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Brachial Plexopathy After Cervical Spine Surgery

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Abstract

Study Design: Retrospective, multicenter case-series study and literature review.

Objectives: To determine the prevalence of brachial plexopathy after cervical spine surgery and to review the literature to better understand the etiology and risk factors of brachial plexopathy after cervical spine surgery.

Methods: A retrospective case-series study of 12 903 patients at 21 different sites was performed to analyze the prevalence of several different complications, including brachial plexopathy. A literature review of the US National Library of Medicine and the National Institutes of Health (PubMed) database was conducted to identify articles pertaining to brachial plexopathy following cervical spine surgery.

Results: In our total population of 12 903 patients, only 1 suffered from postoperative brachial plexopathy. The overall prevalence rate was thus 0.01%, but the prevalence rate at the site where this complication occurred was 0.07%. Previously reported risk factors for postoperative brachial plexopathy include age, anterior surgical procedures, and a diagnosis of ossification of the posterior longitudinal ligament. The condition can also be due to patient positioning during surgery, which can generally be detected via the use of intraoperative neuromonitoring.

Conclusions: Brachial plexopathy following cervical spine surgery is rare and merits further study.

Keywords

brachial plexopathy, cervical spine surgery

Introduction

Brachial plexopathy is a term used to describe dysfunction of the brachial plexus. Symptoms of brachial plexopathy may include pain, motor deficits, and/or sensory deficits in the distribution of the nerves that comprise the brachial plexus (C5-T1), that is, shoulder, arm, wrist, and hand. On physical examination, atrophy and hyporeflexia may also be present in addition to weakness and sensory loss. Common causes of brachial plexopathy include trauma, tumors (ie, Pancoast tumor), inflammatory conditions (ie, brachial plexitis or Parsonage-Turner syndrome), and exposure to toxins.

Brachial plexopathy following cervical spine surgery is an uncommon occurrence. In this multicenter study, we retrospectively reviewed cervical spine surgery cases to determine the prevalence of brachial plexopathy following surgery. Given the low prevalence, we also performed a review of the literature to provide further understanding. Of note, this article focuses on brachial plexopathy after cervical spine surgery and not on C5 palsy.

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Methods

A retrospective multicenter case-series study was conducted involving 21 high-volume surgical centers from the AOSpine North America Clinical Research Network, selected for their excellence in spine care, clinical research infrastructure, and experience. Medical records for 12 903 patients who received cervical spine surgery (levels from C2 to C7) from January 1, 2005 to December 31, 2011 were reviewed to identify the occurrence of 21 predefined treatment complications. The complications included reintubation requiring evacuation, esophageal perforation, epidural hematoma, C5 palsy, recurrent laryngeal nerve palsy, superior laryngeal nerve palsy, hypoglossal or glossopharyngeal nerve palsy, dural tear, brachial plexopathy, blindness, graft extrusion, misplaced screws requiring reoperation, anterior cervical infection, carotid artery injury or cerebrovascular accident, vertebral artery injuries, Horner syndrome, thoracic duct injury, tetraplegia, intraoperative death, revision of arthroplasty, and pseudomeningocele. Trained research staff at each site abstracted the data from medical records, surgical charts, radiology imaging, narratives, and other source documents for the patients who experienced one or more of the aforementioned complications. Data were transcribed into study-specific paper Case Report Forms (CRF). Copies of CRF were transferred to the AOSpine North America Clinical Research Network Methodological Core for processing, cleaning, and data entry. Descriptive statistics were provided for baseline patient characteristics. Paired *t*-test was used to analyze changes in clinical outcomes at follow-up compared with preoperative status.

For the literature review, databases of the US National Library of Medicine and the National Institutes of Health (PubMed) were queried to identify all studies describing brachial plexopathy after cervical spine surgery. Key terms used in the search included "brachial plexopathy after cervical spine surgery" and "brachial plexus injury after cervical spine surgery." Pertinent references cited in all culled articles were also examined.

This study was ethically approved by the institutional ethics committees at all participating sites.

Results

The number of patients who suffered from any of the above complications was 258. The average age of patients who had a complication was 57.0 $\pm$ 13.2 years, and 54.7% were males. The average body mass index (BMI) was 28.8 $\pm$ 6.5 kg/m^2; 8.1% of patients were considered to have a short neck. In terms of tobacco use, 22.4% of patients were current smokers, 29.7% of patients were previous smokers, and 47.8% of patients were nonsmokers. An endotracheal tube was used in 96.9% of cases, and a laryngeal mask airway was used in 1.4% of patients. Cervical traction was utilized in 27.6% of cases, and the patient's neck was rotated in 2.1% of cases. Anterior surgery was performed in 53.9% of patients, posterior surgery in 39.1%, and circumferential surgery in 7.0%. Average operative length was 212.7 minutes and average estimated blood loss was 461.1 $\pm$ 725.5 mL. Blood transfusion during surgery was required in 10.3% of cases in which there was a complication.

Complication rates by level of surgery (in decreasing order) were: C5 89.5%, C6 88.0%, C4 71.3%, C7 64.3%, C3 50.4%, T1 19.8%, C2 17.4%, C1 1.9%, and occiput 0.4%.

