Considerations for Prophylactic Surgery in Asymptomatic Severe Cervical Stenosis

Review Article

Abdel Majid Sheikh Taha, MD · Jennifer Shue, MS · Darren Lebl, MD · Federico Girardi, MD

Received: 3 March 2014/Accepted: 7 November 2014/Published online: 27 January 2015
© Hospital for Special Surgery 2015

Abstract *Background:* Cervical spondylotic myelopathy (CSM) is a devastating pathology that can severely impair quality of life. The symptoms in CSM progress slowly and often do not manifest until they become severe and potentially irreversible. There is a consensus that surgical intervention is warranted in symptomatic patients. The recovery of the neurologic deficit after surgical decompression of the spinal cord varies, and halting the progression of the disease remains the principle aim of surgery. *Questions/Purposes:* The aim of this review is to address the key question of whether or not to intervene in cases that have radiographic evidence of significant cervical stenosis yet are asymptomatic or exhibit minimal symptoms? *Methods:* The PubMed databases for publications that addressed asymptomatic cervical spondylotic myelopathy were reviewed. The relevant articles were selected after screening all the resulting abstracts. The references of the relevant articles were then reviewed, and cross references with titles discussing CSM were picked up for review. *Results:* The search identified 14 papers which were reviewed. Seven articles were found to be relevant to the subject in question. Going through the

references of the relevant articles, three articles were found to be directly related to the topic in study. *Conclusion:* There is paucity of evidence to support for or against surgery in the setting of asymptomatic cervical spondylotic myelopathy despite radiographic evidence of severe stenosis. Patient factors such as age, level of activity, and risk of injury should be considered in formulating a management plan. Moreover, the patient should play an integral role in the process of decision making.

Keywords cervical stenosis · cervical spondylotic myelopathy · nonoperative treatment · surgical treatment · mild cervical spondylotic myelopathy · severe cervical stenosis · Japanese orthopedic association classification · Ranawat classification

Introduction

Cervical spondylosis is the term that describes the degenerative cascade of the different cervical spine structures. These changes can result in impingement of the neural elements whether cord or nerves and thus precipitate symptoms. These symptoms vary between radiculopathy, myelopathy, and axial neck pain. The differentiation between these diagnoses depends solely on the clinical presentation and the corresponding radiographic findings. Cervical myelopathy is a clinical syndrome that has upper motor neuron involvement as part of the presentation, including gait abnormalities, balance problems, bladder dysfunction, motor weakness, and loss of dexterity. It can be secondary to various pathologies that cause canal stenosis and subsequent cord compression including cervical spondylosis, congenital stenosis, ossification of the posterior longitudinal ligament, herniated nucleus pulposus, or a combination. Myelomalacia is the radiographic counterpart of myelopathy denoting cord signal changes on magnetic resonance imaging (MRI). Cervical

Electronic supplementary material The online version of this article (doi:10.1007/s11420-014-9426-4) contains supplementary material, which is available to authorized users.

A. M. Sheikh Taha, MD (✉) · J. Shue, MS · D. Lebl, MD · F. Girardi, MD
Department of Orthopedic Surgery,
Spine and Scoliosis Service,
Hospital for Special Surgery,
535 East 70th Street,
New York, NY 10021, USA
e-mail: abdulmajeed.taha@gmail.com

A. M. Sheikh Taha, MD · D. Lebl, MD · F. Girardi, MD
Weill Cornell Medical College, 1300 York Avenue,
New York, NY 10065, USA

spondylotic myelopathy (CSM) is cervical myelopathy secondary to cervical stenosis resulting from the spondylotic changes of the cervical spine which include degenerative changes namely osteophyte formation and disc degeneration [9] (Fig. 1). CSM is a clinical entity that can be mild, moderate, or severe depending on the constellation of associated signs and symptoms. Cervical stenosis is a radiographic entity that can be mild, moderate, or severe depending on the percentage of canal stenosis. Severe radiographic findings do not necessarily reflect severe clinical findings. Spondylotic changes have been found in up to 60% of asymptomatic individuals depending on age [4, 24]. Therefore, treatment is usually guided by the clinical picture. Surgical decompression is a well-established treatment for severe symptomatic CSM. Its role is to halt the progression of the disease and may help in reversing some of the preoperative symptoms [11, 23].

