Eur Spine J (2012) 21:825–828
DOI 10.1007/s00586-011-2101-2

EUROSPINE FULL PAPER AWARD 2011

Dural lesions in decompression for lumbar spinal stenosis: incidence, risk factors and effect on outcome

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Received: 2 November 2011 / Accepted: 27 November 2011 / Published online: 7 December 2011

Abstract
Introduction Decompression for lumbar spinal stenosis is one of the most frequent operations on the spine today. The most common complication seems to be a peroperative dural lesion. There are few prospective studies on this complication regarding incidence and effect on long-term outcome; this is the background for the current study.
Materials and methods Swespine, the Swedish Spine Register documents the majority (>80%) of lumbar spine operations in Sweden today. Within the framework of this register, totally 3,699 operations for spinal stenosis during a 5-year period were studied regarding complications and 1-year postoperative outcome. Mean patient age was 66 (37–92) years and 44% were males. Fourteen percent were smokers and 19% had undergone previous lumbar spine surgery.
Results The overall incidence of a peroperative dural lesion was 7.4%, 8.5% of patients undergoing decompressive surgery only and 5.5% of patients undergoing decompressive surgery + fusion ($p < 0.001$). A logistic regression analysis demonstrated that (high) age ($p < 0.0004$), previous surgery ($p < 0.036$) and smoking ($p < 0.049$) were significantly predictive factors for dural lesions. An odds ratio estimate demonstrated an age-related risk increase with 2.7% per year. The risk for dural lesions also increased with number of levels decompressed. The 1-year outcome was identical in the two groups with and without a dural lesion.
Conclusion A dural lesion was seen in 7.4% of decompressive operations for spinal stenosis. High age, previous surgery and smoking were risk factors for sustaining a lesion, which, however, did not affect the 1-year outcome negatively.

Keywords Spinal stenosis · Complication · Surgery · Outcome

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Introduction

Decompressive procedures for lumbar spinal stenosis are by far the most common operations on the spine in elderly patients, and, seem to be gradually overtaking the overall dominant role of disc herniation surgery. It should be regarded as the golden standard for surgical treatment of spinal stenosis today and improves pain, walking ability and spine-related disability (ODI) on a group level, although patient satisfaction seems to be achieved only in between 65 and 80% of the cases [1, 18], and the results seem to deteriorate with time [9]. Whereas complications in the form of infection and nerve/cauda equina injury seem to be infrequent, a non-negligible incidence of dural lesions in this type of surgery seems unavoidable. Incidence figures on dural lesions in spinal stenosis surgery in the literature mainly refer to retrospective studies of the complication with the drawbacks of retrospectivity hampering the studies. In the large prospective SPORT study an incidence of 5% is presented [21]. Whether or not a dural lesion peroperatively is a predictor of inferior outcome of surgery is also subject to some controversy [3, 6, 19].

A prospective study such as Swespine, the Swedish Spine Register, has the potential of a large patient material and prospectivity, thereby improving the data on incidence, risk factors and outcome. Swespine documents more than 80% of degenerative lumbar spine surgery in Sweden since 10 years and also includes complication registration.

The purpose of the study presented, thus, was to elucidate the incidence of dural lesions in decompressive surgery for lumbar spinal stenosis and to identify risk factors and effect on postoperative outcome of surgery.

Patients and methods

During the study period 3,699 patients were operated on with decompression for lumbar spinal stenosis. Only patients operated on for central stenosis with or without root canal stenosis were included, isolated lateral spinal stenosis was not included. Decompressive surgery as the only procedure was performed in 2,764 patients (74%) and the remaining 935 also had a concomitant fusion performed at the time of decompressive surgery (26%). Fourteen percent of the patients were smokers and 19% had undergone previous lumbar spine surgery. One-year follow-up was completed by 2,875 of the patients (78%).

Swespine, the Swedish Spine Register has been presented elsewhere [14, 15] and contains patient-based pre- and postoperative data and surgeon-based surgical data including complications such as dural lesions.

