



Comparative effectiveness of uterine fibroids procedures using linked medical record and claims data

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Aims: To compare durability of uterus-conserving procedures for symptomatic fibroids in terms of incidence and time to subsequent procedures. **Patients & methods:** We conducted a retrospective database study of 2648 patients having a uterus-conserving procedure for uterine fibroids from 2005 to 2011 with a minimum of 2 years follow-up. **Results:** Patients with myomectomy or uterine artery embolization as their index procedure had lower risk of a subsequent procedure during the study compared with patients who underwent endometrial ablation. **Conclusion:** While subject to known limitations of using electronic medical record and administrative claims data, this research provides additional evidence regarding expectations for time to subsequent procedures that may be helpful for women and their healthcare providers to consider when making treatment choices.

First draft submitted: 29 May 2018; Accepted for publication: 14 September 2018; Published online: 19 November 2018

Keywords: comparative effectiveness • procedures • uterine fibroids

Uterine leiomyomata, commonly referred to as fibroids, are one of the leading causes of morbidity in reproductive-age women. These benign tumors of uterine smooth muscle and extracellular matrix have a cumulative incidence (based on imaging) by age 50 years of almost 70% for Caucasian women and more than 80% for African-American women [1].

Although most fibroids are asymptomatic, a substantial proportion causes symptoms. The most common symptoms are heavy menstrual bleeding and/or pain, with a peak incidence for symptoms between ages 35–45 years [2]. Studies using both global and disease-specific measures of health-related quality of life show substantial impairment in health-related quality of life women with symptomatic fibroids [3,4].

Symptomatic fibroids are by far the most common cause of hospitalization for benign gynecologic conditions in the USA [5]. Fibroids may also contribute to adverse reproductive outcomes. Fibroids are associated with some cases of infertility [6,7], although this may be due in part to referral bias [8]. Fibroids are common in pregnancy, with approximately 10% of women having detectable fibroids in the first trimester of pregnancy [9] and are also associated with adverse pregnancy outcomes such as miscarriage, preterm birth and an increased risk of cesarean delivery [2,10,11]; although, again, there is uncertainty about whether this association is causal. Approximately 200,000 hysterectomies, 30,000 myomectomies and thousands of selective uterine artery embolizations and high-intensity focused ultrasound procedures are performed annually in the USA to remove or destroy uterine fibroids, with the annual economic burden of these tumors estimated to be between \$5.9 and \$34.4 billion [12,13].

Despite the high burden of disease associated with fibroids, the quality of the evidence on optimal management is poor. A systematic review conducted in 2002 for the Agency for Healthcare Research and Quality found almost no high-quality evidence for the comparative effectiveness of different treatment options for symptomatic fibroids [2]. An update conducted in 2007 found no substantive changes in the state of the evidence and concluded that the “... dearth of high-quality evidence supporting the effectiveness of most interventions for uterine fibroids is remarkable, given how common this problem is. The current state of the literature does not permit definitive conclusions about benefit, harm

or relative costs to help guide women's choices. Significant research gaps include well-conducted trials in United States populations that directly compare interventions on short-, and especially, long-term outcomes, studies on therapeutics for medical management and information on treatment decisions for women who desire a pregnancy" [14].

Because treatment options for symptomatic fibroids involve significant trade-offs, the lack of evidence on outcomes of treatment limits the ability of patients to make informed treatment decisions. Trade-offs include decisions about relative rates of short-term side effects and in the case of procedures, complications and recovery time, the likelihood of cure versus recurrent symptoms and effect on future childbearing potential. There is considerable uncertainty about all of these outcomes for available treatments for fibroids. Additional research, particularly research on the relative effectiveness of available treatments, is needed.

The current study was therefore conducted to help patients and care providers make informed decisions about which treatment options for uterine fibroids are most likely to result in the outcomes that are of greatest importance to patients. Using a unique data resource combining administrative and electronic medical record (EMR) data, we examined the durability of symptom relief after uterus-conserving procedures for symptomatic fibroids in terms of the incidence of subsequent procedures after the initial treatment.

