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Case report

Multiple Segments Thoracal Spinal Canal Stenosis Caused by Ossification of Ligamentum Flavum: A Case Report

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ABSTRACT

Background: Thoracal spinal canal stenosis (SCS) that refers to multiple segments of the thoracic spine is a peculiar clinical condition. Various factors can cause thoracic SCS, including ossification of the ligamentum flavum (OLF). The aim of this study is to explain about the diagnosis for multiple segment thoracal spinal canal stenosis and management properly to prevent further complications.
Case Presentation: A 58-year-old male came to Orthopaedic Outpatient Clinic in Prof. I.G.N.G Ngoerah Hospital, complaining back pain since one year prior to admission. Pain aggravated when he was bending his back. The patient was diagnosed with Thoracal Spinal Canal Stenosis Th 8-9, Th9-10, Th10-11. Patient underwent decompression, stabilization, fusion and biopsy surgery.
Results: Patient underwent decompression, stabilization, fusion and biopsy surgery at RSUP Prof. I.G.N.G Ngoerah. In durante operation, already done laminectomy and eight pieces of pedicle screw was applied in Th8-Th11 (55mm x 40 mm Monoaxial on right side Th8, 55mm x 40 mm Polyaxial on left side Th8; 55mm x 40 mm Monoaxial on right side Th9, 55mm x 35 mm Monoaxial on left side Th9; 55mm x 40 mm Monoaxial on right and left side Th10; 55mm x 40 mm Monoaxial on right and left side Th11). There were no complications found in this patient after 4th day following surgery.
Conclusion: The goal of surgical intervention for SCS is decompression by removing the calcific areas that are responsible for the spinal canal narrowing and subsequent cord compression. Although the diagnosis and choice of intervention can be difficult, early detection and management are critical to postoperative success. Postoperative results are variable and often unsatisfactory.

Keywords: Spinal canal stenosis, ligamentum flavum, spine, surgery

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BACKGROUND

Thoracal spinal canal stenosis (SCS) that refers to multiple segments of the thoracic spine is a peculiar clinical condition. Various factors can cause thoracic SCS, including ossification of the ligamentum flavum (OLF) (Han et al., 2017). The ligamentum flavum (LF) connects adjoining two laminas at the posterior side of the duramater and both side flaps are separated at the midline. It extends laterally to the anterior side of the facet joint and separated from the dura-mater by epidural fat. For convenience of the explanation of the pathologic progression,

LF is divided into two parts: as a capsular portion and an inter-laminar portion (Ahn et al., 2014).

Local biomechanical stress, tissue degeneration, metabolic abnormalities, and several genetic factors are all causes of OLF. A biomechanical mechanism as a cause of this disorder would be different in nature from the usual degenerative processes that occur due to hypermobility because the movement of the thoracic spine is limited compared to the cervical and lumbar spines. The putative mechanism is as follows. When the tensile force increases, BMP-2, TGF-beta, and SOX are elevated in the ligamentum flavum. Then, the fibroblasts become differentiated into chondroblasts and osteoblasts, and finally ossification of the ligament develops (Ahn et al., 2014; Han et al., 2017; Li et al., 2016). OLF the most common cause of thoracic spinal canal stenosis, especially in Asian populations, especially in Japan, China, and Korea. Reportedly, the prevalence of OLF ranges from 3.8% to 26% (Zhang et al., 2016). The disease frequently affects adults and the incidence is 63.9% among between 40 and 60 years of age regardless of the symptoms (Ahn et al., 2014; Shepard et al., 2015; Sun et al., 2011).

The predilection sites are the lower thoracic, high thoracic and mid thoracic areas, in order of frequency. The most frequent site is between T10 and T11, and it is presumed that this is because these segments receive the maximum tensile force (Ahn et al., 2014). The disease begins with thickening of ligamentum flavum and, then, ossification occurs along the superficial layer of the thickened ligamentum flavum. This ossified segment usually compresses the spinal cord, leading to thoracic myelopathy or radiculopathy (Bahadır and Yılmaz, 2016). OLF suggest leads to canal stenosis, which then results in obstruction of blood flow, and when the obstruction exceeds a certain threshold, acute onset of paralysis takes place (Hisatsugu and Satoshi, 2017). The most frequent initial symptoms are tingling or numbness, while the major complaint is paraparesis, usually spastic among patients. Other symptoms are back pain, gait disturbances, lower limb pain, and bladder dysfunction (Shepard et al., 2015).

