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CLINICAL INVESTIGATION

# Cost and Reimbursement for Three Fibroid Treatments: Abdominal Hysterectomy, Abdominal Myomectomy, and Uterine Fibroid Embolization

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## Abstract

*Purpose:* To compare costs and reimbursements for three different treatments for uterine fibroids.
*Methods:* Costs and reimbursements were collected and analyzed from the Thomas Jefferson University Hospital decision support database from 540 women who underwent abdominal hysterectomy ($n = 299$), abdominal myomectomy ($n = 105$), or uterine fibroid embolization (UFE) ($n = 136$) for uterine fibroids during 2000–2002. We used the chi-square test and ANOVA, followed by Fisher's Least Significant Difference test, for statistical analysis.
*Results:* The mean total hospital cost (US$) for UFE was $2,707, which was significantly less than for hysterectomy ($5,707) or myomectomy ($5,676) ($p < 0.05$). The mean hospital net income (hospital net reimbursement minus total hospital cost) for UFE was $57, which was significantly greater than for hysterectomy (−$572) or myomectomy (-$715) ($p < 0.05$). The mean professional (physician) reimbursements for UFE, hysterectomy, and myomectomy were $1,306, $979, and $1,078, respectively.
*Conclusion:* UFE has lower hospital costs and greater hospital net income than abdominal hysterectomy or abdominal myomectomy for treating uterine fibroids. UFE may be more financially advantageous than hysterectomy or myomectomy for the insurer, hospital, and health care system. Costs and reimbursements may vary amongst different hospitals and regions.

**Key words:** Abdominal hysterectomy—Abdominal myomectomy—Uterine fibroid embolization—Treatment costs

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Uterine fibroids, benign smooth muscle tumors, are the most common female genital tract tumor, primarily occurring in women in their thirties and forties. Many women with fibroids will develop symptoms, with a significant number being nonresponsive to medical therapy. Until recently, myomectomy and hysterectomy were the only treatment options for these women. Due to potential morbidities with myomectomy and hysterectomy, the postoperative recovery time, and the psychological effect on the woman of the loss of her uterus, there has been growing interest and demand in finding less invasive, uterine-sparing alternatives for symptomatic fibroid sufferers.

Uterine fibroid embolization (UFE) has become an increasingly popular minimally invasive, uterine-sparing therapy for symptomatic fibroids. UFE is performed by interventional radiologists by guiding a catheter, introduced into the femoral artery, to both uterine arteries, where tiny acrylic copolymer beads (500-700 μm) are infused under fluoroscopy until slow flow or stasis occurs and fibroid vasculature is occluded. UFE is typically performed using local, regional, or intravenous anesthesia. Depending on the institution and radiologist, it is either an outpatient procedure or requires a one-night stay, at most. Based on multiple studies, the American College of Obstetricians and Gynecologists (ACOG), in Committee Opinion 293 (February 2004), states that UFE provides good relief of bulk and bleeding symptoms, with a low complication rate [1]. To date, over 50,000 women worldwide have undergone this procedure since it was first described as a primary treatment for fibroids in 1995, with an estimated 15,000 being treated in 2003 alone [2]. However, this number pales in comparison with the approximately 250,000 women undergoing hysterectomy annually for symptomatic fibroids in the United States alone [3].

Several earlier articles have examined the hospital costs and resource usage of abdominal hysterectomy, abdominal myomectomy, and UFE [4–7] The objective of this study was to compare the hospital costs, as well as hospital reimbursements and net hospital income, for these three treatments for uterine fibroids at a single institution during the same time period. The value of adding reimbursement data to cost is that it allows a more accurate assessment of a procedure's financial impact on the hospital.

