)	-10.70 <sup>a</sup>	-8.41 <sup>a</sup>	-2.29 (-13.45 to 8.87)	-0.42	3.17	-3.59 (-18.65 to 11.46)
DDI	-5.90 <sup>a</sup>	-4.99	0.91 (-6.55 to 8.36)	-14.42 <sup>a</sup>	-5.39	9.03 (-0.82 to 18.88)	-12.72 <sup>a</sup>	0.01	-12.73 (-22.31 to -3.15)	-5.03	5.16	-10.18 (-23.11 to 2.75)

CI, confidence interval; DDI, defecation distress inventory; MCS, mental component summary; MOS, Medical Outcome Study; PCS, physical component summary; SF, Short Form; UAE, uterine artery embolization; UDI, urogenital distress inventory.

<sup>a</sup> Indicates a statistically significant ( $P < .05$ ) change from baseline in the within-group analysis.

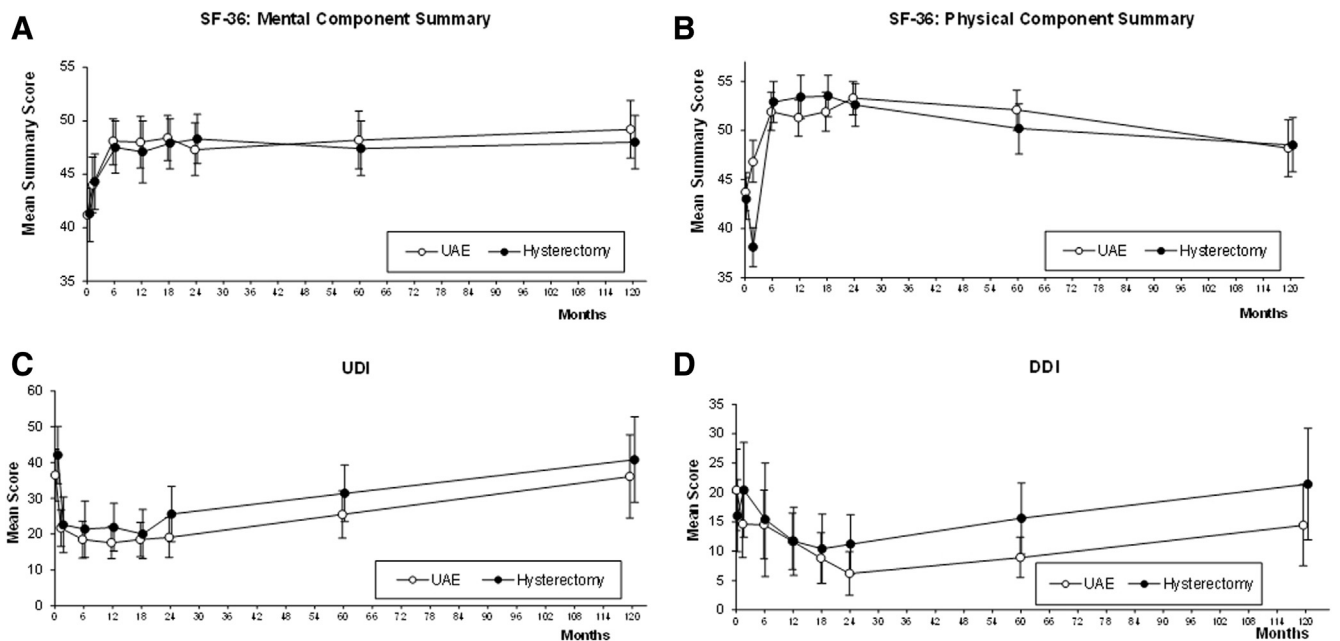
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treatment as an influencing factor for PCS might be explained by patients having a worse physical condition at baseline, thus enabling a higher physical benefit from treatment. In the general population, a high or intermediate educational level is often associated with a better physical and mental condition.<sup>26</sup> Consequently, it is not surprising that these patients had a higher chance of increased PCS scores. Analyses also showed “no previous treatment” to be associated with lower PCS change scores, hence the possibility that these patients have less to gain from treatment because of better PCS scores at baseline. For the first time in follow-up UDI and DDI scores showed no significant improvement compared to baseline scores, which may be explained by physical decline due to increasing age, but not influenced by keeping the uterus.