Diagnosis of OLF occurs through a combination of plain radiograph, computed tomography (CT), and magneting resonate imaging (MRI) (Bahadır and Yılmaz, 2016). On plain radiograph, calcification of the posterior elements of the spinal canal may indicate OLF; however, further investigation with CT is often needed for confirmation. On sagittal CT, thickening and calcification of the laminar components can be identified and used to accurately diagnose OLF (Shepard et al., 2015). While CT shows contours of ossification and additional ossification of dura more precisely, MRI shows the degree of canal compromise and myelopathy more accurately (Bahadır and Yılmaz, 2016).

Prompt surgical is necessary when spinal canal thoracic stenosis symptoms develop. Once diagnosed the goal of surgical intervention is decompression by removing the calcific areas that are responsible for the spinal canal narrowing and subsequent cord compression. The more severe the preoperative symptoms are and the longer the decompression surgery is delayed, the poorer the surgical outcome. Though the prognosis is better than with other causes of spinal canal thoracic stenosis, progress in improving treatment is still not complete (Ahn et al., 2014).

This study reported a case of Spinal Canal Stenosis of Thoracic Region caused by Ossification of Yellow Ligament in Thoracic Region Th8-9, Th9-10, Th10-11 in a 58-year-old male with the chief complaint back pain. He was suspected as having spi-

nal canal stenosis by history taking and physical examination. Radiology investigations was performed and after establishing a working diagnosis of thoracal spinal canal stenosis Th 8,9,10,11. Decompression, stabilization, and fusion are the treatment option for this patient to relieve the compression and stabilize the spine.

CASE PRESENTATION

A 58-year-old male Balinese came to Orthopaedic Outpatient Clinic in RSUP Prof. I.G.N.G Ngoerah, complaining back pain (See figure 1) since one year prior to admission. Pain aggravated when he was bending his back. Numbness over extremity has denied but the patient slowly feel impairment in walking stability. There were no abnormalities in voiding and defecating. The patient's job is as a cleaning service in a traditional market. The medical report illness and family history were not found in this patient.

The patient has done the treatment with the Neurologist with vitamin but, his condition doesn't improve 3 months later and he was advised to do a MRI examination. He was referred by Kerta Usada Hospital by Orthopaedic surgeon with diagnosis of Spinal Myelopathy. He has history of trauma which is fell down with standing position about 10 years ago. History of chronic cough, night sweat, and weight loss was denied. Patient daily life involving lifting heavy weight loads. Patient current job is truck driver.

From physical examination, there was no swelling and deformities were found, midline tenderness was found in T8-L1, without hyposthesia. The motoric powers in upper and lower extremities was found 55555/55555. Physiological reflex was found positive and increased. Clonus was positive, and pathological reflex was positive for Babinsky. Patient underwent Thoracolumbal X-ray AP/Lateral View, Lumbosacral X-Ray AP/Lateral/Dynamic View, EMG-NCV in RSUP Prof. I.G.N.G Ngoerah and MRI Whole Spine Non-contrast in other hospital one year prior to administration. The thoracolumbal X-Ray finding was minimal anterior wedging of Th12 and thoracolumbal spondylosis.

RESULTS

From lumbosacral X-Ray finding was lumbal spondylosis and there was no listhesis, compression or fracture (See figure 2). From EMG-NCV found the lesion between C5 and Th12. The patient later underwent MRI Whole Spine on Siloam Hospital. The finding was kypholordotic curve of cervicothoracal spine are decreased (muscles spasm) and disc desiccation at all lumbar discs (See figure 3). In thoracal, there was disc desiccation at T11-12 level. In lumbal, disc desiccation at L1-2, L3-4, L4-5 levels. There was diffuse disc bulge, causing indentation the thecal sac without significant spinal canal or neural foramina narrowing at L3-L4 level. At L4-L5 level, the disc was bulged diffuse and central annular tear, causing indentation the thecal sac with left neural foramina narrowing. At L5-S1 level also the disc was bulged diffuse, causing indentation the thecal sac with mild bilateral neural foramina narrowing, left more than right. The patient was diagnosed with Thoracal Spinal Canal Stenosis Th 8-9, Th9-10, Th10-11.

