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Editorial

Value and cost in less invasive spinal fusion surgery: lessons from a community hospital

As the contentious debate on healthcare reform in the United States moves into its third decade, attention has been increasingly focused on the twin realities of value and cost. Greater and greater demands are made upon all therapies (but, most deservingly, on expensive, technology-driven treatments like spinal surgery) to describe their proven indications, report their complications, and delineate their outcomes. Much is made of well-designed, longitudinal, prospective trials; calls ring out for Class I evidence; and policy makers turn scrutinizing eyes on the drivers of healthcare expenditures and on the healthcare providers' ability to justify their choices of therapies.[1–3]

At the same time, innovation proceeds apace and evolution occurs within all of medicine. Spinal surgery has evolved, as have all surgical specialties, away from large, disabling procedures, seeking instead to minimize collateral damage while maintaining or improving the outcomes for patients. These 2 realities—that intervention must be worthwhile and that innovation must continue—are, at times, at cross-purposes. One cannot justify newer techniques and novel technologies based on evidence derived from long-term studies of older interventions. Nonetheless, we as surgeons are called to offer our patients treatments of proven value while always searching for ways to provide similar results at lower costs.

It is within this debate that this issue offers information on new, less destructive solutions to spinal maladies. Unfortunately, the evidence level of many of these studies will not rise to Class 1 data; therefore, readers must, at times, rely on evidence that is available about the value of older interventions. In addition, it is wise to remain mindful of the admonition of Sackett et al in 1996[1]: "External clinical evidence can inform, but can never replace, individual clinical expertise, and it is this expertise that decides whether the external evidence applies to the individual patient at all and, if so, how it should be integrated into a clinical decision."

History

Economic evaluations of orthopedic services have been used previously to inform healthcare policy. Hip and knee arthroplasties are some of the most commonly performed surgeries in North America, effectively reducing pain and improving function and quality of life for patients with advanced osteoarthritis. Evidence for cost-effectiveness was provided by high-quality studies with large sample sizes, excellent patient follow-up, and detailed methods used for costing.[4–6] The cost-effectiveness of joint arthroplasty was also shown to be compare favorably with other surgical interventions such as cardiac bypass, liver transplant, or dialysis.[7,8]

In spinal surgery, the recently completed Spine Outcomes Research Trial (SPORT) has proven to a high level of evidence and certainty that surgical intervention results in better outcomes than nonsurgical care in the treatment of lumbar disk herniation, spinal stenosis, and spondylolisthesis.[9–14] However, even as the value of intervention has been documented, recent interpretations of the SPORT results for surgery for spondylolisthesis have questioned the cost-effectiveness of fusion surgery compared to decompression alone for degenerative stenosis with instability.[15] This study noted a quality adjusted life year (QALY) gain of 0.23 in the fusion cohort; but, this came at a cost of $115,600 per QALY gained. (In general, $100,000 denotes a cost-effective therapy.) No breakdown of the 344 fusion surgeries (269 with instrumentation) by type of procedure was provided; however, based on the time frame of the study, it may be inferred that the vast majority of those fusions were performed using traditional open techniques.

We have previously described our early results using less invasive lumbar fusion technologies,[16–18] discussed our fusion results,[19] and reported our 1-year outcomes for a large (> 300) patient series.[20] We have also reported the results of these therapies in difficult anatomic situations[17,21] and extreme patient populations.[18,22] We have discussed our complications in a large series (> 600 patients)[23] and have shown that the complications associated with less invasive fusion are less frequent than the complications reported with traditional open approaches, and the length of hospitalization markedly shorter.

It stands to reason that modern surgical fusion options would be expected to yield a decreased dollar cost per QALY gained, because these minimally invasive surgical (MIS) techniques require shorter hospital stays and result in fewer expensive complications. Our outcomes are being reported and value is thereby shown, but what is the effect on costs of the transition from open to less invasive techniques? Since MIS spine surgery appears to provide benefits to the patients, is it truly cost effective?

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Methods

We analyzed retrospectively the effect on costs seen at our institution (St. Mary's Health Center, Jefferson, City, MO, a 160-bed community hospital in a mid-sized middle American city) associated with the transition from a traditional, open fusion platform to a less destructive surgical approach on a specific intervention and a specific treatment scenario in a selected patient cohort. A hospital cost comparison of the perioperative period was performed between the 2 groups. St. Mary's Health Center (SMHC) operating costs, including direct patient costs and overhead, were retrospectively collected from hospital cost accounting records for each patient in the 2 groups. The perioperative period was defined as the surgery and the first 45 days postoperation. All costs obtained were broken down by hospital revenue code, allowing for a more detailed analysis. Costs were adjusted for inflation to 2009 US dollars.

We elected to study patients treated for degenerative spinal conditions in a specific manner: an instrumented, 2-level lumbar interbody fusion. Prior to 2006, these patients were treated using a traditional open posterior lateral interbody fusion (PLIF) technique. Late that year, we transitioned to a minimally invasive platform and began employing extreme lateral technology (XLIF) from L1-2 to L4-5 and MIS TLIF or transsacral fusion at L5-S1. Having prospectively collected clinical and fusion data on our 2-level PLIF cases and clinical outcomes, and fusion data on our less invasive 2-level fusions, we were able to retrospectively access hospital billing information, and analyze the costs seen during the in-hospital treatment interval and the first 45 days after operation. All patients treated with 2-level instrumented lumbar interbody fusion at SMHC during this time interval were included in the study. The proposed analysis was presented to the SMHC Institutional Review Board and their approval obtained. There were 102 patients in the open 2-level PLIF group and 109 in the less disruptive MIS 2-level fusion group.

