Special Articles

COSTS AND CHARGES ASSOCIATED WITH THREE ALTERNATIVE TECHNIQUES OF HYSTERECTOMY

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ABSTRACT

Background Many hysterectomies are now performed by a laparoscopically assisted vaginal technique. This procedure is controversial, partly because of concern about cost. We studied hospital charges and costs for the procedure as compared with those for total abdominal hysterectomy and total vaginal hysterectomy in clinically similar groups of patients.

Methods From hospital-discharge data and patients' charts, we identified hysterectomies performed in 1993 and 1994 by 96 surgeons at a community teaching hospital to treat benign conditions. The patients were grouped according to the surgical procedures performed in conjunction with the hysterectomy. Data on hospital charges and cost-to-charge ratios for 64 hospital cost centers were used to assess charges and costs for specific resources, as well as for the hospitalization overall.

Results Of 1049 patients studied, 26 percent underwent laparoscopically assisted vaginal hysterectomy, 54 percent underwent abdominal hysterectomy, and 20 percent underwent vaginal hysterectomy. The average hospital stays were 2.6, 3.9, and 2.9 days, respectively, and the mean total charges (facility charges plus professional fees) for the hospitalizations were \$6,116, \$5,084, and \$4,221 ($P<0.001$ for the comparison of the laparoscopic technique with both other techniques). The mean facility costs were \$4,914, \$3,954, and \$3,116, respectively ($P<0.001$ for the same comparison), with similar findings in all subgroups. The higher charges and costs for laparoscopically assisted vaginal hysterectomy were due to higher supply costs, particularly when disposable supplies were used, and to longer operating-room time.

Conclusions Despite shorter hospital stays, in-hospital charges and costs for laparoscopically assisted vaginal hysterectomy are higher than for either alternative procedure, because of the disposable supplies that are typically used and the longer operating-room time. (N Engl J Med 1996; 335:476-82.)

LAPAROSCOPICALLY assisted vaginal hysterectomy has come into widespread use, primarily because morbidity is presumed to be less when the large abdominal incision and invasive intraabdominal manipulations associated with total abdominal hysterectomy are eliminated.[1-3] The laparoscopically assisted procedure has been controversial, however, largely because of concern that it is sometimes used instead of total vaginal hysterectomy, generally considered the simplest and least morbid method of removing the uterus, and because the costs of the laparoscopic procedure may be substantially higher than those of either alternative procedure.[4-8]

According to several studies,[9-11] the average hospital stay of patients undergoing laparoscopically assisted vaginal hysterectomy is shorter than that of patients undergoing the other procedures. However, these findings have often been confounded by differences in the surgical procedures performed in conjunction with hysterectomy, such as salpingo-oophorectomy, adhesiolysis, and repair of pelvic-support defects. Previous assessments of variation in operating-room time for hysterectomy, as well as in the costs of different procedures, have also not determined whether the variation was due to differences inherent in the three techniques or to differences in the types of patients undergoing each procedure.

To assess costs, hospital charges, and use of resources associated with alternative techniques of hysterectomy, we grouped hospitalizations for hysterectomy on the basis of the surgical procedures performed in addition to the removal of the uterus. We then compared overall and specific costs and charges associated with the various techniques.

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METHODS

Study Site

The Greater Baltimore Medical Center, a 372-bed community teaching hospital, has the largest gynecologic-surgery service in Maryland. Laparoscopically assisted vaginal hysterectomy has been performed since February 1, 1990. In 1993 and 1994, the period of this study, 21,610 gynecologic-surgery procedures were performed at the center.

Sources of Data

Three sources of data were used in the study: a computerized file containing hospital-discharge abstracts, with diagnoses, procedures, and charges for all hospitalizations in Maryland, as reported to the state Health Services Cost Review Commission; a computerized data base maintained by the medical center, containing information on diagnoses and procedures, use of resources, and charges submitted for each service provided by the hospital; and patients' hospital records, which we reviewed in a structured fashion.

