ORIGINAL ARTICLE

Prognostication in cervical spondylotic myelopathy: Proposal for a new simple practical scoring system

Vengalathur Ganesan Ramesh[1,2], Manianandan Ganapathi Vel Kannan[1], Kuchalmbal Sriram[1], Chandramouli Balasubramanian[2]

[1]Department of Neurosurgery, Institute of Neurology, Madras Medical College and Government General Hospital, [2]Chettinad Superspeciality Hospital, Chettinad Health City, Kelambakkam, Chennai, Tamil Nadu, India

ABSTRACT

Context: The ability to preoperatively predict the outcome in cervical spondylotic myelopathy (CSM) helps in planning management and counseling the patient and family.

Aims: A simple prognostic scale, namely, the Madras Institute of Neurology Prognostic Scale (MINPS) for CSM has been proposed.

Settings and Design: Six well-known prognostic factors, namely, age, duration of symptoms, neurological disability (Nurick's grade), number of levels of compression, effective canal diameter, and intrinsic cord changes, have been taken into account. Each factor has been divided into three subgroups and allotted a score. The total score in this scale ranges from a maximum of 18 to a minimum of 6.

Materials and Methods: This scale has been evaluated in a group of 85 patients operated for CSM.

Statistical Analysis Used: The usefulness of MINPS was statistically assessed using ANOVA test.

Results: It has been found that majority of patients with a score of 14 or more improved; those with a score of 9 or less deteriorated; those with a score between 10 and 13 remained static.

Conclusions: The MINPS for CSM is a very practical scale which can be applied easily with the available clinical and radiological data, with good accuracy of outcome prediction. This is the first scale of its kind.

Key words: Cervical spondylotic myelopathy, prognostic scale for cervical spondylotic myelopathy, prognostic scales

Introduction

Cervical spondylosis is a common problem affecting the elderly population. It occurs in about 90% of men above 50 years and women above 60 years.[1] Myelopathy is a serious sequelae of spondylosis, occurring in about 5-10% of these patients.[2] Majority require surgical management.

The outcome following surgery is variable.[3-7] The ability to predict the outcome preoperatively will help the surgeon to identify patients with good outcome and also to plan proper rehabilitation for poor outcome groups. It also helps in counseling the patient and his family and to prepare them better for postoperative rehabilitation. The prognostic factors for cervical spondylotic myelopathy (CSM) have been extensively evaluated.[8-15] At present, a few scoring systems are available only for assessing the functional grade of patients with CSM.[16-18] But there is no comprehensive scoring system available to predict the prognosis. Hence, a new prognostic scale, the Madras Institute of Neurology Prognostic scale (MINPS) for CSM, has been proposed.

Access this article online	
Quick Response Code:	Website: www.asianjns.org
	DOI: 10.4103/1793-5482.146391

Address for correspondence:
Prof. Vengalathur Ganesan Ramesh, Department of Neurosurgery, Chettinad Superspeciality Hospital, Chettinad Health City, Kelambakkam, Chennai - 603 103, Tamil Nadu, India.
E-mail: drvgramesh@hotmail.com

Materials and Methods

The Madras Institute of Neurology Prognostic Scale for cervical spondylotic myelopathy

This comprises six well-known prognostic factors, namely, age, duration of symptoms, neurological disability (Nurick's grade), effective canal diameter, number of levels of compression, and intrinsic cord changes as seen in T2-weighted magnetic resonance imaging (MRI). Each factor is further divided into three subgroups and each of these is given a score 1-3 depending on the expected outcome. The factor with the best

prognosis is given 3 points, and the factor with the worst prognosis is given 1 point. The maximum total score of the scale is 18, while the minimum total score is 6. The details of the scale are given in Table 1.

Evaluation of the Madras Institute of Neurology Prognostic Scale

The MINPS for CSM was applied on a group of patients to evaluate the scale. This was a retrospective study on 85 patients operated for CSM. The clinical and radiological findings were documented, and the required data were collected. The age of the patient, duration of symptoms, and functional grade according to Nurick's grade were recorded. The number of levels of compression, the effective canal diameter, and intrinsic cord changes in the T2-weighted image, were noted in the MRI scan of the cervical spine. The effective canal diameter was measured as the distance between the prominence of the posterior osteophyte to the nearest point on the spinolaminar line at the level of maximum compression. The intrinsic cord changes were recorded according to the classification of Chen *et al*.[8] They were divided into, either normal, type I changes or type II changes. The total score on the MINPS was calculated. The patients were followed-up postoperatively, and the outcome was noted according to the Nurick's grade. The outcome was recorded as improvement, static, or deterioration, depending on the comparative pre and postoperative Nurick's grade. The usefulness of MINPS was statistically assessed using ANOVA test, 17.5 version. The significance level was set at $P < 0.05$.

