Review paper

Management of patients with cervical myelopathy

Postępowanie u pacjentów z mielopatią szyjną

Natalia Gołębiowska

Department of Neurosurgery and Spine Surgery, Regional Hospital, Kielce, Poland
Head of the Department: Jacek Gołębiowski MD, PhD

Medical Studies/Studia Medyczne 2019; 35 (4): 319–323
DOI: https://doi.org/10.5114/ms.2019.91250

Key words: cervical spondylosis, myelopathy, anterior surgery, posterior surgery.

Słowa kluczowe: spondyloza szyjna, mielopatia, dostęp przedni, dostęp tylny.

Abstract

Myelopathy is a neurological deficit related to the spinal cord, and cervical spondylosis is its leading cause. The majority of middle-aged people have radiological evidence of significant cervical spine degeneration. The most characteristic symptoms are: neck pain with reduced range of motion, pain and paraesthesias in shoulders, gait disturbance, weakness or instability of lower extremities, loss of manual dexterity, and glove-distribution sensory loss in hands. The pathophysiology of cervical spondylotic myelopathy involves static, dynamic, and ischaemic factors. There are two surgical approaches: anterior and posterior. The posterior approach includes laminectomy and laminoplasty. The anterior approach includes anterior discectomy and fusion, and anterior corpectomy and fusion. This paper reviews the pathophysiology and clinical manifestation of cervical spondylotic myelopathy, and surgical approaches to treat patients with this disease.

Streszczenie

Mielopatia to choroba neurologiczna związana z patologiami rdzenia kręgowego, jej najczęstszą przyczyną jest spondyloza kanału kręgowego w odcinku szyjnym. Radiologiczne cechy znacznej stenozy w tym odcinku ma większość osób w średnim wieku. Najczęściej występującymi objawami są: ból szyi, ograniczony zakres ruchu w odcinku szyjnym kręgosłupa, ból i parestezje ramion, zaburzenia chodu, osłabienie siły i niestabilność kończyn dolnych, zaburzenia wykonywania czynności precyzyjnych dłońmi oraz zaburzenia czucia w okolicy rąk. Czynniki patofizjologiczne wywołujące mielopatię szyjną dzieli się na: statyczne, mechaniczne i niedokrwienne. Wyróżnia się dwa dostępy chirurgiczne – przedni i tylny. Z dostępu tylnego wykonywane są laminektomia i laminoplastyka. Z dostępu przedniego przeprowadza się dyscektomię ze stabilizacją oraz korpektomię i stabilizację. W artykule przedstawiono patofizjologię, obraz kliniczny oraz metody leczenia operacyjnego spondylozy szyjnej.

Introduction

Myelopathy is a neurological deficit related to the spinal cord, and cervical spondylosis is its leading cause [1]. The majority of middle-aged people have radiological evidence of significant cervical spine degeneration, but only 10% of them present clinical symptoms [2, 3]. In this group of patients, it occurs most often in the C5/C6 and C6/C7 levels, and in elderly people it affects the C3/C4 and C4/C5 levels more often [3]. The most characteristic symptoms are: neck pain with reduced range of motion, pain and paraesthesias in shoulders, gait disturbance, weakness or instability of lower extremities, loss of manual dexterity, and glove-distribution sensory loss in hands [2–4].

This paper reviews the pathophysiology and clinical manifestation of cervical spondylotic myelopathy, and surgical approaches to treat patients with this disease.

Pathophysiology

The diameter of a normal cervical canal is estimated to range from 13 to 20 mm, and when its size diminishes to 12 mm it causes spinal cord compression [3].

The myelopathy occurs as a result of static mechanical factors, dynamic mechanical factors, and spinal cord ischaemia [2–5]. Static factors are structural abnormalities that cause the narrowing of the spinal canal and direct spinal cord compression. Osteophytic spurs, protrusion of the intervertebral disc, reduction or reversal of normal cervical lordosis, subluxation, hypertrophy and ossification of ligaments, and hypertrophy of articular facets, lamina, and dura are some of these

