Clinical Neurology and Neurosurgery 139 (2015) 319–323

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Predictors of surgical outcome in ossification of the posterior longitudinal ligament

Jiaao Gu [a], Fulin Guan [a], Lin Zhu [b], Guofa Guan [a], Zhiyong Chi [a], Zhange Yu [a,*], Song Li [a,**]

[a] The 1st Affiliated Hospital of Harbin Medical University, China
[b] Department of Epidemiology of Harbin Medical University, China

ARTICLE INFO

Article history:
Received 27 May 2015
Received in revised form 21 October 2015
Accepted 22 October 2015
Available online 1 November 2015

Keywords:
Predictors
Ossification of posterior longitudinal ligament
Surgical outcome

ABSTRACT

Study design: A retrospective study.
Objective: To clarify the predictors of the operation results for ossification of the posterior longitudinal ligament (OPLL).
Summary of background data: Detailed analyses of surgical outcomes of OPLL have been rare because most survey aimed to investigate cervical spondylotic myelopathy.
Methods: All patients who underwent cervical operation for OPLL between January 2011 and December 2011 were included in this analysis. We investigated the patients' characteristics and surgical approaches, and compared the radiographical characteristics of OPLL.
Results: The mean mJOA score improved from 8.312 ± 3.021 points preoperatively to 11.24 ± 3.43 points at 24 months after operation ($P < 0.001$). The average change in mJOA score was significantly greater in patients with a higher Nirik score than in those with lower Nirik scores ($P < 0.0001$). The average change in mJOA score was also significantly different in patients with trauma history ($P < 0.0001$). The average recovery ratio was 42 ± 26.3% in young patients and 30 ± 31.6% in the group older than 50 years ($P = 0.012$). The average recovery ratio in patients with acute and chronic symptoms was 48 ± 22.9% and 26 ± 33.9%, respectively. There was great difference between the two groups.
Conclusion: OPLL patients with myelopathy would receive good result after the operation. Age and symptom duration are related to the surgical outcomes. Patients with lower Nirick grade and without trauma history would receive better results before and after the operation.

Ossification of the posterior longitudinal ligament (OPLL) is a hyperostotic condition of the spine with severe neurologic deficit [1,2]. This disease was first reported about 160 years ago [3]. OPLL has been recognized as a common cause of cervical myelopathy, especially in Asia. Mechanism of OPLL has not been elucidated clearly. Surgical decompression is usually necessary for the patients with neurological symptoms. Surgical strategies for OPLL can be divided into two approaches: anterior and posterior. Cervical laminoplasty is a procedure designed to decompress the spinal cord by enlarging the spinal canal while preserving the lamina. Since the invention of cervical laminoplasty in Japan, its use had spread throughout the world and had gained increasing usage among spine surgeons. Anterior decompression and resection of OPLL seems also to be a surgical option, because the spinal cord is compressed from the anterior direction.

The optimal treatment strategy of OPLL is depended on both progression and stage of disease [4]. Previous research has identified a variety of potential prognostic indicators that may affect outcomes after the operation of cervical spondylotic myelopathy (CSM), such as increased age, prolonged duration of symptoms, presence of intramedullary signal changes and decreased somatosensory-evoked potentials [5–7]. Nevertheless, current literature is incomplete on patients suffered from OPLL. We aimed to evaluate that whether these factors, some preoperative symptoms and OPLL severity, as graded according to the Nurick classification [8], would be correlated with the surgical outcome. We conducted a retrospective study of these patients who underwent anterior decompression and resection or/and cervical laminoplasty for the treatment of OPLL with a 2-year follow-up.

* Corresponding author at: The 1st Affiliated Hospital of Harbin Medical University, No. 23 Youzheng Street, Nangang District, Harbin, Heilongjaing Province, China.
** Common corresponding author at: The 1st Affiliated Hospital of Harbin Medical University, No. 23 Youzheng Street, Nangang District, Harbin, Heilongjaing Province, China.
E-mail addresses: haerbinmed@aliyun.com (Z. Yu), 297164378@qq.com (S. Li).

http://dx.doi.org/10.1016/j.clineuro.2015.10.031
0303-8467/

1. Materials and methods

This study was approved by the Institutional Review Broad of Harbin Medical University, Heilongjiang, China. Between January 2011 and December 2011, a total of 130 patients underwent operation for cervical OPLL by two senior surgeons (ZG.Y and GF.G) in our department. The diagnosis of OPLL was confirmed by X-ray photographs and computer tomography (CT), showing significant ossification behind posterior border of vertebral body. The cases, in which ossification lesion located on intervertebral levels, were not included in this study. The cases which were difficult to be distinguished from osteophytes were also excluded from the study. The two senior surgeons decided anterior or/and posterior approach for the treatment of OPLL. Trauma is also included in this study. In addition, the exclusion criteria in this study included neoplasm, infection, congenital deformations and chronic system illness such as rheumatoid arthritis and neurodegenerative diseases. Particular attention was paid to information regarding pre-operative OPLL severity, as graded according to the Nurick classification, pre-operative duration of myelopathic symptoms, type of surgery, and surgically addressed levels. Pre-operative and post-operative Nurick grades were recorded for each patient. Pre-operative Nurick grades were defined as a grade before surgery but not specifically at initial presentation. Post-operative Nurick grades were recorded clinically at the last follow-up. All pre- and post-operative Japanese Orthopedic Association (JOA) scores were determined by both the treating spinal surgeons and an attending neurologist. There were 2 patients with pre-operative Nurick grade 0, as no patient without evidence of myelopathy was included.