Results

The total number of patients in this study were 85. The period of follow-up ranged from 2 months to 2 years. The details of the MINPS and outcome in these patients are given in Table 2.

The effect of individual factors on the outcome was also analyzed. The details of the distribution of individual factors and outcome are given in Table 3.

It was found that 81% of the patients with MINPS score of 14 or more had an improved outcome; 80% of the patients with MINPS score of 9 or less deteriorated; 59% of the patients with MINPS score between 10 and 13 were neurologically static.

Discussion

Outcome of surgery in CSM is variable. A number of prognostic factors in CSM has been studied and evaluated. Patient's age, duration of symptoms, preoperative neurological status, radiological findings including number of levels of compression, effective canal diameter, and intrinsic signal changes in the cord, have been found to be the most important of them.[8-15]

Table 1: The MINPS for CSM

Prognostic score	Subdivisions	Score
Age	<40 years	3
	40-60 years	2
	>60 years	1
Duration of symptoms	<1-year	3
	1-2 years	2
	>2 years	1
Neurologic disability (Nurick's grade)	0-2	3
	3	2
	4-5	1
Effective canal diameter	>11 mm	3
	9-11 mm	2
	<9 mm	1
Number of levels of compression	1	3
	2	2
	3 or more	1
Intramedullary signal change (T2-weighted MRI)	No change	3
	Ill-defined lesion (Type I)	2
	Well defined lesion (Type II)	1

Maximum score: 18, Minimum score: 6. MINPS - Madras Institute of Neurology Prognostic Scale, CSM - Cervical spondylotic myelopathy, MRI - Magnetic resonance imaging

Table 2: The distribution of patients according to the MINPS and the outcome

Total MINPS score	Outcome (%)					
	Improvement		Stationary		Deterioration	
	Number	Cumulative	Number	Cumulative	Number	Cumulative
6	0	-	0	-	2 (8.7)	8.7
7	0	-	1 (1)	1	5 (21.73)	30.43
8	1 (2.9)	2.9	1 (1)	2	3 (13.04)	43.47
9	0 (2.9)	2.9	1 (8.7)	10.7	6 (26.09)	69.56
10	0 (2.9)	2.9	3 (10.7)	21.4	3 (12.04)	82.6
11	1 (3)	5.9	6 (21.45)	42.85	1 (4.36)	86.96
12	0 (3)	5.9	3 (10.72)	53.57	1 (4.34)	91.30
13	7 (20.6)	26.5	8 (28.57)	82.14	1 (4.35)	95.65
14	5 (14.68)	41.18	2 (7.14)	89.28	1 (4.35)	100
15	5 (14.72)	55.9	1 (3.58)	92.86	0	
16	3 (8.8)	64.7	1 (3.57)	96.43	0	
17	9 (26.48)	91.18	1 (3.57)	100	0	
18	3 (8.82)	100	0	-	0	

MINPS - Madras Institute of Neurology Prognostic Scale

Age

Cervical spondylotic myelopathy is a disease of middle-aged and elderly. Age has been found to be an important prognostic factor in determining the outcome after surgery in CSM.[11,15,19] Naderi *et al*. in a study of 27 patients with CSM found better neurological improvement in patients younger than 60 years.[19] Ahn *et al*. in their prospective study also found better outcome in patients less than 40 years of age.[15] In the MINPS, the age factor has been divided into three subgroups, namely, below 40 years, 40-60 years, and above 60 years. In

Table 3: The distribution of patients according to each factor in the scale and the outcome category

Factor	Subgroups	Outcome			Total
		Deterioration	Stationary	Improvement	
Age	<40	2	2	19	23
	40-60	12	19	14	45
	>60	9	7	1	17
Duration of symptoms	<1 year	1	5	18	24
	1-2 years	12	19	12	43
	>2 years	10	4	4	18
Nurick' s grade	0-2	3	12	19	34
	3	12	12	14	38
	4-5	8	4	1	13
Effective canal diameter	>11 mm	1	1	17	19
	9-11 mm	9	24	16	49
	<9 mm	13	3	1	17
Number of levels of compression	1	0	4	16	20
	2	1	8	15	24
	3 or more	22	16	3	41
Intrinsic cord change in MRI	No change	1	17	27	45
	Type I change	5	6	5	16
	Type II change	17	5	2	24

MRI – Magnetic resonance imaging

the present study, 83% of patients under the age of 40 years showed improvement, whereas 96% of patients above the age of 60 either remained static or worsened.

