A Predictive Nomogram for Clinical Outcomes following Surgical Correction of Adult Spinal Deformity

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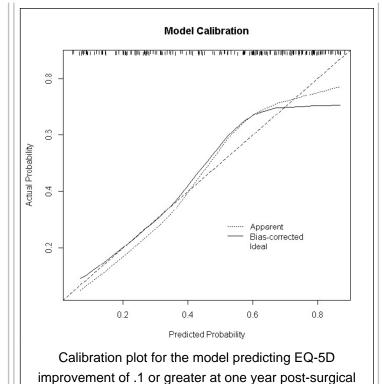Cleveland Clinic, Center for Spine Health

Introduction

Re-alignment surgery for patients with adult spinal deformity has been shown to improve quality of life outcome measures; however, large reconstructive surgery is associated with significant morbidity. We sought to create a preoperative predictive nomogram to determine which patients would benefit from surgery.

Methods

All patients aged 25-years-old with radiographic evidence of ASD and quality of life data that underwent thoracolumbar fusion between 2008 and 2014 were retrospectively identified. Demographic and clinical parameters were obtained. The EuroQol five dimensions questionnaire (EQ-5D) was used to measure health-related quality of life (HRQoL) preoperatively and at 12 months postoperative follow-up. A preoperative to postoperative decline of .10 or greater was used to indicate the presence of clinically relevant decline in HRQoL.

Model P-Values

Variable	p	OR (95% Confidence Interval)
Baseline Eq5D	<.0001	1.79 (1.46 – 2.19)
Sex*Obesity	.022	
Sex	.009	
Among non-obese		3.87 (1.41 – 10.62)
Among obese		27 (.19 – 2.08)
Obesity	.028	
Among males		4.50 (1.18 – 17.11)
Among females		.73 (.328 – 1.62)
Idiopathic Diagnosis	.15	2.01 (.78 – 5.21)
Iatrogenic Diagnosis	.221	.56 (.22 – 1.42)
Age	.162	1.02 (.99 – 1.06)
Surgical History	.4	1.37 (.66 – 2.829)

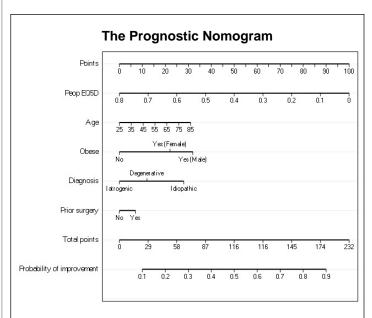Calibration plot for the model predicting EQ-5D improvement of .1 or greater at one year post-surgical follow-up.

Results

Our sample included data from 191 patients. 51% of patients experienced clinically relevant postoperative improvement on the EQ-5D. Seven variables were included in the final model: preoperative EQ-5D score, sex, preoperative diagnosis (degenerative, idiopathic, or iatrogenic), previous spinal surgical history, obesity, and a sex-by-obesity interaction term. Preoperative EQ-5D score independently predicted the outcome. Sex interacted with obesity: obese men were at disproportionately higher odds of improving than non-obese men, but obesity did not affect odds of the outcome among women. Female sex was also shown to be a predictor of postoperative improvement but only among non-obese patients. Model discrimination was good, with an optimism-adjusted c-statistic of 0.739.

Conclusions

Lower preoperative EQ-5D scores were associated with a clinically significant increase in postoperative EQ-5D scores and sex was found to interact with obesity when predicting post-operative EQ-5D scores. The predictive nomogram that we developed using these data can improve preoperative risk counseling and patient selection for deformity correction surgery.

The nomogram can be used to predict the preoperative probability of postoperative improvement. Points (top line) are assigned for each corresponding predictor and totaled and correlated to a probability of improvement (bottom two lines).

Learning Objectives

* Understand the significant predictors of morbidity in patients undergoing surgical correction of ASD

* Understand the utility of predictive modeling for outcomes following ASD surgery

* Consider practice-changing guidelines that reflect findings based on evidence-based modeling