Published in final edited form as:

Neurosurgery. 2015 October ; 77(4): 561–565. doi:10.1227/NEU.0000000000000888.

The Risk of Acute Spinal Cord Injury After Minor Trauma in Patients With Preexisting Cervical Stenosis

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Abstract

BACKGROUND—Cervical stenosis patients are commonly advised to undergo surgery due to the risk of spinal cord injury (SCI) following a traumatic event. However, the actual risk of SCI in this scenario is unknown.

OBJECTIVE—To evaluate the risk of SCI after minor trauma in a cohort of prospectively followed cervical stenosis patients.

METHODS—Clinical and radiographical analysis was performed in 55 nonoperatively-treated patients evaluated between 2009 and 2014. Each patient was asked standardized questions including: 1) whether a previous physician recommended neck surgery, 2) whether a physician indicated that they would become paralyzed following a traumatic event, and 3) whether they had suffered a traumatic event during the follow-up period.

RESULTS—The mean age was 65, with a mean modified Japanese Orthopedic Association score of 16.6. The mean canal diameter was 6.1 mm. Nineteen patients (35%) had evidence of intramedullary T2 signal abnormality. Thirty-one patients (56%) were previously recommended for surgery. Twenty-six patients (47%) were told that they would be paralyzed following a motor vehicle accident or fall unless surgery was performed. Ten patients (18%) experienced a traumatic event during the follow-up, with none sustaining an SCI.

CONCLUSION—Asymptomatic and mildly symptomatic cervical stenosis patients are commonly recommended to undergo surgery due to risk of paralysis following a traumatic event. SCI was not observed following minor trauma in our cohort of prospectively followed patients. It appears that occurrence of SCI in this patient population following minor trauma is likely smaller than many physicians surmise, yet will require future prospective study in a large cohort of patients.

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Disclosure: The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

The abstract was presented at 2015 Annual Meeting of the AANS/CNS Section on Disorders of the Spine and Peripheral Nerves.

Keywords

cervical; myelopathy; stenosis; trauma

INTRODUCTION

The prospect of acute spinal cord injury (SCI) following minor trauma in patients with advanced cervical spondylotic disease is a frequent concern of patients and physicians alike. In clinical practice, it is not uncommon to encounter patients that have clear radiographic evidence of cervical stenosis, including spinal cord compression and T2-weighted signal change, yet are without neurological symptoms or have only mild symptomatology. While the optimal management of such patients is controversial, the argument can certainly be made to treat these patients nonoperatively, as several studies have demonstrated that mildly affected cervical spondylotic myelopathy (CSM) patients can be effectively managed with nonoperative treatment.^{1–6}

However, many asymptomatic or mildly affected cervical spondylosis patients are advised to undergo surgery specifically because they are at a high risk of paralysis following a traumatic event – most notably a motor vehicle accident (MVA) or a fall. Although it is well established that pre-existing cervical stenosis is a prerequisite for central cord syndrome, the actual risk of acute spinal cord injury following trauma in patients with cervical stenosis is not known, and has been understudied. Much of the available medical literature is limited by retrospective analysis or selection bias.

This study seeks to gain understanding regarding the risk of acute neurological injury after trauma in a cohort of asymptomatic or mildly affected patients with advanced cervical spondylosis. Our hypothesis is that the perceived risk of injury is overstated in this population.

METHODS

Study design

This cohort study is comprised of nonoperatively treated, advanced cervical spondylosis patients evaluated in an outpatient setting by the senior author (LTH) between 2009 and 2014 at the David Geffen School of Medicine University of California Los Angeles Spine Center. The patients in the cohort were treated nonoperatively due to either a lack of significant neurological symptomatology despite imaging findings, and/or patient preference for nonoperative management. Each patient had evidence of at least moderate cervical stenosis on MRI. The patients were subsequently entered into a prospective database and followed-up with annual visits and MRIs. The modified Japanese Orthopedic Association^{7, 8} (mJOA) scale was used to quantify neurological status. The Office for the Protection of Research Subjects at our Institution approved the protocol for this study.

Clinical Presentation—The patient presenting symptoms are summarized in Table 1. The most common chief complaint was neck pain (Figure 1), and was encountered in 22 patients.

Arm paresthesias and arm pain were the next most common chief complaints, and encountered in 7 and 6 patients, respectively.