## Materials and Methods

Approval for this project was obtained from the Thomas Jefferson University Institutional Review Board. Financial information was retrospectively collected and analyzed from the Thomas Jefferson University Hospital decision support database for all abdominal hysterectomies, abdominal myomectomies, and UFEs performed with a principal diagnosis of uterine fibroids during the period 2000–2002 at the Thomas Jefferson University Hospital in Philadelphia. The hospital decision support database gathers data from the patient registration system, business operations system, and general ledger system. Vaginal, laparoscopically assisted vaginal (LAVH), and laparoscopic hysterectomy, as well hysteroscopic and laparoscopic myomectomies were excluded, as were uterine artery embolizations performed for indications other than primary treatment for fibroids. Patients undergoing additional procedures at the same time were similarly excluded, with the exception of prophylactic salpingo-oopherectomy, as they might affect costs and reimbursements. The decision support database records hospital cost and reimbursement data and is searchable with ICD-9-CM (*International Classification of Disease, 9th Revision, Clinical Modification*) diagnostic and procedure codes [8]. For each individual procedure, we obtained information on patient characteristics (age, race, and insurance type), length of stay, direct hospital costs, indirect hospital costs, and insurer reimbursements to the hospital. All costs were categorized into five cost groups: operating room, nursing, radiology, laboratory, and pharmacy. Anesthesia costs are included under operating room costs. For UFEs the costs of procedural catheters and particles were assigned to the radiology group. Professional reimbursement (physician reimbursement) was not included in the decision support database due to the organizational structure of the institution. Professional reimbursement for both gynecologists and interventional radiologists was obtained in a similar manner through the Jefferson University Physicians (JUP) financial database.

Direct costs are expenses directly related to providing patient care, which can be specifically traced to or identified with a particular product or service. This would include nursing care, radiology or operating room utilization of anesthesia services and supplies. Indirect costs are of two types: ''transfer costs'' reflecting the cost of services directly provided by other departments, such as dietary and environmental services, and ''allocated costs,'' which are overheads such as billing services and hospital administration.

Both direct and indirect costs are allocated to each patient via a billable product or service such as a laboratory test, radiograph or hour of operating room time. Relative value units (RVUs) determine how the costs are distributed to each product. Each product is assigned an RVU and the value is determined by the appropriate department administrator. They take into account the differing amounts of resource inputs, such as labor time or supplies required for the different procedures.

To validate the accuracy of the data, approximately 10% of all procedures were double-checked with the hospital financial database and patient charts. All outlier costs and reimbursements were similarly verified. As long as they were found to be correct, both outlier costs and reimbursements were included in the analysis.

We used SAS statistical software version 8.1 (SAS Institute, Cary, NC, USA) for data management and descriptive analyses. The chi-square test and ANOVA, followed by Fisher's Least Significant Difference test, were used for statistical analysis. A two-sided type I error was set at 0.05.

**Table 1.** Mean characteristics of patients treated with hysterectomy, myomectomy, or UFE

| | Hysterectomy ($n$ = 299) | Myomectomy ($n$ = 105) | UFE ($n$ = 136) |
|---|---|---|---|
| Age (years) | 47.9 ± 8.2* | 36.5 ± 5.0* | 43.7 ± 6.0* |
| Range (years) | 28–82 | 25–49 | 24–59 |
| Race (%) | | | |
| White | 41.8 | 36.2 | 27.9 |
| Black | 35.1 | 43.8 | 28.7 |
| Unknown | 23.1 | 20.0 | 43.3 |
| Insurance type (%) | | | |
| Managed care | 75.6 | 80.3 | 86.9 |
| Commercial | 17.5 | 17.8 | 11.0 |
| Medicare/Medicaid | 6.9 | 1.9 | 2.1 |

*Statistically significant: $p < 0.05$

## Results

We identified 540 women who underwent hysterectomy ($n$ = 299), myomectomy ($n$ = 105), or UFE ($n$ = 136) for uterine fibroids at Thomas Jefferson University Hospital between 2000 and 2002. Data were 100% complete with respect to patient age, length of stay, cost, and reimbursement. Patient ages and racial distribution are described in Table 1. Race was only available for 86.9%, 80.0%, and 56.6% of hysterectomies, myomectomies, and UFEs, respectively. The mean ages of the patients undergoing the three procedures were statistically different ($p < 0.05$), with patients undergoing hysterectomy being the oldest and those undergoing myomectomy being the youngest. Distribution of insurance type was similar amongst the three groups. The majority of patients had commercial insurance (76–87%), approximately 18% of each group had managed care (HMO), and few (2–7%) had Medicare or Medicaid.