Selection of Patients

Patients who underwent hysterectomy in 1993 and 1994 were identified in the data bases of the Health Services Cost Review Commission and the medical center when one of the following procedure codes established in the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) was assigned: 68.4 for abdominal hysterectomy, 68.5 for vaginal hysterectomy, or 68.5 plus 54.21 (indicating laparoscopy) for laparoscopically assisted vaginal hysterectomy. We reviewed all secondary procedures listed in the data base of the medical center for the 1420 patients identified, and we excluded 182 patients who had undergone one or more major secondary procedures unrelated to hysterectomy (such as partial colectomy or appendectomy). We also excluded 45 patients who had undergone either radical or subtotal hysterectomy (ICD-9-CM codes 68.6 and 68.3), since our focus was on hysterectomy performed to treat benign conditions. Of the remaining 1193 patients, hospital records were not available for 39 (3 percent). After a detailed review of the charts, we excluded an additional 105 patients because their hysterectomies had been performed to treat cancer. Thus, 1049 patients (74 percent of those who underwent hysterectomy at the center in 1993 and 1994) were included in the analysis. The 1049 procedures were performed by a total of 96 surgeons.

Demographic and Clinical Data

Data were abstracted from the hospital charts by one of five registered nurses. The information collected included each patient's age, height, weight, medical history, indications for surgery, operative procedures (including information on whether a vaginal hysterectomy had been converted to an abdominal procedure), intraoperative findings and complications, postoperative complications, and results of pathological studies, including the uterine weight. Each indication for hysterectomy was classified in one of four categories: (1) uterine abnormalities, defined as any clinically diagnosed abnormalities that involved the uterus (such as myomas) or resulted in uterine dysfunction (such as a bleeding disorder); (2) adnexal abnormalities, defined as any clinically diagnosed abnormalities involving an ovary, a fallopian tube, or both (such as an ovarian cyst or a tubo-ovarian mass); (3) abdominal or pelvic abnormalities, defined as any other abnormalities of the abdominal or pelvic region, such as endometriosis, pain, pelvic inflammatory disease, or a mass that was not described as adnexal or a uterine fibroid; and (4) abnormalities of pelvic relaxation, defined as any abnormalities resulting from a support defect of the pelvic fascia. Thus, a patient could have had more than one indication for surgery. An intraoperative finding of extensive adhesions was recorded if the operative note described adhesions as numerous, massive, thick, or requiring extensive adhesiolysis for the surgeon to "free up" or gain access to a pelvic structure. From the records of anesthesia and the nursing records, data were collected on the time spent in the operating room, under anesthesia, and in the recovery room.

Economic Data

Charges made by the facility for all resources used during a hospitalization, such as operating-room time and supplies, and for the hospitalization as a whole, were obtained from the medical-center data base. Facility charges for anesthesia were based on the time under anesthesia and on per-minute charges as provided by the finance department of the medical center.

To estimate the professional fees for each hospitalization, we assigned relative-value units based on Medicare's resource-based relative-value scale to all ICD-9-CM procedure codes that had a professional component, as well as to surgical-pathology services with professional-service components but no ICD-9-CM procedure code. The estimated professional fees for anesthesia were based on the time under anesthesia. The anesthesia time, expressed in minutes, was divided by 15 and rounded to the nearest whole number to obtain relative-value units for anesthesia time for each patient. A base number of relative-value units for each procedure (8 for abdominal hysterectomy and 6 for vaginal hysterectomy and laparoscopically assisted vaginal hysterectomy) was added to the relative-value units for time to obtain the total number of relative-value units for anesthesia. The relative-value units were converted to charges with Medicare's 1993 and 1994 conversion factors for Baltimore. The estimated professional fees for each hospitalization were then totaled.

The medical center's costs, as opposed to its charges, were also estimated for each hospitalization. We computed the proportion of the total hospital charges that was attributable to each of 64 cost centers (such as the operating room, medical and surgical supplies, the pharmacy, and the pathology department). We then selected the cost centers that accounted for the 10 largest shares of the total charges (for example, the operating room accounted for 30 percent of charges). For each of these 10 cost centers, we evaluated all resources that were used in the care of the patients in our sample and ranked the resources in terms of the proportion of the cost center's total charges that was attributable to each resource (for example, within medical and surgical supplies, sutures accounted for 14 percent of charges, endoscopic staplers for 12 percent, and so on). We then identified the 10 resources with the highest total charges in each cost center or, if 90 percent of the charges in a cost center were attributable to fewer than 10 resources, the resources that accounted for 90 percent of the charges.