Patients & methods

This was a retrospective study to compare the durability of four uterus-conserving procedures for treatment of symptomatic fibroids: myomectomy, endometrial ablation, uterine artery embolization, and MRI-guided focused ultrasound ablation in terms of incidence of and time to subsequent procedures. Due to the very small number of MRI-guided ultrasound procedures identified ($n = 2$), however, we focused on the other uterus-conserving procedures in this article.

We used an EMR data source, Q-EMR, which was linked with administrative claims data from Truven MarketScan. The Q-EMR data were obtained from a national network of out-patient offices whose providers allow their de-identified patient-level data to be made available for research. Clinical data were captured from more than 525 member institutions and more than 30,000 providers. The Q-EMR data were then linked to the Truven MarketScan claims data using an algorithm based on specific data elements (gender, month/year of birth and three digit zip codes) and healthcare service dates [15].

The study population was female patients with a diagnosis of uterine fibroids who had a record of at least one of the uterus-conserving procedures of interest occurring during the time period of 1 January 2005–31 December 2011, with the first instance being designated as the index date. The study time period spanned from 1 January 2004 to 31 December 2013 to allow for 12 months preindex for evaluating baseline demographic and clinical characteristics and 24 months postindex, ensuring a minimum of 2 years follow-up. Only patients aged 18–54 years at the index date were included in the analysis and we applied the following exclusion criteria: patients with a diagnosis of gynecologic cancer (ovarian, uterine, cervical); first recorded diagnosis of uterine fibroids occurring beyond 4 weeks after the index date (only for patients who underwent endometrial ablation or hysterectomy); and patients with a record of any procedures of interest occurring before 1 January 2005. A total of 2648 patients who met these criteria were identified.

Patient demographics and relevant medical history were extracted from the linked Q-EMR and claims data. Potential predictors were evaluated, including patient demographics (age, race/ethnicity, geographic region), comorbid medical conditions, and symptoms (e.g., bleeding, pain) at the time of the index procedure. Comorbidities were classified into the following categories: none; any high risk comorbidity (including coronary artery disease, heart failure, myocardial infarction, stroke, cardiac dysrhythmias); any other nonhigh risk comorbidity (hypertension, Type 2 diabetes mellitus, disorders of lipid metabolism) and obesity (obesity alone and obesity with any other high-risk comorbidity). Symptoms were classified into three groups: bleeding (anemia, menorrhagia), pain (pelvic pain not related to menstrual cycle, dysmenorrhea), and other symptoms (urinary retention, leukorrhea, hydronephrosis, shortness of breath, dyspareunia, constipation, diarrhea, back pain, leg pain, dysuria).

Demographic and other baseline characteristics of the study cohort were described as counts and percentages for categorical variables and measures of central tendency (mean, standard deviation, median, interquartile range) for continuous variables.

A multivariable logistic regression model was used to compare the incidence of subsequent procedures following myomectomy, endometrial ablation, and uterine artery embolization and to calculate odds ratios (OR), controlling for potential confounding variables at baseline (race, region, index procedure, symptoms, comorbidities and age) as covariates in the multivariable models. Cox proportional hazard models [16] were used to compare time to

subsequent procedures following the myomectomy, endometrial ablation, and uterine artery embolization and to calculate hazard ratios (HRs), controlling for potential confounding variables. Kaplan–Meier curves were created to graphically present time to the first subsequent procedure.

To ensure equal follow-up time for study patients, we only included 2 years of follow-up after the index procedure in the logistic regression modeling, regardless of the total follow-up time available for individual patients. All available follow-up data were included in the time to event analyses, namely the Cox proportional hazards modeling. For analyses examining the incidence of and time to subsequent procedures, we excluded procedures coded as having occurred within ≤ 60 days of the index procedure (except for hysterectomy, which was included regardless when the procedure occurred). The rationale for this decision is that we assumed that the procedures were likely related to coding issues as clinically, we would not expect to see a subsequent procedure (with the exception of hysterectomy) occurring so soon after the index treatment.