The perioperative costs collected were divided into 4 groups: the index surgical procedure and initial hospital stay, transfusions, reoperations, and residual events. The index surgical procedure and reoperations were prospectively recorded in clinical databases. Costs were obtained based on patient identification numbers and dates provided to the hospital. Transfusions were not tracked prospectively in the open group, so the hospital laboratory obtained transfusion records retrospectively based on the list of patient identification numbers and the index procedure date. Records included patient typing, cross-matching, autologous donation, and transfusions. Those records were sent to the hospital cost accounting department and costs were acquired.

Residual events were defined as any event, excluding the initial procedure and hospital stay, that occurred in the first 45 days following surgery. Residual events encompassed ER visits or readmissions to the hospital for pain or complications relating the surgery, physical therapy and other postoperative rehabilitative treatments, and additional diagnostics. Residual events were not tracked prospectively in the open group. To retrospectively obtain all residual events without compromising private health information not relevant to this study, the hospital provided a blinded list of all patients' hospital events occurring between 2005 and 2009. Hospital diagnosis and procedure codes identified each event. Three staff members, the research coordinator and 2 coding specialists, reviewed the list of events and excluded those not relevant. The hospital then provided cost information for the residual events. Because of the tracking methods used to determine transfusion in the open PLIF group, transfusions were classified as residual events (in both groups) and those costs assigned accordingly.

Table 1
Total costs, erioperative period up to 45 days postoperatively

	Open	MIS
Total patients	101	109
Original procedure	$2,552,503.48	$2,581,871.77
Residual events	$131,825.50	$33,387.67
Totals per group	$2,703,824.32	$2,638,679.15
Average total cost per procedure	$26,770.54	$24,208.07

Results

This report represents a preliminary discussion of our findings in the format of a position paper, and it is our intention to provide a more detailed accounting in the near future. In brief, we found that the average length of stay in the MIS group was 49% less than open group (1.2 vs 3.2 days) and that the average cost for the surgical procedure and initial hospital stay in the MIS group was 6% ($997/patient) less than the open group.

These cost savings increased in the early postoperative period as the residual events began to occur. There was a 76% decrease in the rate of residual events from the open to the less invasive group. The costs savings from this decrease in residual events was $986/patient.

Transfusion-related costs were calculated separately from residual event costs. In the open group, all patients were cross-matched for 2 units of packed red blood cells and 18 patients (17.6%) received transfusions. After reviewing this data, we noted that only 1 of the 109 patients in the less invasive group had required a transfusion, but these patients had been routinely cross-matched by hospital protocol. This change in our protocol will result in savings of $123/patient going forward.

For the entire perioperative period, including both surgical and post-surgical costs out to 45 days, there was an average savings of 9.6% or $2,563/patient (Table 1).

Discussion

As the costs of health care continue to grow, it becomes imperative that all providers critically examine their as-

sumptions about the efficacy, value, and cost-effectiveness of the interventions they employ to treat their patients. As mentioned earlier, large-scale, well-controlled trials have documented the efficacy of surgical intervention for lumbar disk herniation, spinal stenosis, and spondylolisthesis using traditional open surgical techniques.[9–15] The value of intervention has been proven.

However, advances in technology have begun the evolution of spinal surgery from an open to a less invasive specialty. In a series of reports from the podium and in the literature, the improvements in complication rates, decreases in hospitalization time, and the overall good outcomes of less invasive techniques have been well documented.[24–32] Within one subcategory of spinal surgery, less invasive lumbar fusion, we have reported our own improvements in length of hospitalization,[16] complication incidence,[18,23] and patient outcomes.[20] We have demonstrated the applicability of these new techniques to complex anatomic,[21] clinical,[17] and demographic scenarios.[18,22]

These improvements in technology come at a cost: an investment of private and public capital in research and development, physician training, and patient education. These investments can be recovered on a societal basis if the results of intervention with these new technologies results in more effective care, even if that care is initially more costly. In a recent report from Toronto, Rampersaud et al[33] reported marked improvements in health utility index between patients treated with less invasive fusion techniques compared to traditional open surgery.

Our own data will not, at present, allow calculation of health utility indices, because the follow-up intervals are different for our 2 groups. It should be noted, however, that even in the very early going, less invasive fusion has resulted an absolute cost savings of over $2500/patient in groups of similar patients treated with the similar operations (2-level interbody lumbar fusion) at the same center. The savings are nearly equally divided between the initial treatment hospitalization (which derive primarily for the decrease in length of stay) and the occurrence of residual events that may or may not be considered complications but which necessitate expenditures for treatment. While longer-term deterioration of the less invasive cohort might result in a loss of some of these savings, we must opine that it is our impression that the rate of residual events in the less invasive group is significantly decreased when compared to the open group, even out to 12 months after the index procedure. Furthermore, going forward, we have identified from an analysis of this data at least 1 area (cross-matching of blood for transfusion) where an additional $120/patient will be saved.

What then is the importance of the savings we herein report? In comparison to the trillions of dollars that health care will cost in the coming years, what difference does $2500 make? It is not in the individual treatment interval where less invasive spinal surgery offers its true promise, obviously, but rather in the potential savings to society from the application of these cost-saving technologies to the half million lumbar fusions done each year in the United States.[2,3,34,35] A nearly 10% reduction in costs, within the first 45 days after an intervention, augurs well for a massive cost savings if implemented on a societal scale.

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