We estimated the direct and indirect costs of these resources with data from the finance department. For example, we calculated the direct cost for the operating rooms by dividing the total operating-room expenses by the total number of minutes patients spent in the operating room. The costs of supplies and pharmacy services were estimated by reducing the average charges for each supplied item and pharmaceutical by the amount of the hospital's markup. Costs for the use of the blood bank and histologic tests were derived from the cost-accounting system of the hospital laboratory.

For each of the top 10 cost centers, we computed a ratio of costs to charges by dividing the total costs of the top 10 resources in that cost center by the total charges for the same resources. The cost-to-charge ratio for each cost center was applied to all resources in that cost center. We then calculated a weighted average cost-to-charge ratio for the top 10 cost centers by taking the total costs for each center and dividing them by the sum of the charges for all 10 cost centers. Finally, we applied this weighted average cost-to-charge ratio to each of the 54 cost centers that were not included among the top 10 cost centers. The cost-center–specific estimates of cost were summed to obtain an estimate of the total facility costs for each hospitalization. We did not assign costs (as opposed to charges) to the professional-service components of the procedures.

Statistical Analysis

To account for differences in operative complexity and the postoperative care of patients who underwent different surgical procedures, each patient was assigned to one of the following seven mutually exclusive subgroups on the basis of the surgical procedures performed in conjunction with the hysterectomy: (1) no related secondary procedure; (2) repair of vaginal prolapse, surgical treatment for urinary incontinence, or both, but no other procedure ("surgical repair"); (3) adhesiolysis, but no other procedure; (4) salpingectomy, oophorectomy, or both, but no other procedure; (5) surgical repair and salpingectomy, oophorectomy, or both; (6) salpingectomy, oophorectomy, or both, and adhesiolysis; and (7) other procedures.

The characteristics and outcomes of the patients treated by each technique of hysterectomy were assessed separately for each of the first six categories, and for all the patients in the study, on an intention-to-treat basis. For example, a patient whose procedure began as laparoscopically assisted vaginal hysterectomy but was converted to abdominal hysterectomy because of technical difficulty or a complication was considered to have undergone laparoscopically assisted vaginal hysterectomy. Pairwise comparisons were performed by Student's t-test (for continuous variables) or the chi-square test (for categorical variables).[12] Separate multivariate linear regression analyses were performed for three categories — all patients, those with no related secondary procedures, and those who underwent salpingectomy, oophorectomy, or both — in which there were enough patients for the independent association between the technique of hysterectomy and various economic outcomes (such as operating-room time and facility charges) to be assessed, with control for the patient's age, the number of coexisting medical conditions, and uterine weight.[13]

Finally, to assess the association between the use of disposable instruments and the cost of laparoscopically assisted vaginal hysterectomy, the patients who underwent that procedure were divided into three mutually exclusive subcategories on the basis of the type of supplies used in the operation. Disposable instruments can be used in each step of laparoscopically assisted vaginal hysterectomy. If such instruments (that is, an endoscopic stapling device, an endoscopic hemoclip, staple-reloading cartridges, disposable hand instruments, and disposable trocars) were used during every step of the procedure, we categorized the surgery as performed with disposable instruments. If the surgeon used several types of these disposable instruments, but not all (for example, if he or she used disposable trocars but relied on electrocautery or sutures for hemostasis), the procedure was classified as one that used a combination of disposable and nondisposable instruments. The third category was one in which no disposable

TABLE 1. CHARACTERISTICS OF THE PATIENTS ACCORDING TO TECHNIQUE OF HYSTERECTOMY.*

CHARACTERISTIC	LAPAROSCOPICALLY ASSISTED VAGINAL HYSTERECTOMY (N=273)	TOTAL VAGINAL HYSTERECTOMY (N=210)	TOTAL ABDOMINAL HYSTERECTOMY (N=566)
Age (yr)	44±8†	50±13	45±9†
Body-mass index‡	26.0±5.4§	26.2±5.0	28.4±6.9†
Coexisting conditions			
No. per patient	0.4±0.8¶	0.6±0.9	0.4±0.7†
Percent of patients	46¶‖	58	57
Preoperative indications (% of patients)			
Uterine abnormality	78†**	56	84†
Adnexal abnormality	7† ††	0.48	15†
Abdominal or pelvic abnormality	52†	17	45†
Pelvic relaxation	10†**	60	6†
Secondary procedures (% of patients)			
None	32‡‡	41	21
Surgical repair	1	38	0.4
Adhesiolysis	6	0	5
Salpingectomy, oophorectomy, or both			
As only secondary procedure	43	8	45
With repair of vaginal prolapse	3	11	3
With adhesiolysis	0.73	0.48	0
Intraoperative findings (% of patients)			
Extensive adhesions	21†	2	27†
Endometriosis	26‡‡	1	15
Uterine weight (g)	171.1±159.2‡‡	113.3±84.1	335.5±343.9

*Plus–minus values are means ±SD.