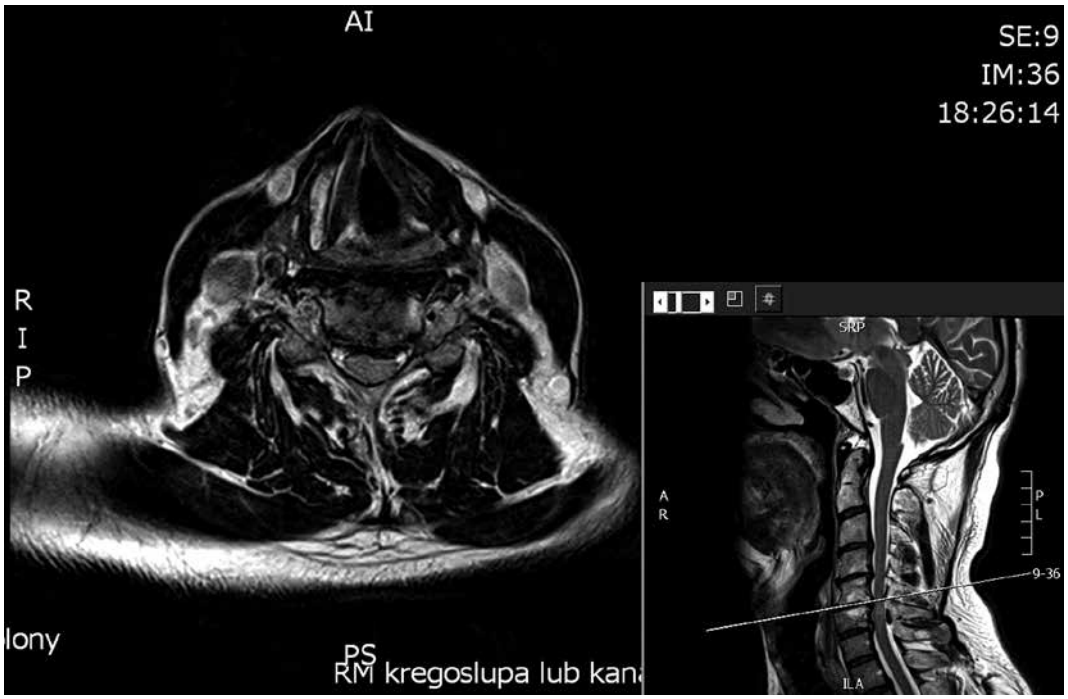

Figure 1. T2 MRI image of spinal cord compression due to cervical spondylosis

[2, 5–7] (Figure 1). In the presence of static factors, dynamic movement of the cervical spine, both extension and flexion, lead to repeated spinal cord injuries, which constitutes the dynamic factor of myelopathy [2, 5].

Secondarily to degenerative changes, spinal cord ischaemia may develop due to compression of vascular structures. Anterior spinal artery, posterior spinal artery, radicular arteries, or spinal cord arteries can be directly compressed and thus lead to ischaemia. In the case of venous compression, venous congestion and further ischaemia may develop [2–5].

Clinical presentation

Some patients present a slow and progressive deterioration, whereas others have a stepwise pattern with periods of worsening and periods of stabilisation, which is the most common pattern. An acute presentation is not common and is presented by about 5% of patients [3].

The most common first manifestations are gait and balance disturbance with weakness and stiffness of lower extremities [2–4]. Symptoms experienced by patients can be sensory, motor, or sphincter dysfunctions.

Sensory abnormalities may be minimal and may not present radicular distribution. Most common are: glove sensation loss in the hands, neck and shoulder pain, paraesthesia in upper extremities, or proprioceptive dysfunctions [2, 4, 6–8].

Motor dysfunctions can be caused by cord or root compression presenting upper or lower motor neuron syndrome. The most common motor system is gait disturbance [2, 3]. Other symptoms that patients complain of are deterioration of fine motor skills, weakness in triceps, atrophy of intrinsic hand muscles, and weakness of proximal muscles of lower extremities [2, 3, 4, 8].

Increased urinary urgency or frequency can also be observed; however, anal sphincter disorders are uncommon.

During physical examination hyperactive reflexes can be observed. Upper motor neuron signs can also be seen, such as Babiński sign, Hoffman's sign, Oppenhaim's sign, inverted radial reflex, or clonus. Lhermitte's sign, which indicates dysfunction in the posterior column, can be also present [2–4].

