Case report

Spinal cord injury following operative shoulder intervention: A case report

Christine Cleveland, Heather Walker

Department of Physical Medicine and Rehabilitation, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Context: Cervical myelopathy is a spinal cord dysfunction that results from extrinsic compression of the spinal cord, its blood supply, or both. It is the most common cause of spinal cord dysfunction in patients greater than 55 years of age.

Findings: A: 57-year-old male with right shoulder septic arthritis underwent surgical debridement of his right shoulder and sustained a spinal cord injury intraoperatively. The most likely etiology is damage to the cervical spinal cord during difficult intubation requiring multiple attempts in this patient with underlying asymptomatic severe cervical stenosis.

Conclusion: Although it is not feasible to perform imaging studies on all patients undergoing intubation for surgery, this patient's outcome would suggest consideration of inclusion of additional pre-surgical screening examination techniques, such as testing for a positive Hoffman's reflex, is appropriate to detect asymptomatic patients who may have underlying cervical stenosis.

Keywords: Spinal cord injury, Cervical stenosis, Hoffmann's reflex, Intubation

Introduction

It is estimated that ~4.9% of all adults, and 9% of those over age 70 meet criteria for diagnosis of cervical stenosis.¹ The presence of spinal stenosis and the possibility of injury to the spinal cord and subsequent myelopathic outcome are important to consider when evaluating a patient for surgery, and particularly for intubation which places the cervical spine in hyperextension. If a patient has a known history of cervical stenosis or has symptoms suggesting cervical myelopathy, there are methods that can be used to lower the risk for spinal injury during intubation; however, there are patients who do not have myelopathic symptoms and have not yet been diagnosed with spinal stenosis. How can pre-surgical screening best identify such patients and prevent a potential neurological insult? We present the case of a patient with undiagnosed underlying cervical stenosis who sustained a spinal cord injury (SCI) while undergoing shoulder surgery.

Case description

This case describes a patient who was noted to have a SCI during shoulder surgery. The patient was a 57-year-old male who was admitted to an internal medicine service at an academic medical center with fatigue, chills, nausea, and known positive blood culture for Gram-negative cocci in clusters. During his hospitalization, he complained of increased right shoulder pain and a subsequent magnetic resonance imaging (MRI) showed a possible septic acromioclavicular joint. The Orthopedic Surgery team was consulted, and the patient was taken to the operating room for surgical debridement. The patient was placed in beach chair position in preparation for surgery, and the operative reports indicate that intubation required two attempts with a video laryngoscope secondary to decreased neck range of motion in extension and a Mallampati score of 3. Purulent fluid and tissue were evident at the acromioclavicular joint and the patient underwent acromioplasty, bursectomy, and joint irrigation. The patient reported decreased strength in his upper and lower extremities in the immediate post-operative period, and he was unable to stand unassisted. An MRI of the cervical spine was obtained on post-

Correspondence to: Heather Walker, Department of Physical Medicine and Rehabilitation, School of Medicine, University of North Carolina at Chapel Hill, 101 Manning Drive, CB #7200, Chapel Hill, NC 27599, USA; Email: heather_walker@med.unc.edu

Figure 1 MRI of cervical spine completed on POD 3 revealed posterior disk osteophyte complex from C3 to C7 with spinal cord compression and increased cord signal noted C3–C6.