†P<0.001 for the comparison with total vaginal hysterectomy.

‡Body-mass index was calculated by dividing the weight in kilograms by the square of the height in meters.

§P<0.001 for the comparison with abdominal hysterectomy.

¶P=0.01 for the comparison with total vaginal hysterectomy.

‖P=0.002 for the comparison with abdominal hysterectomy.

**P=0.05 for the comparison with abdominal hysterectomy.

††P=0.007 for the comparison with abdominal hysterectomy.

‡‡P<0.001 for each pairwise comparison.

laparoscopic instruments were used. Costs of medical and surgical supplies, operating-room time, and total charges for these subcategories were compared by Student's t-test. All statistical analyses were performed with SAS version 6.10.

RESULTS

Characteristics of the Patients

Of the 1049 patients, 273 (26 percent) underwent laparoscopically assisted vaginal hysterectomy, 566 (54 percent) underwent abdominal hysterectomy, and 210 (20 percent) underwent vaginal hysterectomy (Table 1). The group undergoing vaginal hysterectomy was slightly older, on average, than the other two groups, which were similar in age. The patients who underwent abdominal hysterectomy tended to have higher body-mass indexes and heavier uteri than the patients in either of the other groups. In 89 percent of patients with a uterine weight of at least 400 g, abdominal hysterectomy was performed.

Secondary procedures related to hysterectomy were performed in 79 percent of the patients undergoing abdominal hysterectomy, 68 percent of the patients undergoing laparoscopically assisted vaginal hysterectomy, and 59 percent of the patients undergoing vaginal hysterectomy (Table 1). The most common secondary procedure performed in conjunction with laparoscopically assisted vaginal hysterectomy and abdominal hysterectomy was salpingectomy, oophorectomy, or both, with or without adhesiolysis. The most common secondary procedure performed in conjunction with vaginal hysterectomy was repair of vaginal prolapse or surgical treatment for incontinence.

Surgical Outcomes

Intraoperative complications occurred in 6 percent of the patients undergoing laparoscopically assisted vaginal hysterectomy, 2 percent of those undergoing vaginal hysterectomy, and 4 percent of those undergoing abdominal hysterectomy ($P=0.02$ for the comparison of the first and second groups, and $P=0.10$ for the comparison of the first and third groups). Twelve percent of laparoscopically assisted vaginal hysterectomies were converted to open laparotomy, as compared with 2 percent of total vaginal hysterectomies ($P<0.001$).

Use of Resources and Costs of Care

The mean hospital stay of the patients who underwent laparoscopically assisted vaginal hysterectomy (2.6 days) was significantly shorter than that of those who underwent vaginal hysterectomy (2.9 days) or abdominal hysterectomy (3.9 days) ($P<0.02$ for all comparisons). The mean stay for patients undergoing laparoscopically assisted vaginal hysterectomy was more than one day shorter than that for patients undergoing abdominal hysterectomy both when no secondary procedure was performed and when salpingectomy, oophorectomy, or both were performed, regardless of whether adhesiolysis was performed. For the patients undergoing laparoscopically assisted vaginal hysterectomy and those undergoing vaginal hysterectomy, the mean stay was similar when no secondary procedure was performed. Salpingectomy, oophorectomy, and the two together did not influence the mean stay, but adhesiolysis and repair of prolapse both increased it.

