Original Article

Spine surgery complexity score predicts outcomes in 671 consecutive spine surgery patients

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INTRODUCTION

Characterizing procedural complexity related to postsurgical outcomes can aid neurosurgeons in patient selection, preoperative counseling, and determining the prognosis.[5] It also helps establish risk models along with surgical outcomes assessment.

Here, we attempt to validate the spine surgery complexity score (SSCS), recently proposed by us,[6] to predict hospital length of stay (LOS) and postoperative complications (i.e., as described by the Clavien-Dindo score [CDS]).[6]
MATERIALS AND METHODS

Data collection

The patients undergoing spine surgery were identified from operating room logs of the Department of Neurosurgery, Westchester Medical Center, 2015–2017. A 4-level subjective complexity scale (SSCS) was devised based on what year of residency trainees typically learn each procedure [Table 1].[3] Patients undergoing spinal procedures were selected, and each was assigned a score from 1 to 4 based on the predefined SSCS categories. Subsequently, the following factors were assessed: hospital LOS and complications (i.e., as defined by CDS – spell out).

Statistical analysis

Spearman’s correlation and univariate linear regression analysis were performed for comparing continuous variables and Likert scale scores. Significance was set at a cutoff of $P < 0.05$. All statistical analyses were performed using SPSS 24 software (IBM Corp., Armonk, NY).

RESULTS

A total of 671 patients were included in this study with average age of 50 ± 17.15 years. Of these patients, 53.6% were men and 46.4% were women. The median SSCS was 2 (IQR:1); the average LOS was 7.14 ± 10.4 days; and the median CDS was 0 (IQR:2) [Figure 1]. The SSCS significantly correlated with both LOS and CDS [Table 2] and was predictive of LOS and CDS in linear regression analysis [Table 3].

DISCUSSION

Agreed-upon scales for both complexity and surgical outcomes are increasingly required for standardized evaluation of procedures, LOS, and outcomes in neurological surgery. In 2008, multiple neurosurgical organizations created the NeuroPoint Alliance (NPA) to create a national database for neurosurgical outcomes and to centralize outcome reporting.[1] Although the NPA’s prospective clinical registry, the National Neurosurgery Quality and Outcomes Database (N2QOD), has led to studies assessing validity of lumbar spine surgery, a broadly applicable spine procedure complexity scale has not yet been devised.[2,7,9] The SSCS, validated in this study, is a product of consensus expert opinion based on surgical experience. Compared to other neurosurgical outcome scales, the SSCS offers a middle ground of objectivity, being based both on expert opinion and statistical models. Unique to the SSCS is its basis in resident training timelines. As more complexity scales emerge in this, and other fields, they can also be used to guide and evaluate resident training.

Emphasizing postsurgical complications rather than patient functional impairment, the SSCS is also the only neurosurgical scale to use CDS as an endpoint, instead of, for example, change in Glasgow Coma Score (GCS). The most appropriate outcome measure may vary by subspecialty within neurosurgery. For example, a spine complexity scale that measures change in GCS may not yield important information about the difficulty of the preceding procedure. The most appropriate outcome measure may vary by subspecialty within neurosurgery. Current efforts by the N2QOD spine division are focused on preventing readmission.

| Complexity | Frequency |
|------------|-----------|
| 1          | 250       |
| 2          | 350       |
| 3          | 400       |

Table 1: Spine surgery complexity score.

1. Microdiscectomy
2. Posterior cervical laminectomy/ fusion
3. Extramedullary spine tumors
4. PSO/deformity
5. Single level posterior spinal fusion (TLIF, PSF, PLIF, etc.)
6. ACDF (three levels)
7. Lumbar/thoracic corpectomies
8. Cervical corpectomy – single level
9. C1-2 procedures
10. Multiple level posterior spinal fusion
11. Occipitocervical procedures
12. Thoracic pedicle screws (intraoperative navigation)
13. Cervicothoracic junction
14. Intramedullary spine tumors
15. Odontoid screw

TLIF: Transforaminal lumbar interbody fusion, PSF: Posterolateral spinal fusion, PLIF: Posterior lumbar interbody fusion, ACDF: Anterior cervical discectomy and fusion

Figure 1: Frequency of cases by the spine surgery complexity score.
after spine surgery and comparing effectiveness of different approaches to surgical treatment of spondylolisthesis using patient-reported outcome data. They also evaluate the endpoints of blood loss and LOS as reflections of surgical efficiency. Ultimately, future work should include evaluation of multiple endpoints to offer comprehensive analysis of surgical risk and operative complexity. Finally, as national patient databases become increasingly available, statistically derived complexity scales should be devised and compared to existing ones.

**CONCLUSION**

Stratifying procedures using the SSCS may enable neurosurgeons to assess surgical risk and predict hospital courses and outcomes for patients after spine surgery.

**Declaration of patient consent**

Institutional Review Board (IRB) permission obtained for the study.

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**Conflicts of interest**

There are no conflicts of interest.

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