Medical Journal of the
Islamic Republic of Iran

Volume 18
Number 4
Winter 1383
February 2005

CERVICAL SPONDYLOTIC MYELOPATHY: THE PATTERN OF NEUROLOGIC DEFICITS AND IMPROVEMENT FOLLOWING ANTERIOR

K. HADDADIAN, M.D., O. REZAEE, M.D., S. SADEGHI, M.D., A. MODARRES ZAMANI, M.D., G. SHARIFI, M.D., AND A. ALI ASGARI, M.D.

From Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

ABSTRACT

We evaluated the specific pattern of pre- and postoperative neurological signs and symptoms of cervical spondylotic myelopathy (CSM) to determine findings which had a predictive value for surgical outcome. Consecutive patients with CSM caused by osteophytic ridge or intervertebral disc herniation who underwent anterior cervical decompression and fusion in Loghman Hakim Hospital from 1999-2003 were prospectively enrolled. Patients were evaluated postoperatively by office visit. Outcome was assessed by objective neurological examination and scoring with multiple functional rating scales. Forty - three patients (30 male, 13 female) with a mean age of 48.8 years fulfilled our inclusion criteria. The most common preoperative symptoms were sensory deficit in distal upper limbs (88.4%), gait disturbance (69.8%) and sensory deficit of distal lower limbs (58.1%). The most common signs were hyperreflexia (95.3%), Hoffman's sign (93%) and Babinski's sign (83.7%). Vertebral osteophyte and soft disc herniation were found in 86% and 14% of the patients, respectively. Overall functional improvement, evaluated by using a modification of the Japanese Orthopedic Association Scale was noted in 79.7% of the patients who had an abnormal scale preoperatively. Strength improved considerably and significantly after operation. However, less than half of the patients experienced functional improvement in the lower limbs, a discrepancy that was probably caused by persistent spasticity. Atrophy of the hand muscles, preoperative spastic gait and cord atrophy as shown in MRI were poor prognostic factors.

MJIRI, Vol. 18, No. 4, 331-335, 2005.

Keywords: Cervical Spondylosis; Myelopathy; Anterior Cervical Decompression.

INTRODUCTION

The pathogenesis of cervical spondylotic myelopathy (CSM) was first described by Brain et al. in 1952[1] and then by others.[2,3] Shortly thereafter, spinal decompression for the treatment of CSM was established by Smith[4] and Cloward,[5] and it has been used extensively so far. Determination of the efficacy of anterior decompression methods in improving neurologic deficits, and the exact pattern of these deficits and clinical improvement of the patient after the operation is difficult, as repeated in different studies. The limitations of previous studies were inadequate samples, which made statistical analysis dif-

Corresponding author: Guive Sharifi, M.D., Department of Neurosurgery, Loghman-Hakim Medical Center, Kamali Ave., Tehran/ Iran. Tel: +98-21-5414065;+98-21-5419005-9, Fax: +98-21-5414065. E-mail: guivesharifi@hotmail.com

ficult,[6,7,8] indetermination of surgical indications and analyzing a heterogeneous group of patients with different symptoms such as neck pain, radiculopathy and myelopathy.[9] Although some of the authors reported improving neurologic function in many of their patients, others presented reports of worsening functions or unchanged conditions.[7,10-12] Still others were in doubt about the efficacy of surgery in changing the clinical course of CSM.[13,11,14-16,33] We decided to analyze a group of patients undergoing anterior cervical decompression concerning improvement of neurologic deficits and the pattern of this improvement after operation.

MATERIAL AND METHODS

CSM was defined as progressive gait disorders and paresis or sensory problems in upper extremities and imaging results of compressive effects of bony osteophyte or soft disc on the anterior cord area and cord deformity.

Consecutive patients with CSM caused by osteophytic ridge or intervertebral disc herniation who underwent anterior cervical decompression and fusion in Loghman Hakim hospital from 1999-2003 were prospectively enrolled. Patients who underwent anterior operation for instability or surgery for neurologic deficit following trauma, those with primary or metastatic bony neoplasms or infectious processes, those with ossification of the posterior longitudinal ligament and those with radiculopathy without myelopathy were excluded from the study.

Histories of upper and lower extremity sensory complaints, gait disorders, sphincter disorders and in males, sexual disorders were recorded in standard questionnaires.

Bedside routine and complete neurologic examinations were performed for all patients. We evaluated the patients' functions according to Coopers & Epstein scale (Table I).[17] The modified scale of the Japanese Orthopedic Association (mJOA) was used for qualitative evaluation of the patients' function (Table II).[18]

Imaging procedures including plain spinal X-ray and cervical MRI were performed for all patients. CT-myelography or CT-scan was used mostly for evaluating vertebral osteophytes. The major pathology of CSM was categorized into soft disc herniation or vertebral osteophytes.