On the other hand, treating patients who have severe cervical stenosis but have mild clinical symptoms of CSM is controversial. Understanding the spectrum of myelopathy, the natural history of the disease and the radiographic to clinical correlation is crucial to establish a management plan. The questions that remain unanswered: is surgery justified in this setting? Are there factors that would favor surgery over conservative treatment?

Fig. 1. Spondylotic changes in the cervical spine can result in significant stenosis that may cause myelomalacia.

Methods

The PubMed database was searched to look into the current evidence on the management of asymptomatic cervical spondylotic myelopathy in the setting of severe cervical stenosis. The keywords used for this search were as follows: asymptomatic, cervical, stenosis, myelopathy, spinal, and spondylotic. All the related MeSH terms were included in the search inquiry. The search was limited to human subjects. The abstracts of the obtained articles were then screened for relevance to the subject matter. All the articles that discussed cervical spondylotic myelopathy diagnosis, treatment, and/or radiographic findings were considered relevant and thus selected for inclusion. Articles that did not discuss CSM exclusively were excluded. The references of the relevant articles were then reviewed, and articles with titles related to the question in study were reviewed. The initial search yielded 14 publications of which 6 satisfied the selection criteria with a total of 176 references. Only three references compared surgical versus conservative treatment in the setting of mild CSM.

Results

Assessment of Cervical Spondylotic Myelopathy

CSM is a serious pathology that can negatively impact function. Depending on severity, an individual with myelopathy can be fully functional, functional with limitations, or significantly debilitated. CSM poses a great risk for impairment and disability with subsequent unemployment and functional dependence. Clinical presentation of myelopathy is a wide array of signs and symptoms including weakness of the extremities, paresthesia, gait problems, balance problems, and/or bladder dysfunction. Many myelopathy classification schemes address the degree of myelopathy. The Nurick classification scheme grades myelopathy on a scale of 5 depending on gait and ambulatory function: grade 0, only root symptoms or normal; grade 1, evidence of cord compression but no gait problems; grade 2, gait difficulties but patient is able to fulfill his ADLs and is fully employed; grade 3, gait difficulties affect employment but no assistance needed for ambulation; grade 4, needs assisted ambulation; and grade 5, wheelchair bound [20]. Ranawat, on the other hand, looked into myelopathy in the setting of cervical spondylitis in patients with rheumatoid arthritis. He classifies myelopathy based on the degree of weakness and ambulatory status. In his classification, class I has no neurologic deficit but can have pain; class II has subjective weakness with findings of hyperreflexia and dysesthesia on exam; class III A has objective weakness, long tract signs but remains ambulatory; and class III B is nonambulatory [21]. A widely used outcome instrument for myelopathy is the one defined by the Japanese Orthopedic Association (JOA). It is commonly used in clinical trials because it assesses the four different functions that are usually affected: motor power in upper extremities including dexterity, motor power in lower extremities including ambulatory status, sensation, and bladder function [12]. This classification has

a scoring system that sums up to a total of 17 points standing for normal. The only drawback of this classification lies in assessing the upper extremity motor function which includes the use of chopsticks which varies with cultural differences. A modified JOA classification was proposed by Chile et al. [7] in which they substituted the ability to use the knife and fork for chopsticks. Another modified version was proposed by Benzel et al [3]. In their modification, they used the ability to button a shirt to substitute for chopsticks use.

Clinical Progression of CSM

The rate of progression of CSM exhibits a lot of variation. The majority of patients experience periods of exacerbations interrupted by periods of static neurologic function which can last for years. This presentation accounts for almost 75% of the cases. Approximately, 20% of the cases have a steady progressive disease and only 5% usually have a rapidly progressing form of the disease. This variability was reported by Lee et al. and Clarke et al. [8, 17] in their classic papers about the natural history of CSM.

Radiographic Evaluation

Radiographic evaluation consists of plain roentograms to look for degenerative changes, osteophyte formation, disc collapse, and signs of instability on flexion/extension films. MRI usually evaluates the degree of cord compression by looking at CSF effacement, the cord ratio, and the extent of myelomalacia. Though imaging helps in delineating the source and the level of compression in establishing a treatment strategy, the decision for surgery relies more on the clinical findings. Boden et al. [4] studied the prevalence of degenerative findings on MRI in asymptomatic volunteer subjects. They reported a prevalence of 14% for subjects less than 40 years of age and 28% for subjects older than 40. They emphasized the danger of making operative decisions based on radiographic findings without precisely correlating them to the clinical signs and symptoms [4].

