SOMATOSENSORY EVOKED POTENTIALS ARE NOT A SENSITIVE INDICATOR OF POTENTIAL POSITIONING INJURY IN THE PRONE PATIENT

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ABSTRACT. Objective. This study monitored somatosensory evoked potentials (SSEP) at the median and ulnar nerves in awake volunteers placed in a simulated position for prone surgery. Neurologic symptoms were used as a surrogate endpoint for position related peripheral nerve injury; the occurrence of these symptoms was correlated with the presence or absence of SSEP changes in median and ulnar nerves. Methods. Median and ulnar nerve SSEP data was obtained from awake volunteers in the supine and prone positions. With the head midline in the prone position, SSEPs were measured as the arms were advanced in four cephalad increments. Symptoms, defined as tingling, numbness, or aching in the hand, forearm, or upper arm, were recorded at each position. SSEP changes were considered significant when amplitude decreased 60% and/or latency increased 10% compared with baseline prone measurements. Symptoms were correlated with SSEP changes using chi-squared analysis (p < 0.05), and Fisher’s exact analysis (p < 0.07). Results. Data were collected on 14 patients, mean age 34 ± 3 years. Seven (50%) subjects reported symptoms with changes in position, while four (29%) subjects displayed SSEP changes. There was no statistically significant association between symptoms and SSEP changes. There were no false positives (no symptoms in the presence of significant SSEP changes), but there were 3 (21%) false negatives (positive symptoms without SSEP changes). Conclusions. While all SSEP changes were associated with symptoms, the development of symptoms in 3 of 7 patients without SSEP changes suggests that SSEPs may be an imperfect monitor for the detection of positioning injury. The limited sensitivity of SSEPs in this study may be due to the duration of the monitoring, sample size, or the validity of symptoms as a surrogate for nerve injury.


INTRODUCTION

In a review of closed claims, 15% were for perioperative nerve injury [1]. Improper positioning is a known cause of peripheral nerve injury [2,3]. The ulnar, brachial plexus, and lumbosacral roots were the most frequent source of claims [1]. While pain and/or paresthesias are considered to be markers of potential injury, the absence of symptoms under anesthesia can permit a patient to be placed in positions that would not be tolerated when awake and that may be potentially injurious. In the preoperative visit, preanesthetic holding area, or even operating room, it is possible to evaluate and recheck postural limitations before a patient is anesthetized. Intraoperative neurophysiologic monitoring has been used to
predict peripheral nerve injury during cardiac surgery [4–6] and to possibly minimize the risk of sciatic nerve injury during hip surgery [7] although a recent study by Rasmussen [8] questions the efficacy of SSEP monitoring in this instance. Few studies have examined the use of upper extremity somatosensory evoked potentials (SSEPs) to monitor for nerve injury in prone spinal surgery, and no studies have examined the correlation between symptoms and SSEP changes [9–11]. This study monitored the median and ulnar nerve SSEPs in awake volunteers placed in the simulated position for prone surgery. The occurrence of symptoms was correlated with the presence or absence of SSEP changes in the median and ulnar nerves.

MATERIALS AND METHODS

After institutional review board approval and informed consent were obtained*, median and ulnar nerve SSEPs were recorded from awake volunteers in the supine and prone positions. Each volunteer was assessed before the study to have no gross neurologic deficits by history and physical examination. Each volunteer lay supine on an operating room table with arms at the side, and baseline recordings of median and ulnar nerve SSEPs were obtained. Following the supine recordings, the volunteer then assumed the prone position atop chest rolls with arms positioned such that the shoulders were abducted 65° to the thorax and elbows adducted 80°. The arms rested on foam padding with elbows and wrists level with the mid-axillary line. The head was at midline resting on a foam support. SSEPs were measured in the following positions as arms were advanced cephalad in an attempt to deliberately create symptoms: 1) baseline: shoulder abduction to 65° and elbow flexion 80°, 2) neutral: (simulated surgical position) 90° shoulder and 80° elbow, 3) minimum extension: 105° shoulder and 80° elbow, 4) moderate extension: 120° shoulder and 90° elbow, and 5) maximum extension: arms straight and relaxed. (Fig 1). Each position was maintained for approximately 10 to 15 minutes, after which median and ulnar nerve SSEPs and the presence or absence of symptoms were recorded.

SSEP recordings

SSEPs were recorded using a Viking IV Nicolet Instruments Intraoperative Monitoring Program, (Madison, Wisconsin). Silver-silver chloride self-gelled, electrical stimulating electrode pads were placed over the ulnar and median nerves at the wrist. Stimulus parameters were a constant current stimulation at 4.7 Hz, and duration of 0.2 ms, and an intensity 10 to 18 mA. The intensity was adjusted to produce a small visible twitch in the thenar (median) and hypothenar (ulnar) muscles; this level was not changed for the duration of each study. SSEPs were recorded using silver EEG surface electrodes cup (10 mm) with electrode paste. Using the International 10–20 System, electrode placement was as follows: Cp4-Fpz and Cp3-Fpz for cortical recordings; C5s (5th cervical spine) –Fpz for cervical or subcortical readings; and EpL (left)-EpR (right) for the peripheral recordings. All impedances were matched and maintained at less than 3 kohms. Filters were 30 Hz to 1000 Hz and 600 to 1000 stimuli were averaged (as determined by reprodu-