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Original Contribution

Trends, Major Medical Complications, and Charges Associated With Surgery for Lumbar Spinal Stenosis in Older Adults

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ABSTRACT

Context In recent decades, the fastest growth in lumbar surgery occurred in older patients with spinal stenosis. Trials indicate that for selected patients, decompressive surgery offers an advantage over nonoperative treatment, but surgeons often recommend more invasive fusion procedures. Comorbidity is common in older patients, so benefits and risks must be carefully weighed in the choice of surgical procedure.

Objective To examine trends in use of different types of stenosis operations and the association of complications and resource use with surgical complexity.

Design, Setting, and Patients Retrospective cohort analysis of Medicare claims for 2002-2007, focusing on 2007 to assess complications and resource use in US hospitals. Operations for Medicare recipients undergoing surgery for lumbar stenosis (n = 32 152 in the first 11 months of 2007) were grouped into 3 gradations of invasiveness: decompression alone, simple fusion (1 or 2 disk levels, single surgical approach), or complex fusion (more than 2 disk levels or combined anterior and posterior approach).

Main Outcome Measures Rates of the 3 types of surgery, major complications, postoperative mortality, and resource use.

Results Overall, surgical rates declined slightly from 2002-2007, but the rate of complex fusion

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procedures increased 15-fold, from 1.3 to 19.9 per 100 000 beneficiaries. Life-threatening complications increased with increasing surgical invasiveness, from 2.3% among patients having decompression alone to 5.6% among those having complex fusions. After adjustment for age, comorbidity, previous spine surgery, and other features, the odds ratio (OR) of life-threatening complications for complex fusion compared with decompression alone was 2.95 (95% confidence interval [CI], 2.50-3.49). A similar pattern was observed for rehospitalization within 30 days, which occurred for 7.8% of patients undergoing decompression and 13.0% having a complex fusion (adjusted OR, 1.94; 95% CI, 1.74-2.17). Adjusted mean hospital charges for complex fusion procedures were US $80 888 compared with US $23 724 for decompression alone.

Conclusions Among Medicare recipients, between 2002 and 2007, the frequency of complex fusion procedures for spinal stenosis increased while the frequency of decompression surgery and simple fusions decreased. In 2007, compared with decompression, simple fusion and complex fusion were associated with increased risk of major complications, 30-day mortality, and resource use.

INTRODUCTION

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In planning spine operations, surgeons have wide discretion. For pain-related surgery, consensus on indications for specific procedures (eg, decompression alone or decompression plus fusion) is generally lacking[1-3] despite randomized trials for some condition and procedure combinations.[4-10] Furthermore, individual surgeon preferences may outweigh patient and disease characteristics in choosing procedures.[3] Such choices are important because greater invasiveness is associated with greater complications, health care use, and mortality[4, 11-12] but generally similar clinical benefit.[7-10,12]

Risks of spine surgery are particularly important in older adults, for whom stenosis is the most common surgical indication. Symptomatic lumbar stenosis results from progressive degenerative changes in intervertebral joints and ligamentous structures, leading to spinal canal and neural foraminal narrowing. Diagnosis and treatment require complex judgments integrating data from imaging, clinical findings, and the patient's clinical course.

Surgery for spinal stenosis was the fastest-growing type of lumbar surgery in the United States from 1980 to 2000.[13-14] Randomized trials indicate that for severely affected patients, decompression without fusion offers greater efficacy than nonsurgical treatments.[5-6] However, assessment of therapeutic safety often requires observational data, because randomized trials may exclude high-risk patients, be too short to identify some risks, or be too small to detect uncommon events.[15]

Better information on surgical complications would help surgeons, referring physicians, and patients weigh benefits and risks and would permit more individualized decision making. We therefore studied the Medicare population (adults ≥65 years, who receive federal health insurance coverage) to better define (1) trends in the use of various surgical procedures for lumbar stenosis; (2) how complications vary as a function of age, comorbid conditions, previous surgery, and complexity of the surgical procedure; and (3) health care use associated with stenosis surgery, including hospital length of stay, hospital charges, rehospitalization, and postoperative nursing home care.

METHODS

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Data Source

We used Part A claims (the Medicare Provider Analysis and Review, or MedPAR database) for the most recent available years (2002-2007) to examine trends in use of various surgical procedures. This database includes 100% of Medicare

hospital claims, using surgical procedure codes from the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*). We excluded beneficiaries receiving Social Security Disability Income, those with end-stage renal disease, or those enrolled in a health maintenance organization. The latter are often excluded from Medicare data analyses because detailed claims may not be available.[16-17]

These data files have unique patient identifiers that allow linkage among files and identification of repeat hospitalizations. Institutional review boards at the University of Washington, Oregon Health and Science University, and Dartmouth College approved the project.

Trends in Surgical Procedures

To examine surgical trends, we selected patients aged 65 years or older with a primary diagnosis of lumbar spinal stenosis (98.2% of cases) or spondylogenic compression of lumbar spinal cord. We included those with a surgical procedure indicating any combination of diskectomy, laminectomy, or fusion. We excluded patients if any diagnosis at the index hospitalization indicated cancer, vehicular crash, spinal infection, inflammatory spondyloarthropathies, vertebral fractures or dislocations, or cervical or thoracic spine procedures. Race and ethnicity were determined by what was reported on Medicare claim files as submitted by hospitals.