Radiographic Evaluation—Radiographic analysis of the cervical spine MRI was performed using a single PACS viewer and imaging software (Centricity, GE Medical Systems, Milwaukee, WI). The measurement of the sagittal spinal canal diameter at the most stenotic level was performed using digital calipers at uniform magnification (200%).

The degree of spinal canal stenosis was stratified into the following categories: 1) Moderate stenosis - trace or no CSF around the spinal cord without spinal cord deformity; 2) Moderately severe stenosis – trace CSF around the spinal cord with spinal cord deformity; 3) Severe stenosis – no CSF around spinal cord with spinal cord deformity.

Other analyzed radiographic parameters include the presence of intramedullary T2 weighted signal, and global alignment of the cervical spine (lordotic, neutral, kyphotic).

Patient Queries—As part of the evaluation, the patients in the cohort were asked several standardized questions:

1. Prior to your visit in our clinic has a physician ever told you that you needed surgery on your cervical spine?
2. Has a physician ever told you that if you do not have surgery on your neck that you would become paralyzed if involved in a car accident, fall, or other traumatic event?
3. Have you had a car accident, fall, or other traumatic event during the follow-up period?

Results

A total of 55 patients were included in the study. Twenty-eight patients were men, and 27 were women. The mean age was 65 years, with a range from 46 to 91 years of age. The mean follow-up time was 2.3 years, with a range from 4 months to 5 years. The mean mJOA score was 16.6, while the median mJOA was 17 (range 14–18, SD 1.5).

The mean canal diameter was 6.1 mm, with a range of 4.5 to 9.2 mm (median 6.0 mm, SD 0.7 mm). Nineteen of 55 patients (35%) had evidence of intramedullary T2 signal change. A neutral cervical alignment was encountered in 20 patients (36%), lordotic in 19 patients (35%), and kyphotic in 16 patients (29%).

A total of 31 patients (56%) were previously told by another physician that they needed to undergo surgery on their neck due to the spinal canal narrowing. In addition, 26 patients (47%) were told by another physician that they would be paralyzed following an MVA or fall unless surgery was performed.

Of the 55 total patients, 45 patients did not suffer a traumatic event after their evaluation at our institution and MRI documentation of cervical stenosis. The mean age of this cohort was 64. Twelve of these patients had moderate cervical stenosis, 20 had moderately severe

cervical stenosis, and 13 had severe cervical stenosis. Fifteen of the patients had increased T2 weighted spinal cord signal change.

The remaining 10 patients (18%) sustained a traumatic event during their follow-up period. The mean age of this group was 68 years. Three of these patients had moderate cervical stenosis, 4 had moderately severe cervical stenosis, and 3 had severe cervical stenosis. Four of the ten patients had increased T2 weighted spinal cord signal change. Seven of the ten patients suffered a fall (Figure 2), and 3 were involved in MVAs. None of the 10 patients (0%) suffered paralysis or an SCI following their traumatic event. One patient noted the new onset of unilateral upper extremity tingling which spontaneously resolved in several days.

DISCUSSION

Cervical spondylosis is an expected consequence of aging, with an incidence of 10% at age 25 and 75% by the age of 65.⁹ Cervical stenosis is a commonly encountered feature of advanced spondylotic disease and a frequent concern of both physicians and patients. Whether a patient with preexisting cervical stenosis is truly at increased risk of SCI after sustaining a minor trauma is an important question, particularly considering the great potential for disability and shortened life expectancy from a cervical spinal cord injury.^{10–13} However, there is a paucity of high-quality evidence that provides an adequate quantification of risk to provide a definitive answer.¹⁴ This study attempts to provide a prospective analysis from a cohort of patients with preexisting cervical stenosis over a five-year period.

The presence of cervical stenosis as a potential risk for various forms of cervical SCI has been previously reported in the literature. In a report by Aarabi et al of 211 patients that sustained acute traumatic central cord syndrome, 79 (37.4%) presented with stenosis alone without any evidence of fractures, dislocation, or disc herniations.¹⁵ Similarly, Kato et al identified 127 (incidence of 32.2%) trauma patients with cervical SCI without any evidence of bony injury.¹⁶ A pair of recent studies published by Aebli et al evaluated different radiographic parameters as predictors for sustaining cervical SCI after trauma.^{17, 18} In one study the authors evaluated Torg-Pavlov ratio as a predictor of SCI, and in the other MRI measurements were assessed. These retrospective investigations included a study group of SCI patients and a control group of patients that had sustained flexion-extension trauma without evidence of SCI. In both reports, falls were the most common mechanism of injury in the SCI cohort followed by motor vehicle accidents. The authors identified a Torg-Pavlov ratio less than 0.7 and spinal canal diameter less than 8 mm as positive predictors for suffering SCI.