Patients were intubated with minimal extension of the neck according to the pathology. Soft tissues of the neck were dissected using an approach that has been well described.[15] Bone removal was performed using a fine curette and high speed air drill and operative microscope. The amount of bone removal was determined by specific anatomy of the compression. Autograft of iliac crest was used for interbody fusion in all patients. All patients used a rigid cervical collar for 8-12 weeks postoperatively.

Table I. Cooper scales for grading upper and lower extremity function.

Lower extremity function
Grade 0: Intact
Grade 1: Walk independently but not normally
Grade 2: Walk but need cane or walker
Grade 3: Stands but cannot walk
Grade 4: Slight movement but cannot walk or stand
Grade 5: Paralysis
Upper extremity function
Grade 0: Intact
Grade 1: Sensory symptoms only
Grade 2: Mild motor deficit with some functional impairment
Grade 3: Major functional impairment in at least one upper extremity but upper extremities useful for simple tasks
Grade 4: No movement or flicker of movement in upper extremities; no useful function

During the follow-up period, patients were visited 3 and 6 months after the operation. During each visit precise history and physical examination were done. The fusion rate was determined using plain spinal X-ray. Final muscle function was recorded during the last follow-up visit and patient function was evaluated postoperatively using Cooper and mJOA scale.

Muscle function and muscle strength in upper and lower extremities was compared before and after the operation. Improvement was defined as increase of one or more in muscle strength grade.

Quantitative data are presented with mean ± standard deviation. The Wilcoxon signed rank and McNemar tests were used to compare functional scores before and after surgical intervention. Statistical analysis was done using SPSS software.

RESULTS

Forty-three patients consisting of 30 males and 13 females with a mean age of 48.8 years were analyzed. The mean age of the men was 50.9 ± 13.2, and that of the women was 46.8 ± 11.8 (p=0.33). The major pathology in our patients was vertebral osteophytes (86%) and soft disc (14%). The frequency of discs as the major pathol-

Table II. Modified Japanese Orthopedic Association scale.

1. Motor dysfunction of the upper extremity
0: Unable to feed oneself
1: Unable to use knife and fork; able to eat with a spoon
2: Able to use fork and knife with much difficulty
3: Able to use fork and knife with slight difficulty
4: None
2. Motor dysfunction of the lower extremity
0: Unable to walk
1: Can walk on flat floor with walking aid
2: Can walk up and/or down stair with handrail
3: Lack of stability and smooth gait
4: None
3. Sensory deficit
0: Upper extremity, severe sensory loss or pain
1: Upper extremity, mild sensory loss
2: Upper extremity, none
0-2: Lower extremity
0-2: Trunk
4. Sphincter dysfunction
0: Unable to void
1: Marked difficulty in micturition (retention)
2: Difficulty in micturition
3: None

Table III. Frequency of sensory complaints, gait, sphincter and sexual disturbances in patients with cervical spondylotic myelopathy before and after anterior cervical decompression.

Variable	Pre-op		Post-op		Significance
	No.	%	No.	%	
UE sensory complaints	38	88.4	32	74.4	0.031
LE sensory complaints	25	59.1	17	39.5	0.008
Hand dysfunction	28	65.0	22	51.1	0.009
Gait disturbance	30	69.8	23	53.5	0.016
Sphincteric disturbance	5	11.6	4	9.0	NS
Sexual disturbance (male)	3	6.9	2	4.6	NS

UE: upper extremity; LE: lower extremity; NS: not significant

ogy for myelopathy was more in females compared to males (p= 0.004).

The mean interval from symptoms onset to hospital presentation was 10.78 ± 7.3 months.

A total of 53 levels were decompressed: 33 patients were decompressed in one level and in 10 cases 2 adjacent levels were decompressed. Cervical involvement was: C_5-C_6 in 19 cases, C_4-C_5 in 17 cases, C_6-C_7 in 5 cases and C_3-C_4 in 2 cases. Corpectomy was not performed for myelopathy in any patient.

The most common complaints were: sensory problems of the distal upper extremities in 38 cases (88.4%), gait disorder in 30 cases (69.8%) and sensory problems of distal lower extremities in 25 cases (58.1%). Sexual disorders were found in 6.9% of the males. Table III compares the frequency of sensory complaints, gait, sphincter and sexual disturbances before and after operation.