All analyses were performed using SAS® 9.4.M3 and SAS/STAT 14.1 (SAS, NC, USA). This study was approved by the New England Institutional Review Board.

Results

Of the 2648 patients with uterus-conserving index procedures, 1274 (48.1%) had endometrial ablation, followed by myomectomy ($n = 1076$; 40.6%) and uterine artery embolization ($n = 298$; 11.3%). As noted, given that only two patients had MRI-guided ultrasound as the index procedure, we focused the analyses on the other uterus-conserving treatments.

Demographic and clinical characteristics of the patient sample, overall and by index procedure, are presented in [Table 1](#). The mean age of patients was 42.7 (SD = 6.2) years. Patients receiving a myomectomy as the index procedure had a mean age of 39.9 (SD = 6.7) years. The mean ages for women who underwent endometrial ablation and uterine artery embolization were 44.8 (SD = 5.0) and 43.7 years (SD = 5.0), respectively. Of the patients with known geographic region ($n = 2628$), the majority were from the southeast ($n = 1445$; 55.0%), followed by the northeast ($n = 662$; 25.2%) and midwest ($n = 320$; 12.2%), with fewer than 10% living in the west. These distributions held when stratified by index procedure.

Among those patients with known race ($n = 1883$ or 71.1% of the 2648 total patients), the majority were White/Caucasian ($n = 1126$; 59.8%), followed by Black or African–American ($n = 649$; 34.5%). Endometrial ablation was the index procedure for 59.7% of White/Caucasian patients and for 31.3% of Black/African–American patients. Only 33.3% of White/Caucasian women had myomectomy as the index procedure, compared with 48.4% of Black/African–American women.

The mean and median follow-up time for the cohort was 53.4 and 48.5 months, respectively (range: 24 to 112 months). 30% of women who had an endometrial ablation as index procedure had a subsequent procedure for treatment of uterine fibroid disease at any time during the follow-up period, compared with 25% of women who had myomectomy and 19% who had uterine artery embolization as index procedures ([Table 2](#)). Within 2 years of the index procedure, 18% of the endometrial ablation group had a subsequent procedure for uterine fibroids versus 13% of the myomectomy group and 11% of the uterine artery embolization group. Both the median and mean time to subsequent procedure were somewhat longer among women who had a myomectomy (mean = 822.1 [SD = 671.2] days; median = 624.5) compared with women who underwent uterine artery embolization (mean = 753.2 [508.9] days; median = 619) or with those who underwent endometrial ablation (mean = 684.1 [540.2] days; median = 537.5).

Results of a multivariable logistic regression analysis indicated that patients who were Black/African–American had subsequent procedures within 2 years following their index procedure about as often as White/Caucasian patients, after adjusting for potential confounding (OR: 1.13; 95% CI: 0.84; 1.52; [Table 3](#)). Patients with myomectomy and uterine artery embolization as the index procedure had lower odds of having a subsequent procedure within 2 years of their index procedure than patients with an index procedure of endometrial ablation (OR: 0.68 [95% CI: 0.50; 0.92]; OR: 0.59 [95% CI: 0.38; 0.94]; respectively). Patients with symptoms in one symptom group (OR: 1.57; 95% CI: 0.98; 2.52) or two or three symptom groups at study entry (OR: 1.56; 95% CI: 0.98; 2.51) had increased odds of having a subsequent procedure within 2 years compared with those with no recorded symptoms at study entry, though these findings were not statistically significant. Age was not a significant predictor of subsequent procedures.

Black/African–American patients underwent subsequent procedures during the study period about as often as White/Caucasian patients (HR: 1.12; 95% CI: 0.91; 1.37), based upon the results of a multivariable proportional

Table 1. Patient demographic and clinical characteristics, overall and by index procedure.

