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Physical Signs and Clinical Features of Cervical Myelopathy in Elderly Patients, Especially 80 Years or Older: Comparison of 100 Consecutive Operative Cases across Three Age Groups

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Study Design: Retrospective cohort study.

Purpose: The present study aimed to examine the characteristics of physical signs in elderly patients with cervical myelopathy (CM) and to compare the findings in three different age groups.

Overview of Literature: As the global population ages, the incidence of CM in elderly patients is increasing.

Methods: We evaluated 100 consecutive surgical patients with CM and divided them into the following groups: 80s (34 patients; mean age, 83.9 years), 70s (33 patients; mean age, 73.9 years), and 69 or younger (33 patients; mean age, 60.9 years). The clinical symptoms and physical signs were evaluated and recorded.

Results: Although the recovery rate decreased with increasing age, all groups demonstrated a significant improvement in clinical symptoms relative to preoperative values. The Hoffman sign and hyperreflexia of the triceps tendon were, respectively, present in 82% and 88% of patients in the 80s group, 74% and 64% of those in the 70s group, and 69% and 82% of those in the 69 or younger group, with no significant difference among the groups. In contrast, the rates of hyperreflexia of the patellar and Achilles tendons were, respectively, 59% and 32% in the 80s group, 85% and 48% in the 70s group, and 91% and 70% in the 69 or younger group, with significant differences.

Conclusions: The positivity rate of the lower extremity hyperreflexia decreased significantly with increasing age in patients with CM. The absence of hyperreflexia, particularly lower extremity, is not uncommon in elderly patients with suspected CM.

Keywords: Cervical myelopathy; Physical sign; Neurological findings; Elderly patient; Hyperreflexia; Recovery rate

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Introduction

With the ever-increasing aging population, the incidence of cervical myelopathy (CM) in elderly patients has also been increasing. According to a United Nations survey, the number of people of exceedingly advanced ages is increasing: the global population aged 80 years or older is projected to grow from 125 million in 2015 to 202 million in 2030 and to 434 million in 2050 [1]. Reports on surgical outcomes in elderly CM patients, especially those aged 80 years or older, have suggested that appropriate surgical results can be obtained if the patients were correctly selected and the procedures were properly performed [2,3].

The diagnosis of CM in elderly patients may occasionally be complicated because of complex physical findings related to aging or the presence of complications (e.g., lumbar canal stenosis, diabetes) that may mimic myelopathic signs. Despite significant advances in our understanding of this disorder, the majority of physical signs and clinical tests to detect CM are poor to moderate in quality [4], and Rhee et al. [5] demonstrated that not all patients with CM exhibit characteristic findings of myelopathy. Hence, it is important to check for physical signs when diagnosing CM, because CM is a clinical diagnosis based on a history of myelopathic complaints, myelopathic signs on physical examinations, and advanced imaging studies showing correlative compression of the cervical spinal cord. Although several reports have described the clinical features and surgical outcomes of patients with elderly CM patients [2,3,6-8], little is known about the prevalence of physical findings [9]. The purpose of this study was to examine the physical signs and clinical features of elderly patients with CM and compare the findings in three different age groups.

Materials and Methods

1. Patients

This retrospective study of 100 consecutive surgical patients with CM was conducted between 2008 and 2013. The inclusion criteria were as follows: (1) history of myelopathic symptoms (hand clumsiness, gait instability, upper and/or lower extremity [L/E] numbness, bowel and bladder incontinence, etc.), (2) correlative spinal cord compression (diagnosed on magnetic resonance imaging [MRI] and/or computed tomography-myelogram), (3) underwent surgery, and (4) improved symptoms after the surgery. These criteria constituted the "gold standard" to confirm a diagnosis of CM [5]. The exclusion criteria were as follows: (1) trauma, (2) tumor, (3) re-operation, and (4) presence of radiculopathy alone. The patients were divided into three groups depending on their age: 80s (34 patients; 15 men and 19 women; range, 80–91 years; average, 83.9 years); 70s (33 patients; 18 men and 15 women; range, 70–79 years; average, 73.9 years); and 69 or younger (33 patients; 25 men and eight women; range, 41–69 years; average, 60.9 years).

