



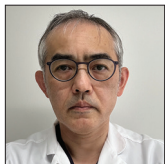
Original Article

Cerebrospinal fluid protein concentration in patients with lumbar spinal stenosis

Hitoshi Yamahata¹, Kosei Ijiri², Fumito Tanabe², Kyoichi Murasumi², Yushi Nagano¹, Ryutaro Makino¹ , Nayuta Higa¹, Ryosuke Hanaya¹

¹Department of Neurosurgery, Graduate School of Medical and Dental Sciences, Kagoshima University, ²Department of Orthopaedics, Kirishima Orthopaedics, Kirishima, Kagoshima, Japan.

E-mail: *Hitoshi Yamahata - yamahata3@gmail.com; Kosei Ijiri - kirishimaortho@yahoo.co.jp; Fumito Tanabe - tnb2310@po4.synapse.ne.jp; Kyoichi Murasumi - kyoichimura@gmail.com; Yushi Nagano - yuushinagano@gmail.com; Ryutaro Makino - 775sen2014@gmail.com; Nayuta Higa - nayuhiga@gmail.com; Ryosuke Hanaya - hanaya@m2.kufm.kagoshima-u.ac.jp



***Corresponding author:**

Hitoshi Yamahata,
Department of Neurosurgery,
Graduate School of Medical and
Dental Sciences, Kagoshima
University, Kagoshima, Japan.

yamahata3@gmail.com

Received: 22 July 2024

Accepted: 01 August 2024

Published: 23 August 2024

DOI

10.25259/SNI_610_2024

Quick Response Code:



ABSTRACT

Background: In this study, we examined the impact and degree of lumbar stenosis on cerebrospinal fluid (CSF) protein concentration.

Methods: In this retrospective study, we analyzed protein concentrations in CSF samples of 61 patients with lumbar spinal stenosis (LSS) obtained during pre-operative myelography. Patients were divided into two groups: those showing no block to contrast (Group A) versus those showing medium block to contrast below the lumbar puncture level (Group B).

Results: The CSF protein concentration in Group B (104.3 ± 59 g/dL) patients with medium block was significantly greater than that in Group A (65.1 ± 33 g/dL) patients without medium block.

Conclusion: A higher average CSF protein concentration was seen in Group B patients with significant lumbar stenosis versus Group A patients without significant lumbar stenosis. Theoretically, damage to the cauda equina in patients with LSS may cause these elevated CSF protein levels.

Keywords: Cerebrospinal fluid, Lumbar spinal stenosis, Lumbar spine, Protein concentration

INTRODUCTION

Previous studies showed that aging alone increased cerebrospinal fluid (CSF) protein concentrations.^[4,7,9-11] Here, we asked whether patients with severe lumbar spinal stenosis (LSS) had higher CSF protein concentrations versus those with mild lumbar stenosis.

MATERIALS AND METHODS

Patients

Our institutional review board approved this retrospective study. The study population included 61 patients (33 men and 28 women), averaging 68.3 years of age [Table 1]. We evaluated all 61 patients with X-ray and MR-documented LSS-related low back pain with/without leg pain (2021–2022). Lumbar Myelo-CT studies (i.e., flexion–extension bending in the upright position)

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were utilized further to assess the extent/severity of “surgical LSS.” Patients were divided into two groups: those without a medium block [Group A, Figure 1a] and those with a medium block to contrast (i.e., below the lumbar puncture level) [Group B, Figure 1b]. We employed multiple exclusion criteria [Table 2].

Study design

Lumbar punctures for Myelo-CT studies were performed cephalad to the level of significant lumbar stenosis. Lab studies included total protein concentrations, glucose levels, and cell counts. The 61 patients with LSS were divided into two groups based on the Myelo-CT findings: Group A patients had no myelographic block, versus Group B patients with medium block to contrast below the puncture level [Figure 1b].

Table 1: CSF analysis of patients with lumbar spinal stenosis.

	Total n=61	Men n=33	Women n=28	P-value*
Age (years)	68.3±9.7	66.5±9.7	70.4±9.4	0.045
CSF protein (mg/dL)	75.4±45	80.5±50	69.4±38	0.35
CSF glucose (mg/dL)	65.4±10	66.1±11	64.7±9.4	0.62
CSF cell (number)	2.6±2.2	2.5±2.0	2.8±2.5	0.72

*P-value of comparison between the men and women.
CSF: Cerebrospinal fluid

Statistical analyses

Categorical variables were analyzed using the Chi-square test, Fisher’s exact test, and Mann–Whitney *U*-test. The correlation between CSF protein concentration and age was analyzed using Spearman’s correlation coefficient (*r*).