Among baseline data, age, sex, smoking habits, working conditions, consumption of analgesics, walking distance, back and leg pain are included on the VAS scale and the Oswestry Disablity Index, the SF-36 and the EQ-5D questionnaires. These data are completed by the patients preoperatively and at postoperative intervals. Postoperatively also global satisfaction with outcome as well as improvement of leg and back pain is graded. As a control, patient-reported complications are also included.

Statistical analysis

All data were entered into the SAS statistical program (version 9.2). Logistics regression was used to estimate odds ratio and its 95% confidence interval and *p* value. For outcome comparisons the Student's *t* test was used.

Results

The patients operated on for spinal stenosis had a high level of pain, low quality of life and low function as measured by walking distance, factors which were all reversed after surgery (Table 1).

The overall incidence of a peroperative dural lesion was 7.5%. Patients undergoing decompressive surgery only had an incidence of 8.5% as compared to 5.5% for patients undergoing decompressive surgery + fusion ($p < 0.001$). The logistic regression analysis (Table 2) demonstrated high age, previous surgery and smoking to be risk factors for sustaining a dural lesion at surgery. At incremental age,

Table 1 Patient-based estimation of pain, walking distance, consumption of analgesics and quality of life, reported prior to surgery and at one-year postoperatively

	Preoperatively	Postoperatively
Leg pain VAS	63	30
Back pain VAS	56	32
Walking distance <100 m (%)	43	18
Regular consumption of analgesics (%)	52	26
EQ-5D	0.35	0.63
SF-36		
Physical functioning	35	58
Role physical	11	44
Bodily pain	27	53
General health	57	59
Vitality	39	56
Social functioning	55	74
Role emotional	37	61
Mental health	64	72

Table 2 Logistic regression analysis of patient-related risk factors for dural lesion

Logistic regression	*p* value	Odds ratio	95% CI
Age	0.0004	1.027	1.012–1.043
Previous op	0.036	0.699	0.499–0.978
Smoking	0.049	0.696	0.485–0.999
Gender	0.33	1.013	0.652–1.157
Leg p duration	0.87	1.013	0.862–1.191
LBP duration	0.40	1.072	0.909–1.265
Walking ability	0.72	1.124	0.845–1.124
VAS Leg	0.95	1.000	0.993–1.006
VAS Back	0.25	0.996	0.990–1.003

Odds ratio with 95% confidence interval is given as well as the *p* value

Table 3 Age-related risk for dural lesion

	Odds ratio	*p* value
≤50	0.48	0.053
51–60	0.40	0.002
61–70	0.56	0.027
71–80	0.83	0.455

The figures given in the table relate the Odds ratio and the *p* value for each age group when compared with patients >80 years of age. The Odds ratio 0.40 means that patients aged 51–60 years have a 40% risk of that of patients aged over 80 years

Table 4 Incidence of dural lesion related to number of levels operated on (%)

	Percent
1 level	5.1
2 levels	7.7
3 levels	7.6
≥4 levels	11.5

a risk increase according to odds ratio calculation increased by 2.7% per year of life. For patients aged ≤70 years, the risk for sustaining a lesion was significantly lower than for the age group >80 years (Table 3). The risk for the younger patients was 40 (51–60 years) to 56 (61–70 years) percent of that of the oldest patient group (≥80 years).

The incidence of dural lesions increased with number of levels decompressed from 5.1% in one-level decompression to 11.5% when four or more levels were decompressed (Table 4).

At 1 year after surgery, a significant improvement of back and leg pain, EQ-5D and SF-36 scores was seen (Table 1). In no aspects of the patient-based outcome parameters was there any significant difference in outcome between patients with and without a dural lesion.

Lost to follow-up

For the 22% of patients who failed to complete the 1-year follow-up questionnaire, neither baseline data nor incidence of peroperative dural lesion differed from the studied group of 2,875 patients reported.

Discussion

It goes without saying that operations within the spinal canal may entail a risk to injure nerve structures and the dural sac. The improved information preoperatively on the contents of the spinal canal using MRI gives a good possibility to be prepared for where troubles may arise during surgery. For spinal stenosis, open, microscopic and also endoscopic techniques have been developed but only to a limited extent compared [17].