Despite the shorter mean stay with laparoscopically assisted vaginal hysterectomy, the mean total charges (including both facility charges and professional fees) were highest for the patients undergoing that procedure (Table 2). The average total charges for laparoscopically assisted vaginal hysterectomy were higher than those for abdominal hysterectomy by $1,032 ($P<0.001$) and higher than those for vaginal hysterectomy by $1,895 ($P<0.001$). The total charg-

TABLE 2. TOTAL CHARGES FOR VARIOUS SUBGROUPS OF PATIENTS, ACCORDING TO TECHNIQUE OF HYSTERECTOMY.*

SUBGROUP	TOTAL NO. STUDIED	LAPAROSCOPICALLY ASSISTED VAGINAL HYSTERECTOMY		TOTAL VAGINAL HYSTERECTOMY		TOTAL ABDOMINAL HYSTERECTOMY	
		NO.	TOTAL CHARGES ($)	NO.	TOTAL CHARGES ($)	NO.	TOTAL CHARGES ($)
All subgroups	1049	273	6116±1816†	210	4221±1174	566	5084±1768
No secondary procedure	293	87	5804±1581†	87	3522±737	119	4548±763
Surgical repair only	85	4	7856±3642‡	79	4673±920	2	5808±1939
Adhesiolysis only	43	17	6674±2389§	0	—	26	5078±1429
Salpingectomy, oophorectomy, or both							
As only secondary procedure	389	117	6030±1681	17	3976±702	255	4890±1252¶
With repair of vaginal prolapse	49	7	7694±1486‖	23	5077±1344	19	6004±1210**
With adhesiolysis	181	37	6236±2044	1	6448	143	5689±2724

*Plus–minus values are means ±SD.

†$P<0.001$ for each pairwise comparison.

‡$P<0.001$ for the comparison with total vaginal hysterectomy.

§$P=0.009$ for the comparison with abdominal hysterectomy.

¶$P=0.003$ for the comparison with total vaginal hysterectomy.

‖$P=0.007$ for the comparison with abdominal hysterectomy.

**$P=0.03$ for the comparison with total vaginal hysterectomy.

es for laparoscopically assisted vaginal hysterectomy were $1,140 higher than those for abdominal hysterectomy when oophorectomy, salpingectomy, or both were performed and $1,256 higher when no related secondary procedure was performed.

The differences in facility costs associated with hospitalizations for the three types of hysterectomy paralleled the differences in charges (Table 3). The mean overall facility costs for laparoscopically assisted vaginal hysterectomy were $1,167 higher than those for abdominal hysterectomy when no related procedure was performed and $1,060 higher when salpingectomy, oophorectomy, or both were performed.

In part, the higher costs and charges for laparoscopically assisted vaginal hysterectomy were due to longer operating-room times. When there was no related procedure, laparoscopically assisted vaginal hysterectomy required 35 minutes more operating-room time than abdominal hysterectomy (158 vs. 123 minutes) and 70 minutes more than vaginal hysterectomy (158 vs. 88 minutes) ($P<0.001$ for both comparisons). When salpingectomy, oophorectomy, or both were performed, but not adhesiolysis, the mean operating-room time needed for laparoscopically assisted vaginal hysterectomy was 46 minutes more than for abdominal hysterectomy and 72 minutes more than for vaginal hysterectomy. A similar amount of recovery-room time was needed for all three techniques both when there was no secondary procedure and when salpingectomy, oophorectomy, or both were performed.

The average charge for medical and surgical supplies was $1,190 higher for laparoscopically assisted vaginal hysterectomy ($1,485) than for abdominal hysterectomy ($295), and $1,251 higher than for vaginal hysterectomy ($234) ($P<0.001$ for both comparisons). These differences were similar regardless of which secondary procedures were performed, or whether any were performed.

We compared the total charges, facility charges, and costs for medical and surgical supplies that were associated with laparoscopically assisted vaginal hysterectomy according to whether the procedure was performed with disposable supplies, nondisposable supplies, or a combination of the two (Table 4). Mean costs for supplies were higher by $1,496 when procedures were performed with disposable supplies than when they were performed with nondisposable supplies. Despite the potential savings of time associated with the use of an endoscopic stapler, the average operating-room time with disposable supplies was greater, not less, than for operations performed with nondisposable supplies. Among the patients who underwent laparoscopically assisted vaginal hysterectomy with no related secondary procedure, the mean operating-room time was 165 minutes when disposable supplies were used (67 patients), 143 minutes when nondisposable supplies were used (7 patients), and 122 minutes when a combination of the two was used (13 patients). Thus, overall facility charges and total charges (with professional fees added) were substantially higher for laparoscopically assisted vaginal hysterectomy only when disposable supplies were used.