Clinical evaluation

An magnetic resonance imaging (MRI) test is a gold standard for patients with suspected cervical spondylotic myelopathy. It provides information not only about the spinal canal but can also show abnormalities in the spinal cord and the discs, ligaments, and subarachnoid space (Figure 2). The most commonly used images are T1- and T2-weighted, and the presence of hypointense signal on T1 and hyperintense signal in spinal cord on T2 sequences is a poor prognostic factor that indicates spinal cord damage [3, 4, 8]. Computed tomography (CT) scans are a supplementary imaging tool to MRI and can provide specific information about bone structure, osteophytes, and degenerative alterations [2, 3]. Plain X-ray scan may provide some useful information about dynamic instability or sagittal balance, or it can be used to assess

the Torg-Pavlov Ratio, which is the ratio between the AP diameter of the spinal canal and vertebral body diameter. This ratio is also useful to assess postoperative outcomes. Electromyography and somatosensory evoked potentials are not routinely used.

There are two functional scales that are most commonly used, tested for validity and reliability: the modified Japanese Orthopaedic Association scale (mJOA) and the Neck Disability Index. The mJOA is based on four categories: motor dysfunction of upper extremity, motor dysfunction of lower extremity, sensory dysfunction, and sphincter dysfunction, with a maximum score of 18 points. Mild myelopathy is indicated by 15 or more points, moderate by 12 to 14, and severe by less than 12 points. The Neck Disability Index is a modification of the Oswestry Disability Index, consisting of a 10-point questionnaire, with the total result of 100%. A score of 10–28% is classified as mild, 30–48% as moderate, 50–64% as severe, and over 70% as complete disability [2, 8]. Another commonly used scale is the Nuric Grade [3, 4].

Nonsurgical treatment

In cases of mild degenerative spondylotic myelopathy nonsurgical treatment can be taken into consideration. Analgesics, anti-inflammatory drugs, physiotherapy, low-risk activities, and cervical immobilisation are prescribed [2, 3].

The latest research indicates that this disease leads to continued neurological deterioration, and prolongation of the time of nonsurgical treatment leads to irreversibility of these deficits [2]. It is uncertain if the nonsurgical treatment can stop the progression of the disease even in its mild phase [9]. It is now increasingly recommended to perform a surgery when the disease is still in the moderate phase [4, 9, 10].

Surgical approaches

Surgery is the only method that can stop the disease progression and significantly improve patients' quality of life. There are two types of surgical cervical approaches: anterior and posterior. The posterior options include laminectomy and laminoplasty. The anterior approach includes the following options: anterior cervical discectomy and fusion; anterior cervical corpectomy and fusion. Use of a microscope is essential to avoid spinal cord damage during the surgery. The use of somatosensory evoked potentials or motor evoked potentials to monitor spinal cord function is recommended when operating on patients with myelopathy [11]. The aim of surgery is to decompress the spinal cord, restore lordotic alignment of the cervical spine, and to stabilise the spine [12].

Posterior cervical approaches

This approach is initially chosen in the following situations: disease affecting more than three levels,

Figure 2. Same patient, transverse T2 MRI images of cervical spondylosis

primary posterior pathology, congenital cervical stenosis, or in case of ossification of posterior longitudinal ligament or yellow ligament [11, 13, 14]. Kyphotic alignment of the cervical spine is a contraindication to this surgery. Posterior approaches include laminectomy and laminoplasty. Both surgeries can be expanded by performing fusion, which is typically done with lateral mass screws [11, 12]. Both surgeries increase the space available for the spinal cord.

Laminectomy is performed most often on the C3–C6 level, which is called a standard laminectomy. If the surgery includes C2 and C7 levels it is called an extended laminectomy [2]. The patient is placed under general anaesthesia, lying in a prone position. Surgery can also be performed with the patient in a sitting position, but there is a higher risk of air embolism, hypotension, cord ischaemia, or stroke [2, 15]. An incision is made in the midline longitudinally. Then stripping of the paraspinal muscles is performed to expose the vertebra. Decompression is achieved by removing the spinous process and the lamina on both sides on the level of compression [5, 14]. Then a nerve hook or a dissector is used to assess the spinal canal area. Use of a hard cervical collar is necessary after surgery for up to 6 weeks [15]. Possible complications include: spinal cord injuries (0–10%), kyphosis and spinal deformity (14–47%), axial neck pain, C5 nerve root palsy (3–5%), dural tear with cerebrospinal fluid leakage, infection, and haematoma [2, 4, 12, 15].

