Risk modeling predicts complication rates for spinal surgery

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Learning Objectives

1. Identify factors associated with complications in spine surgery
2. Use regression analysis to develop a risk model for complications in spinal surgery
3. Highlight the value of clinical registries to develop risk models and improve outcomes in spinal surgery

Introduction

In the current era of quality reporting and pay for performance, neurosurgeons must develop models to identify patients at high risk of complications. We sought to identify risk factors for complications in spine surgery and to develop a score predictive of complications.

Methods

We examined spinal surgeries from the American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database. 22,430 cases were identified based on CPT.

Table 1

Risk Score	Number of Cases (% of total)	Number of complications (%)
0	412 (1.8)	5 (1.2)
1	1737 (7.7)	40 (2.3)
2	3056 (13.6)	80 (2.6)
3	3819 (17.0)	139 (3.6)
4	4106 (18.3)	224 (5.5)
5	3570 (15.9)	368 (10.3)
6	2540 (11.3)	374 (14.7)
7	1604 (7.2)	372 (23.2)
8	942 (4.2)	299 (31.7)
9	382 (1.7)	160 (41.9)
10	179 (0.8)	104 (58.1)
11	60 (0.3)	32 (53.3)
12	22 (0.1)	14 (63.6)
13	1 (0.004)	1 (100)

Complication rate by risk score

Results

The overall complication rate for the cohort was 9.9%. The most common complications were post-operative bleeding requiring transfusion (4.1%), non-wound infections (3.1%), and wound-related infections (2.2%). Multivariate regression analysis identified twenty factors associated with complications. Assigning one point for the presence of each factor a risk model was developed. The range of scores for the cohort was 0-13 with a median score of 4. Complication rates for a risk score of 0-4 was 3.7% and for scores 5-13 was 18.5%. The risk model robustly predicted complication rates, with complication rate of 1.2% for score of 0 (n=412, 1.8% of total) and 63.6% and 100% for scores of 12 and 13 (n=22 patients, 0.1% of total cohort) respectively (p < .001). The risk score also correlated strongly with total length of stay, mortality, and total work relative value units (wRVU) for the case.

Conclusions

Patient-specific risk factors including co-morbidities are strongly associated with surgical complications, length of stay, cost of care, and mortality in spine surgery and can be used to develop risk models that are highly predictive of complications.

Table 2

Risk Category	Number of Cases (% of total)	Number of complications (%)
Low (Score 0-4)	13130 (58.5)	488 (3.7)
Intermediate (Score 5-7)	7714 (34.4)	1114 (14.4)
High (Score 8-13)	1586 (7.1)	610 (38.5)

Complication rate by risk category