Patient underwent decompression, stabilization, fusion and biopsy surgery on August 1st 2019 at RSUP Prof. I.G.N.G Ngoerah. In durante operation, already done laminectomy and eight pieces of pedicle screw was applied in Th8-Th11 (55mm x 40 mm Monoaxial on right side Th8, 55mm x 40 mm Polyaxial on left side Th8; 55mm x 40 mm Monoaxial on right side Th9, 55mm x 35 mm Monoaxial on left side Th9;

55mm x 40 mm Monoaxial on right and left side Th10; 55mm x 40 mm Monoaxial on right and left side Th11) (See figure 4 & 5). We found ossification on ligamentum flavum then excision and biopsy was done. The sample was taken from left side of Th8 and Th9. Then stabilization was done on Th8-Th11 by two pieces of rod size 110 mm, crosslink size 38 mm and eight pieces of nutt. Next, the fusion was done on facet joint Th8-Th11. Ossification of ligamentum flavum is thought as the cause of thoracal spinal canal stenosis in this patient. There were no complications found in this patient after 4th day following surgery. In August 8th 2019, the result of pathology anatomy was done. The result was hyalinisation of chondroblast and fibrosis.

Figure 1. Clinical Picture of the Patient

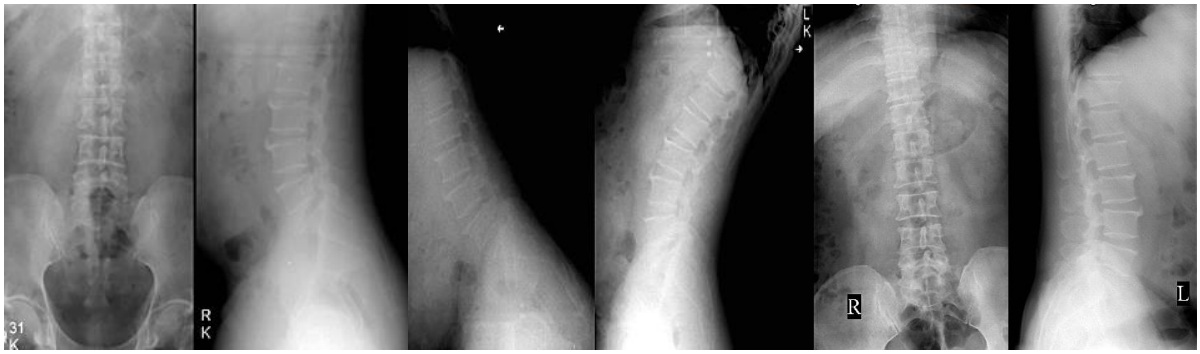
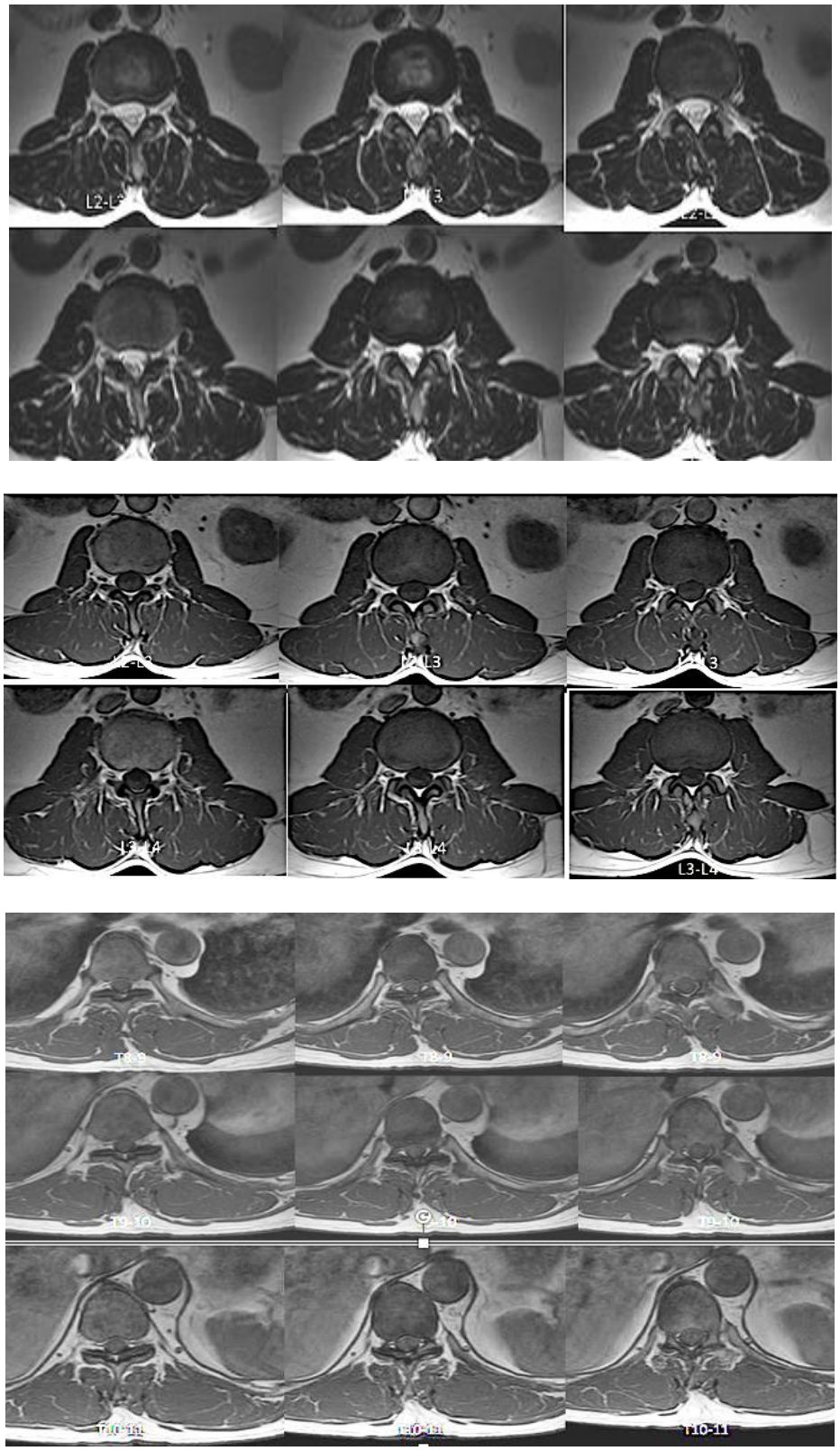


Figure 2. Lumbosacral X-Ray (A) AP/Lateral (B) Dynamic View, (C) Thoracolumbal X-Ray AP/Lateral View.