operative day (POD) number 3, and this revealed osteophytes, facet hypertrophy, severe canal stenosis, and spinal cord signal change from C3 through C6, therefore the Neurosurgical team was consulted. Unfortunately, a comprehensive neurological examination had not been documented in the immediate post-operative period; however, examination performed by the Neurosurgical consultants revealed significant motor impairments in the upper extremities, with 3/5 strength proximally and 1/5 strength in hand intrinsics, and lower extremity strength was 4/5–5/5 throughout. Repeat examination on POD 4 was stable, however examination on POD 5 revealed significant deterioration with worsening upper extremity weakness and no voluntary movement noted in the lower extremities. Consultation with Infectious Disease specialists was obtained, and no further infectious workup was recommended. The patient was cleared for operative intervention, and he underwent an emergent surgical decompression of C3–C6 on POD 5. The patient was subsequently admitted to the acute inpatient rehabilitation center, and his initial examination was consistent with a C4 American Spinal Injury Association Impairment Scale C SCI. He underwent 8 weeks of inpatient SCI rehabilitation. At time the time of his discharge, he required maximum to total assist with all transfers, Activities of daily living (ADLs), and bed mobility, but was modified independent with power wheelchair mobility and was able to direct his care independently. The patient fortunately continued to make significant motor gains in the

outpatient setting, and by 1 year post-SCI he was ambulating household distances with the use of a rolling walker (Fig. 1).

Discussion

Cervical myelopathy is defined as spinal cord dysfunction secondary to extrinsic compression of the cord, its blood supply, or both. Spinal canal stenosis is any narrowing of the spinal canal that may lead to such impingement on the spinal cord, and there are multiple methods used to evaluate it. Typically, an Anteroposterior (AP) view of the canal diameter is considered normal at 17 mm, relatively narrowed at 10–13 mm, and severely narrowed if measured <10 mm. The Torg–Pavlov ratio is another method used to evaluate stenosis, comparing the spinal canal to vertebral body ratio. A ratio of <0.80 is considered stenotic.²

Cadaveric studies estimate that cervical stenosis is present in 4.9% of the adult population with the percentage rising with age with an estimated 9% of adults over the age of 70 meeting the criteria for cervical stenosis.¹ The pathophysiology of cervical stenosis has been well studied and can arise from a variety of sources including disk degeneration, subperiosteal bone formation, ossification of the posterior ligament, or hypertrophy of the ligamentum flavum. The presence of any of the above-mentioned changes in conjunction with a mechanically dynamic spine can lead to compression of the cord or its vascular supply.

The typical clinical presentation for a patient with cervical spondylotic myelopathy can include neck pain, difficulty in walking, extremity pain, numbness, and paresthesias, unsteady gait, loss of dexterity in the upper extremities, and changes in bladder and bowel habits. There can be a concomitant compression of the cervical nerve roots that would lead to radicular pain as well. It is not uncommon for patients to have stenosis present in both their lumbar and cervical spine. It is important to recognize myelopathic symptoms so that surgical intervention can be considered to preserve the patient's neurological function.

There are several potential etiologies for the patient's SCI, including intraoperative spinal cord infarct, SCI due to infectious etiology, or traumatic SCI sustained during intubation. There have been reports of poor neurological outcomes related to the use of the "beach chair" position in surgery.³ Such injuries have been attributed to the risk of cerebral hypotension related to this position and the decreased sympathetic response present due to sedation; however, this explanation seems unlikely in this case as review of the detailed

intraoperative anesthesia records showed no recorded evidence of hypotension during the procedure. Infectious etiology must be considered in this patient with known septic arthritis. Epidural abscess, diskitis, or osteomyelitis should be considered as a potential etiology for the patient's SCI; however, imaging studies, operative findings, and the opinion of the Infectious Disease specialists involved in this case determined that the patient's neurological decline was not due to infectious etiology.

The most likely etiology for this patient's SCI is a hyperextension injury during intubation. The anesthesia notes indicate that three attempts were made at intubation before it was finally achieved using a video laryngoscope. With a Mallenpati score of 3, these attempts almost certainly would have involved ever greater extension of the neck and thrusting of the jaw in order to try to better visualize the vocal cords for intubation. Studies have shown that the greatest degree of motion in the cervical spine during intubation is found at C0–C1 and C1–C2, just above where the signal change was appreciated in the patient's post-surgical MRI.⁴ This would be further support of the theory of an intubation-related etiology for the spinal injury.