2. Clinical and radiological examinations

The physical signs, including the results of the manual muscle testing and 10-second grip-and-release test [10], were evaluated by a single spine surgeon with more than 20 years of experience (T.H.). Myelopathic signs were evaluated as the presence of hyperreflexia of the biceps, brachioradialis, triceps, patella, and Achilles tendons. Hyperreflexia was defined as the presence of a tendon reflex ≥grade 3 (0=absent, 1=hypoactive, 2=normal, 3=hyperactive without clonus, 4=very hyperactive, often with clonus) [11]. Provocative signs of the upper extremities, including the Hoffman sign and inverted brachioradialis, were also evaluated. Neurologic conditions were assessed using the scoring system developed by the Japanese Orthopedic Association (JOA) (−2 to 17; total for normal patients=17) [12]. The presence or absence of diabetes was evaluated to account for comorbidities that may produce physical findings. All patients underwent high-resolution T1- and T2-weighted MRI imaging before surgery. The high signal intensity of the spinal cord on T2-weighted MRI images (evidence of cord signal changes and/or myelomalacia) was assessed. Preoperatively, we performed myelography in all the patients to check for lesions in the cervical and lumbar regions. We defined lumbar lesions as contrast medium defects at one or more lumbar spine levels. All patients were treated using an expansive open-door laminoplasty technique [12] with the aid of a surgical microscope [3,13].

The preoperative duration of myelopathic symptoms was assessed, and the postoperative recovery rate was calculated by considering the JOA score. The following formula was used to calculate the recovery rate [12]: recovery rate (%)=(postoperative JOA score–preoperative JOA score)×100/(17–preoperative JOA score).

This study was conducted in accordance with the ethical standards of the institutional review board of the National Hospital Organization, Kure Medical Center, and Chugoku Cancer Center (approval no., 28-34) and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

3. Statistical analysis

Statistical analysis was performed after creating a database using the software package JMP ver. 7.0 (SAS Institute Inc., Cary, NC, USA). The significance of differences in parameters was assessed using the chi-square test, Kruskal-Wallis test, and Mann-Whitney test. Statistical significance was defined as a *p*-value of less than 0.05.

Results

1. Prevalence of physical signs among the three age groups (80s, 70s, and 69 or younger)

The positivity rates for provocative signs of the upper extremities (Hoffman, inverted brachioradialis) were not significantly different among the three groups. The positivity rates for triceps hyperreflexia (64%–88%) and the Hoffman sign (69%–82%) were high, indicating that these upper extremity (U/E) signs were highly sensitive in all three age groups (Table 1). In contrast, the rate of L/E hyperreflexia significantly diminished with increasing age, and CM patients, especially those aged 80 years or older, did not always have L/E hyperreflexia.

The was no difference in the incidences of muscle weakness, diabetes, or the duration of symptoms among the three groups, nor was there an association between high signal intensity of the spinal cord on T2-weighted MRI images. However, the results of the 10-second grip-and-release test decreased, and lumbar lesions increased significantly with increasing age (Table 2). On MRI, the compressive lesions were most commonly detected at the C3–4 and C4–5 levels in the 80s group, and the C4–5 and C5–6 levels in the other two groups (Table 2).

The preoperative JOA score, L/E motor and bladder functions, and total scores significantly diminished with increasing age. Although the recovery rate also decreased significantly with increasing age, all groups, including the 80s, showed significant improvement in comparison with the preoperative values (Table 3).

2. Patellar tendon reflex, Achilles tendon reflex, and clinical features

When focusing on the findings of L/E reflex testing, patients without L/E hyperreflexia (patellar tendon reflex [PTR] and Achilles tendon reflex [ATR]) were significantly older than those with L/E hyperreflexia (Table 4). The postoperative total JOA scores of those without ATR hyperreflexia were significantly lower than those of pa-

Table 1. Prevalence of physical signs among three age groups

Variable	Age group (yr)			*p*-value
	80s	70s	69 or younger	
Provocative signs				
Hoffman[a]	82	74	69	NS
inverted BR[a]	38	39	55	NS
Hyperreflexia				
Biceps[a]	65	67	70	NS
BR[a]	38	27	24	NS
Triceps[a]	88	64	82	NS
Patella[a]	59	85	91	<0.05*
Achilles[a]	32	48	70	<0.05*

Values are presented as %.
NS, not significant; BR, brachioradialis.
*p<0.05 (statistically significant). [a]By chi-square test.