Categorizing Surgical Procedures

We defined 3 broad categories of spine surgery: decompression, simple fusion, or complex fusion. Decompression included any combination of discectomy and laminectomy without fusion. A simple fusion involved a single surgical approach (only codes for anterior fusion or only for transverse process or posterior fusion techniques), and involved only 1 or 2 disk levels (corresponding to the *ICD* code for fusion involving 2 or 3 vertebrae). Complex fusions involved 360^{o} spine fusion by single incision (during the years this code was available); any combination of anterior with either transverse process or posterior fusion techniques; or any fusion of more than 2 disk levels. If the number of levels was not coded, cases were classified by approach only (single vs combined anterior and posterior approach).

Complications

To study complications, we focused on January 1 to December 1, 2007, providing 30 days of postoperative observation for all patients. The index operation was the first operation meeting our eligibility requirements. We selected only patients aged 66 years or older, so that most would have had a full year of Medicare eligibility to identify recent previous spine surgery, hospitalizations, and comorbid conditions.

Complications in 3 categories were considered: major medical complications, wound complications, and mortality. These may be associated with any surgery and are not specific for lumbar spine surgery. Major medical complications included procedure codes for cardiopulmonary resuscitation or repeat postoperative endotracheal intubation and mechanical ventilation. They included diagnosis codes for cardiorespiratory arrest, acute myocardial infarction, respiratory failure, pulmonary embolism, bacterial pneumonia, aspiration pneumonia, pneumonia with unknown organism, and stroke, excluding late effects. These complications were chosen because of their major effect on health and more consistent coding, in contrast to minor complications.[18]

Wound complications included hemorrhage, hematoma, or seroma complicating a procedure; disruption of operation wound; nonhealing surgical wound; postoperative infection; and other infection. We also included patients with a procedure code for "excisional debridement of wound, infection or burn," or a diagnosis related group code for wound debridement and skin graft.

Mortality was determined from a file identifying date of death. We calculated mortality within 30 days of hospital discharge, including in-hospital death.

Health Care Use

MedPAR includes length of hospital stay and hospital charges but not professional fees. The file also identifies discharges to a skilled nursing facility. We examined rehospitalizations within 30 days because short-term rehospitalizations are a target for quality improvement,[17] suggesting complications, poor discharge planning, inadequate outpatient follow-up, or other problems.

Measures of Comorbidity

We modified the comorbidity index of Quan and colleagues.[19-20] We removed codes such as acute myocardial infarction or acute stroke that could represent postoperative complications when recorded at the index hospitalization. However, we used the full index to identify comorbid conditions in any hospitalization during the previous year. We also calculated number of hospitalizations in the year prior to the index hospitalization (excluding those for spine surgery), as a marker of overall disease burden.

Previous Spine Surgery

We identified patients with previous lumbar surgery in 2 ways. First, we identified diagnosis or procedure codes suggesting previous surgery, such as postlaminectomy syndrome, or refusion. Second, we searched hospitalizations in the previous year to identify lumbar spine procedures.

Statistical Analysis

Trends in use of surgical procedures were examined using both volume and rates of relevant procedures per 100 000 Medicare beneficiaries. Age and sex were adjusted by the direct method to the 2002 Medicare population. Charges were adjusted for inflation using the health care component of the consumer price index, adjusting to 2009 US dollars.

Proportions of patients with complications, rehospitalizations, or nursing home discharge among subgroups were compared using χ^2 analyses for bivariate analyses and using logistic regression for multivariate analyses. In regressions, these events were modeled as a function of age, race, sex, comorbidity, previous spine surgery, secondary diagnoses of spondylolisthesis or scoliosis, and complexity of surgical procedure.

Length of stay and hospital charges were compared among subgroups with *t* tests or analysis of variance, then modeled in linear regressions. Regressions were performed using untransformed charges because mean estimates were similar to those of alternative approaches that better account for skewed data.[21-24] Means are often sufficient in large data sets.[22] All significance tests were 2-sided, with an α of .05, which we considered to be statistically significant. Statistical analysis was performed with Stata software, version 10 (StataCorp, College Station, Texas).

RESULTS

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Surgical Trends

In 2007, there were 37 598 operations for a primary diagnosis of lumbar stenosis among patients meeting our criteria. The aggregate hospital bill was nearly US $1.65 billion (2009 dollars). Over the years 2002-2007, the number of operations and the rate per 100 000 beneficiaries decreased slightly (Figure). The adjusted rate of lumbar stenosis surgery per 100 000 Medicare beneficiaries was 137.4 in 2002 and 135.5 in 2007.

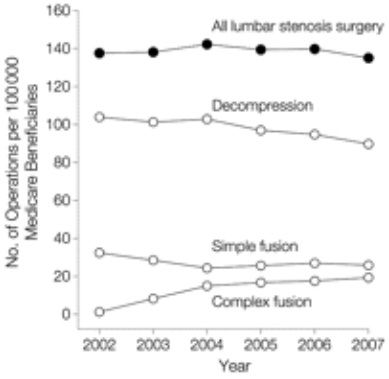

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Figure. Surgical Procedures for Lumbar Stenosis per 100 000 Medicare Beneficiaries 65 Years or Older

Adjusted for age and sex by the direct method to the 2002 population.