Length of stay averaged 2.8 days (SD 1.0) with a range of 1–9 days, 2.6 days (SD 1.0) with a range of 1–6 days, and 1.0 day (SD 0.2) with a range of 1–3 days for hysterectomy, myomectomy, and UFE, respectively. Length of stay was significantly less for UFE compared with hysterectomy or myomectomy. Although only 1 of 136 patients who underwent UFE had an overnight stay, each post-UFE observation period was reported as a 1 day stay.

Table 2 presents the hospital costs and reimbursement for hysterectomy, myomectomy, and UFE in US$. Reim-

**Table 2.** Mean hospital costs and reimbursement for hysterectomy, myomectomy, and UFE in US$

| | Hysterectomy ($n$ = 299) | Myomectomy ($n$ = 105) | UFE ($n$ = 136) |
|---|---|---|---|
| Direct cost (DC) Range | 3591 ± 778*1086–7338 | 3579 ± 838*1264–7460 | 2084 ± 419*583–3861 |
| Indirect cost (IC) Range | 2115 ± 529*760–5426 | 2097 ± 584*877–4879 | 623 ± 282*174–3282 |
| Total cost (DC + IC = TC) Range | 5707 ± 1288*1845–12764 | 5676 ± 1408*2141–12340 | 2707 ± 612*757–5746 |
| Reimbursement (R) Range | 5135 ± 2882*0–21947 | 4961 ± 2882*18–19697 | 2764 ± 2412*0–14341 |
| Net hospital income (R – TC) Range | –572 ± 2879*–7594–15938 | –715 ± 2946*–7061–14203 | 57 ± 2361*–4262–8662 |

*Statistically significant: $p < 0.05$

bursements include paid dollars from insurers plus co-pays, deductibles, and other monies received from patients. Cost is divided between direct and indirect costs. Total cost is the sum of the direct and indirect costs. Hospital net income is defined as total hospital cost subtracted from total hospital reimbursement. The mean total hospital cost for UFE was $2,707, which was significantly less than for hysterectomy ($5,707) or myomectomy ($5,676) ($p < 0.05$). The median total hospital costs for UFE, hysterectomy, and myomectomy were $2,784, $5,608, and $5,494, respectively. Both direct and indirect hospital costs for UFE were similarly significantly less compared with hysterectomy or myomectomy ($p < 0.05$). There was no statistical difference in direct, indirect, or total hospital cost between hysterectomy and myomectomy. The mean hospital net income (hospital net reimbursement minus total hospital cost) for UFE was $57, which was significantly greater than for hysterectomy (−$572) or myomectomy (−$715) ($p < 0.05$). The median hospital net incomes for UFE, hysterectomy, and myomectomy were −$623, −$1,133, and −$1,083, respectively. There was no statistical difference in hospital net income between hysterectomy and myomectomy. The mean professional (physician) reimbursements for UFE, hysterectomy, and myomectomy were $1,306, $979, and $1,078, respectively.

Table 3 compares the breakdown of mean hospital total costs by percentage amongst the three procedures into five categories. The majority of costs for hysterectomy and myomectomy were for operating room and nursing expenses. The majority of cost for UFE, however, was in radiology charges.

**Table 3.** Comparison of breakdown of hospital mean total costs (%)

| | Hysterectomy ($n$ = 299) | Myomectomy ($n$ = 105) | UFE ($n$ = 136) |
|---|---|---|---|
| Operating room | 56.9 | 58.9 | 2.5 |
| Nursing | 33.0 | 31.9 | 2.2 |
| Radiology | 0.5 | 0.3 | 92.5 |
| Laboratory | 5.0 | 4.4 | 0.6 |
| Pharmacy | 4.6 | 4.6 | 2.2 |