Characteristic	Index procedure			
	Myomectomy n = 1076	Endometrial ablation n = 1274	Uterine artery embolization n = 298	Total [†] n = 2648
Age (years)				
Mean (SD)	39.9 (6.7)	44.8 (5.0)	43.7 (5.0)	42.7 (6.2)
Median (range)	39 (22, 54)	45 (28, 54)	44 (27, 54)	44 (22, 54)
Age group (years), n (%)				
18–35	311 (79.1%)	62 (15.8%)	20 (5.1%)	393
36–45	521 (41.0%)	592 (46.6%)	158 (12.4%)	1271
46<55	244 (24.8%)	620 (63.0%)	120 (12.2%)	984
Region, n (%)				
Northeast	278 (42.0%)	315 (47.6%)	69 (10.4%)	662
Midwest	117 (36.6%)	161 (50.3%)	42 (13.1%)	320
Southeast	601 (41.6%)	671 (46.4%)	173 (12.0%)	1445
West	73 (36.3%)	115 (57.2%)	13 (6.5%)	201
Unknown	7 (35.0%)	12 (60.0%)	1 (5.0%)	20
Race, n (%)				
Black/African–American	314 (48.4%)	203 (31.3%)	132 (20.3%)	649
White/Caucasian	375 (33.3%)	672 (59.7%)	79 (7.0%)	1126
Other	54 (50.0%)	43 (39.8%)	11 (10.2%)	108
Unknown	333 (43.5%)	356 (46.5%)	76 (9.9%)	765
Baseline symptoms [‡] , n (%)				
No symptom group	201 (64.8%)	53 (17.1%)	56 (18.1%)	310
1 Group	430 (38.9%)	554 (50.1%)	121 (11.0%)	1105
2–3 Groups	445 (36.1%)	667 (54.1%)	121 (9.8%)	1233
Comorbidities [§] , n (%)				
None	39 (32.2%)	72 (59.5%)	10 (8.3%)	121
Any high risk	229 (36.4%)	328 (52.1%)	72 (11.4%)	629
Any other nonhigh risk	645 (45.2%)	623 (43.7%)	159 (11.1%)	1427
Obesity only	77 (28.8%)	153 (57.3%)	37 (13.9%)	267
Obesity & any other nonhigh risk	86 (42.2%)	98 (48.0%)	20 (9.8%)	204

[†]Two women with MRI-guided focused ultrasound as their index procedure are not included in this table and were not included in the comparative analyses due to the small sample size.

[‡]Symptoms were categorized into three groups: bleeding (anemia, menorrhagia), pain (pelvic pain, dysmenorrhea), other (urinary retention, leukorrhea, hydronephrosis, shortness of breath, dyspareunia, constipation, diarrhea, back pain, leg pain, dysuria).

[§]Nonhigh risk comorbidities included: hypertension, Type 2 diabetes, disorders of lipid metabolism. High risk comorbidities included: coronary artery disease, heart failure, myocardial infarction, stroke, cardiac dysrhythmias.

SD: Standard deviation.

Table 2. Frequency of and time to new procedures following the initial uterus-sparing procedure[†].

Variable	Myomectomy n = 1076	Endometrial ablation n = 1274	Uterine artery embolization n = 298
Patients with subsequent procedure during the follow-up period			
n (%)	266 (24.7%)	386 (30.3%)	57 (19.3%)
Days to subsequent procedure			
Mean (SD)	822.1 (671.2)	684.1 (540.2)	753.2 (508.9)
Median (Q1, Q3)	624.5 (283, 1313)	537.5 (259, 987)	619 (428, 985)
Patients with subsequent procedure occurring within 2 years following the index procedure			
n (%)	141 (13.1%)	233 (18.3%)	33 (11.1%)

[†] Excluded coded procedures (except hysterectomy) occurring within 60 days of the initial procedure.

SD: Standard deviation.