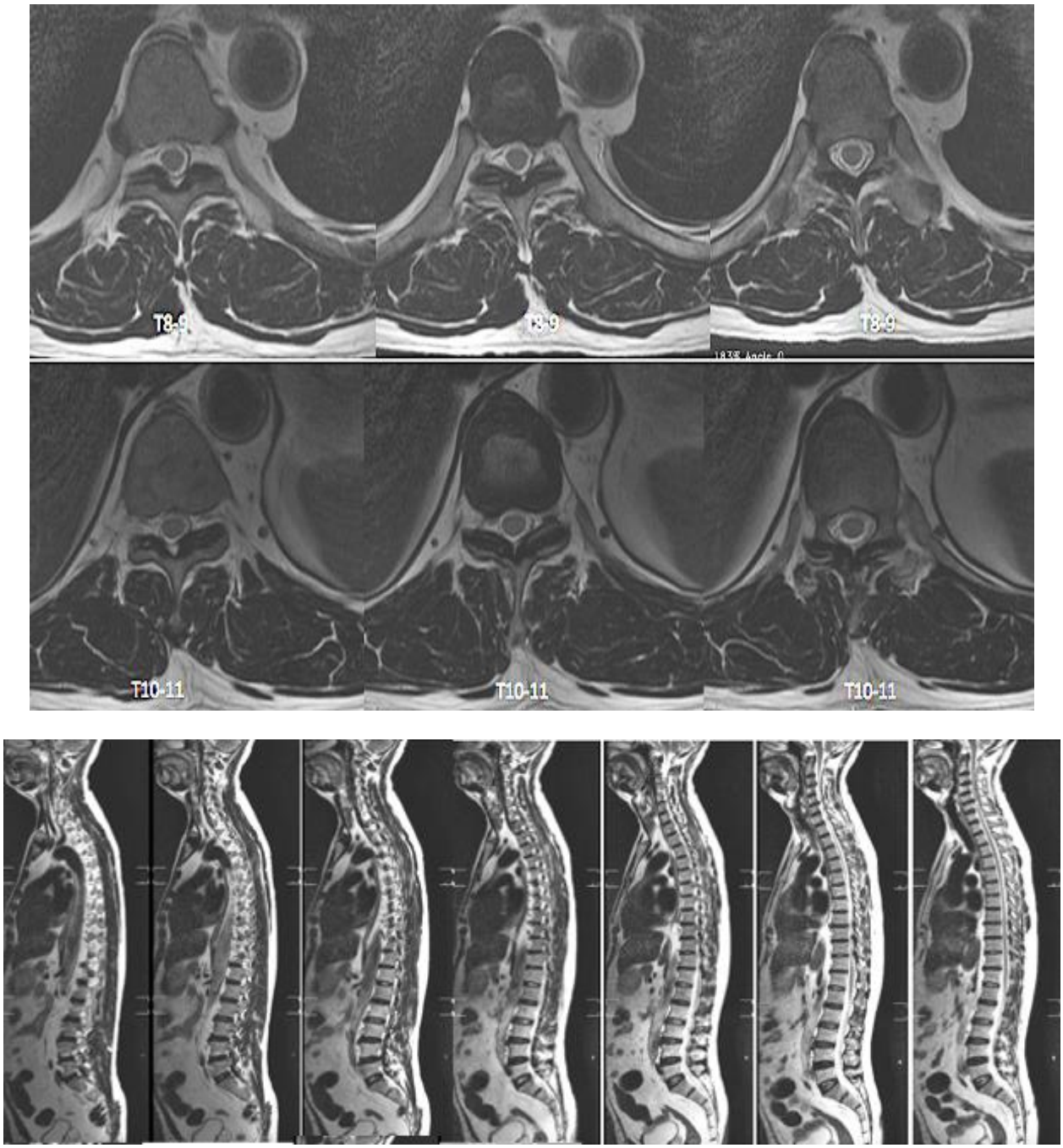


Figure 3. MRI Thoracolumbal (A) Non Contrast T2W Axial View, (B) Non contrast T1W axial view (C) Thoracol non contrast T1W Axial View (D) Thoracal non contrast T2W Axial view (E) Whole Spine Non contrast T2W sagital New