Surgical Intervention

Surgical intervention is the standard of care in advanced cases of CSM. The aim of surgery is to decompress the cord and stop the progression of the disease, thus serving to preserve remaining functionality. Preoperative pain and paresthesia usually improve following surgical decompression [11]. Many types of procedures have been used to treat CSM. Anterior surgery as well as posterior surgery has been utilized [10]. Choosing the type of procedure usually depends on many variables including the patient's overall medical status, the number of levels involved, the source of the stenosis, and the mobility and the overall alignment of the cervical spine. Anterior cervical decompression and fusion (ACDF) has been used with good overall results. Posterior cervical decompression alone or with instrumentation and fusion are also

options for treatment. Many posterior decompression techniques have been described including laminectomy and laminoplasty. Each procedure has its own merits and defects. Laminectomy is usually contraindicated in cases of preoperative cervical kyphosis, and the procedure itself increases the risk of postoperative progressive kyphosis [16]. Laminoplasty is an alternative procedure that has gained popularity since its first introduction in Japan in the 1970s. It also poses some risk of postoperative kyphosis. Combined anterior and posterior surgery can be employed especially in cases of rigid deformities where adequate decompression and proper alignment can be only achieved by a combined approach. Both anterior and posterior approaches are valid options and effective when used in the right setting. A systematic review reported that both have comparable safety profiles. The rate of C5 nerve palsy is comparable [13]. Anterior surgery showed a higher rate of dysphagia, whereas posterior surgery was associated with a higher infection rate [10].

Discussion

Surgery has been recommended for many entities based on the nature of the disease or other factors pertaining to the patient and the surrounding environment. For instance, prophylactic cervical fusion surgery has been advised in rheumatoid patients with signs of instability and a space available to the cord (SAC) of less than 14 mm even if there is no evidence of clinical myelopathy [5]. Another example is the highly recommended prophylactic cholecystectomy for astronauts with gallstones despite the sparse evidence and lack of supporting randomized controlled trials [6]. Clinical decisions have become more and more evidence-based over the past decades owing to the advances in the science of epidemiology and the ever-growing interest in conducting research. Despite what was just said, the decision is often times not straightforward because of the lack of supporting evidence that would favor treatment A over B. Weighing the risks versus the benefits of a medical intervention remains the gold standard rule physicians follow in making treatment decisions.

Surgical intervention is the standard of care for patients with moderate to severe CSM in the absence of contraindications. There is little evidence to support such intervention in mild cases irrespective of the degree of cervical stenosis. The interpretation of findings in the case of mild CSM and formulating a plan of management is often challenging due to the lack of sound evidence to advise for or against surgery in this patient population. Counseling this group of patients needs a lot of care, and many factors should be considered. These factors include the patient age, medical morbidities, level of activity, compliance with follow up, the rate of disease progression, and extent of radiographic findings. Thus, the management strategy should be tailored according to the patient needs and expectations.

Many studies have reported the rate of progression of cervical myelopathy in the setting of cervical stenosis. This

Fig. 2. Dynamic compression of the spinal cord with the flexion and the extension of the spinal column. (Reprinted with permission from: Bernhardt M, Hynes RA, Blume HW, White AA. Current concepts review: cervical spondylotic myelopathy. *J Bone Joint Surg Am.* 1993;75; 119–28.).

risk was reported to be between 1 and 5% annually [2, 18, 19]. This annual risk is cumulative, thus putting younger patients at greater risk of progression during their lifetime. Based on this data, a patient with cervical stenosis has on average 50% risk of progression of myelopathy in 20 years. Moreover, taking patient factors into account might as well increase this risk tremendously. Patients who are younger tend to be more active and participate in higher levels of exertions which in principle put them at a higher risk of progression and injury. Availability and ease of accessibility to health care facilities is another factor that should be considered when deciding to treat CSM conservatively. Patients who live far from health care facilities will tend to miss follow-up appointments and will be vulnerable to acquire delayed care in the setup of acute injury.