RESULTS

Finding of significantly higher CSF protein levels in patients with LSS

There was a significantly higher average level of protein in the CSF for those in Group B, 104.3 ± 59 g/dL, versus Group A was 65.1 ± 33 g/dL [Table 3]. There were no statistically significant differences in baseline characteristics, including average age and sex distribution [Table 3]. The linear regression analysis showed that the CSF protein concentrations were not significantly correlated with age ($r = -0.15$, $P = 0.23$).

DISCUSSION

We found the average CSF protein concentration in the LSS patient, Group B, was significantly higher than that in the Group A patients without medium block. Theoretically, the increased CSF protein concentration with LSS was due to the leakage of plasma proteins into the CSF spaces through the blood–nerve barrier at the compression site. Other



Figure 1: (a) Patients without a contrast medium block (Group A). Sagittal MRI showing LSS (left). Sagittal reconstructed CT after myelography demonstrates LSS at the same level (right). The contrast media can be observed from the stenosis’s cranial to the caudal side. (b) Patients with a contrast medium block (Group B). Sagittal MRI revealed severe LSS (left); the contrast medium was blocked at the stenosis on the sagittal reconstructed CT image (right). The contrast media cannot be observed below the stenosis level. LSS: Lumbar spinal stenosis, CT: Computed tomography, MRI: Magnetic resonance imaging.

Table 2: Patient demographics, exclusion criteria.

Total number	61
Men/Women	33/28
Average age	68.3 years (Range 47–85)
Exclusion criteria	Acute trauma, spinal tumors, infectious diseases, acute lumbar disc herniation, scoliosis. Patients in whom the lumbar puncture was performed caudal to the spinal canal stenosis were also excluded.

Table 3: Comparison of the CSF average protein concentrations and other data for patients with medium block versus without medium block.

	Lumbar spinal stenosis		P-value
	Group A block (–)	Group B block (+)	
	n=45	n=16	
Age (years)	67.3±9.7	71.1±9.6	0.22
Sex (M/F)	26/19	7/9	0.39
CSF protein (mg/dL)	65.1±33	104.3±59	0.003
CSF glucose (mg/dL)	65±11	66.7±10	0.68
CSF cell (number)	2.6±2.0	2.8±2.8	0.68

*P-value of the comparison between Group A and B. CSF: cerebrospinal fluid

studies have demonstrated that the levels of proinflammatory cytokines in the CSF are elevated in patients with lumbar disc herniations.^[4,7] Yoshihara *et al.* reported a reference range of lumbar CSF protein concentrations ranging from 10 to 40 mg/dL for all ages in Japan.^[12] Ahonen *et al.* found no significant difference between CSF protein concentrations in LSS patients versus controls.^[1] Ohtori *et al.* examined 30 patients with LSS and found that the concentration of interleukin-6 (IL-6) was significantly higher in the CSF of patients with LSS versus the CSF of controls; there was a significant correlation between the concentration of IL-6 and the severity of stenosis (IL-6 elevation likely reflected nerve damage or degeneration of the spinal nerve root).^[9] Ohya *et al.* measured the levels of the phosphorylated neurofilament heavy subunit, an axon fiber structural protein, in 33 patients with LSS; the phosphorylated neurofilament heavy subunit was positive in 32 of 33 patients with LSS and negative in 21 control participants.^[10] Fautsch *et al.* examined CSF protein concentrations in 633 patients; they found the mean CSF protein concentration was 52.2 ± 18.4 mg/dL, and 55 (8.7%) patients had spinal stenosis.^[5]

Impact of age on lumbar CSF protein levels in patients with LSS

Several recent studies have documented that CSF protein concentrations increase gradually with age, and

concentrations in older populations are significantly higher than the current standard upper reference limit.^[2,3,6,8] The average age in the present study was relatively high; therefore, aging could be one of the factors related to CSF protein elevation.

CONCLUSION

In 61 patients, utilizing lumbar Myelo-CT studies, we found higher average lumbar CSF protein concentration in Group B patients with LSS (104.3 ± 59 g/dL: i.e., with medium block to contrast) versus Group A patients (65.1 ± 33 g/dL) without medium blockage.

Ethical approval

The research/study approved by the Institutional Review Board at Kirishima Orthopaedics, number 0024, dated August 30, 2022.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Yamahata H, Ijiri K, Tanabe F, Murasumi K, Nagano Y, Makino R, *et al.* Cerebrospinal fluid protein concentration in patients with lumbar spinal stenosis. *Surg Neurol Int.* 2024;15:303. doi: 10.25259/SNI_610_2024

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