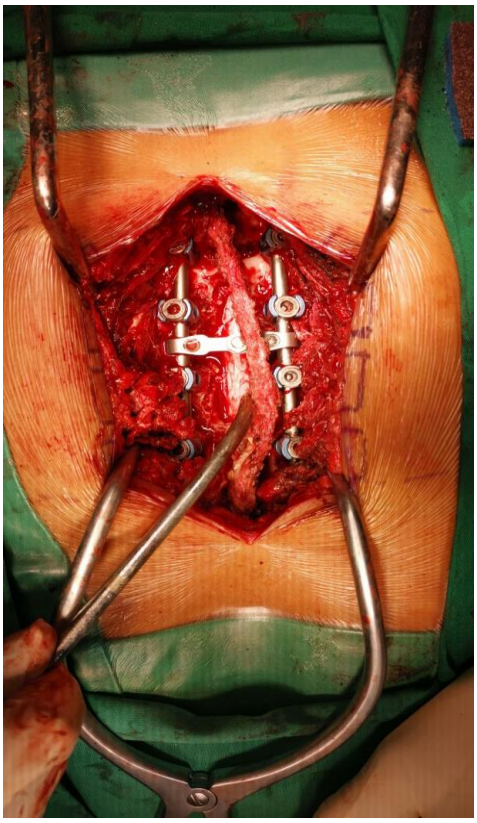


Figure 4. Intraoperative view in the thoracolumbal

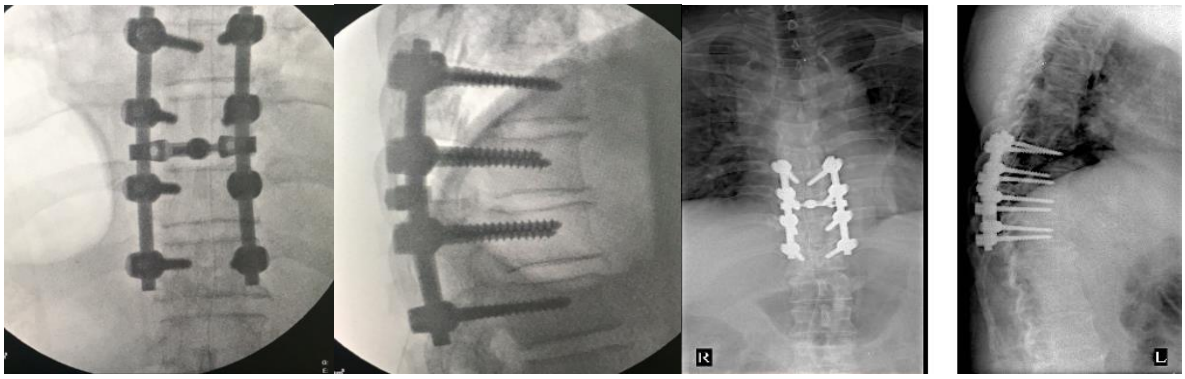


Figure 5. Post-operative Thoracal (AP/Lateral) C-Arm intraoperative view.

DISCUSSION

Multiple segments of Thoracic SCS is a rare clinical condition. The incidence of thoracic canal spinal stenosis is significantly lower than cervical stenosis and lumbar spinal stenosis. Various factors can cause thoracic SCS. OLF is the most important factor that leads to this disease. It can cause thoracic spinal canal volume smaller, thoracic spinal cord and nerve root compression which can lead to the corresponding clinical symptoms and signs of disease (Han et al., 2017).

Although the exact etiology is unknown, the incidence of thoracic OLF is reported to be higher in patients with diffuse idiopathic skeletal hyperostosis, fluorosis, diabetes mellitus, ankylosing spondylitis, and ossification of the posterior longitudinal ligament (Bahadır and Yılmaz, 2016). Most frequently, lower thoracic segments (T9-12) are involved, as they are the

regions where flexion, extension, and rotation occur most (Bahadır and Yılmaz, 2016). As lower thoracic spine sustains greater forces due to frequent motion, severity of OLF increases as thoracolumbar junction is approached. When the tensile force increases, BMP-2, TGF-beta, and SOX are elevated in the ligamentum flavum. Then, the fibroblasts become differentiated into chondroblasts and osteoblasts, and finally ossification of the ligament develops (Ahn et al., 2014). In this case the patient was Asian male in his near sixty. Patient was a truck driver. His occupations and daily living involving lifting heavy weight loads. He also has a history fell down with standing position about 10 years ago which cause OLF more likely to occur.

