

Cervical Radiculomyelopathy due to Calcification of the Ligamentum Flavum

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The authors experience a rare case of the cervical radiculomyelopathy due to calcification of ligamentum flavum at the level of C4-6 and report it with review of the literature. A 60-year-old woman was admitted, complaining progressive quadriplegia, gait disturbance and neck pain. She had been treated with diabetes mellitus and hypertension for several years. On radiologic study, calcification of ligamentum flavum (CLF) at the C4-6 level was demonstrated on cervical spine CT and MR scan. Decompressive laminectomy of the C4-6 and removal of CLF were performed. During operation, thecal sac was severely compressed by hypertrophic ligamentum flavum and there were tight adhesion between calcified ligamentum flavum and dura. After the operation, her motor function and neck pain improved and she could walk with an assistant.

KEY WORDS : Ligamentum flavum · Calcification · Radiculomyelopathy.

Introduction

Hypertrophy and ossification of the ligamentum flavum (OLF) are relatively well known disorders in the thoracic and lumbar vertebrae^{9,11}. Cervical myelopathy caused by calcification of the ligamentum flavum (CLF) is a rare disease, but most evident in Korean and Japanese¹⁴. Although OLF usually is located in the lower half of the thoracic spine, CLF characteristically occurs in the cervical spines of older women. The authors experienced a case of the CLF at the level of C4-6 and report it with review of the literature.

Case Report

A 60-year-old woman was admitted, complaining progressive quadriplegia, gait disturbance and cervicalgia. She was 159cm in height, 61kg in weight and had been treated with diabetes mellitus and hypertension for several years. She had no previous history of trauma. About 1 month before admission, she first noticed motor weakness of both legs, voiding difficulty and clumsiness of both hands. General physical examination showed no abnormalities. A neurological examination at the time of admission revealed marked motor weakness of both legs and sensory changes. She could not walk and void. Plain

x-ray films of the cervical spine showed a degenerative change and computerized tomography (CT) of the cervical spine demonstrated an oval mass of high density, which projected into the spinal canal at C4/5 and C5/6 (Fig. 1). Magnetic resonance imaging (MRI) of the cervical spine showed a hypertrophic ligamentum flavum, which produced marked stenosis of the cervical spinal canal and canal diameter was 4.5mm in maximal compression level.

In addition, C4/5 and C5/6 disc herniations aggravated the stenosis. The ligamentum flavum was hypointense on T1- and T2-weighted sequences, suggesting that it was calcified or ossified lesion. T2-weighted magnetic resonance images revealed an intramedullary area of high-intensity sig-

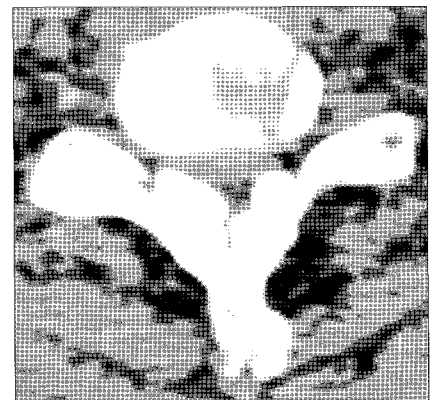


Fig. 1. Axial computed tomography scan at C5-6 level shows an oval mass of high density projecting into the spinal canal and hypertrophic ligamentum flavum produced marked stenosis. The spinal cord is compressed severely.

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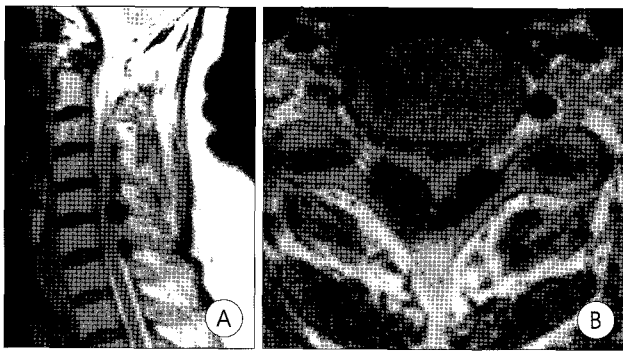


Fig. 2. A : In magnetic resonance imaging of cervical spine, T2-weighted sagittal imaging(T2WI) shows an oval mass with hypointense signal in ligamentum flavum between C4-6. And it shows severely compressed spinal cord with intramedullary signal change in T2WI. B : Axial magnetic resonance image of cervical spine shows compressed spinal cord posteriorly by a hypointense signal mass in T2-weighted sagittal imaging.

nal at the level of C4/5(Fig. 2). Decompressive laminectomy of the C4-6 and removal of CLF were performed with posterior approach. During operation, the thecal sac was severely compressed by hypertrophic ligamentum flavum and there were tight adhesion between calcified ligamentum flavum and dura. This layer of ligamentum flavum was excised *en bloc* for the whole length of the laminectomy. Histological examination of a fragment of the surgical specimen revealed some foci of calcification, without mature bone formation, in a degenerative ligamentum(Fig. 3). After the operation, her motor function and neck pain improved and she could walk with an assistant. The postoperative radiologic findings revealed decompressive laminectomy of C4-6 and release of cord compression(Fig. 4).