In general, anterior decompressive surgery was performed more frequently in patients with focal pathology (one, two or three levels) and transverse area (TA) < 45 mm^2. In contrast, posterior cervical decompression and fusion was performed more frequently in patients with multilevel pathology and TA > 45 mm^2. If the OPLL involves one level, we conducted ACDF with plate fixation. If the OPLL involves two levels, we conducted corpectomy with plate fixation. If the OPLL involves three levels, we combined ACDF and corpectomy with plate fixation. If the OPLL involves four levels, we conducted subtotal multivertebrectomy.

All patients were clinical and radiographically evaluated before surgery. Clinical evaluation consisted of medical history and physical examination. The clinical results were assessed with the JOA scoring system for OPLL. Standard anterior–posterior and lateral X-rays in a standing position, computed tomography (CT) and magnetic resonance imaging (MRI) of the cervical spine were conducted as preoperative radiological evaluation. A radiologist (L.S.), blinded to the patients' clinical and neurological status, analyzed all magnetic resonance (MR) images using TA of the spinal cord at the site of maximal compression. Double-layer sign characterized by anterior and posterior rims of hyperdense ossification separated by a central hypodense was investigated to indicate dural ossification (DO). MRI showed compression of the spinal cord and presence of high intensity zone (HIZ) in the spinal cord.

2. Result

There were 62 men and 68 women; mean age was 57 years (range: 32–86 years). Table 1 presents demographic and diagnostic characteristics of patients. The mean mJOA score improved from 8.312 ± 3.021 points preoperatively to 11.24 ± 3.43 points at 24 months after operation ($P < 0.001$). The anterior approach (ACDF/corpectomy with instrumented fusion) for decompressive spinal surgery was performed in 64 patients, posterior approach (either laminectomy and fusion or laminoplasty) was performed in 62 patients, and combination of both anterior and posterior approaches was performed in 4 patients. The patients whose symptoms were not relieved well or even deteriorated also received adequate cord decompression as confirmed by MRI. None of them required revision surgery for inadequate cord decompression. The type of surgical procedure was not associated with mJOA scores ($P = 0.130$).

Table 1
Characteristics of patients with OPLL in this series.

Characteristics	*n*
Age (mean age ± SD)	51.32 ± 8.28
Symptom duration (mean days ± SD)	568.83 ± 734.32
Gender	
Male	62 (47.7%)
Female	68 (52.3%)
OPLL lesion	
1	24 (18.5%)
2	32 (24.6%)
3	30 (23.1%)
4	32 (24.6%)
5 + 7	12 (9.2%)
HIZ	
No	76 (58.5%)
Yes	54 (41.5%)
OPLL type	
Continuous	52 (40%)
Segment	78 (60%)
Trauma history	
No	112 (86.2%)
Yes	18 (13.8%)
Surgical approach	
Anterior	64 (49.2%)
Posterior	62 (47.7%)
Combine	4 (3.1%)
TA	
>45 m^2	64 (49.2%)
<45 m^2	66 (50.8%)
JOA score	
Preoperation	8.312 ± 3.021
Postoperation	11.24 ± 3.43

Postoperative complications related specifically to cervical spine surgery occurred in 7 (5.4%) of the 130 patients – 3 patients had hoarseness of voice which resolved at 8 months after operation and 3 patient had cerebrospinal fluid leak after anterior cervical surgery which resolved. 11 patients (8.5%) showed neurological deterioration at 12-month follow-up. 2 patients died within the first 24 h after the operation and 4 patients died in 2 years after surgery.

3. Correlation of baseline mJOA with patients' demographics and MRI

The mean preoperative mJOA score was 7.9 ± 2.88 in young patients and 8.71 ± 3.11 in the group older than 50 years ($P = 0.241$). The mean preoperative mJOA score was 8.02 ± 3.08 in patients with more acute symptoms (<12 months of symptom duration) and 8.64 ± 2.97 in patients with more chronic symptoms (longer than 12 months of symptom duration). The preoperative mJOA score was similar in patients with more chronic symptoms and in the acute group ($P = 0.409$). The mean preoperative mJOA score was 10.50 ± 1.76 in patients with Nurick1 and 2, 8.620 ± 2.02 in the patients with Nurick 3 and 5.28 ± 2.57 in patients with Nurick 4 and 5 ($P < 0.001$). This means that patients with lower Nurick grade have a better symptom compared with patients with higher Nurick grade. The mean preoperative mJOA score was 8.93 ± 2.51 in patients without trauma history and 4.51 ± 3.25 in the patients with trauma history ($P < 0.001$), which indicate that patients with trauma history often have a more severe symptom. The preoperative mJOA score was significant lower in patients with continuous OPLL lesion and in the segmental OPLL lesion group ($P < 0.001$).