Laminoplasty is much more tissue sparing than laminectomy and preserves motion relatively well. It allows reconstruction of cervical lordosis without fusion [16]. Nowadays laminoplasty has become the

preferred procedure for treating multilevel cervical spondylotic myelopathy. The patient is placed under general anaesthesia, lying in a prone position. Then an incision is made in the midline longitudinally. Then stripping of the paraspinal muscles is performed to expose the vertebra. Next the laminoplasty is performed in one of the two ways: the open-door (single door) technique and the double-door (French door) technique. In the open-door technique, an opening is made on one side by dividing the junction of lateral mass and lamina, and on the other side a hinge is created by thinning the dorsal cortex and thus creating a greenstick fracture. In the French-door technique a midline osteotomy is performed through the spinous process and a gutter is made in the lamina, so that the hinge is created bilaterally. In both techniques the opening can be maintained by using a bone graft, ceramic spacers, or plates [5, 11, 14]. Possible complications include: loss of cervical lordosis, decreased cervical range of motion (17–20%), axial neck pain (40–60%), dural tear with cerebrospinal fluid leakage, C5 nerve root palsy (5–12%), infection (3–4%), and potential progression of ossification of posterior longitudinal ligament [4, 8, 11, 16]. The latest research has shown that preservation of the C2 and C7 muscular attachments can prevent post-surgical axial neck pain and reduced range of cervical motion [5, 16].

Anterior cervical approaches

This approach is selected to treat pathologies that involve one or two vertebral bodies. Anterior cervical approaches include anterior cervical discectomy and fusion or corpectomy. The advantage of this type of surgery is better correction of cervical lordosis.

Anterior cervical discectomy and fusion – this approach allows direct access to the pathologies compressing the spinal cord such as the disc material or osteophytes. The patient is placed under general anaesthesia and lies in a supine position with his/her neck in an extension. A C arm is used to mark the appropriate level. Next a transverse incision is made on the anterolateral side of the neck. Then dissection of neck muscles is performed; special care must be taken during this process due to the proximity of the oesophagus, trachea, carotid, and vertebral artery. Then the discectomy and removal of osteophytes is performed with the use of a microscope. A cage implant is placed into the intervertebral space to restore its height and to stabilise the spine under the C arm control. Possible complications: C5 nerve root palsy (4.6%), reduced range of cervical motion, spinal cord injury, dysphagia (2–48%), hoarseness (temporary 3–11%), pseudarthrosis, perforation of the oesophagus, graft complication, carotid or vertebral artery injury (0.03%), dural tear with cerebrospinal fluid leakage, and degeneration of adjacent segments (3%) [4, 17, 18].

Anterior corpectomy – this technique is preferred when multilevel discectomy is necessary or when there are pathologies surrounding the vertebral body and it is necessary to decompress a large area of the spinal canal [5, 19]. The patient is placed under general anaesthesia and lies in a supine position with his/her neck in an extension. Next, depending on the surgeon's preference, a longitudinal or transverse incision is made at the appropriate level. A longitudinal incision is made along the medial border of the sternocleidomastoid muscle while the transverse incision is performed parallel to the medial border of this muscle. Next, the sympathetic chain must be localised and retracted medially. Then a C arm is used to confirm the level of surgery. In the next step the vertebral body is removed. To fill the defect a titanium interbody cage and a bone graft are used. Then the anterior plate is used to secure the construct [20]. Possible complications include: C5 nerve root palsy, spinal cord injury, dysphagia (2–48%), hoarseness (temporary 3–11%), pseudarthrosis, perforation of the oesophagus, graft complication, carotid or vertebral artery injury (0.03%), dural tear with cerebrospinal fluid leakage, transient Horner syndrome, and degeneration of adjacent segments (3%) [4, 19].

Conclusions

Cervical spondylosis is the most common cause of myelopathy, and it is a common problem in elderly people. A surgical approach is the treatment of choice, and its goal is to decompress the spinal cord and to restore cervical lordosis. It is still a matter of controversy whether to use the anterior or posterior approach because both approaches have their advantages and disadvantages. Sometimes it is necessary to perform combined anterior-posterior or posterior-anterior surgery in selected cases. The optimal surgical approach should be carefully chosen depending on the location and extension of the spinal cord compression, sagittal alignment, or instability.

Conflict of interest

The authors declare no conflict of interest.

References

1. Sawaya R, Nachef Z. Differential diagnosis of myelopathies. Int J Med 2014; 2. 10.14419/ijm.v2i1.1784.
2. Greenberg MS. Handbook of Neurosurgery. Thieme Medical 2016; 71: 1083-1093.
3. Vilaça C, Orsini M, Leite M, de Freitas M, Davidovich E, Fiorelli R, Fiorelli S, Fiorelli C, Pessoa B. Cervical spondylotic myelopathy: what the neurologist should know. Neurol Int 2016; 8: 6330.
4. Bakhsheshian J, Mehta V, Liu J. Current diagnosis and management of cervical spondylotic myelopathy. Global Spine J 2017; 7: 572-586.

