Editorial

Fast tracking lumbar fusion: reducing costs with an ERAS program for minimally invasive transforaminal lumbar interbody fusion

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More than 298,000 lumbar fusion surgeries are performed each year, with an estimated cost of $11 billion in the United States alone (1). With the introduction and refinement of the minimally invasive surgical transforaminal lumbar interbody fusion (MIS TLIF), the past 15 years have seen significant advancement in reducing the morbidity of these procedures (2). In addition to greater safety, the minimally invasive approach offers earlier mobilization, return to daily life, and reduced cost over open TLIF (3). More recently, focus has turned to safely streamlining these operations by making protocol adjustments in either the pre-, intra-, or post-operative windows.

Adjuvant local anesthesia techniques such as intrathecal, epidural, or subfascial morphine or bupivacaine have been used for some time in lumbar surgery, effectively reducing pain scores and narcotic usage in the acute post-operative period (4-7). Alternatively, carefully selected, low risk patients have been shown to safely undergo same-day discharge following traditional MIS TLIF (8), while a larger, more varied group of patients safely underwent unilateral MIS TLIF with same-day discharge, achieving comparable outcomes to those who were admitted to the hospital post-operatively. Given the evolving landscape of American health care and the high prevalence of lumbar fusion surgery, the development of an inexpensive, safe, and effective fast-track algorithm for MIS TLIF would be welcome.

Wang *et al.* have demonstrated the safety and efficacy of an Enhanced Recovery After Surgery (ERAS) program for MIS TLIF by comparing cost of hospital admissions between an ERAS cohort and historical controls (9). Notably, their ERAS program introduced six practice changes. Sedation with propofol and ketamine was used in place of general endotracheal anesthesia and no foley catheter was placed. Tissue trauma was minimized with the introduction of a working channel endoscope through an 8 mm incision, which also allows for the use of an expandable interbody cage, allograft bone morphogenetic protein, and small caliber percutaneous screws. Prior to screw placement, the tracts are injected with long-acting liposomal bupivacaine. A consecutive case series of the first 38 patients treated with ERAS MIS TLIF was compared to 15 consecutive MIS TLIF patients prior to ERAS implementation. Baseline demographics, pathology being treated, surgical level, blood loss, hospital length of stay, perioperative complications, clinical metrics, and cost of hospitalization were evaluated.

This study reported several intriguing findings (9). While both groups were deemed clinically similar, without significant difference in degree of disease or medical comorbidities, the ERAS group carried an older average age and greater number of spinal levels treated. Intuitively, this may suggest an increase in risk of perioperative complications or poor outcomes. However, similar improvements were observed between the two groups in the final (24 months) Oswestry Disability Index and there

was no increase in symptomatic or radiographic nonunion, suggesting no clinical disadvantage to the ERAS protocol. Further, the ERAS group showed decreased operative time, intraoperative blood loss, hospital length of stay, and average cost of hospitalization. The greatest contributors to the 15.2% reduction in hospitalization cost were found to be reduction in intensive care unit costs from medical complications, reduced length of stay, and shorter operating room time. Notably, such cost reduction was maintained even with the addition of readmission costs for three ERAS patients and two standard MIS TLIF patients.

We found several strengths in this study. The consecutive case series approach to cohort selection was relatively unbiased and resulted in moderately heterogeneous cohorts that may be representative of the larger population. The ERAS protocol itself combines several techniques that have been previously studied and found to be effective, such as the use of endoscopy and a long-acting local anesthetic. Further, these techniques are broadly applicable either as a whole or individually in a variety of hospital settings. We found the authors' analysis of fusion success acceptable. Radiographic confirmation of fusion was not systematically obtained, given the retrospective nature of this study. However, it was sought in cases where there was clinical question of nonunion, an approach likely more in line with standard clinical practice. Therefore, we find the reported fusion rate in the ERAS protocol to be both in line with clinical standards and calculated fairly. We also appreciated the authors' discussion of each protocol (ERAS or standard MIS TLIF) on re-hospitalization. This study's focus is on the cost of index hospitalization, however it is imperative to consider the consequences of differing therapies when comparing costs. The preservation of cost difference between treatment protocols when including costs of any re-admissions or re-operations is a necessary point and only serves to strengthen the cost argument in favor of the ERAS protocol.

Even so, this study contains some methodologic limitations. The retrospective nature of the study leads to inherent heterogeneity in patient selection and management. Most concerning is the lack of mention regarding how many patients did not qualify for the ERAS protocol during this time period. As the authors admit, standard MIS TLIF is a more versatile approach and would likely be favored in cases of severe stenosis or significant medical comorbidities. Without knowledge of the surgeon's pre-operative decision making, it is left unknown what disease severity was effectively treated with the ERAS protocol. It is imperative to clarify the patient and disease characteristics that would allow for greatest benefit from this novel, expedited approach before introducing it on a broad scale to mitigate potential complications.

For the sake of group homogeneity and to ease direct comparison of costs, we would support the exclusion of the four two-level cases in the ERAS cohort. The 11 month mean follow-up time for the ERAS cohort is shorter than preferred. A minimum 12 months follow-up time (if not longer) is necessary to truly evaluate the long-term efficacy of any fusion surgery. The greatest cost reduction was derived from a lack of intensive care unit admissions in the ERAS cohort. This is an interesting result given the understandably low rate of intensive care needs following any one or two level, minimally invasive spinal fusion. We would welcome elaboration on these specific complications given their rarity and the substantial effect they had on the paper's ultimate conclusion.

This paper introduces an intriguing fast-track protocol, "Enhancing Recovery After Surgery," for MIS TLIF that results in lower costs to the patient together with reduced intraoperative blood loss, operative time, and length of hospitalization. These benefits appear to be without any sacrifice in efficacy in this brief follow-up period. A clarification of which patients would benefit most from this streamlined approach to lumbar fusion surgery is warranted. We commend the authors on their excellent work.

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Footnote

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aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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