Muscle weakness was most frequently observed in intrinsic hand muscles and triceps (Table IV). From 83.7% of the patients with preoperative upper extremity motor impairment, 22.7% improved, which is statistically significant (p= 0.017). Signs of spasticity were not changed after surgery as shown in Table V.

Of 39 patients with preoperative upper limb functional impairments using Cooper's scale (Table VI), 20 improved, 15 remained unchanged and 4 became worse (p= 0.001). In lower limbs, of 31 with preoperative functional impairment 25 remained unchanged, 3 improved and 3 worsened, which is not significant (p= 0.14).

Using mJOA scale (Table VII), from 43 patients with preoperative abnormal scales, 35 improved (79.7%), 6 remained unchanged (13%) and 2 worsened (7%). The

Table IV. Frequency of preoperative muscle weakness in patients with cervical spondylotic myelopathy.

Location	Number	Percent
Upper proximal	33	76.7
Upper distal	37	83.7
Lower proximal	27	68.2
Lower distal	27	68.2

Table V. Frequency of signs of spasticity in patients with cervical spondylotic myelopathy before and after anterior cervical decompression.

Variable	Pre-op		Post-op		Significance
	No.	%	No.	%	
Hoffman sign	40	93.0	37	86.0	NS
Hyperreflexia	41	95.3	39	90.6	NS
Babinski	36	83.7	34	79.1	NS

Table VI. Cooper's scale in patients with cervical spondylotic myelopathy before and after anterior cervical decompression.

	Pre-op		Post-op	
Score	**No.**	**%**	**No.**	**%**
Upper limb				
0	4	9.3	8	18.6
1	1	2.3	9	20.9
2	31	72.1	25	58.1
3	7	16.2	1	2.3
4	0	0.0	0	0.0
Lower limb				
0	11	25.6	15	34.8
1	23	53.4	23	53.4
2	9	21.0	5	11.8
3	0	0.0	0	0.0
4	0	0.0	0	0.0
5	0	0.0	0	0.0

Table VII. The modified Japanese Orthopedic Association scale in patients with cervical spondylotic myelopathy before and after anterior cervical decompression*.

	Pre-op		Post-op	
Score	**No.**	**%**	**No.**	**%**
9	1	2.3	1	2.3
10	3	7.0	0	0.0
11	2	4.7	1	2.3
12	2	4.7	3	7.0
13	15	34.9	6	14.0
14	5	11.6	11	25.6
15	14	32.6	12	27.9
16	1	2.3	9	20.9
17	0	0.0	0	0.0

* The maximum score indicating normal function is 17.

mean mJOA score in all of the patients was 12.4 preoperatively and 14.9 postoperatively, (p<0.001). The Spearman's Rho non-parametric test showed that patients with a higher preoperative mJOA score had a greater degree of improvement in limb function (p<0.001, R=0.79).

In 33 (76.7%) cases, cord signal change in MRI was seen and 10 (23.3%) had cord atrophy (at involved level). Cord signal change in MRI was more common in men (p= 0.04). Patients with cord atrophy and signal change in MRI had a lower mean rank improvement in mJOA score postoperatively compared to the group without (p<0.001).

Graft collapse was seen in 4 cases, but graft dislodgement was not seen in any patient. Transient dysphagia was seen in 10 patients, which responded to a longer liquid diet. C5 root injury was seen in 2 cases; one improved by 3 months and the other remained permanently. CSF leak, Horner's syndrome or apparent recurrent laryngeal injury did not occur in any patient.

DISCUSSION

The primary symptoms of our patients were: gait disturbance, sensory and motor complaints of the upper limbs. Upper limb symptoms were hand paresthesia, which manifested simultaneously with gait disturbance. Although sensory and motor complaints of upper limbs may not be present very early in the beginning of CSM, their absence is unusual in those with severe gait disturbance and other causes of myelopathy might be ruled out.[19] Brain et al,[1] and Nurick[15] noted that neurologic manifestations of CSM trend toward stability, but this was not the case in our patients. Actually we had episodic worsening of neurologic deficits with intervals of neurologic stability, sensory symptoms started from the tip of the fingers, often limited to the hands and did not have a radicular pattern. In addition, hand paresis was frequent; however, we had only two cases of spondylosis in C_7-T_1 level. In an electromyographic study, Stark[20] noticed that muscle dysfunction of the groups innervated by C_8 is because of anterior horn cell loss and not root compression. Taylor and Byrnes[21] proposed that the reason for anterior horn cell loss is cord venous congestion secondary to spondylosis. Although gait disturbance was a common symptom in our patients (69.8%), fewer than 17% had postoperative improvements; the retained postoperative spasticity might explain this finding, rather than lower limb muscle weakness.