5. Mardhika P, Marta K, Maliawan S, Mahadewa T. Cervical spondylotic myelopathy: pathophysiology and surgical approaches. Recent Adv Biol Med 2017; 3: 83-91.
6. Gibson J, Nouri A, Krueger B, Lakomkin N, Nasser R, Gimbel D, Cheng J. Degenerative cervical myelopathy. Yale J Biol Med 2018; 91: 43-48.
7. Wilson J, Tetreault L, Kim J, Shamji M, Harrop J, Mroz T, Cho S, Fehlings M. State of the art in degenerative cervical myelopathy: an update on current clinical evidence. Neurosurgery 2017; 80: 33-45.
8. Joaquim A, Ghizoni E, Tedeschi H, Hsu W, Patel A. Management of degenerative cervical myelopathy – an update. Rev Assoc Méd Bras 2016; 62: 886-894.
9. Tetreault L, Rhee J, Prather H, Kwon B, Wilson J, Martin A, Andersson I, Dembek A, Pagarigan K, Dettori J, Fehlings M. Change in function, pain, and quality of life following structured nonoperative treatment in patients with degenerative cervical myelopathy: a systematic review. Global Spine J 2017; 7: 42-52.
10. Rhee J, Tetreault L, Chapman J, Wilson J, Smith J, Martin A, Dettori J, Fehlings M. Nonoperative versus operative management for the treatment degenerative cervical myelopathy: an updated systematic review. Global Spine J 2017; 7: 35-41.
11. Rhee J, Basra S. Posterior surgery for cervical myelopathy: laminectomy, laminectomy with fusion, and laminoplasty. Asian Spine J 2008; 2: 114-126.
12. Abdel-Salam M, Elgawhary S, El Naggar A. Cervical laminectomy and lateral mass fusion for the treatment of cervical spondylotic myelopathy: influence of sagittal alignment on clinical outcomes. 2018 doi: 10.13140/RG.2.2.18264.14082.
13. Ren D, Li F, Zhang Z, Kai G, Shan J, Zhao G, Sun T. Comparison of functional and radiological outcomes between two posterior approaches in the treatment of multilevel cervical spondylotic myelopathy. Chin Med J 2015; 128: 2054-2058.
14. Visocchi M, Della Pepa G, Roselli R, Rocca G, Conforti G, Spallone A, Barbagallo G. Laminoplasty and laminectomy in cervical stenotic myelopathy: allies not enemies. J Neurosurg Sci 2014; 58: 101-105.
15. Epstein N. Laminectomy for cervical myelopathy. Spinal Cord 2003; 41: 317-327.
16. Otani K, Iwabuchi M, Sato K, Konno S, Kikuchi S. Postoperative neck symptoms of posterior approach for cervical compressive myelopathy: expansive open-door laminoplasty vs. segmental partial laminectomy. Fukushima J Med Sci 2018; 64: 54-59.
17. Soo Kang M, Kim K, Bae J, Jang I. Treatment of two level artificial disc replacement for cervical spondylotic myelopathy. J Minim Invasive Spine Surg Tech 2018; 3: 34-38.
18. Zhao C, Chen Q, Zhang Y, Huang A, Ding W, Zhang W. Anterior cervical discectomy and fusion versus hybrid surgery in multilevel cervical spondylotic myelopathy: a meta-analysis. Medicine 2018; 97: e11973.
19. Chibbaro S, Mirone G, Makiese O, George B. Multilevel oblique corpectomy without fusion in managing cervical myelopathy: long-term outcome and stability evaluation in 268 patients. J Neurosurg Spine 2009; 10: 458-465.
20. Shaw K, Griffith M, Mottern E, Gloystein D, Devine J. Preventing construct subsidence following cervical corpectomy: the bump-stop technique. Asian Spine J 2018; 12: 156-161.

Address for correspondence:

Natalia Gołębiowska MD
Department of Neurosurgery and Spine Surgery
Regional Hospital
ul. Grunwaldzka 45, 25-001 Kielce, Poland
Phone: +48 668 111 142
E-mail: natalia.golebiowska@yahoo.com