Multivariate regression analyses were performed to compare the three techniques of hysterectomy with respect to costs and the use of resources, with adjustment for age, the number of coexisting medical conditions, uterine weight, and the secondary procedures performed. These adjustments had little effect on the results. Regression analyses also demonstrated that patients at least 60 years old had mean total charges that were $938 higher than those of patients

TABLE 3. FACILITY COSTS FOR VARIOUS SUBGROUPS OF PATIENTS, ACCORDING TO TECHNIQUE OF HYSTERECTOMY.*

SUBGROUP	TOTAL NO. STUDIED	LAPAROSCOPICALLY ASSISTED VAGINAL HYSTERECTOMY		TOTAL VAGINAL HYSTERECTOMY		TOTAL ABDOMINAL HYSTERECTOMY	
		NO.	FACILITY COSTS ($)	NO.	FACILITY COSTS ($)	NO.	FACILITY COSTS ($)
All subgroups	1049	273	4914±1710†	210	3116±969	566	3954±1601
No secondary procedure	293	87	4642±1496†	87	2626±659	119	3475±676
Surgical repair only	85	4	6397±3515‡	79	3400±771	2	4110±1485
Adhesiolysis only	43	17	5449±2207§	0	—	26	3960±1312
Salpingectomy, oophorectomy, or both							
As only secondary procedure	389	117	4851±1622‡¶	17	2978±621	255	3791±1128‖
With repair of vaginal prolapse	49	7	6177±1376‡**	23	3747±1242	19	4601±1082††
With adhesiolysis	181	37	5010±1890	1	5224	143	4510±2499

*Plus–minus values are means ±SD.

†$P<0.001$ for each pairwise comparison.

‡$P<0.001$ for the comparison with total vaginal hysterectomy.

§$P=0.008$ for the comparison with abdominal hysterectomy.

¶$P<0.001$ for the comparison with abdominal hysterectomy.

‖$P=0.004$ for the comparison with total vaginal hysterectomy.

**$P=0.005$ for the comparison with abdominal hysterectomy.

††$P=0.024$ for the comparison with total vaginal hysterectomy.

TABLE 4. CHARGES AND COSTS FOR LAPAROSCOPICALLY ASSISTED VAGINAL HYSTERECTOMY ACCORDING TO WHETHER THE SUPPLIES USED WERE DISPOSABLE.*

TYPE OF SUPPLIES	NO. OF PROCEDURES	TOTAL CHARGES ($)	FACILITY CHARGES ($)	COST OF MEDICAL AND SURGICAL SUPPLIES ($)
Disposable	210	6419±1818†	5514±1770†	1782±1089†
Nondisposable	10	4563±7089‡	3644±6115§	286±515§
Both combined	53	5208±1401	4295±1328	581±344¶

*Plus–minus values are means ±SD.

†$P<0.001$ for the comparison with procedures using disposable and nondisposable supplies in combination.

‡$P<0.002$ for the comparison with procedures using disposable supplies.

§$P<0.001$ for the comparison with procedures using disposable supplies.

¶$P=0.01$ for the comparison with procedures using nondisposable supplies.

under the age of 40, and facility charges that were $817 higher, after adjustment for the number of coexisting conditions and for uterine weight. After we controlled for uterine weight and the number of coexisting conditions, an increase of 10 years in age (for example, when a patient 65 years old was compared with a patient 55 years old) was associated with an increase of $246 in facility costs ($P<0.001$). In addition, patients with a uterine weight of at least 400 g had mean total charges and mean facility charges that were $280 higher than those of patients with a uterine weight below 400 g, after we controlled for age and the number of coexisting conditions. Finally, after we controlled for age and uterine weight, patients with one or more coexisting conditions had mean facility costs $239 higher than those of patients with no coexisting conditions ($P=0.01$).

