TRANSCRANIAL ELECTRIC MOTOR EVOKED POTENTIAL DETECTION OF COMPRESSIONAL PERONEAL NERVE INJURY IN THE LATERAL DECUBITUS POSITION

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ABSTRACT. The peroneal nerve is susceptible to injury due to compression at the fibular head for patients placed in the lithotomy, hemilithotomy or lateral decubitus positions during surgery. Upper extremity somatosensory and transcranial electric motor evoked potential monitoring has proven efficacious for identifying impending positional brachial plexopathy or upper extremity peripheral neuropathy in adult and pediatric patients undergoing spine surgery. We report on two cases to illustrate the usefulness of monitoring transcranial electric motor evoked potentials recorded from tibialis anterior muscle to identify emerging peroneal nerve compression secondary to lateral decubitus positioning.

KEY WORDS. peroneal nerve palsy, lateral decubitus position, intraoperative neurophysiological monitoring, motor evoked potentials, somatosensory evoked potentials.

INTRODUCTION

Neural injury secondary to intraoperative positioning is an unfortunate, but oftentimes preventable perioperative complication. The use of intermittent pneumatic pressure stockings [1–4] or placement in the lithotomy or hemilithotomy position during surgery has been associated with well-limb peroneal nerve palsy [5–7]. The lateral decubitus position may increase the risk for compartment syndrome and compressive peroneal nerve injury in the dependent leg [8, 9]. Consequently, despite efforts at careful positioning and limb padding, neurologic deficit as a result of intraoperative peroneal nerve compression remains problematic.

A number of studies have established the sensitivity of intraoperative ulnar nerve somatosensory evoked potentials (SSEP) to emerging brachial plexopathy or ulnar neuropathy secondary to positioning for cardiac [9–12] and spine surgery [13–18]. Kamel et al [17] performed a retrospective analysis of 1,000 consecutive spine surgeries during which upper extremity somatosensory evoked potentials were monitored for identification of positional brachial plexopathy or peripheral neuropathy. They found that the lateral decubitus and prone “superman” positions were associated with the highest incidence of position-related SSEP changes. Recently, Schwartz, et al. reported on the sensitivity of transcranial electric motor evoked potentials (tceMEP) to impending positional brachial plexopathy and upper extremity peripheral neuropathy in patients undergoing anterior cervical spine surgery [18].
In contrast to the number of studies and case reports lauding the benefits of upper extremity somatosensory evoked potential monitoring for the intraoperative detection of positional brachial plexopathy, there is a paucity of reports related to neurophysiological identification of position-related lower extremity peripheral nerve injury. We report on two cases to illustrate the benefits of monitoring transcranial electric motor evoked potentials (tceMEPs) recorded intraoperatively from tibialis anterior muscle to identify peroneal nerve compression secondary to lateral decubitus positioning.

CASE REPORTS

Case 1

A 65-year-old male initially presented with severe thoracic pain. Radiographic studies showed lesions in the thoracic and lumbar spines, with a compression fracture at T6. Magnetic resonance imaging studies showed retro-pulsion of bony fragments into the spinal canal. Physical exam revealed normal sensory and motor function in bilateral upper and lower extremities. This patient underwent a thoracotomy in the left lateral decubitus position and T6 corpectomy with interbody fusion.

The neurophysiological monitoring protocol included transcranial electric motor evoked potentials from bilateral first dorsal interosseous, rectus abdominis, quadriceps, tibialis anterior, and abductor hallucis muscles, as described elsewhere [19–25]. Cortical and sub-cortical somatosensory evoked potentials were recorded to interleaved stimulation of the left and right ulnar nerves, as well as to interleaved stimulation of the left and right lower extremities.

Anesthesia was maintained using a total intravenous anesthetic technique of propofol (100–250 mcg/kg/min) and remifentanil (0.05–0.5 mcg/kg/min) infusions, supplemented with boluses of midazolam (1–2 mg) as needed. Succinylcholine was used for intubation to facilitate rapid clearance of the neuromuscular junction for motor evoked potential monitoring during patient positioning. This total intravenous anesthesia protocol has been described in more detail elsewhere [23–25].

Prior to left lateral decubitus positioning, large-amplitude, bilaterally symmetrical transcranial electric motor evoked potentials were recorded from all monitored myotomes in the upper and lower extremities. There were no remarkable post-positioning changes in tceMEP and posterior tibial nerve SSEP amplitudes relative to pre-positioning as illustrated in Figures 1 and 2, respectively.

Case 2

A 39-year-old male presented initially with chief complaint of back pain secondary to osteomyelitis at T12 and L1. His past medical and surgical histories were unremarkable except for two previous lumbar discectomies. This patient underwent anterior T12 and L1 corpectomies prior to incision, a non-depolarizing paralytic agent (rocuronium 50 mg) was administered to facilitate surgical exposure, thereby precluding reliable tceMEP recordings as evidenced in Figure 3 by significant attenuation of abductor hallucis responses to train-of-four (TOF) electrical stimulation of the posterior tibial nerve. During this time, therefore, intraoperative monitoring was limited to somatosensory evoked potentials which remained stable and unchanged from pre-positioning baselines (Figure 2).

Upon adequate clearance of the neuromuscular junction, shown by return of four large responses to TOF stimulation approximately 45 min following incision, tceMEP monitoring was resumed (see Figures 1, 3). At this time, motor evoked potentials from the majority of left and right lower extremity muscles were stable and consistent with baseline, indicative of uncompromised spinal cord function. Curiously, the tceMEP from left tibialis anterior muscle, though present, remained relatively attenuated. Peak-to-trough amplitude was approximately 200 μV, compared both to earlier responses measuring over 1,000 μV as well as those from right tibialis anterior muscle having amplitudes exceeding 600 μV, as illustrated in Figure 1.

Since the main focus of attention was on ensuring spinal cord integrity for a thoracic procedure, and since both the foot flexor tceMEP responses, as well as the cortical SSEPs to posterior tibial nerve stimulation remained stable bilaterally, thereby verifying intact spinal cord function, the incomplete return of left tibialis anterior muscle motor evoked potential amplitude after recovery from neuromuscular blockade was viewed as a puzzling anomaly. Moreover, since it remained stable for the balance of the procedure, albeit reduced in amplitude relative to baseline responses recorded prior to administration of neuromuscular blocking agent (see Figure 1), it was not considered clinically alarming. There were no other remarkable changes in the neurophysiological monitoring data during the surgical course.

Upon anesthesia emergence, the patient presented with profound left foot drop. Subsequent neurologic evaluation confirmed left peroneal nerve palsy, likely due to prolonged pressure on the nerve at the level of the fibular head. This gradually improved over the course of 9 months.