Table 3. Association of patient factors with the occurrence of new procedures within 2 years after the initial uterus-sparing procedure (n = 1869).

Variable	OR [†]	95% CI
Race		
White/Caucasian (referent group)	–	–
Black/African–American	1.13	0.84, 1.52
Other	1.14	0.66, 1.96
Region		
Northeast (referent group)	–	–
Midwest	0.91	0.58, 1.44
South	0.85	0.62, 1.18
West	1.04	0.62, 1.74
Index procedure		
Endometrial ablation (referent group)	–	–
Myomectomy	0.68	0.50, 0.92
Uterine artery embolization	0.59	0.38, 0.94
Comorbidity[‡]		
None (referent group)	–	–
Any high-risk	0.85	0.45, 1.61
Any other nonhigh-risk	1.05	0.77, 1.43
Obesity only	1.09	0.68, 1.76
Obesity & any other nonhigh-risk	0.77	0.48, 1.23
Baseline symptoms[§]		
None (referent group)	–	–
1 Group	1.57	0.98, 2.52
2–3 Groups	1.56	0.98, 2.51
Age (years)		
36–45 (referent group)	–	–
18–35	0.95	0.64, 1.42
46–55	0.81	0.62, 1.08

[†] OR estimate from the multivariable logistic regression model.

[§] Symptoms were categorized into three groups: Bleeding (anemia, menorrhagia), pain (pelvic pain, dysmenorrhea), other (urinary retention, leukorrhea, hydronephrosis, shortness of breath, dyspareunia, constipation, diarrhea, back pain, leg pain, dysuria).

CI: Confidence interval; OR: Odds ratio.

hazards model (Table 4). Patients who underwent either a myomectomy (HR: 0.74; 95% CI: 0.60; 0.92) or uterine artery embolization (HR: 0.61; 95% CI: 0.43; 0.86) as their index procedure were at reduced risk of having a subsequent procedure during the study period compared with patients who had endometrial ablation. The corresponding Kaplan–Meier curves, which also illustrate the reduced risk of subsequent procedure for uterine artery embolization and myomectomy versus endometrial ablation are shown in Figure 1. Note that though the Kaplan–Meier curves for uterine artery embolization and myomectomy begin to cross at about 100 months, the size of the patient sample available for analysis at this time point was very small (n = 30).

Discussion

We describe here a retrospective database study of uterine fibroid patients conducted for the purpose of comparing the uterus-conserving procedures of interest in terms of incidence of and time to subsequent procedures. This study addresses a gap in the literature regarding the effectiveness of various treatments for uterine fibroids.

We found that endometrial ablation was the most common uterus-conserving index procedure, followed by myomectomy and uterine artery embolization. When treatment patterns were analyzed by race, Black/African–American women underwent myomectomy more frequently than White/Caucasian women and White/Caucasian women had endometrial ablations at a higher frequency than Black/African–American women.

Within 2 years of the index procedure, fewer than 20% of patients had a subsequent procedure (18% for endometrial ablation, 13% for myomectomy, and 11% for uterine artery embolization). This is in agreement

Table 4. Risk of subsequent procedure within full study period following initial uterus-sparing procedure (n = 1869).

Variable	HR [†]	95% CI
Race		
White/Caucasian (referent group)	–	–
Black/African–American	1.12	0.91, 1.37
Other	0.94	0.62, 1.41
Region		
Northeast (referent group)	–	–
Midwest	1.11	0.81, 1.52
South	0.94	0.75, 1.18
West	1.17	0.82, 1.66
Index procedure		
Endometrial ablation (referent group)	–	–
Myomectomy	0.74	0.60, 0.92
Uterine artery embolization	0.61	0.43, 0.86
Comorbidity[‡]		
None (referent group)	–	–
Any high risk	0.91	0.59, 1.41
Any other nonhigh-risk	1.01	0.82, 1.26
Obesity only	0.89	0.62, 1.29
Obesity & any other nonhigh-risk	0.94	0.68, 1.29
Baseline symptoms[§]		
None (referent group)	–	–
1 group	1.22	0.89, 1.68
2–3 Groups	1.34	0.98, 1.84
Age (years)		
36–45 (referent group)	–	–
18–35	0.71	0.49, 1.03
46–54	0.74	0.61, 0.90

[†]HR estimate from the Cox proportional hazards model.