Discussion

In 1960, the first case was reported about ossification of the ligamentum flavum(OLF) causing thoracic myelopathy by Yamaguchi¹⁵⁾, since then OLF are well known disorders of the thoracic and lumbar vertebrae. But, only a few reports are described patients with calcification of the ligamentum flavum (CLF)^{5,7)}. CLF, OLF and calcium pyrophosphate dihydrate crystal deposition disease(CPPD) of the ligamentum flavum are confused because of inadequate histological examination. In a recent study, Higashi⁴⁾ found three patterns of calcium components in the deposits located in the ligamentum flavum. These calcium components were CPPD alone, apatite alone, and a double-layer structure with an outer CPPD and an inner apatite layer. And they suggested that the chondrocytes may have played a role in calcification in all types. The precise cause of CLF has not been established. Maybe aging, mechanical factor, endocrine abnormalities, the great mobility of the C3-C7 level have been postulated as predisposing factors^{1,3,5)}.

As in cervical spondylosis, spinal stenosis is considered imp-

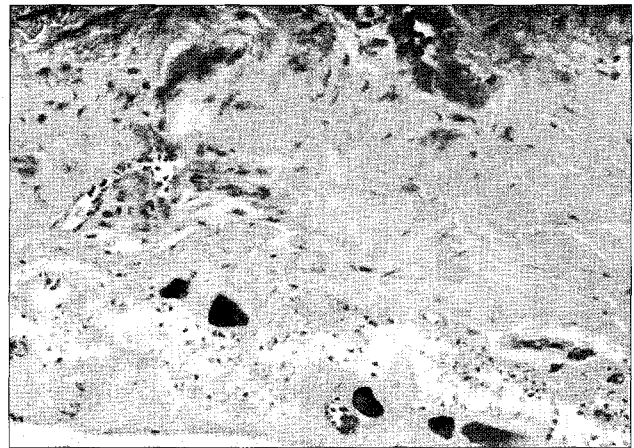


Fig. 3. Histopathologic findings. Degenerative ligamentum shows some foci of basophilic calcium deposition with no mature bone formation (H & E, ×100).

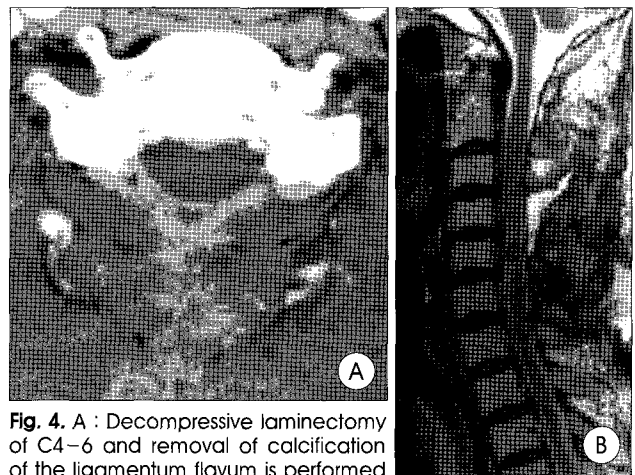


Fig. 4. A : Decompressive laminectomy of C4-6 and removal of calcification of the ligamentum flavum is performed in computed tomography scan. B : Cord compression is marked improved after operation but intramedullary signal change in T2-weighted sagittal imaging is still remained.

ortant as a predisposing factor for the manifestation of symptoms. Nagashima⁶⁾, Sato and Tsuru¹²⁾ measured the sagittal diameter of the spinal canal in Japanese patients and found the values to be smaller than those in white patients. Although the symptoms differ, the initial symptoms of patients include 1. clumsiness of the hands, and pain radiating into the arms or all four extremities; 2. restriction of neck movement; 3. weakness of the arms and legs⁷⁾.

And radiographic characteristics were as follows in CLF. Plain radiography showed evidence of abnormal shadows of calcification on the posterior wall of the spinal canal and CT scans disclosed round or oval masses of high density projecting from the posterolateral side into the spinal canal⁵⁾. MRI demonstrated spinal cord compression from the posterolateral aspect. The cord was compressed not only by the calcified mass but also by hypertrophied ligamentum flavum^{2,13)}.

Although ossification of the ligamentum flavum is a well established finding, ossification and calcification may occasionally

Table 1. Characteristics of calcification and ossification of the ligamentum flavum^{14)*}

Characteristics	CLF	OLF
Location	Cervical	Lower thoracic
Age at presentation	7th decade	Younger than with presentation of CLF
Sex	Almost exclusively women	No sex prevalence
Axial CT	Nodular or diffuse calcification	Nodular or V-shape ossification
MRI	Hypointense on T1- and T2 weighted images	Hypointense on T1- and T2-weighted images at intervertebral level
Histology	Granules of calcification	Mature bones
Other possible findings	-	Ossification of posterior longitudinal ligament

*CLF : calcification of the ligamentum flavum, OLF : ossification of the ligamentum flavum, CT : computed tomography, MRI : magnetic resonance image

be confused. Usually CLF at the cervical level presents as progressive radiculomyelopathy. In OLF, lower thoracic vertebrae are *more frequent location and the mean age is more younger than CLF*. And CLF is more predominant in female, OLF is no difference in sex. Most of all, in CLF, calcified granules are deposited within the degenerative ligamentous fibers, with no mature bone formed within the ligament, which is the main difference between CLF and ossification of ligamentum flavum^{11,14)} (Table 1).