Severe cervical stenosis put patients at a higher risk of cord compression [15]. The cervical spine is a mobile structure. MRI is a static evaluation. Thus, it does not reflect the cord condition under the various modes of exertion, i.e., flexion, extension, rotation, and lateral bending. Thus, repetitive trauma and ischemia secondary to cervical mobility is not accounted for during routine radiographic evaluation and subsequently decision making (Fig. 2). In this setting, taking the cervical spine through extreme range of motion can result in disability. Whiteson et al. [25] reported a case of tetraparesis following dental extraction in the setting of advanced spondylosis and spinal stenosis. Other factors that should be accounted for in the setting of severe stenosis include patient morbidities or social habits that would entail a higher risk of falls or injury. Histories of arrhythmias, vertigo, high athletic behavior, or bad drinking habits are examples that can be encountered routinely. In such

situations, even low-energy trauma might result in significant injury to the cord and central cord syndrome [18]. Surgical decompression in the setting of traumatic central cord syndrome as a salvage procedure was shown to result in only mild improvement in ASIA motor score in 74% of the patients. Moreover, 25% experienced complications [1].

There are no studies in the literature that favor surgery over conservative treatment in mild CSM or vice versa [22] (Table 1). Kadanka et al. [13, 14] addressed this question in their prospective study. They reported on a negligible clinical difference between the two treatment arms. Their study lacks power because it involved a small patient population. Moreover, they did not report the degree of cervical stenosis. On the other hand, there is no evidence that conservative treatment is superior to surgery.

In mild CSM with severe radiographic stenosis, we recommend weighing the risks of surgery versus the risk of injury. Case tailored analysis, extensive patient education, addressing the patient expectations, and involving the patient in the decision making process would help the physician reach a suitable management plan. Younger patients who are more active and participate in contact activities or older patients who have balance issues secondary to medical problems other than myelopathy are at a higher risk of neurologic injury even in the setting of minor trauma and may benefit from prophylactic surgery. A well-designed prospective study is needed to make decisions based on stronger evidence.

Disclosures

Conflict of Interest: Abdel Majid Sheikh Taha, MD, Jennifer Shue, MS, and Darren Lebl, MD have declared that they have no conflict of interest. Federico Girardi, MD reports pending patents with Centinel Spine, LP, Ethicon, LANX, Inc., LDR Spine, USA, Inc., LifeSpine, Inc., Orthogem, Ltd., Paradigm Spine, LLC, Pioneer Surgical, Scient'x USA, Small Bone Innovations, LLC, Spinal Kinetics, Spineart USA, Spineview Inc., Wenzel Spine, Inc.; receives royalties for a patent with DePuy Spine, Inc., NuVasive, Inc., Ortho Development Corp., Healthpoint Capital Partners, outside the work.

Human/Animal Rights: This article does not contain any studies with human or animal subjects performed by the any of the authors.

Informed Consent: N/A

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

Table 1 Conservative versus operative treatment in mild cervical spondylotic myelopathy

Study	Conclusion
Rhee JM et al. [22]	Paucity of evidence in favor of non-operative treatment
Kadaňka Z et al. [13]	No evidence to favor one treatment over the other; low number of patients for final evaluation
Kadaňka Z et al. [14]	No substantial difference between the two treatment groups; short follow up period (2 years)