Operations for lumbar spine stenosis are the most common spine operations in the elderly but the trend of increasing surgery rates noted in Sweden [15] does not seem to be prevalent in the US [5]. Decompression is the golden standard when surgical treatment is indicated, at times supplemented with fusion, especially to be considered in spondylolisthesis. Fusion rates in conjunction with decompression seem to vary a lot over the world and also seem to be afflicted with higher complication rates [4].

Complication rates in general and dural lesions in particular have been to some extent sparsely documented in the literature and the complication rates reported probably are minimum figures. A minor dural lesion noted during surgery, adequately sutured and treated with a day of bed rest postoperatively is no major issue but in the other end of the spectrum complication problems such as dural fistulas and cysts, meningitis, arachoiditis and epidural abscesses can occur. In addition to direct closure by sutures, also fascial, muscular and artificial grafts exist, further fibrin glue, and, another possibility, sub arachnoid drainage also may be utilized [10]. Some conflict regarding the long-term outcome after dural lesion exists [11, 12].

Incidence figures for dural lesions in disc surgeries seem to be in the region of 2–6% [13, 16, 20] with previous surgery being a strong predictor of the complication. In spinal stenosis surgery higher figures should be expected to be encountered due to the wider exposure of the dural sac and to the difficulties created by ligamentous hypertrophy and osteophytes on the facet joints in decompression especially afflicting the nerve roots but also the central cauda. Most previous studies on dural lesions refer to spinal surgery in general [6, 8, 12, 19] but a large series from the Scoliosis Research Society [7] demonstrated an incidence of dural lesions of 3% but in this study patients previously operated on in the lumbar spine were excluded. Incidence figures reported must be regarded as minimum figures but most likely are more correct in prospective than in retrospective studies.

The fact that high age and smoking are risk factors for dural injury may indicate that the strength and elasticity of the dural sac becomes reduced with increasing age and by smoking.

In stenosis surgery previous surgery seems to be a risk factor for dural lesion and with an increasing number of procedures performed yearly, an increasing number of dural lesions has to be anticipated in the future. Our study strongly suggests that the long-term results of decompression in patients sustaining dural lesion are not inferior to those without a peroperative dural lesion which means that basically a dural lesion is a problem that has to be solved at time of surgery and if this is adequately carried out the patient will do as well as a patient without this complication.

The finding in our study of dural lesions being less frequent in patients treated with concomitant fusion seems to relate to the fact that this patient group is somewhat younger and is operated on fewer levels. High age, smoking and previous surgery all were identified as risk factors for sustaining a peroperative lesion. It seems mandatory that decompressive surgery for spinal stenosis is performed under the best circumstances with good light sources, loupe magnification or microscopic visualization of the operating field. Further, a surgeon prepared with maximum study of the preoperative MRI or CT images is probably less prone to run into trouble during surgery.

The after-treatment when the dural lesion has occurred is usually arbitrarily defined as 1 day of bed rest before mobilization. The rather slow healing of dural repair in a canine model presented by Cain et al. [2] may be interpreted as requiring longer bed rest than 24 h but from a clinical perspective normally this time period seems enough.

In conclusion, spinal stenosis surgery when studied in a large patient material from Swespine, the Swedish Spine Register, demonstrated an incidence of dural lesions during surgery of 7.4%, somewhat less frequent when decompression was combined with fusion. Risk factors for sustaining a lesion using a logistic regression model were high age, previous surgery and smoking. The incidence also increased with number of levels decompressed from 5.1% in one-level decompression to 11.5% when four or more levels were decompressed. The 1-year outcome was not affected negatively in the patient group who sustained a peroperative lesion.

Acknowledgments The authors highly appreciate statistical help and advice given by Caddie Zhou at the National Centre for Quality Registers, Lund Sweden. The economical funding by the Swedish Association of Local Authorities and Regions (SALAR) is also acknowledged.

Conflict of interest None.

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