Table 2. Clinical and radiological features among three age groups

Variable	Age group (yr)			*p*-value
	80s	70s	69 or younger	
Muscle weakness (MMT <3)[a]	(18)	(36)	(33)	NS
Mean grip-and-release test score[b]	14.0	14.3	17.3	<0.05*
Diabetics[a]	(24)	(30)	(21)	NS
Lumbar lesion[a]	(70)	(67)	(30)	<0.05*
Mean duration (mo)[b]	17.7	18.5	10.5	NS
MRI cord signal change[a]	(79)	(70)	(73)	NS
Main level of the incidence on MRI				
C3–4	13 (38)	4 (12)	9 (27)	
C4–5	15 (44)	15 (45)	13 (39)	
C5–6	6 (18)	13 (39)	11 (33)	
C6–7	0	1 (3)	0	

Values are presented as (%), mean, or number (%), unless otherwise stated.
MMT, manual muscle testing; NS, not significant; MRI, magnetic resonance imaging.
*p<0.05 (statistically significant). [a]By chi-square test. [b]By Kruskal-Wallis test.

tients with ATR hyperreflexia; however, even the patients without ATR hyperreflexia showed significant improvement after surgery.

3. Influence of diabetes and lumbar lesions in Patellar tendon reflex and Achilles tendon reflex

Patients with lumbar lesions accounted for 56% of all groups, and among these patients, there were no significant differences between patients with lumbar lesions with and without PTR hyperreflexia; however, patients with lumbar lesions without ATR hyperreflexia were significantly more numerous than those with ATR hyperreflexia (Table 4). Patients with diabetes accounted for 25% of the study population, and there were no significant differences in the number of diabetes patients with and without PTR hyperreflexia; however, patients with diabetes without ATR hyperreflexia were significantly more than those with ATR hyperreflexia.

Table 3. Preoperative and postoperative JOA score and recovery rate

Variable	Age group (yr)			*p*-value
	80s	70s	69 or younger	
Motor function				
U/E[a]	2.0	2.1	2.3	NS
L/E[a]	1.1	1.4	2.0	<0.05*
Sensory function				
U/E[a]	1.1	1.0	1.1	NS
Trunk[a]	1.7	1.8	1.8	NS
L/E[a]	1.0	1.2	1.2	NS
Bladder function[a]	1.3	1.4	1.7	<0.05*
Preoperative total JOA[a]	8.0	8.7	9.9	<0.05*
Postoperative JOA[a]	10.9	11.8	13.4	<0.05*
Recovery rate (%)[a]	(30.8)	(37.9)	(49.3)	<0.05*

Values are presented as mean or (%), unless otherwise stated.
JOA, Japanese Orthopedic Association; U/E, upper-extremity; L/E, lower-extremity; NS, not significant.
*p<0.05 (statistically significant). [a]By Kruskal-Wallis test.

Discussion

In the present study, we examined the physical signs and clinical features of elderly patients with CM. We demonstrated that positive rates of L/E hyperreflexia were significantly diminished in older patients with CM, especially those aged 80 years or older.

Rhee et al. [5] demonstrated that characteristic myelopathic signs may be absent in approximately one-fifth of CM patients and cannot be relied upon to make the diagnosis. In our study of CM, although the physical signs of L/E hyperreflexia were not significantly different among older adults from different age groups, the rate of L/E hyperreflexia significantly diminished with increasing age. On the other hand, the preoperative symptoms of L/E motor function deteriorated significantly with age, although the preoperative clinical motor functions of U/E did not vary with age. Therefore, in terms of clinical features, older patients showed more severe L/E symptoms (e.g., gait disturbance) compared with U/E; however, they showed fewer L/E physical signs which may lead to misdiagnosis of CM.

