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Clinical Study

Detection of postoperative neurologic deficits using somatosensory-evoked potentials alone during posterior cervical laminoplasty

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Abstract

BACKGROUND CONTEXT: The use of neurophysiologic monitoring during anterior and posterior cervical decompression procedures in patients with spondylotic myelopathy remains controversial. The ideal neurophysiologic monitoring modality of choice is also highly debated.

PURPOSE: The purpose of this study was to evaluate the utility of neurophysiologic monitoring with only somatosensory-evoked potentials (SSEPs) in a consecutive series of laminoplasty procedures with regard to the detection of new postoperative neurologic deficits.

STUDY DESIGN: Retrospective case series.

PATIENT SAMPLE: Eighty consecutive patients who underwent a posterior cervical laminoplasty were reviewed.

OUTCOME MEASURES: We analyzed intraoperative SSEP amplitude and latency changes from baseline with regard to the development of new postoperative neurologic deficits.

METHODS: We retrospectively reviewed 80 patients who underwent a posterior cervical ''open-door'' laminoplasty with a standard SSEP neurophysiologic monitoring protocol. Intraoperative SSEP amplitude and latency changes from baseline (''alerts'') were analyzed with regard to the development of new postoperative neurologic deficits.

RESULTS: Baseline SSEP values were obtained in all patients. There were five (6%) procedures that had SSEP alerts. All alerts occurred shortly after the lamina was hinged open. Four patients with SSEP alerts developed new postoperative neurologic deficits, including three unilateral upper extremity motor and sensory deficits and one complete spinal cord injury. In the immediate postoperative period, our experience with SSEP monitoring demonstrated 4 true-positive, 75 true-negative, and 1 false-positive monitoring results.

CONCLUSIONS: In this series of laminoplasty procedures, SSEP neurophysiologic monitoring had a high sensitivity and specificity for predicting new neurologic deficits in the early postoperative period. Somatosensory-evoked potentials are an effective tool for spinal cord monitoring when performing a posterior cervical laminoplasty procedure.

Keywords: Somatosensory; Neurophysiologic monitoring; Laminoplasty; Cervical

Introduction

Degenerative cervical spondylosis remains the most common cause of cervical myelopathy [1,2]. Various methods of spinal cord decompression are described for the treatment of this disease [3]. Anterior approaches accomplish direct spinal cord decompression by either corpectomy and strut grafting [4] or multilevel discectomy and

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Institutional review board approval was obtained before the initiation of this study.

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fusion [5]. Posterior approaches have become more popular for multilevel cervical degeneration and spinal cord decompression by either laminectomy, with or without fusion, or laminoplasty [6,7].

The use of spinal cord monitoring by either somatosensory-evoked potentials (SSEPs) or transcranial motor-evoked potentials (tcMEPs) has been extensively studied in scoliosis corrective surgery since the advent of the Stagnara wake-up test [8] and remains the gold standard of care [9–13]. Despite this, the use of spinal cord monitoring during cervical decompression procedures remains controversial [14–22]. Most published series have assessed the utility of spinal cord monitoring with anterior cervical procedures [14,16–22]. From these reports, spinal cord monitoring may be most beneficial for patients undergoing corpectomy, patients diagnosed with spondylotic myelopathy, or during surgical stabilization after cervical trauma [22]. The use of spinal cord monitoring during routine anterior cervical decompression and fusion procedures for cervical radiculopathy is less commonly used and is suggested by a number of authors as being unnecessary [17,18].

When spinal cord monitoring is desired, the choice of which modality is most efficacious is also extensively debated. The use of tcMEP has been reported to have a higher sensitivity when compared with SSEP and may detect spinal cord insults sooner [14,23]. Additionally, the use of multimodal neurophysiologic monitoring (tcMEP, SSEP, and electromyography) can improve the accuracy of detecting new neurologic deficits. Multimodal techniques allow for continuous monitoring of three separate and distinct neurologic pathways, all of which could be subjected to injury during cervical surgery [14,19,22]. Despite these advantages, the use of tcMEP monitoring may be limited by a number of factors. The use of paralytic agents must be avoided, which may increase intraoperative blood loss, and certain medical comorbidities (seizure disorder, cardiac implants, or cerebral implants) contraindicate the use of tcMEP in cervical surgery.

The use of spinal cord monitoring (SSEP and tcMEP) in posterior cervical procedures is not as well defined as with scoliosis or anterior cervical surgery [15,24]. These previous authors have demonstrated unacceptable results of detecting neurologic injuries, particularly with regard to delayed neurologic deficits, following posterior cervical decompression procedures [15,24]. The objective of this study is to report on the utility of spinal cord monitoring at our institution with regard to detecting new postoperative neurologic deficits in the early postoperative period in a consecutive series of patients undergoing posterior cervical laminoplasty for spondylosis and myelopathy.

EVIDENCE & METHODS

Context
SSEP monitoring is commonly used during cervical spine procedures but its value is commonly debated.

Contribution
In this retrospective review of 80 consecutive cases of myelopathy treated by open-door laminoplasty, SSEP monitoring was found to be abnormal in all four cases with serious intraoperative neurological injury detected, and one apparent false-negative SSEP alert was reported.

Implication
The accurate real-time detection of neurological deterioration allows for immediate efforts (eg, increasing blood pressure, administration of steroids, ensuring adequate decompression, etc.) aimed at reversal or minimalization. The use of SSEP in this patient population remains controversial. Although theoretically possible, it remains to be shown whether intraoperative measures prompted by the SSEP alerts in this procedure can minimize or avert a neurological injury. It is also possible the injury associated with opening the laminoplasty hinge is irreversible; unlike the distraction injury seen in deformity surgery in which the release of correction may reverse the event.

—The Editors

Materials and methods

Institutional review board approval was obtained before the collection or analysis of any data associated with this study. The medical records of a consecutive series of patients who had undergone a posterior cervical ''open-door'' laminoplasty procedure from June 2001 to April 2008 were retrospectively reviewed. A total of 80 patients were identified. Fifty-six of the patients were men and 24 were women. The average patient age (and standard deviation) at the time of the laminoplasty procedure was 60.9±13.3 years (range, 35–87 years). The indication for posterior cervical laminoplasty was spondylotic myelopathy in all cases. Somatosensory-evoked potential monitoring was used throughout the entire procedure in all patients. Transcranial motor-evoked potential monitoring was not used.

A number of different cervical levels were decompressed based on the site of associated compression. Twelve patients underwent a laminoplasty across two cervical levels, 34 underwent a laminoplasty across three cervical levels, 16 underwent a laminoplasty across four cervical levels, and 18 underwent a laminoplasty across five cervical levels. The hinge of the ''open-door'' laminoplasty was held open by a Ti-Mesh LP System miniplate (Medtronic Sofamor Danek, Memphis, TN, USA) in 57 patients. Before the advent of these plates, the hinge was held open in 23 patients by wires, sutures, or bone graft.

A standard SSEP protocol was used to monitor the upper and lower extremities throughout the cervical laminoplasty procedure. The ulnar nerve was stimulated at the cubital