Symptoms may vary according to the patient's age, cause of stenosis, duration, extent of the compression, and level of stenosis. Symptoms include one or both legs may be heavy, weak, and stiff, impairing balance when walking. extensive numbness and (or) pain in one or both legs, spinal cord-related claudication, difficulty in urination and defecation or sexual dysfunction, zonesthesia on the chest or abdomen, radiculopathy in the chest or abdomen (Han et al., 2017). Signs including signs indicating upper motor neuron disorder such as hypermyotonia in the legs and positive Babinski or Chaddock signs, signs indicating mixed upper and lower motor neuron disorder such as patellar tendon hyperreflexia combined with Achilles tendon hyporeflexia. This type of sign is usually found in spinal stenosis of the thoracolumbar region. Signs indicating extensive lower motor neuron disorder that cannot completely be explained by lumbar spinal disease (Chen and Sun, 2015). The most common clinical manifestation at the time of the diagnosis is loss of functional gait. The diagnosis is commonly missed and delayed because of its insidious and chronic progression and the frequent presence of other spinal diseases. Clinical manifestations and imaging tests are the two mainstays in the diagnosis (Ahn et al., 2014). Initial evaluation of a patient with spinal stenosis often begins with a detailed history of symptoms and physical exam, with a focus on sensation, motor strength, reflexes, and gait (Hisatsugu and Satoshi, 2017). The patient in this case complained back pain since one year prior to admission. Pain aggravated when he was bending his back. Numbness over extremity has denied but the patient slowly feel impairment in walking stability without abnormalities in voiding and defecating. From physical examination, there was no swelling and deformities were found, midline tenderness was found in T8-L1, without hypoesthesia and anesthesia . The motoric powers in upper and lower extremities was found 55555-/55555. Physiological reflex was found positive and increased. Clonus was positive, and pathological reflex was positive for Babinsky.

Imaging examination is an important part of the diagnosis and management of thoracic SCS (Han et al., 2017). Ossification of the ligamentum flavum (OLF) was discovered by Polgar through a lateral X-ray film. CT and MR imaging are effective for the diagnosis. CT can clearly reveal abnormal ossification of the soft tissue. MRI is a valuable tool before surgical decompression because it allows the visualization not only of the magnitude of spinal cord compression but also of intramedullary signal intensity. The presence of intramedullary increased signal intensity (ISI) on T2-weighted imaging (WI) in patients with thoracic OLF reflects chronic spinal cord compression (Zhang et al., 2016). However, the differential diagnosis of hypertrophy or calcification is difficult

even with an MRI (Ahn et al., 2014). The patient in this case underwent Thoracolumbal X-ray AP/Lateral View and Lumbosacral X-Ray AP/Lateral/Dynamic View in RSUP Prof. I.G.N.G Ngoerah. The thoracolumbal X-Ray finding was minimal anterior wedging of Th12 and thoracolumbal spondylosis. From lumbosacral X-Ray finding was lumbal spondylosis and there was no listhesis, compression or fracture. From EMG-NCV found the lesion between C5 and Th12. The patient later underwent MRI Whole Spine non-contrast on Siloam Hospital. The finding was kypholordotic curve of cervicothoracal spine are decreased (muscles spasm) and disc desiccation at all lumbar discs. In thoracal, there was disc desiccation at T11-12 level. In lumbal, disc desiccation at L1-2, L3-4, L4-5 levels. There was diffuse disc bulge, causing indentation the thecal sac without significant spinal canal or neural foramina narrowing at L3-L4 level. At L4-L5 level, the disc was bulged diffuse and central annular tear, causing indentation the thecal sac with left neural foramina narrowing. At L5-S1 level also the disc was bulged diffuse, causing indentation the thecal sac with mild bilateral neural foramina narrowing, left more than right.

The treatment and prognosis of thoracic spinal canal stenosis is different from cervical and lumbar spinal stenosis disease. This condition is caused by reduction of the thoracic spinal cross section, which can lead to compression of the spinal cord (Han et al., 2017). Conservative treatment does not work. Surgical decompression is necessary and should be done as soon as symptoms develop. The options of decompression surgery are Laminotomy, Laminoplasty, En block laminectomy+dural excision leaving arachnoid, En block laminectomy+dural excision+patch graft, and Laminectomy+floating ossified dura mater (Ahn et al., 2014). Decompression and laminectomy play an important role in the cure of thoracic SCS. The pertinent method according to the classification is French type laminectomy up to the enlarged type. Bilaterally ossified ligaments can be excised separately. En bloc laminectomy is necessary above the fused type. Below the extended type without dural adhesions, decompression can be performed with laminotomy or laminoplasty. The universal method, bilateral laminectomy and excision of ossified ligament, is the third technique used (Ahn et al., 2014). Posterior en bloc or segmental laminectomy or floating decompression is recommended in thoracal SCS secondary to OLF. A high speed drill should be used. Internal fixation and fusion can be performed in patients with thoracolumbar regional stenosis and those who have undergone multiple segmental laminectomy (Chen and Sun, 2015).