In a patient with the facet hypertrophy and cervical stenosis on multiple levels noted in the post-surgical MRI, the patient most likely had asymptomatic, but chronic cervical stenosis present before surgery. For patients with known cervical stenosis video laryngoscopy is often used.⁵ This technique allows the patient's neck to be kept in a neutral position while the vocal cords are visualized with the laryngoscope, thus limiting spinal motion and possible spinal cord compression.

Although the patient reported no radicular or myelopathic symptoms before his surgery, the documented neurological screening and examinations were minimal documenting only that he was awake, alert, and oriented x3. With unexplained limited cervical range of motion (ROM) and proposed surgical positioning with rare but documented neurological injuries, perhaps a more thorough examination could have been considered.

Sung *et al.* performed a prospective study investigating the correlation between a positive Hoffmann's reflex and cervical pathology in asymptomatic patients. They found that those asymptomatic patients with a positive Hoffman's reflex had an extremely high likelihood (94%) of having some cervical pathology causing some degree of spinal cord compression.⁶ Such a study would suggest that the inclusion of this simple test in a pre-surgical screening could be effective in helping to identify asymptomatic patients that may be at risk due

to undiagnosed cervical pathology. Testing for a positive Hoffman's reflex is non-invasive, does not require any radiological intervention making it a more cost-effective, and would appear to provide vital information to help avoid unforeseen, life-altering outcomes from routine surgeries as was seen in our patient's case.

It is not feasible to perform imaging studies on all of the patients undergoing surgery; however, a plane cervical X-ray could be obtained with a minimal expense in patients with neck pain or any upper motor neuron signs on examination to evaluate for cervical stenosis. In the pre-operative setting, using cervical spine X-rays to calculate a Torg–Pavlov ratio could help to stratify a patient's risk of injury, knowing that a patient with a Torg–Pavlov ratio of <0.7 has an increased risk of spinal stenosis.⁷ In addition, measures such as the use of a video laryngoscope for intubation in patients who are potentially at risk could avoid the risk of an outcome which our case patient suffered. Further study is warranted to determine if inclusion of additional pre-operative screening examination techniques, such as testing for a positive Hoffman's reflex to detect those patients who may have undiagnosed cervical stenosis.

Disclaimer statements

Contributors All contributors participated in preparation and revisions of the manuscript.

Funding None.

Conflicts of interest None.

Ethics approval None.

References

- 1 Lee MJ, Cassinelli EH, Riew KD. Prevalence of cervical spine stenosis. Anatomic study in cadavers. *J Bone Joint Surg Am* 2007; 89(2):376–80.
- 2 Wheelless C. Wheelless' textbook of orthopedics. In: Wheelless C, (ed.) Towson, MD: Data Trace Internet Publishing LLC; 1996–2013
- 3 Murphy GS, Szokol JW. Blood pressure management during beach chair position shoulder surgery: what do we know? 2011. *Can J Anaesth* 58(11):977–82
- 4 Sawin PD, Todd MM, Traynelis VC, Farrell SB, Nader A, Sato Y, *et al.* Cervical spine motion with direct laryngoscopy and orotracheal intubation. An in vivo cinefluoroscopic study of subjects without cervical abnormality. *Anesthesiology* 1996;85(1):26–36.
- 5 Avitsian R, Lin J, Lotto M, Ebrahim Z. Dexmedetomidine and awake fiberoptic intubation for possible cervical spine myelopathy: a clinical series. *J Neurosurg Anesthesiol* 2005;17(2):97–9.
- 6 Sung RD, Wang JC. Correlation between a positive Hoffmann's reflex and cervical pathology in asymptomatic individuals. *Spine (Phila Pa 1976)* 2001;26(1):67–70.
- 7 Aebli N, Wicki AG, Ruegg TB, Petrou N, Eisenlohr H, Krebs J. The Torg–Pavlov ratio for the prediction of acute spinal cord injury after a minor trauma to the cervical spine. *Spine J* 2013; 13(6):605–12.