Acharya et al. [14] reported that signs of U/E hyperreflexia, such as the Hoffman sign or hyperreflexia of the triceps, were more sensitive in diagnosing CM, and we showed similar results not only in all groups but also in

Table 4. PTR, ATR, and clinical findings

Variable	PTR			ATR		
	With hyperreflexia (n=78)	Without hyperreflexia (n=22)	*p*-value	With hyperreflexia (n=50)	Without hyperreflexia (n=50)	*p*-value
Age (yr)[a]	71.2	79.3	<0.01*	70.1	75.9	<0.05*
Preop JOA[a]	9.1	7.8	NS	9.1	8.6	NS
Postop JOA[a]	12.3	11.1	NS	12.5	11.6	<0.05*
Recovery rate (%)[b]	(40.4)	(35.3)	NS	(42.4)	(36.0)	NS
Lumbar lesion + (%) (n=56)[b]	(50.0)	(77.3)	NS	(40.0)	(72.0)	<0.05*
Diabetic + (%) (n=25)[b]	(21.8)	(36.4)	NS	(16.0)	(34.0)	<0.05*

Values are presented as mean or (%), unless otherwise stated.
PTR, patellar tendon reflex; ATR, Achilles tendon reflex; JOA, Japanese Orthopedic Association; Preop, preoperative; Postop, postoperative; NS, not significant.
*p<0.05 (statistically significant). [a]By Mann-Whitney test. [b]By chi-square test.

older patients. In addition, the 10-second grip-and-release test scores decreased depending on the patient's age, which should be taken into account during the evaluation process.

We found that many patients with CM, particularly those who were older, did not have L/E hyperreflexia. This may be due to age-related changes in peripheral nerves, especially the degenerative dropout of large-diameter myelinated fibers. L/E hyperreflexia in older adults with CM diminishes because the incidence of peripheral nerve degeneration may increase with age. Peripheral nerve degeneration may worsen the L/E motor function in elderly patients with CM. Patients with L/E hyperreflexia in elderly patients with CM tend to show slightly poorer improvement, still, they recover from myelopathy symptoms after surgery. Surgeons should be aware that the absence of hyperreflexia, particularly of the L/E, is not uncommon in elderly patients with suspected CM. Theoretically, lumbar lesions and diabetic neuropathy may attenuate deep tendon reflexes. Our results suggest that the presence of lumbar lesions and/or diabetes did not affect the PTR, but significantly decreased the presence of ATR hyperreflexia. This may be due to the length of the peripheral nerves because the tibial nerve (ATR) is longer than the femoral nerve (PTR). Because it induces a length-dependent sensorimotor polyneuropathy, peripheral nerve dysfunction due to lumbar lesions and/or diabetes is more likely to affect longer nerves [15]. Moreover, the aging process deeply influences the dysfunction of the peripheral nervous system [16,17]. There were still some patients whose findings could not be explained; however, aging, lumbar lesions, and diabetes may be the factors for CM patients without ATR hyperreflexia.

For other clinical features of elderly patients, our study revealed that the most compressive lesions were detected at the C3–4 and C4–5 levels on MRI, corroborating previous reports [3,6-8]. This may be due to a high susceptibility to age-related postural changes in the elderly population [7].

Jacobs et al. [18] reported the frequent coexistence of cervical and lumbar degenerative diseases. Our study also showed coexisting cervical and lumbar lesions in 56% of all study patients, and in 70% of those aged 80 years or older. The presence of lumbar lesions increased significantly with age.

Older patients tended to have more severe myelopathy because preoperative L/E motor and bladder function and total JOA scores were significantly worse than those in the other groups [19]. However, these patients still showed postoperative improvement. Thus, despite the slightly lower recovery rate for elderly patients, surgery offers many advantages in keeping them active and independent, and elderly candidate patients with the potential to demonstrate improved activities of daily living should not be overlooked.

Our study had some limitations: the clinical findings were assessed by a single surgeon, and we did not examine the Babinski and clonus signs. Moreover, our study did not have a control group. These limitations need to be addressed in future research.

Conclusions

Although the three groups showed no significant differences in the rate of positive provocative U/E signs, the positivity rates of L/E hyperreflexia significantly diminished with increasing age. The absence of hyperreflexia, particularly of the L/E, is not uncommon in elderly patients with suspected CM, and surgeons should be aware of the same. Although pre- and postoperative JOA scores and recovery rates significantly decreased with increasing age, even patients aged 80 years or older showed significant postoperative improvement. Surgical decision-making should consider other physical signs and imaging findings, particularly in elderly patients.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Author Contributions

Takahiko Hamasaki wrote and prepared the manuscript, Toshio Nakamae contributed to the final version of the manuscript, and all of the authors participated in the study design. All authors have read, reviewed, and approved the article.