DISCUSSION

Despite the reduced invasiveness and shorter hospital stay associated with laparoscopically assisted vaginal hysterectomy, we found that the operating-room time, anesthesia time, cost of supplies, facility costs and charges, and total charges (facility charges plus professional fees) for that procedure were substantially higher than those for either vaginal hysterectomy or abdominal hysterectomy. The cost of a hospitalization for laparoscopically assisted vaginal hysterectomy was higher regardless of which related surgical procedures were also performed, or whether any such procedures were performed. In addition, the procedure was substantially more expensive when disposable, as compared with nondisposable, supplies were used in every step of the laparoscopic portion of the procedure. When laparoscopically assisted vaginal hysterectomy was performed with either nondisposable supplies or a combination of disposable and nondisposable supplies, the facility charges were not substantially higher than for abdominal hysterectomy.

It is not surprising that the costs associated with laparoscopically assisted vaginal hysterectomy were higher than those of the two alternative procedures. Because laparoscopically assisted vaginal hysterectomy combines both abdominal and vaginal approaches, two sets of instruments and drapes and two different operating configurations are required, increasing both time and labor. Moreover, when uterine weight is 400 g or more, the vaginal portion of the operation often becomes more difficult, increasing the operating-room time.

Few disposable instruments are routinely used in either abdominal hysterectomy or vaginal hysterectomy. With laparoscopically assisted vaginal hysterectomy, however, disposable instruments are available for every step of the laparoscopic portion of the procedure. The most expensive of these instruments are the endoscopic stapling devices. Some surgeons believe that stapling instruments substantially reduce the operating time required for this portion of the hysterectomy. In addition, disposable instruments are always clean and sharp and are designed to facilitate specific steps in the operation. Nonetheless, there was no overall reduction in operating time when disposable instruments were used for all steps in the laparoscopic portion of the procedure.

We compared costs and use of resources in the care of patients defined as clinically similar on the basis of the secondary procedures (if any) performed in conjunction with hysterectomy. We adjusted the analysis for age, the number of coexisting conditions, and uterine weight. As a result, we believe the differences in cost were attributable to differences between the techniques of hysterectomy used, rather than differences in the type of patients treated. To make our comparisons accurate and exclude patients who underwent more substantial surgery for cancer, we reviewed more than 1000 patients' hospital charts in detail, instead of relying solely on computerized

administrative data. These reviews enabled us to obtain data on age, weight, and indications for surgery for each patient and to identify procedures that began as laparoscopically assisted vaginal hysterectomy but were converted to abdominal hysterectomy and thus were coded and billed as the latter on the discharge abstracts.

We estimated facility costs, as well as facility charges, using cost-to-charge ratios specific to each cost center. We could thus draw conclusions about the costs associated with each technique from the perspective of the hospital as well as the insurer.

The most noteworthy limitation of our analysis is that we studied only a single institution. The costs and charges for the three techniques of hysterectomy may differ at other institutions, but it is likely that our major conclusions are generalizable. We examined the experience of nearly 100 surgeons but did not control for differences among them in technical expertise.

Judgments about the preferred approach for hysterectomy should be based on several factors, including the indications for the procedure, the clinical characteristics of the patient (such as estimated uterine size and weight), and the morbidity and cost associated with the technique. When vaginal hysterectomy can be performed, our analysis confirms that it is the least costly approach and that intraoperative complications are less frequent with it than with laparoscopically assisted vaginal hysterectomy. Laparoscopically assisted vaginal hysterectomy may offer patients several advantages over abdominal hysterectomy, such as reduced postoperative discomfort, a shorter period of recuperation after discharge, and the chance to avoid a major abdominal incision, but our analysis suggests that when disposable instruments are used for all steps in the laparoscopic portion of the procedure, the in-hospital costs to both the hospital and the insurer are substantially higher for the laparoscopic procedure.

It is not likely that using disposable instruments throughout laparoscopically assisted vaginal hysterectomy confers enough advantages over abdominal hysterectomy to justify the added cost. Whether the benefits to the patient of the laparoscopically assisted technique without the use of disposable instruments are worth the extra cost is a question requiring a value judgment. A prospective study now under way will evaluate patients' quality of life, ability to return to work, and productivity after hysterectomy, to clarify the relative benefits and cost effectiveness of the two procedures.

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CORRECTION

Costs and Charges Associated with Three Alternative Techniques of Hysterectomy

Costs and Charges Associated with Three Alternative Techniques of Hysterectomy . On page 477, the sentence that begins in the fifth line of the left-hand column should have read, ``Laparoscopically assisted vaginal hysterectomy has been performed *at the center* since February 1, 1990.´´