[‡]Nonhigh-risk comorbidities included: hypertension, Type 2 diabetes, disorders of lipid metabolism. High-risk comorbidities included: coronary artery disease, heart failure, myocardial infarction, stroke, cardiac dysrhythmias.

[§]Symptoms were categorized into three groups: Bleeding (anemia, menorrhagia), pain (pelvic pain, dysmenorrhea), Other (urinary retention, leukorrhea, hydronephrosis, shortness of breath, dyspareunia, constipation, diarrhea, back pain, leg pain, dysuria).

CI: Confidence interval; HR: Hazard ratio.

with previous studies which found reintervention rates to be low within 2 years, although these small randomized controlled trials reported higher reintervention rates in uterine artery embolization compared with myomectomy [17]. Women who underwent a myomectomy or uterine artery embolization had 26 and 39% reduction, respectively, in risk of subsequent procedure during the study period compared with those who underwent endometrial ablation. The risk of subsequent procedure was similar between African–American and White patients (12% higher risk among African–American patients, though not statistically significant). Having more uterine fibroid symptoms recorded in the medical record preprocedure was associated with a nearly 60% greater odds of a subsequent procedure within 2 years compared with women without any preprocedure symptoms; however, this association was not as strong or statistically significant in analyses looking at the risk of subsequent procedure over the full study period. This may be related to the indication for the treatment – if the indication for treatment in women without symptoms was related to infertility, then post-treatment pregnancies within the 2 two years may have served as a competing risk for recurrence.

The data source used has several strengths relative to other existing databases, namely the ability to capture inpatient as well as outpatient procedures and to follow a large number of individual patients, both of which would not be possible with large cross-sectional surveys of hospital data, for example, the Healthcare Cost and Utilization Project (www.hcup-us.ahrq.gov/) and the National Hospital Discharge Survey (www.cdc.gov/nchs/nhds/). Additionally, we were able to include an age-appropriate sample of women based upon the epidemiology