## *Conclusions*

UFE is becoming an increasingly utilized treatment for women suffering from symptomatic uterine fibroids. Factors influencing this include the desire for uterine preservation, avoidance of major surgery, and a shorter recovery period. Several prior publications have evaluated hospital costs and charges for UFE [4–7]. We chose to analyze hospital costs rather than charges for three treatments for uterine fibroids: UFE, abdominal hysterectomy, and abdominal myomectomy. Charge data may not accurately reflect resource usage due to inter-institutional variation in profit margins. Thus, costs better represent resource usage for operating room, nursing, radiology, laboratory, and pharmacy, than charges [4]. While other publications reviewed charges or costs for the three procedures, we also chose to include reimbursement data in our analysis. By calculating the hospital net income (hospital net reimbursement minus total hospital cost), we can better compare the institutional financial impact of each procedure for treating uterine fibroids.

In our analysis, we found that total hospital cost for UFE ($2,707) was significantly less than for hysterectomy ($5,707) or myomectomy ($5,676) ($p < 0.05$). Further, hospital net income (hospital net reimbursement minus total hospital cost) was better for UFE ($57) compared with hysterectomy (−$572) or myomectomy (−$715) ($p < 0.05$). Thus, for each patient who underwent UFE in lieu of hysterectomy or myomectomy, it was economically advantageous for the hospital by $629 and $772, respectively. While the mean professional (physician) reimbursement for UFE ($1,306) was greater than for hysterectomy ($979) and myomectomy ($1,078), with no data on actual professional costs available the professional component cannot be factored into this economic analysis. Outlier values for reimbursement, ranging from as little as $0 to as much as $21,947, were verified to be the amounts arbitrarily paid by the insurers, without any other explanation found.

Why is there a net loss on patients who underwent hysterectomy and myomectomy? The reimbursement for both these procedures was based on contracts that the hospital had negotiated with third party insurers. The procedures were paid on a per diem methodology. Given that these procedures are surgical, have a very high cost for the first day of stay, with operating and recovery room time, and a short length of stay, the reimbursement was not in line with the actual cost of providing these two procedures to our patients. Since the time of this study, the contracts with many of our payers have been renegotiated with higher rates. Without further analysis it cannot be determined whether these two procedures would now be reimbursed at a

rate that would exceed the cost, as total expenses for many items may have similarly increased.

Similar to the finding of other studies, our length of stay for UFE was shorter than for hysterectomy or myomectomy, which may free up finite hospital resources, such as patient rooms and nursing staff, to treat other patients. Our length of stay was shorter for all groups than reported previously [6]. Amongst all three groups, there was a statistical difference in age distribution, which averaged 48, 44, and 37 years for hysterectomy, UFE, and myomectomy, respectively. The age distribution may have been influenced by many patients who elected myomectomy desiring future fertility, as may have some who chose UFE. While a similar percentage of white and black patients underwent UFE, white patients were more likely to have a hysterectomy, while black patients more often chose myomectomy. This trend was present even after factoring in patient age. Black patients may be more interested in uterine preservation or this may represent a physician bias in patient counseling or referral. The outpatient nature of UFE explains why over 90% of its costs are assigned to the radiology group, while the bulk of the surgical procedures costs are in the operating room or nursing groups.

Similar total hospital costs for UFEs performed at Georgetown University Medical Center were reported by Subramanian, with a mean total cost of $3,080 and a range of $2,058 to $4,951. The major cost component was similarly radiological, but it accounted for only 62% of the total compared with 92.5% in our study. This difference is explained by the fact that 78% of their patients stayed overnight compared with only one patient in our study. Data were derived from charges, with cost-to-charge ratios employed to derive the cost estimates. Other fibroid treatments were not analyzed in that study [4].

Another study by the same group also used charge information and cost-to-charge ratios to estimate costs for 23 UFEs and 17 abdominal myomectomies performed during 2001 in a single institution. Their estimated hospital cost for UFE was $3,193, which was significantly lower than the $5,598 estimated cost for abdominal myomectomy ($p < 0.0001$). These hospital costs are similar to our findings. They also reported professional (physician) costs, which were significantly higher for UFE ($2,220) than for abdominal myomectomy ($1,611) ($p = 0.002$). They also calculated an overall associated cost, which added hospital cost and professional cost, as well as imaging costs, which assumed pre- and post-UFE magnetic resonance images and a single pre-myomectomy pelvic ultrasound. The overall associated cost was lower for UFE ($6,708) compared with abdominal myomectomy ($7,630); however the study did not have enough power to show statistical significance [5].