In our total population of 12 903 patients over 21 sites, only 1 patient had postoperative brachial plexopathy, for a prevalence rate of 0.01%. The prevalence rate by site ranged from 0% to 0.07%. She was a 59-year-old nonsmoking woman who was 157 cm in height and 52 kg in weight. Her preoperative diagnosis was degenerative disc disease, and she was neurologically intact at baseline. She underwent an anterior C6-C7 arthroplasty. For her procedure, the patient was intubated and no cervical traction or rotation was utilized. Her arms were tucked to her side, with shoulder braces, shoulder tape, or wrist restraints used. Her upper extremities were not padded. Intraoperative neuromonitoring (motor-evoked, somatosensory-evoked [SSEPs], and electromyographic [EMG] potentials) was used without any changes noted throughout her procedure. Her operative time was 140 minutes; estimated blood loss was 25 mL, and no blood transfusion was required. Five days after surgery, the patient was noted to have just 3/5 strength in the left biceps, triceps, wrist extensors, and finger abductors. A postoperative magnetic resonance imaging study did not demonstrate any abnormal findings. Her deficits eventually resolved within 1 year of surgery after conservative management.

Discussion

In this multicenter study of 12 903 patients who underwent cervical spine surgery, only 1 patient had a postoperative brachial plexopathy; this condition was rare and had an overall prevalence rate of 0.01% and a maximum prevalence rate of 0.07% at the site where the plexopathy occurred. Given the low occurrence of this complication, we performed a literature search in order to attain a more thorough understanding of the risk factors for developing a true postoperative brachial plexopathy (and not just a C5 palsy).

The occurrence of brachial plexopathy after cervical spine surgery is infrequently reported. Hasegawa et al[1] theorized that upper extremity palsy following cervical decompression results from a transient spinal cord lesion secondary to reperfusion. In their retrospective study of 857 patients, the authors performed anterior decompression and fusion in 424 patients, laminoplasty in 345 patients, and laminectomy in 88 patients. In total, 19 patients (2.2%) had postoperative upper extremity palsy involving multiple segments. The authors found that the highest risk factors for the development of postoperative weakness were age, anterior surgical procedures, and a diagnosis of ossification of the posterior longitudinal ligament. Of note, our patient with postoperative brachial plexopathy was not elderly but did have an anterior cervical arthroplasty performed for degenerative disc disease.

We suspect that the difference in the prevalence of brachial plexopathy between our study and the study by Hasegawa et al[1] may be a result of 2 factors. First, our study was conducted over 21 centers whereas the study by Hasegawa et al[1] included patients from just 1 center. A multicenter study will provide a larger denominator as well as more potential recall bias, both of which can decrease a prevalence rate. Second, the Hasegawa study collected data between 1980 and 2005, whereas our study collected data from 2005 to 2011. It is possible that our more current study consisted of more advanced surgical techniques, and thus a decreased prevalence of brachial plexopathy.

Brachial plexopathy after cervical spine surgery may be secondary to positioning and not due to the surgery itself. The use of intraoperative neuromonitoring can help to detect its occurrence. Intraoperative neurophysiologic monitoring is a battery of tests (including motor- and SSEPs, and EMG) used to assess the functional integrity of the spinal cord, nerve roots, and other peripheral nervous system structures (including the brachial plexus) during spinal surgery. Jahangiri et al[2] reported a patient undergoing anterior cervical surgery who had a change in SSEPs and transcranial electrical motor–evoked potentials (TCeMEPS) during draping, that is, before incision was made. The specific muscle groups involved were the bilateral abductor pollicus brevis, abductor digiti minimi, biceps, and left deltoids. The patient's shoulders had been pulled downward and draped, and after removing the tape there was a return of SSEPs and TCeMEPS to baseline. Schwartz et al[3] reported their series of 3806 patients who underwent anterior cervical spine surgery with TCeMEPs, SSEPs, and spontaneous EMG. In 69 patients (1.8%), neuromonitoring detected impending neurologic injury due to patient positioning, 45 of whom had the brachial plexus as the site of evolving injury. The most common cause of impending brachial plexopathy was shoulder taping for counter-traction, while the second most common cause was neck extension. These studies underscore the importance of neuromonitoring during cervical spine surgery, with baseline signals obtained as early as possible.

One potential cause of brachial plexopathy after cervical spine surgery is brachial neuritis, also known as Parsonage-Turner syndrome. Brachial neuritis (or plexitis) is an inflammatory disorder that involves the sudden onset of severe pain in the shoulder region, followed by the development of weakness in muscles innervated by the brachial plexus.[4,5] The muscles most commonly involved are those innervated by the axillary, suprascapular, long thoracic, and/or musculocutaneous nerves.[6] This syndrome occurs due decreased physical resistance due to illness, trauma, pregnancy, or surgery. Park et al[7] reported on 2 patients who underwent anterior cervical surgery who developed shoulder pain and proximal upper extremity weakness 5 to 6 days after surgery, as opposed to immediately after surgery as is generally the case with C5 palsy. Useful adjuncts for the diagnosis of brachial neuritis include an EMG/nerve conduction velocity and magnetic resonance imaging of the brachial plexus after 3 weeks of symptoms. Management of this condition is nonoperative (physical therapy).[8]

Conclusion

Brachial plexopathy after cervical spine surgery is rare, with a maximum reported prevalence of 2.2% (and 0.07% in this study). It manifests as motor and/or sensory disturbances in distributions innervated by the brachial plexus. Previously identified surgical risk factors include increasing age, anterior approaches, and a diagnosis of ossification of the posterior longitudinal ligament. Patient positioning is probably a more common cause of postoperative brachial plexopathy. The use of intraoperative neuromonitoring can help to identify impending brachial plexopathy.

Declaration of Conflicting Interests

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