Earlier we reported on a significantly better defecation function as a new finding in the UAE group, however repeated analyses of our 10-year follow-up data no longer showed this difference.<sup>6</sup> This might be explained by the fact that there were fewer respondents, resulting in insufficient power to remain significant (the effect size was still present but the CI widened) (Table 3). We note that there is still a trend toward better defecation function in the UAE group compared with the hysterectomy group (Figure 3, C and D). Menopausal symptoms did not reveal any differences between both treatment arms. It did however find a significant increase in Wiklund scores over time in comparison to baseline values in both groups, probably explained by more women reaching (perimenopausal) menopausal age. The mean age for reaching menopause in industrialized societies is 51 years,<sup>27,28</sup> while the mean age of women in the embolization and hysterectomy groups was 55 and 56 years, respectively. Only 7 women in the UAE group still reported menstrual blood loss. Three of these are theoretical candidates for hysterectomies in the future since they value the amount of blood loss as more than a normal menstruation.



**FIGURE 3**  
Graphs show health related quality of life scores through 10 years of follow-up



For Short Form (SF)-36 mental and physical component summaries, higher scores indicate better functioning; for urogenital distress inventory (UDI) and defecation distress inventory (DDI), higher scores indicate worse functioning.

UAE, uterine artery embolization.

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**Strengths and limitations of this study**

Our study is the only randomized controlled trial ever published with 10 years of follow-up results and therefore important in providing clinicians with unique insight for patient counselling in

terms of clinical outcomes and various aspects of quality of life.

However, our response rate was not 100%, which might contribute to insufficient power for reaching significant results. Ten patients in the UAE group did not have a secondary

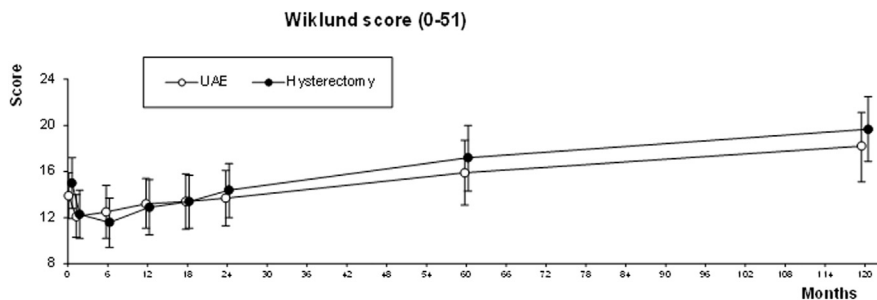
hysterectomy at 5-year follow-up and did not respond to the 10-year questionnaire, however we find it very unlikely that all of these patients underwent hysterectomy between 5-10 years of follow-up. Furthermore, surgical techniques for both hysterectomy and UAE have changed over the years; currently, hysterectomies are progressively done by laparoscopy and technical failures for UAE are becoming less prevalent. This might have influenced results, when the study would have been performed currently.

**Conclusion**

After 10 years of follow-up, in 69% of all women undergoing a technical successful UAE, a hysterectomy was avoided. Also, HRQOL and satisfaction rates did not differ between the randomized groups.

In view of the short- and long-term available clinical and quality-of-life evidence, we conclude that all women who are candidates for hysterectomy because

**FIGURE 4**  
Wiklund score for menopausal symptoms through 10 years of follow-up



Wiklund score for menopausal symptoms through 10 years of follow-up. Higher scores indicate more menopausal symptoms.

UAE, uterine artery embolization.

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## APPENDIX

Predictors for failure	Effect of baseline variables on HRQOL
Age (continuous)	Age (continuous)
Ethnicity (Caucasian as reference category)	Ethnicity (Caucasian as reference category)
Body mass index (continuous)	Body mass index (continuous)
Parous (yes/no)	Parous (yes/no)
Smoking (yes/no)	Smoking (yes/no)
Educational level (intermediate or higher vs lower)	Educational level (intermediate or higher vs lower)
Married (yes/no)	Married (yes/no)
Paid work (yes/no)	Paid work (yes/no)
Comorbidity (yes/no)	Comorbidity (yes/no)
Previous surgical treatment (yes/no)	Previous surgical treatment (yes/no)
Previous hormonal treatment (yes/no)	Any previous treatment (yes/no)
Duration of menorrhagia symptoms (>/<1 y)	Duration of menorrhagia symptoms (continuously)
Hemoglobin level (continuous)	Previous iron substitution therapy/blood transfusion (yes/no)
Anemia (yes/no)	Anemia before treatment (yes/no)
No. of fibroids (continuous)	No. of fibroids (continuous)
Uterine volume (continuous)	Uterine volume (continuous)
Volume of fibroids (continuous)	Volume of fibroids (continuous)
	Intended treatment (UAE/hysterectomy)
	Baseline and after 24 mo SF-36 MCS (continuously, not on MCS change outcome)
	Baseline and after 24 mo SF-36 PCS (continuously, not on PCS change outcome)

HRQOL, health-related quality of life; MCS, mental component summary; PCS, physical component summary; SF, Short Form; UAE, uterine artery embolization.

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