From the durante operation, we found thickening of ligamentum flavum from Th8 until Th11. The patient was treated with decompression, stabilization with internal fixation, and fusion surgery. We insert pedicle screw start from Th8 until Th11 then laminectomy and continued with insert the rod and crosslink. The surgery option stated because the patient has a spinal compression symptom and conservative treatment before administration to the hospital did not work.

Histological examination of OLF typically shows mature lamellar bone associated with proliferating cartilage replacing the ligamentum flavum (endochondral ossification), which begins near the facet joint, at the junction between the joint capsule and the ligamentum flavum. The proliferation of cartilaginous tissue triggers the ossification (Hur et al., 2009). In this case, we have done histological examination from left Th9 and the result was hyalinization chondroblast cell and fibrosis.

Complications of thoracic SCS surgery mainly include nerve injury, cerebrospinal fluid leakage, supply vascular compression of the spinal cord, epidural hematoma. This operation can extend the thoracic spinal canal to allow for complete decompression of the spinal cord (Ahn et al., 2014; Han et al., 2017). In this case patient was discharge from the hospital without another complication from surgery. Another follow up examination needed to asses patient condition after surgery.

Recognition of the best timing for surgery to ensure neurological improvement is an important clinical issue (Yamada et al., 2021). Thus far, numerous factors have been reported to affect postoperative outcomes in patients with thoracic OLF. Age, duration of myelopathic symptoms, levels of OLF, CT axial classification, signal intensity changes on preoperative MRI, and preoperative (Japanese Orthopaedic Association) JOA score have been considered key predictors (Kikkawa and Hoshino., 2006). However, the list of predictive factors differs according to researchers, and the prognostic significance of these factors remains controversial (Zhang et al., 2016). Criteria for Evaluating the Surgical Outcome of TSS based on clinical evaluation and radiologic evaluation (Abbas et al., 2021). Clinical Evaluation include changes in spinal cord function should be assessed by calculating Japanese Orthopaedic Association thoracic spinal cord (full score=11) or Chinese Orthopaedic Association thoracic spinal cord scores (full score= 22), changes in pain should be assessed with VAS scores (0–10), changes in social and psychological state should be assessed with the SF-36. Radiological Evaluation consist of decompression of the spinal cord: assessment of completeness of resection of the compressive lesion and the appearance of the spinal cord and dural sac, changes in curvature of the thoracic and whole spine: identification and assessment of postoperative deterioration in thoracic kyphotic angle (iatrogenic kyphosis), improvement in preoperative kyphotic deformity and the sagittal and coronary balance of the trunk, location of the implants: assessment as to whether the locations of the screws and cages meet the requirements for mechanical stability and results of fusion: assessment as to whether bony fusion has been achieved by the 6 month follow-up (Chen and Sun, 2015). After 2 years follow up, we have evaluated the outcome by clinical evaluation and calculating the Japanese Orthopaedic Association thoracic spinal cord. The backpain was improved that we evaluated by calculating ODI score which is the ODI score was 10 (mild disability). The patient still feel impairment in walking stability without neurological deficit. There is no impairment in voiding and defecation. When we compared the JOA score between pre-operative and post-operative, there is no significant change which is the JOA score was 10 (fair).

Our case presented ossification of ligamentum flavum on thoracal region treated surgically with decompression, fusion and stabilization. Although the diagnosis and choice of intervention can be difficult, early detection and management are critical to postoperative success. Postoperative results are variable and often unsatisfactory. Though the prognosis is better than with other causes of thoracic myelopathy, progress in improving treatment is still not complete.

AUTHOR CONTRIBUTION

I Gusti Lanang Ngurah Artha Wiguna is the main author who determines the concept and review. I Nyoman Yuda Raditya searching for literature, editing and reviews Ida

Bagus Gede Arimbawa determines the concept and review

FINANCIAL AND SPONSORSHIP

None.

CONFLICT OF INTEREST

We declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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