A Canadian study of 545 women treated for fibroids by abdominal myomectomy, abdominal and vaginal hysterectomy, and UFE between 1997 and 2001 similarly found that women undergoing myomectomy were younger than those undergoing hysterectomy or UFE. They also found that the bulk of surgical costs were attributed to the operating room and nursing care. Catheters and particles for UFEs were assigned to the operating or procedure room group, rather than the radiology group as in our study. UFE had a lower hospital cost than the other three surgical procedures [6].

A study from Massachusetts General Hospital compared total hospital costs of UFE ($n = 57$) and hysterectomy ($n = 300$) between 1998 and 2001. Their hospital's cost accounting system calculated costs on the basis of relative value units. Patient characteristic data were also analyzed, finding that those who underwent UFE had a larger mean diameter of the largest fibroid (8.0 vs. 6.3 cm, $p = 0.001$) and a larger mean number of fibroids (2.8 vs. 2.0, $p < 0.0001$). Their reported costs for both UFE and hysterectomy were much greater than in other studies. This is the only study in which the total hospital costs for UFE were greater than for hysterectomy, ($8,223 vs. $6,046, $p < 0.0001$), but no explanation for this variation was discussed [7].

Our study has several limitations. It is a retrospective analysis in which no uniform protocols in technique were adhered to for any of the three procedures. Groups differed in both age and race. No data were evaluated on the number or size of fibroids. We did not look at complications or readmissions to the hospital. Hysterectomy has been shown to have a higher complication rate than UFE (50% vs. 27.5%, $p = 0.01$), and thus including data on costs due to complications would further increase the hospital costs and decrease the hospital net income for hysterectomy or myomectomy compared with UFE [9]. No long-term data are available in terms of future additional procedures needed in each group for continued symptoms. Costs of pre- and post-procedural evaluation, including imaging studies, were also not included. As MRI is often carried out before and after UFE, while only a single pre-surgical ultrasound is usually ordered in patients undergoing myomectomy and hysterectomy, this may increase the cost associated with fibroid embolization. The determination of costs and actual costs at Thomas Jefferson University Hospital may differ from that at other institutions. Allocation of costs between direct and indirect costs may vary among decision support systems used within other institutions. Reimbursements from all insurers, which are based on contractual agreements, may also vary greatly by region and institution.

Not all women who are candidates for hysterectomy or myomectomy are similarly candidates for UFE. Pelvic infection, arteriovenous shunting, current pregnancy, renal insufficiency, contrast allergy, an undiagnosed pelvic mass or genital tract malignancy, and a history of pelvic radiation are contraindications. Desire for future fertility remains a relative contraindication [1, 10, 11].

Other studies have similarly assessed costs of laparoscopic gynecologic procedures compared with open procedures. Stringer et al. compared total hospital cost for laparoscopic and open myomectomy for 98 patients. Average total hospital costs in 1995 dollars were $13,814 for

laparoscopic and $14,461 for open myomectomies [12]. More studies have evaluated hospital costs for laparoscopic compared with open hysterectomy. Total hospital costs were not statistically different for the two procedures in a 1999 study from York Hospital in Pennsylvania [13]. Another study from Jefferson Medical College in 2005 reported higher operating room costs, yet lower total hospital costs, for several minimally invasive surgeries, including laparoscopic hysterectomy [14]. No reimbursement data were reported for any of the above studies.

In summary, our study found that UFE has lower hospital costs and greater hospital net income than hysterectomy or myomectomy. UFE may be more financially advantageous than hysterectomy or myomectomy as a treatment for uterine fibroids for the insurer, hospital, and health care system. Costs and reimbursements may vary amongst different hospitals and regions. Future prospective economic analyses are needed, which should include professional costs and reimbursements, total pre- and post-procedural costs, and disability costs due to time away from work.

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