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Clinical Study

Surgical complications associated with spinal decompression surgery in a Japanese cohort

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ABSTRACT

The aim of the present study was to identify risk factors for perioperative complications associated with spinal surgery for cervical, thoracic, and lumber spinal stenosis in a Japanese cohort. Patients with spinal stenosis who underwent spinal surgery between 2008 and 2012 were included. Neurological and/or surgical site complications within 30 days of index surgery were retrospectively collected, and the rates of complications were calculated. Using univariate and multivariate logistic regression analyses, risk factors for complications were identified. A total of 364 patients underwent 407 spinal surgeries. Of the 407 surgeries performed, 236 were cervical, 28 were thoracic, and 143 were lumbar surgeries. Ossification of the ligamentum flavum was the most common diagnosis in patients with thoracic stenosis (85%), whereas spinal degenerative stenosis and disc herniation were the two most common diagnoses in patients with cervical and lumbar stenosis. Laminoplasty and laminectomy alone were the two most frequently performed procedures. The rate of complications was greater in patients with thoracic stenosis (36%) than in those with cervical (16%) or lumbar stenosis (13%, p = 0.013). After a multivariate analysis, only thoracic stenosis (odds ratio 2.87) remained an independent risk factor for surgical complications. The novel result of the present study was that the level of stenosis in the spine had a significant impact on complications after spinal surgery in a Japanese cohort. The result can be explained by the fact that challenging ossified lesions are a common cause of thoracic stenosis in eastern Asia.

1. Introduction

Spinal stenosis is a common disease caused by degenerative changes in the spine in the adult population worldwide [1]; however, the causes of spinal stenosis differ among countries and races. In eastern Asia, one of the common causes of spinal stenosis is an ossified ligamentous lesion including ossified posterior longitudinal ligament (OPLL) and ossified ligamentum flavum (OLF), which are rare in other areas in the world [2,3]. Furthermore, surgical procedures for spinal decompression are restricted by the health care system of each country [4]. The complications of spinal surgery may vary according to ethnic or social background. Therefore, the aim of the present study was to identify risk factors for perioperative complications associated with spinal surgery for cervical, thoracic, and lumber spinal stenosis in a Japanese cohort.

2. Methods

This study protocol was approved by the Institutional Review Board at the Tokyo Metropolitan Neurological Hospital, Japan. Since this was a non-invasive study, written patient informed consent was not obtained. A public notice that provided information on this study was instead posted on our hospital website.

2.1. Patient selection

Patients over 20 years old with spinal stenosis due to objective radiological findings including osteophytes, disc herniation, OPLL and OLF were identified at our hospital between 2008 and 2012. We excluded patients with congenital, traumatic, infectious, neoplastic and vascular lesions. Medical records were retrospectively reviewed by T.M. for 2008 and 2011, H.Y. for 2009, J.Y. for 2010, and R.H. for 2012. All records were then independently reviewed a second time for accuracy and reproducibility by K.T.

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2.2. Complication classification

Surgical complications (deteriorated or new neurological deficits and/or surgical site complications) within 30 days of index surgery were collected. Complications were considered major if they required invasive intervention, resulted in a prolonged hospital stay of more than 2 weeks, or resulted in permanent morbidity.

2.3. Statistical analysis

To analyze the relationship between complications and multiple risk factors, every possible confounding factor was thoroughly collected based on earlier studies [5,6–20]. Patients were stratified into three groups by the level of the spinal lesion treated, and risk factors were compared across the groups (Table 1, 2). The analysis of variance test was used for continuous valuables and the chi-square test (or Fisher's exact test if there were less than six variables) was used for categorical valuables. Surgical outcomes were assessed using the Wilcoxon signed-rank test.

Potential risk factors for complications were identified via a univariate logistic regression analysis, from which variables with a p value <0.1 were selected. A multivariate logistic regression analysis was then used to determine independent risk factors for complications. The Statistical Package for the Social Sciences (version 11, SPSS Japan Inc., Tokyo, Japan) was used for statistical analyses, which were two sided with $p < 0.05$ being considered significant.

Table 1
Baseline characteristics and comorbidities in 364 patients with spinal stenosis