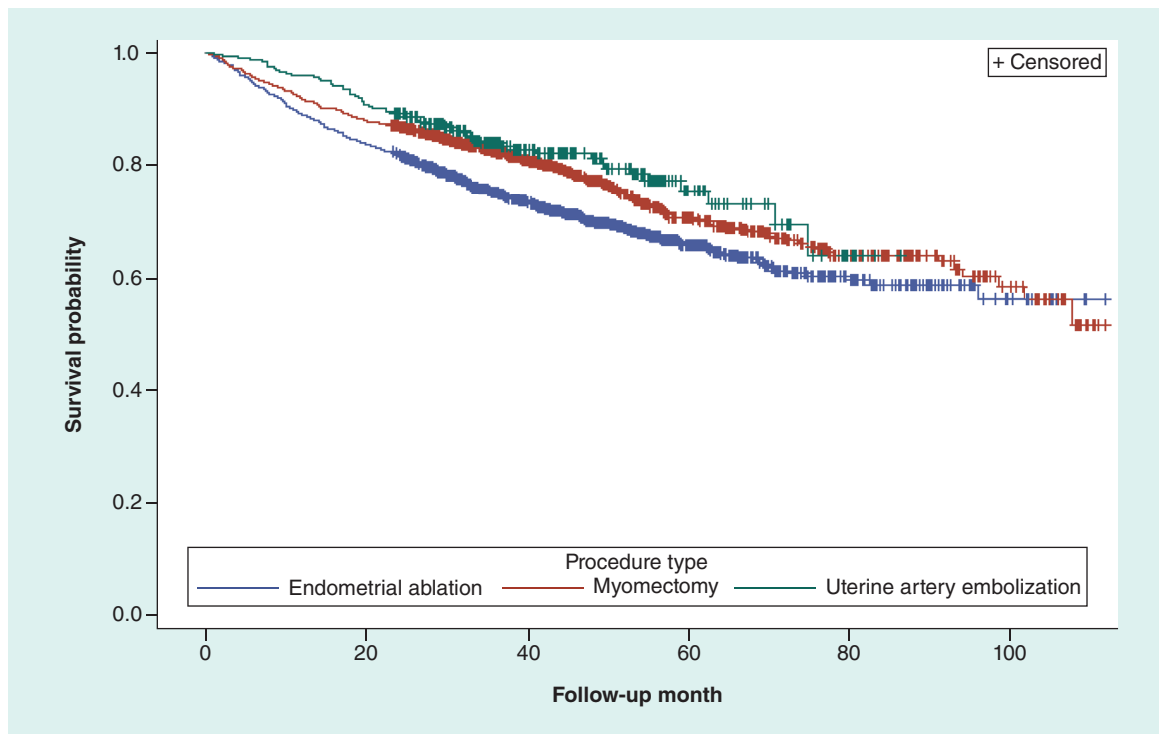


Figure 1. Time to subsequent procedure after first 60 days postindex procedure, Kaplan–Meier curve. Endometrial ablation (blue line, bottom on left); myomectomy (red line, middle); and uterine artery embolization (green line, top).

of uterine fibroids, compared with medicare data. The study was designed and analyzed in a manner to minimize the likelihood that bias would be an alternative explanation for the observed results. However, there are inherent limitations to using EMR and administrative data. Information biases due to inconsistencies in coding practices, as well as coding that reflects ‘rule out’ diagnoses or ‘upcoding’ practice related to maximizing reimbursement. There was also substantial missing data for some key variables of interest, especially race (a common problem encountered in analyses of EMR and claims data sources), which may or may not be missing at random. The underlying cause of symptoms identified in this study cannot be determined in this study. This may result in inclusion of some symptoms assumed to be uterine fibroid-related which are due to other causes. Also, only symptoms reported to and entered by the healthcare provider in the EMR are captured in this study. Thus, a patient could have experienced additional symptoms, both prior to the index procedure and after, that were not captured in the EMR.

Some important potential confounders including markers for disease severity such as number, size, location of fibroids, indication for surgery, knowledge of a woman’s childbearing goals and other reasons that she and her physician might choose one procedure over another for treatment of uterine fibroids were not available within discrete fields in the EMR. While specific type of surgery performed was available in the EMR through procedure codes, this was not included in the analysis due to small numbers for certain types of procedures. This unmeasured confounding may have led to overestimates or underestimates of the true associations of specific uterine-sparing procedure with incidence of and time to subsequent procedures if reasons underlying choice of initial procedure also influence willingness to undergo an additional procedure or if specific procedures were more likely to be used in women with more severe disease burden, who also had a greater need to consider undergoing subsequent procedures (confounding by indication).

While specific efforts were made to ensure regional representativeness and racial diversity through selection of the linked Q-EMR and claims data, the patterns of care, including frequency of specific procedures for treatment of uterine fibroids and characteristics of the patient population within these networks may not be fully generalizable to the US population. In addition, only patients with commercial insurance seeking medical treatment for their uterine fibroids were reflected in these data sources.

