Electromyographic Changes of Brachial Plexus Root Avulsions*

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TRACTION INJURIES of the brachial plexus usually result in avulsion of the anterior and posterior roots from the spinal cord since these represent the weakest link in the plexus. This type of injury presents sufficiently characteristic electromyographic findings so that the site of the lesion can be accurately localized to the spinal canal (proximal to the level of the dorsal root ganglion). These findings depend on the functional integrity of the peripheral sensory axons which remain in continuity with the dorsal root ganglion. The motor axons, on the other hand, undergo Wallerian degeneration. The absence of Wallerian degeneration in the peripheral sensory axons is reflected by a normal evoked sensory nerve action potential during nerve conduction studies in spite of complete anesthesia of the involved extremity.

We are reporting the electromyographic data recorded from two patients with brachial plexus root avulsion.

**Technique**

Motor and sensory conduction studies were performed in the ulnar and median nerves. The muscle action potential was evoked by percutaneously stimulating the median nerve at the elbow and wrist while recording with surface electrodes from the thenar muscles. The same procedure was followed in studying the ulnar nerve while recording from the hypothenar muscles (Fig. 1). The motor conduction velocity was calculated for the segment of nerve between the two points of stimulation by dividing the distance between these two points on the nerve by the time necessary for the electrical impulse to travel this distance.

The sensory nerve action potential was recorded from the median and ulnar nerves with surface electrodes at the wrist by percutaneous stimulation of the second and fifth fingers respectively. The distal sensory latency was measured in milliseconds from the stimulus artifact to the peak of the sensory nerve action potential.

Monopolar teflon coated electrodes were used for intramuscular recordings of spontaneous and motor unit potentials.

In carrying out conduction studies and needle electromyography, we used Tektronix amplifier 3A74, differential amplifier 2A61, time base 2B67, and cathode ray oscilloscope 561A to amplify and display electrical potentials. A Grass S4 stimulator was used for nerve stimulation. Data were recorded on Kodak TRI-X-Pan 35 mm film.

**Case Reports**

**Case 1.** This 28-year-old man was involved in a car accident after which his left...
The arm was immediately paralyzed and anesthetic.

**Examination.** There was flaccid weakness involving muscles innervated by the C5-T1 roots, loss of all sensation in the C5-T1 dermatomes in the left arm, and a left Horner's syndrome. No long tract signs were present. There were abrasions on the left side of the face and neck. Cervical spine x-ray films revealed fracture of the transverse processes of the seventh cervical and eighth thoracic vertebrae on the left. The characteristic dural sacs commonly known as traumatic meningoceles were noted in the region of C5-T1 root processes on the left.

The patient's neurological status remained unchanged over the following 6 months.

**Electromyographic Studies.** Serial conduction studies were carried out from 5 days to 6 months following the accident. At 5 days post-injury despite complete flaccid paralysis and anesthesia in the left arm, a normal evoked muscle action potential was obtained in the left median nerve together with a normal motor conduction velocity of 53.5 m/sec (normal range 48 to 70 m/sec), and a normal distal sensory latency of 2.6 msec (distance of 13.0 cm). By 8 days post-injury, the muscle action potential could not be evoked. In the left ulnar nerve 5 days after injury, the motor conduction velocity was 55.6 m/sec (normal range 45 to 75 m/sec). The evoked muscle action potential became progressively smaller and was last obtained on the eleventh day post-injury. The distal sensory latency was normal at 2.4 msec (distance of 11.1 cm). The sensory nerve action potential in the left median and ulnar nerves persisted, and the distal sensory latency remained normal up to 6 months post-injury (Fig. 2).

**Case 2.** This 16-year-old boy noted paralysis and anesthesia of his left arm after being thrown out of a car.

Examination. Flaccid paralysis of all muscles in the left arm innervated by the C5-T1 roots was present, as was anesthesia in C5-T1 dermatomes. A left Horner's syndrome was present and long tract signs absent. There were abrasions of the left side of the face and upper medial aspect of the left arm. The cervical spine x-ray films were normal, but the cervical myelograms showed large traumatic meningoceles at C-6 to T-1 and an accentuated C-5 root pouch on the left side. The spinal cord was slightly displaced to the opposite side (Fig. 3).

The patient's neurological status remained unchanged during the ensuing 6 months.

**Electromyographic Studies.** Serial conduction studies were performed 1 and 5½ months post-injury. No muscle action potential could ever be evoked. At 1 month post-injury, the sensory nerve action potential and the distal sensory latency were normal.