Duration of symptoms

Long standing compression results in irreversible changes within the spinal cord. Hence, patients presenting with shorter duration of symptoms do better. This has been corroborated by various studies.[14,20,21] Patients with duration of symptoms less than 1-year have been shown to have a better outcome than those with longer duration of symptoms. Hence, in the MINPS, the duration of symptoms factor has been divided into three subgroups, namely less than 1-year, 1-2 years and more than 2 years. In the present study, 75% of patients presenting with symptoms less than 1-year duration showed good improvement after surgery, whereas 78% of patients having duration of symptoms more than 2 years worsened or remained static.

Preoperative neurological status

Preoperative neurological status plays a very important role in determining the outcome after surgery. This has been corroborated by various studies. Holly *et al*. have shown that patients with lower Nurick's grade had a better outcome.[10] In MINPS, the pre-operative neurological status has been divided into three subgroups based on Nurick's grade, namely, 0-2, 3, 4-5. In the present study, 56% of patients with preoperative Nurick's grade 1 and 2 showed improvement; whereas, 92% of patients with grade 4 and 5 either remained static or worsened.

Effective canal diameter

Effective cervical canal diameter has been found to be a very important factor determining the outcome after surgery in CSM.[11,22,23] The normal midsagittal diameter in the cervical spine C3 to C7 is 17-18 mm. Canal diameter <10 mm is considered significant and is associated with varying neurological deficits. The effective canal diameter is measured from the prominence of the posterior osteophyte to the nearest point in the spino-laminar line. Ahn *et al*., White and Panjabi, Fager, and Fergusson noted that effective canal diameter is one of the important prognostic factors, and better prognosis is seen when the effective canal diameter is above 11 mm.[15,23,24,25] In the MINPS, the effective canal diameter factor is subdivided into three subgroups, namely, more than 11 mm, 9-11 mm and less than 9 mm. In the present study, 90% of patients with effective canal diameter more than 11 mm showed improvement; whereas 94% of patients with effective canal diameter 9 mm or less either worsened or remained static.

Number of levels of compression

CSM is commonly due to compression opposite C5-6 and C6-7 discs. This is due to accelerated osteophyte formation at the level of maximum movement during neck flexion and extension. The progress of the disease is, usually, contiguous and may be rostral or caudal. Fujiwara, Ahn have found that patients with one or two levels of cord compression had a better outcome than those with three or more levels of compression.[9,15] In MINPS, the factor of a number of levels of compression has been subdivided into 3 groups namely, single level, 2 levels and 3 or more levels. In the present study, 80% of patients with a single level of compression improved, whereas 93% with 3 or more levels of compression worsened or remained static.

Intrinsic cord changes

Intrinsic signal changes seen in T2-weighted MRI, reflects the pathological changes in the cord due to compression. Chen *et al*. studied MRI findings in 64 patients with CSM and classified intramedullary hyperintense signal changes in T2-weighted images into: Type I, where the hyperintense signal had a faint, fuzzy border and Type II, where the hyperintense signal had sharp well-defined border.[8] The Type I signal changes were indicative of edema and ischemia which are reversible, and Type II signal changes were indicative of myelomalacia which is irreversible. In the MINPS, the factor intramedullary signal changes has been subdivided into three groups, namely, no changes, Type I changes and Type II changes. In the present study, 60% of patients with no intramedullary signal change improved, whereas 92% with Type II signal change worsened or remained static.

All these prognostic factors have been extensively studied and found to be important in determining the outcome after surgery in CSM. But there is no comprehensive prognostic

scale till today, which can objectively predict the outcome in advance. The MINPS has been devised to enable the physician to know the possible outcome after surgery and plan further rehabilitation. The MINPS is very simple, can be routinely applied with the minimum available clinical and radiological information and is readily reproducible. The MINPS has been found to correlate well with outcome: A score of 14 and above, 10-13 and 9 and less, are indicative of improvement, static outcome and deterioration, respectively. MINPS is likely to find wide acceptance and form part of the physician's armamentarium. We also plan to evaluate MINPS on a larger population, in multiple centers and also plan to undertake a prospective study to further validate this scale.