There are multiple possible explanations for the observed associations of measures of treatment durability with specific uterine-sparing procedures. In addition to the possibility of true underlying differences in effectiveness of symptom relief between the procedures, channeling bias, in which specific procedures were most commonly selected for women with more severe uterine fibroid disease who were also likely to require additional treatment sooner than women with less severe uterine fibroid disease, should also be considered. Other explanations include more complex relationships between choice of procedure, desire to preserve fertility and desire to postpone subsequent procedures. For example, endometrial ablation destroys the uterine lining and is used as a treatment for heavy menstrual bleeding due to multiple etiologies; because the treatment does not physically affect fibroids, recurrence of symptoms or appearance of symptoms unrelated to bleeding is not unusual. In randomized trials of endometrial ablation compared with hysterectomy for bleeding for all causes, recurrence rates are high [18]. It is often understood when choosing uterus-conserving procedures that they are not a permanent or curative treatment but will improve symptoms and quality-of-life in the short-term while preserving fertility or postponing the option of a hysterectomy for other reasons. Thus, it is expected that a subsequent procedure will be likely be required in the future and without the initial procedure being considered a treatment 'failure'. In this study over 80% of women who underwent these procedures did not have a subsequent procedure within 2 years of the index procedure.

Conclusion

In summary, this analysis of linked EMR and claims data revealed that women who had uterine artery embolization as an index procedure were less likely to have a subsequent procedure during the study period than women who had endometrial ablation, with women who had myomectomy falling in between. This research provides new evidence regarding expectations for time to subsequent procedures among women with uterine fibroids that may be helpful to women and their healthcare providers to consider when making treatment choices. In addition to providing new information that can inform patient and provider treatment decisions, some of the current study findings can also be applied to inform development of future prospective studies of outcomes in women with uterine fibroids (e.g., COMPARE-UF, a large patient registry), which will not share the same limitations of this study related to retrospective analysis of existing EMR and claims data.

Summary points

- Despite the high burden of disease associated with fibroids, high-quality evidence on optimal management is lacking.
- We performed a retrospective study of uterine fibroid patients to compare the durability of uterus-conserving procedures (myomectomy, endometrial ablation, uterine artery embolization) using an electronic medical record data source linked with administrative claims data.
- Multivariable regression analyses were performed to examine whether a subsequent procedure was performed within 2 years following the index procedure (first procedure during the study period) and Cox proportional hazard models were used to assess the time to next procedure, adjusting for potential confounding variables.
- Within 2 years of the index procedure, 18% of the endometrial ablation group had a subsequent procedure for uterine fibroids versus 13% of the myomectomy group and 11% of the uterine artery embolization group.
- Patients with myomectomy and uterine artery embolization as the index procedure had lower odds of having a subsequent procedure within 2 years of their index procedure than patients with an index procedure of endometrial ablation (OR: 0.68 [95% CI: 0.50, 0.92]; OR: 0.59 [95% CI: 0.38, 0.94]; respectively).
- Women who underwent a myomectomy had a 26% reduction and women with uterine artery embolization had a 39% reduction in risk of subsequent procedure during the study period compared with those who underwent endometrial ablation.
- The data source used has several strengths relative to other existing databases, including relatively large sample size, the ability to capture inpatient and outpatient procedures and to follow-up individual patients and having an age-appropriate sample of women based upon the epidemiology of uterine fibroids.
- Limitations of the study include dependence on coding assumptions regarding treatment and symptoms and that we were unable to capture symptom severity and other potential confounders of interest, such as size of uterine fibroids and future childbearing plans of women in the study. Finally, to the extent it reflects a mostly commercially insured population, the database is not necessarily representative of the broader population of women with fibroids.
- This research provides an additional evidence regarding expectations for time to subsequent procedures that may be helpful to women and their healthcare providers to consider when making treatment choices.

Acknowledgments

The authors are grateful to the individuals who provided support to this research study, including the staff at the Center for Medical Technology Policy for administrative leadership for this project; the statistical programming team at QuintilesIMS for conducting statistical analyses and the staff at Patient-Centered Outcomes Research Institute for their guidance and support throughout the course of the study.

Financial & competing interests disclosure

This study was funded through a Patient-Centered Outcomes Research Institute Award (award no. CE-12-11-4430). The statements presented in this paper are solely the responsibility of the authors and do not necessarily represent the views of Patient-Centered Outcomes Research Institute, its Board of Governors or Methodology Committee. The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

No writing assistance was utilized in the production of this manuscript.

Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

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