References

- Anderson DG, Sayadipour A, Limthongkul W, et al. Traumatic central cord syndrome: neurologic recovery after surgical management. *Am J Orthop (Belle Mead, NJ)*. 2012; 41(8): E104-E108.
- Bednarik J, Kadanka Z, Dusek L, et al. Presymptomatic spondylotic cervical cord compression. *Spine (Phila Pa 1976)*. 2004; 29(20): 2260-2269.
- Benzel EC, Lancon J, Kesterson L, Hadden T. Cervical laminectomy and dentate ligament section cervical spondylotic myelopathy. *J Spinal Disord*. 1991; 4: 286-295.
- Boden SD, McCowin PR, Davis DO, et al. Abnormal magnetic-resonance scans of the cervical spine in asymptomatic subjects. A prospective investigation. *J Bone Joint Surg Am*. 1990; 72(8): 1178-1184.
- Boden SD, Dodge LD, Bohlman HH, Rechtine GR. Rheumatoid arthritis of the cervical spine. A long-term analysis with predictors of paralysis and recovery. *J Bone Joint Surg Am*. 1993; 75(9): 1282-1297.
- Chad G, Ball MD, Andrew W, Kirkpatrick MD, David R, Williams MD. Prophylactic surgery prior to extended-duration space flight: is the benefit worth the risk? *Can J Surg*. 2012; 55(2): 125-131.
- Chiles BW III, Leonard MA, Choudhri HF, Cooper PR. Cervical spondylotic myelopathy: patterns of neurological deficit and recovery after anterior cervical decompression. *Neurosurgery*. 1999; 44(4): 762-769.
- Clarke E, Robinson PK. Cervical myelopathy: a complication of cervical spondylosis. *Brain*. 1956; 79: 483-510.
- Emery SE. Cervical spondylotic myelopathy: diagnosis and treatment. *J Am Acad Orthop Surg*. 2001; 9: 376-388.
- Fehlings MG, Barry S, Kopjar B, et al. Anterior vs posterior surgical approaches to treat cervical spondylotic myelopathy: outcomes of the Prospective Multicenter AOSpine North America CSM study in 264 patients. *Spine (Phila Pa 1976)*. 2013.
- Furlan JC, Kalsi-Ryan S, Kailaya-Vasan A, et al. Functional and clinical outcomes following surgical treatment in patients with cervical spondylotic myelopathy: a prospective study of 81 cases. *J Neurosurg Spine*. 2011; 14: 348-355.
- Hukuda S, Mochizuki T, Ogata M, Schichikawa K, Shimomura Y. Operations for cervical spondylotic myelopathy: a comparison of the results of anterior and posterior procedures. *J Bone Joint Surg (Br)*. 1985; 67B: 609-615.
- Kadaňka Z, Bednarík J, Vohánka S, et al. Conservative treatment versus surgery in spondylotic cervical myelopathy: a prospective randomized study. *Eur Spine J*. 2000; 9(6): 538-544.
- Kadaňka Z, Bednarík J, Novotný O, et al. Cervical spondylotic myelopathy: conservative versus surgical treatment after 10 years. *Eur Spine J*. 2011; 20(9): 1533-1538.
- Kanchiku T, Taguchi T, Kaneko K, et al. A correlation between magnetic resonance imaging and electrophysiological findings in cervical spondylotic myelopathy. *Spine (Phila Pa 1976)*. 2001; 26(13): E294-E299.
- Kaptein GJ, Simmons NE, Replogle RE, et al. Incidence and outcome of kyphotic deformity following laminectomy for cervical spondylotic myelopathy. *J Neurosurg*. 2000; 93: 199-204.
- Lee F, Turner JWA. Natural history and prognosis of cervical spondylosis. *BMJ*. 1963; 2: 1607-1610.
- Lenehan B, Boran S, Street J, et al. Demographics of acute admissions to a National Spinal Injuries Unit. *Eur Spine J*. 2009; 18(7): 938-942.
- Matsunaga S, Sakou T, Taketomi E, Komiya S. Clinical course of patients with ossification of the posterior longitudinal ligament: a minimum 10-year cohort study. *J Neurosurg*. 2004; 100(3 Suppl Spine): 245-248.
- Nurick S. The pathogenesis of spinal cord disorder associated with cervical spondylosis. *Brain*. 1972; 95: 87-100.
- Ranawat CS, O'Leary P, Pellicci P, et al. Cervical spine fusion in rheumatoid arthritis. *J Bone Joint Surg Am*. 1979; 61-A: 1003-1010.
- Rhee JM, Shamji MF, Erwin MW, et al. Nonoperative management of cervical myelopathy: a systematic review. *Spine (Phila Pa 1976)*. 2013.
- Sampath P, Bendebba M, Davis JD, et al. Outcome of patients treated for cervical myelopathy. A prospective, multicenter study with independent clinical review. *Spine*. 2000; 25: 670-676.
- Teresi LM, Lufkin RB, Reicher MA, et al. Asymptomatic degenerative disk disease and spondylosis of the cervical spine: MR imaging. *Radiology*. 1987; 164(1): 83-88.
- Whiteson JH, Panaro N, Ahn JH, Firooznia H. Tetraparesis following dental extraction: a case report and discussion of preventive measures for cervical spinal hyperextension injury. *J Spinal Cord Med*. 1997; 20(4): 422-425.