References

1. Batzdorf U. Complex cervical myelopathies. In: Frymoyer J, editor. The Adult Spine; Principles and Practice. New York: Raven Press; 1991. p. 1207-18.
2. Young PH. Degenerative cervical disc disorders: Pathophysiology and clinical syndrome. In: Young PH, editor. Microsurgery of the Cervical Spine. New York: Raven Press; 1991. p. 49-63.
3. Bertalanffy H, Eggert HR. Clinical long-term results of anterior discectomy without fusion for treatment of cervical radiculopathy and myelopathy. A follow-up of 164 cases. Acta Neurochir (Wien) 1988;90:127-35.
4. Cusick JF. Pathophysiology and treatment of cervical spondylotic myelopathy. Clin Neurosurg 1991;37:661-81.
5. Jeffreys RV. The surgical treatment of cervical myelopathy due to spondylosis and disc degeneration. J Neurol Neurosurg Psychiatry 1986;49:353-61.
6. Lunsford LD, Bissonette DJ, Jannetta PJ, Sheptak PE, Zorub DS. Anterior surgery for cervical discectomy without fusion for treatment of cervical spondylotic myelopathy in 32 cases. J Neurosurg 1980;53:12-9.
7. Uttley D, Monro P. Neurosurgery for cervical spondylosis. Br J Hosp Med 1989;42:62-70.
8. Chen CJ, Lyu RK, Lee ST, Wong YC, Wang LJ. Intramedullary high signal intensity on T2 weighted magnetic resonance images in cervical spondylotic myelopathy: Prediction of prognosis with type of intensity. Neuroradiology 2001;221:789-94.
9. Fujiwara K, Yonenobu K, Ebara S, Yamashita K, Ono K. The prognosis of surgery for cervical compression myelopathy. An analysis of the factors involved. J Bone Joint Surg Br 1989;71:393-8.
10. Holly LT, Matz PG, Anderson PA, Groff MW, Heary RF, Kaiser MG, *et al.* Clinical prognostic indicators of surgical outcome in cervical spondylotic myelopathy. J Neurosurg Spine 2009;11:112-8.
11. Kun YT. Analysis of 13 prognostic factors in cervical spondylotic myelopathy. J Korean Soc Spine 2005;13:78-86.
12. Lees F, Turner JW. Natural history and prognosis of cervical spondylosis. Br Med J 1963;2:1607-10.
13. Lunsford LD. The natural history and the results of surgical treatment of the spinal cord disorder associated with cervical spondylosis. Brain 1972;95:101-8.
14. Suri A, Chabbra RP, Mehta VS, Gaikwad S, Pandey RM. Effect of intramedullary signal changes on the surgical outcome of patients with cervical spondylotic myelopathy. Spine J 2003;3:33-45.
15. Ahn JS, Lee JK, Kim BK. Prognostic factors that affect the surgical outcome of the laminoplasty in cervical spondylotic myelopathy. Clin Orthop Surg 2010;2:98-104.
16. Nurick S. The pathogenesis of the spinal cord disorder associated with cervical spondylosis. Brain 1972;95:87-100.
17. Ranawat CS, O'Leary P, Pellicci P, Tsairis P, Marchisello P, Dorr L. Cervical spine fusion in rheumatoid arthritis. J Bone Joint Surg Am 1979;61:1003-10.
18. Hukuda S, Mochizuki T, Ogata M, Shichikawa K, Shimomura Y. Operations for cervical spondylotic myelopathy. A comparison of the results of anterior and posterior procedures. J Bone Joint Surg Br 1985;67:609-15.
19. Naderi S, Ozgen S, Pamir MN, Ozek MM, Erzen C. Cervical spondylotic myelopathy: Surgical results and factors affecting prognosis. Neurosurgery 1998;43:43-9.
20. Arnasson O, Carlsson CA, Pellettieri L. Surgical and conservative treatment of cervical spondylotic radiculopathy and myelopathy. Acta Neurochir (Wien) 1987;84:48-53.
21. Tanaka J, Seki N, Tokimura F, Doi K, Inoue S. Operative results of canal-expansive laminoplasty for cervical spondylotic myelopathy in elderly patients. Spine (Phila Pa 1976) 1999;24:2308-12.
22. Burrows EH. The sagittal diameter of the spinal canal in cervical spondylosis. Clin Radiol 1963;14:77-86.
23. White AA 3rd, Panjabi MM. Biomechanical considerations in the surgical management of cervical spondylotic myelopathy. Spine (Phila Pa 1976) 1988;13:856-60.
24. Fager CA. Results of adequate posterior decompression in the relief of spondylotic cervical myelopathy. J Neurosurg 1973;38:684-92.
25. Ferguson RJ, Caplan LR. Cervical spondylitic myelopathy. Neurol Clin 1985;3:373-82.

How to cite this article: Ramesh VG, Kannan MG, Sriram K, Balasubramanian C. Prognostication in cervical spondylotic myelopathy: Proposal for a new simple practical scoring system. Asian J Neurosurg 2017;12:525-8.

Source of Support: Nil, **Conflict of Interest:** None declared.