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Peri-operative ischemic optic neuropathy in spinal fusion surgery: Validating a predictive scoring system

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INTRODUCTION

Ischemic optic neuropathy (ION) in association with spine surgery is a relatively rare, although devastating, complication. Identifying high risk patients is important for proper informed consent and surgical planning. Recently, a risk prediction model for ION associated with spine fusion surgery was developed through application of principal component analysis of mixed data to cross sectional inpatient medical claims data from the National Inpatient Sample (NIS) and validated internally.¹ The objective of this study was to externally validate the model using subjects in a longitudinal medical claims database, which has the advantage of longer term follow-up to more accurately identify pre-existing diagnoses and ION.

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MATERIALS & METHODS

Subjects were selected from the de-identified Clinformatics® Data Mart Database (OptumInsight, Eden Prairie, MN; ZIP5, 2007–2017), which includes medical administrative claims data for a large national health insurer in the United States.² The Stanford Research Compliance Office Institutional Review Board deemed the study exempt.

All members 18 years of age with a current procedural terminology(CPT) or International Classification of Disease(ICD)-9 procedures code(PCS) or ICD10-PCS code for thoracic or lumbar spine fusion surgery with a posterior open approach without ischemic optic neuropathy (ICD9 377.31 or ICD10 h47.01*(*=blank, 1, 2, 3, 9) prior to the surgery admission date were screened.³ Subjects with an ION code between the surgery admission and discharge dates were identified as ION cases. Additional cases were identified if they a nonspecific vision loss ICD diagnostic(CM) code between the surgery admission and discharge dates(ICD9 368.11, 368.12, 369.*, 377.49, 377.9 or ICD10 H47.09*, h47.9, h53.1, h53.12*, h53.13*, h53.8, h53.9, h54*; *=blank or alphanumeric value) and first instance of ION code within 12 months following discharge and. All subjects with qualifying spine fusion surgery and without ION were controls. Each case and control were for one surgery in one subject.

Demographic and medical characteristics included in the previously developed ION risk prediction model¹ were obtained for each subject from the Clinformatics® enrollment (age, sex) and medical claims tables. Age at date of admission was categorized as <40, 40–64 and >64 years. Obstructive sleep apnea(OSA) was based on ICD-9 CM 327.2* or ICD-10 CM G47.3* during the hospitalization.

Clinformatics® data was then applied to externally validate a previously published risk prediction score, which was developed based on a logistic regression model using NIS data.¹ The score is calculated by summing 1 point for male, 1 point for age > 39, and 1 point for OSA to generate a score between 0 and 3. The score was calculated for each Clinformatics® subject. For different cutoffs of score, sensitivity, specificity, positive likelihood ratio and negative likelihood ratio for ION or not prediction were evaluated. Area under the receiver operating characteristic(ROC) curve(AUC) was calculated.

RESULTS

There were 65 perioperative ION cases, 52 of which had an ION code during hospitalization and 13 of which had a vision loss code during hospitalization and an ION code during follow up, and 106,871 controls who underwent spinal fusion without ION (Table 2). Score cutoffs of 1 and 3 offered 100% sensitivity and 100% specificity, respectively, whereas a cutoff of 2 had the highest Youden index (i.e., sensitivity+specificity-1) of 26.2%. The ROC had an AUC of 0.68 for discrimination (Table 2).

DISCUSSION

We present external validation of a recently published risk prediction model for ION in spine fusion surgery.¹ Using a population derived from a different medical claims data set that

leveraged longitudinal outpatient and inpatient data to assign case status, we found sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and ROC AUC to be similar to that for the internal validation (0.68 external vs 0.65 internal validation). Identifying cases and assigning variables using Clinformatics® Data Mart differs from that used to build the predictive model using NIS claims data by inclusion of ICD-10 and CPT codes, and confirmation of diagnoses based upon longitudinal claims information.

This provides further support for the previously published ION risk score¹ for counselling patients regarding risk of this rare, though devastating complication of spinal fusion. Such counselling should take into account the low positive predictive value given the low prevalence of this condition and the fair receiver operating characteristic.

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Table 1:Clinformatics® Data Mart spine fusion subjects used for external validation of ION risk prediction model¹

Characteristics	Clinformatics® Data Mart spine fusion subjects [#] n=106,936 n (%)
Number of subject with ION	65 (0.06)
Age, mean (SD)	58.5 (13.6)
Age category	
18–39	10,650 (10.0)
40–64	57,058 (53.3)
65+	39,228 (36.7)
Male, n (%)	46,354 (43.4)
OSA, n(%)	18 (0.02)

[#] (CPT 22610, 22612, 22630, 22633, 27279, 27280) AND ((ICD9-PCS 81.05, 81.07, 81.08, 81.35, 81.37, 81.38) OR (ICD10-PCS 0rg60*, 0rg70*, 0rg80*, 0rga0*, 0sg00*, 0sg10*, 0sg30*; *71, 7j, a1, aj, j1, jj, k1, kj, z1, zj)) OR (CPT OR ICD with coding consistent with spine fusion on record review)

Table 2:

Diagnostic characteristics of the ION risk prediction model using Clinformatics® Data Mart spine fusion subjects

Score Cutoff	Sensitivity (%)	Specificity (%)	Positive Likelihood Ratio	Negative Likelihood Ratio
1	100	5.0	1.05	0.00
2	64.6	61.6	1.68	0.57
≥3	21.5	100		0.79