Most patients underwent laminectomy by posterior approach, which possibly leads to loss of stability. Osteoplastic expansive laminectomy, either by unilateral opening or by midline sagittal splitting, is a choice without significant loss of stability. In most cases, rapid recovery after operation is expected, because the posterior origin of the compression and therefore sparing of the anterior spinal circulation has been suggested as the explanation¹⁰⁾.

As stated in other reports^{2,5,13)}, computed tomography and MRI are the optimal diagnostic methods, providing both an adequate evaluation of the cord compression and an exact definition of the extent of the disease. Regarding intramedullary high-intensity areas, some authors have reported that they reflect edema and gliosis and they are associated with a poor prognosis. The postoperative course in our patient was satisfactory, with good recovery in spite of the existence of an intramedullary high-intensity signal on the preoperative MRI scan. Nakamura and Fujimura⁸⁾ suggested that the existence of high-intensity signal in patients with OLF who have no history of trauma may be due to reversible cord changes and this signal is not necessarily associated with a poor prognosis.

Conclusion

Reports of CLF-induced cervical myelopathy are rare and mainly discovered in Korea and Japan. Although sym-

ptomatic cervical CLF usually affects women older than 60 years of age, assuming that it is a progressive disease that starts early in life and becomes symptomatic later in life when spinal stenosis occurs. MRI and CT provide adequate diagnosis and allow proper surgical planning for decompression. Surgical decompressions was recommended as early as possible to avoid permanent deficits and to obtain improvement of the patient's symptoms.

References

1. Beamer YB, Garner JT, Shelden CH : Hypertrophied ligamentum flavum : Clinical and surgical significance. *Arch Surg* 106 : 289-292, 1973
2. Brown TR, Quinn SF, D'Agostino AN : Deposition of calcium pyrophosphate dihydrate crystals in the ligamentum flavum : evaluation with MR imaging and CT. *Radiology* 178 : 871-873, 1991
3. Gomez H, Chou S : Myeloradiculopathy secondary to pseudogout in the cervical ligamentum flavum : case report. *Neurosurgery* 25 : 298-302, 1989
4. Higashi S, Hamada J, Ono W, Tamai K, Saotome K : Calcification of cervical ligamentum flavum. *Ryumachi* 37 : 794-803, 1997
5. Iwasaki Y, Akino M, Abe H, Tsuru M, Tashiro K, Miyasaka K, et al : Calcification of the ligamentum flavum of the cervical spine. Report of four cases. *J Neurosurg* 59 : 531-534, 1983
6. Nagashima C : Cervical myelopathy due to developmental stenosis of the cervical spinal canal, part 1. *The sagittal diameter of the spinal canal. No Shinkei Geka* 1 : 163-171, 1973
7. Nakajima K, Miyaoka M, Sumie H, Nakazato T, Ishii S : Cervical radiculopathy due to calcification of the liamenta flava. *Surg Neurol* 21 : 479-488, 1984
8. Nakamura M, Fujimura Y : Magnetic resonance imaging of the spinal cord in cervical ossification of the posterior longitudinal ligament. Can it predict surgical outcome?. *Spine* 23 : 38-40, 1998
9. Okada K, Oka S, Tohge K, Ono K, Yonenobu K, Hosoya T : Thoracic myelopathy caused by ossification of the ligamentum flavum. Clinicopathologic study and surgical treatment. *Spine* 16 : 280-287, 1991
10. Ormola MF, Cardoso ER, Fox AJ, Drake CG, Durward QJ : Thoracic myelopathy secondary to ossified ligamentum flavum. *J Neurosurg* 56 : 448-450, 1982
11. Rhyu KU, Lee KJ, Park SC, Park HK, Cho KK, Rha HK, et al : Calcification of the ligamentum flavum causing radiculopathy. *J Korean Neurosurg Soc* 26 : 1748-1753, 1997
12. Sato M, Tsuru M : The antero-posterior diameter of the cervical spinal canal in cervical spondylosis (part 1). *No Shinkei Geka* 4 : 359-364, 1976
13. Shshil P, Anant K : Ossified-calcified ligamentum flavum causing dorsal cord compression with computed tomography-magnetic resonance imaging features. *Surg Neurol* 41 : 441-442, 1994
14. Ugarriza LF, Cabezudo JM, Porras LF, Rodriguez-Sanchez JA : Cord compression secondary to cervical disc herniation associated with calcification of the ligamentum flavum : case report. *Neurosurgery* 48 : 673-680, 2001
15. Yamaguchi M, Tamagaka S, Fugita S : A case of ossification of the ligamentum flavum causing thoracic myelopathy. *Orthop Surg(Tokyo)* 11 : 951-956, 1960