Factor	Spinal level			p value
	Cervical	Thoracic	Lumbar	
Patients, n	227	20	117	
Mean age ± SD (years)	66 ± 13	67 ± 14	67 ± 12	0.817
Males	145 (64)	16 (80)	93 (80)	**0.007**
Dependent status (mRS ⩾3)	100 (44)	14 (70)	35 (30)	**0.001**
Diagnosis				**<0.001**
Degenerative stenosis	151 (67)	0	63 (54)	
Disc herniation	25 (11)	1 (5.0)	25 (21)	
OPLL	34 (15)	2 (10)	0	
OLF	0	17 (85)	0	
Degenerative spondylolisthesis	0	0	24 (21)	
Craniocervical lesion	13 (5.7)	0	0	
Foraminal stenosis	4 (1.8)	0	6 (5.1)	
Medical comorbidities				
Obesity (BMI ⩾25)	63 (28)	9 (45)	40 (34)	0.173
Anemia (Hb <12.0 g/dl)	47 (21)	7 (35)	30 (26)	0.252
Malnutrition (albumin <3.5 g/dl)	11 (4.8)	2 (10)	5 (4.3)	0.552
Hypertension	98 (43)	10 (50)	50 (43)	0.827
Diabetes	37 (16)	7 (35)	17 (15)	0.073
Insulin use	14 (6.2)	1 (5.0)	4 (3.4)	0.554
Hypercholesterolemia	27 (12)	2 (10)	21 (18)	0.267
Current smoker	37 (16)	5 (25)	15 (13)	0.349
Restrictive pulmonary disease	28 (13)	1 (5.0)	6 (5.1)	**0.026**
Obstructive pulmonary disease	25 (11)	1 (5.0)	9 (7.7)	0.375
Cardiac disease	16 (7.0)	2 (10)	15 (13)	0.208
Digestive disease	22 (9.7)	2 (10)	9 (7.7)	0.820
Urological disease	14 (6.2)	0	12 (10)	0.569
Involuntary movement disorder	14 (6.2)	0	14 (12)	0.067
History of cerebral ischemia	10 (4.4)	1 (5.0)	6 (5.1)	0.953
History of cancer	8 (3.5)	1 (5.0)	7 (6.0)	0.709
Steroid use	11 (4.8)	0	4 (3.4)	0.520
ASA physical status				0.891
Class 1	57 (25)	5 (25)	27 (23)	
Class 2	162 (71)	15 (75)	87 (74)	
Class 3	8 (3.5)	0	3 (2.6)	

Bold type indicates statistical significance.
ASA = American Society of Anesthesiologists, BMI = body mass index, Hb = hemoglobin, mRS = modified Rankin Scale, OLF = ossified ligamentum flavum, OPLL = ossified posterior longitudinal ligament, SD = standard deviation.

Table 2
Surgical procedure-related variables in 407 spinal surgeries for spinal stenosis

Factor	Spinal level			p value
	Cervical	Thoracic	Lumbar	
Surgeries, n	236	28	143	
Surgical procedures				**<0.001**
Laminoplasty	160 (68)	0	0	
Laminectomy	36 (15)	23 (82)	91 (64)	
Posterior discectomy	0	0	30 (21)	
Posterior decompression and fusion	12 (5.1)	4 (14)	11 (7.7)	
Anterior decompression and autograft fusion	24 (10)	0	0	
Posterior foraminotomy	1 (0.4)	0	10 (7.0)	
Others	3 (1.3)	1 (3.6)	1 (0.7)	
Repeat surgery at the same/adjacent level(s)	7 (3.0)	5 (18)	13 (9.1)	**0.002**
Repeat surgery at remote level(s)	2 (0.8)	3 (11)	12 (8.4)	**<0.001**
Posterior approach	212 (90)	28 (100)	143 (100)	**<0.001**
Mean no. of laminae (vertebrae) treated ± SD	3.0 ± 1.0	2.4 ± 0.8	2.0 ± 0.8	**<0.001**
Operated by a trainee (resident, fellow)	138 (59)	7 (25)	68 (48)	**0.001**
Mean total op time ± SD (minutes)	265 ± 112	319 ± 168	263 ± 107	0.053
Op blood loss (ml)				0.106
1–399	214 (91)	22 (79)	122 (85)	
400–799	16 (6.8)	3 (11)	16 (11)	
800+	6 (2.5)	3 (11)	5 (3.5)	
Instrumentation use	12 (5.1)	4 (14)	11 (7.7)	0.148

Bold indicates statistical significance.
no. = number, op = operative, SD = standard deviation.

3. Results

3.1. Patient and surgeon factors

A total of 364 patients were identified (Table 1), of whom 227 underwent cervical, 20 underwent thoracic, and 117 underwent lumbar decompression. The most common diagnosis differed among the three groups: OLF was the most common diagnosis in the thoracic group (85% of patients with thoracic stenosis), whereas spinal degenerative stenosis and disc herniation were the two most common diagnoses in the cervical (67% and 11%, respectively) and lumbar groups (54% and 21%, respectively). A total of 407 surgeries, including 43 repeat surgeries, were performed on 364 patients (Table 2). Of the 407 surgeries performed, 236 were cervical, 28 thoracic, and 143 were lumbar surgeries. The surgical procedures performed differed among the three groups. Laminoplasty was the most common procedure in the cervical group (68% of cervical surgeries), whereas laminectomy alone was the most common in the thoracic (82%) and lumbar groups (64%). Most thoracic lesions (75%) were operated on by board-certified neurosurgeons who had 13–28 years of experience as the first operator, because most of these lesions had critical spinal cord compression. Of the repeat surgeries at the same or adjacent level(s) of index surgery, recurrent thoracic OLF was the most common, followed by recurrent lumbar stenosis. Of the repeat surgeries at remote level(s) of index surgery, lumbar decompression after cervical decompression was the most common.

3.2. Surgical outcomes

During the median 24 months follow-up (range 1–77 months), the rate of independent status significantly increased after surgery regardless of the level of the spinal lesions (Fig. 1). An independent neurological status (modified Rankin Scale score <3) was observed