Preoperative neurological status was the most important predictor of surgical outcome.

Furthermore, it was shown that postoperative improvement was more pronounced in those patients in which decompression was performed in one level.

Hand muscle atrophy and cord atrophy (as shown in MRI) were important variables in predicting the outcome of the disease. Finally preoperative spastic gait was found to be a predictor of poor outcome.

Anterior cervical decompression for CSM is a promising procedure for these patients. Upper and lower extremities' sensory complaints, gait and hand dysfunction improve greatly after the procedure; however, sphincteric and sexual disturbances do not change signifi-

cantly. Earlier consideration of surgery in these patients might improve the surgical outcome noticeably.

REFERENCES

1. Brain WR, Northfield WD, Wilkinson M: The neurologic manifestations of cervical spondylosis. Brain 75: 187-225, 1952.
2. Adams CBT, Logue V: Studies in cervical spondylotic myelopathy: I-Movement of the cervical roots, dura and cord, and their relation to the course of the extrathecal root. Brain 94:557-568, 1971.
3. Adams CBT, Logue V: Studies in cervical spondylotic myelopathy: II-The movement and contour of the spine in relation to the neural complication of cervical spondylosis. Brain 94:569-586, 1971.
4. Smith GW, Robinson RA: The treatment of certain cervical spine disorders by anterior removal of the intervertebral disc and anterior fusion. J Bone Joint Surg Am 40A:607-624, 1958.
5. Cloward RB: The anterior approach for removal of ruptured cervical discs. J Neurosurg 15:602-617, 1958.
6. Banerji D, Acharya R, Behari S, Chhabra DK, Jain VK: Corpectomy for multi-level cervical spondylosis and ossification of the posterior longitudinal ligament. Neurosurg Rev 20:25-31, 1997.
7. Lesoin F, Bouasakao N, Clarisse J, Rousseaux M, Jomin M: Results of surgical treatment of radiculomyelopathy caused by cervical arthrosis based on 1000 operations. Surg Neurol 23:350-355, 1985.
8. Mosdal C: Cervical osteochondrosis and disc herniation. Eighteen years use of interbody fusion by Clowards technique in 755 cases. Acta Neurochir (Wien) 70:207-225, 1984.
9. Guidetti B, Fortuna A: Long term results of surgical treatment of myelopathy due to cervical spondylosis. J Neurosurg 30:714-721, 1969.
10. Galera R, Tovi D: Anterior disc excision with interbody fusion in cervical spondylotic myelopathy and rhizopathy. J Neurosurg 28:305-310,1968.
11. Lunsford LD, Bissonette DJ, Zorub DS: Anterior surgery for cervical disc disease: Part 2-Treatment of cervical spondylotic myelopathy in 32 cases. J Neurosurg 53:12-19, 1980.
12. Wohlert L, Buhl M, Eriksen EF, Fode K, Klaerke A, Kroyer L, Lindeberg H, Madsen CB, Strange P, Espersen JO: Treatment of cervical disc disease using Cloward's technique: Evaluation of cervical spondylotic myelopathy in 138 cases. Acta Neurochir (Wien)71:121-131,1984.
13. Lees F, Turner JW: Natural history and prognosis of cervical spondylosis. Br Med J 2:1607-1610, 1963.
14. Nurick S: The pathogenesis of the spinal cord disorder associated with cervical spondylosis. Brain 95:87-100, 1972.
15. Nurick S: The natural history and the results of surgical treatment of the spinal cord disorder associated with cervical spondylosis. Brain 95(1):101-8, 1972.
16. Rowland LP: Surgical treatment of cervical spondylotic myelopathy: Time for a controlled trial. Neurology 42:5-13, 1992.
17. Cooper PR, Epstein F: Radical resection of intramedullary spinal cord tumors in adults. Recent experience in 29 patients. J Neurosurg 63:492-499, 1985.
18. Chiles BW 3rd, Leonard MA, Choudhri HF, Cooper PR: Cervical spondylotic myelopathy: patterns of neurological deficit and recovery after anterior cervical decompression. Neurosurgery 44(4):762-9, 1999.
19. Lee TT, Manzano GR, Green BA: Modified open-door expansive laminoplasty for spondylotic myelopathy; Operative technique, outcome, and predictors for gait improvement. J Neurosurg 86:64-68,1997.
20. Stark RJ, Kennard C, Swash M: Hand wasting in spondylotic high cord compression: An electromyographic study. Ann Neurol 9:58-62, 1981.
21. Taylor AR, Byrnes DP: Foramen magnum and cervical cord compression. Brain 97:473-480, 1974.