While a retrospective review of trauma databases can be helpful in identifying different patterns of SCI, the extrapolation of SCI risk from the data set is fraught with potential confounders. By nature, these studies have an inherent bias towards patients who have sustained an injury; otherwise these patients would not be identified in the first place. One of the limitations of the studies by Aebli et al is the fact that the patients only met enrollment criteria if they were admitted to the hospital. In practice, the majority of cervical spondylosis patients are evaluated in an outpatient setting and not included in this type of investigation.

Another study by Stein et al evaluated all MVA victims in a national database.¹⁹ This study showed that of 109,321 MVA occupants over the 14-year study period there was an overall incidence of 0.35% for sustaining a cervical SCI. This number reflects the overall risk of all crash survivors, and not only those with pre-existing cervical stenosis.

In contrast to the aforementioned reports, the present study is a prospective investigation which examines the risk of SCI following minor trauma in a cohort of nonoperatively treated patients with known cervical stenosis. The mean spinal canal diameter within the cohort was 6.1 mm, which is well below the cutoff value of 8.0 mm that yielded the largest positive predictive value and likelihood ratio for predicting SCI in the study by Aebli et al. Additionally, 35% of our cohort had evidence of T2-weighted signal change. Thus, this cohort represents an appropriate group of patients with clear cervical stenosis to prospectively assess for the effects of minor trauma.

Due to the radiographic findings, almost 50% of our cohort was previously told by a physician that they would become paralyzed if involved in a car accident or suffered a fall. Ten patients in our study suffered a traumatic event during their clinical follow-up period, including 7 falls and 3 motor vehicle accidents. None of these patients developed paralysis or spinal cord injury following the event. Several of the events resulted in other bodily injuries including broken bones in the upper or lower extremities. Despite the fact that SCI did not occur in our patient population, the expectation of a zero percent risk of SCI is not reasonable, particularly considering the 0.35% incidence of cervical SCI following MVA demonstrated in a large national registry over a 14-year span.¹⁹ However, based on the results from our study, the actual risk is likely significantly lower than perceived by many physicians. Additionally, the majority of patients were told that they required surgery, despite being neurologically asymptomatic or only mildly symptomatic. Thus, the concern for paralysis following a traumatic event was likely a major driver for the recommendation of surgical intervention.

Limitations

One limitation of the study is that some specific details regarding the severity of the traumatic event (e.g. speed that the car was traveling during the MVA) are not available. This limitation is, in part, mitigated by the fact that when physicians mention the risk of paralysis following a traumatic event to this patient population, the traumatic event is mentioned in only general terms, without any reference to the threshold required to cause neurological injury. Additionally, this study principally investigates asymptomatic or mildly affected patients, as the mean mJOA score was 16.6. Whether there is a higher risk of SCI following a traumatic event in patients with more advanced CSM is beyond the scope of this study

Conclusion

Asymptomatic and mildly symptomatic patients with cervical stenosis are commonly recommended to undergo surgical intervention due to risk of paralysis following a traumatic event. In a cohort of prospectively followed patients with documented cervical stenosis, SCI was not observed following minor trauma. It is likely that occurrence of SCI in this patient

population following minor trauma is likely smaller than many physicians surmise, yet this will require future prospective study in a large cohort of patients.

Acknowledgments

Research Funding

NIH/NINDS R21NS065419

NIH/NINDS R01NS078494

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Figure 1. 54-year-old woman with a history of neck pain. She was without neurological symptoms and had an mJOA score of 18. Sagittal (A) and axial (B) MRI demonstrated severe cervical stenosis with T2 weighted signal abnormality.

Figure 2.

74-year-old man who presented with intermittent paresthesias in his upper extremities (mJOA 17). His sagittal and axial MRI demonstrated moderately severe cervical stenosis. He suffered a fall while walking and did not sustain any neurological worsening after the traumatic event.

Table 1

Presenting Symptoms

Chief Complaint	Number of Patients
Neck pain	22
Arm paresthesias	7
Arm pain	6
Hand numbness	5
Hand paresthesias	4
Leg weakness	3
Tremor	2
Balance problems	2
Hand weakness	1
Gait difficulty	1
Leg pain	1
Soft tissue neck tumor	1