References

1. United Nations. World population ageing 2015: highlights. New York (NY): United Nations; 2015.
2. Johansen TO, Vangen-Lonne V, Holmberg ST, et al. Surgery for degenerative cervical myelopathy in the elderly: a nationwide registry-based observational study with patient-reported outcomes. Acta Neurochir (Wien) 2022;164:2317-26.
3. Tanaka N, Nakanishi K, Fujimoto Y, et al. Clinical results of cervical myelopathy in patients older than 80 years of age: evaluation of spinal function with motor evoked potentials. J Neurosurg Spine 2009;11:421-6.
4. Cook CE, Wilhelm M, Cook AE, Petrosino C, Isaacs R. Clinical tests for screening and diagnosis of cervical spine myelopathy: a systematic review. J Manipulative Physiol Ther 2011;34:539-46.
5. Rhee JM, Heflin JA, Hamasaki T, Freedman B. Prevalence of physical signs in cervical myelopathy: a prospective, controlled study. Spine (Phila Pa 1976) 2009;34:890-5.
6. Matsuda Y, Shibata T, Oki S, Kawatani Y, Mashima N, Oishi H. Outcomes of surgical treatment for cervical myelopathy in patients more than 75 years of age. Spine (Phila Pa 1976) 1999;24:529-34.
7. Mihara H, Ohnari K, Hachiya M, Kondo S, Yamada K. Cervical myelopathy caused by C3-C4 spondylosis in elderly patients: a radiographic analysis of pathogenesis. Spine (Phila Pa 1976) 2000;25:796-800.
8. Tani T, Yamamoto H, Kimura J. Cervical spondylotic myelopathy in elderly people: a high incidence of conduction block at C3-4 or C4-5. J Neurol Neurosurg Psychiatry 1999;66:456-64.
9. Hamasaki T, Yasumoto M, Hachisuka H, et al. Deep tendon reflex of cervical myelopathy in patients aged 80 years or older: a prospective study. J Spine Res 2012;3:744-6.
10. Ono K, Ebara S, Fuji T, Yonenobu K, Fujiwara K, Yamashita K. Myelopathy hand: new clinical signs of cervical cord damage. J Bone Joint Surg Br 1987;69:215-9.
11. Litvan I, Mangone CA, Werden W, et al. Reliability of the NINDS Myotatic Reflex Scale. Neurology 1996;47:969-72.
12. Hirabayashi K, Miyakawa J, Satomi K, Maruyama T, Wakano K. Operative results and postoperative progression of ossification among patients with ossification of cervical posterior longitudinal ligament. Spine (Phila Pa 1976) 1981;6:354-64.
13. Baba I. Microscopic surgery in practice: 1. CSM and OPLL. In: Baba I, editor. Color atlas of microsurgery of the spine & spinal corded. Hiroshima: Department of Orthopaedic Surgery, Hiroshima University; 2007. p. 15-23.
14. Acharya S, Srivastava A, Virmani S, Tandon R. Resolution of physical signs and recovery in severe cervical spondylotic myelopathy after cervical laminoplasty. Spine (Phila Pa 1976) 2010;35:E1083-7.
15. Tesfaye S, Boulton AJ, Dyck PJ, et al. Diabetic neuropathies: update on definitions, diagnostic criteria, estimation of severity, and treatments. Diabetes Care 2010;33:2285-93.
16. Verdu E, Ceballos D, Vilches JJ, Navarro X. Influence of aging on peripheral nerve function and regeneration. J Peripher Nerv Syst 2000;5:191-208.
17. Sabbahi MA, Sedgwick EM. Age-related changes in monosynaptic reflex excitability. J Gerontol 1982;37:24-32.
18. Jacobs B, Ghelman B, Marchisello P. Coexistence of cervical and lumbar disc disease. Spine (Phila Pa 1976) 1990;15:1261-4.
19. Machino M, Ando K, Kobayashi K, et al. The feature of clinical and radiographic outcomes in elderly patients with cervical spondylotic myelopathy: a prospective cohort study on 1025 patients. Spine (Phila Pa 1976) 2018;43:817-23.