Closed median nerve rupture from elbow trauma

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Published online: 24 May 2014
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Introduction

Though relatively uncommon, median nerve injury following bony trauma of the upper extremity has been described in the literature following humeral fracture [4], forearm fracture [5], and combined dislocation of the shoulder and elbow [6]. Previous reports of median nerve injury from elbow dislocation describe injuries in which the median nerve remains in continuity and functional recovery is spontaneous [8, 9]. In this manuscript, we report a case of a complete, closed, median nerve rupture, requiring repair after elbow dislocation.

Case Report

A 43-year-old male experienced trauma to the left arm in a motor vehicle accident. He suffered dislocation of the left elbow, with a comminuted fracture of the distal left ulna, and an open proximal phalanx of the left long finger. Left median and left ulnar nerve palsies were noted, with loss of motor activity and sensation in the distribution of both nerves. The long finger was debrided and underwent open reduction internal fixation. The left elbow was reduced, and the distal ulna was repaired by open reduction and internal fixation. The median and ulnar nerve palsies were followed with electromyography (EMG) studies. Ulnar nerve function partially recovered over the next 3 months; however, the patient had persistent median nerve palsy unchanged from initial

examination. Five months post injury, the patient demonstrated no further clinical improvement and was referred to us for further evaluation and management.

Initial examination at our center demonstrated dense anesthesia in the distribution of the median nerve, along with the following additional findings. Atrophy was noted of both the flexor pronator muscles of the left forearm and the thenar eminence of the left hand. There was an absence of flexor digitorum superficialis (FDS) and flexor pollicis longus (FPL) function as well as flexor digitorum profundus (FDP) function to the index and long fingers. The patient lacked function of the intrinsic thumb musculature and demonstrated ulnar deviation of the wrist with flexion. Hypesthesia was noted in the small finger and ulnar aspect of the ring finger, and weak motor function of the FDP to the small and ring fingers was present. Sensation was present in the dorsum of the hand, as was digital extension. Normal active flexion, extension, abduction, adduction, and internal and external rotation were noted at the shoulder, with 5/5 strength of the internal and external rotators. The neck exam was also normal, including no pain with manipulation of the cervical spine. However, a Tinel sign was appreciated at the level of the axillary fold. Electrodiagnostic studies demonstrated nonreactive sensory latencies and sharp waves/fasciculations in median nerve-innervated muscles of the hand and forearm indicating neurotmesis/axonotmesis over neurapraxia. These findings were consistent with motor and sensory dysfunction of the median nerve that localized to either the distal medial cord or median nerve. Operative exploration of the infraclavicular plexus and median nerve were planned.

Surgical exploration began at the lateral border of the sternocleidomastoid (SCM). No scar was noted in the interval between the SCM and inferior scalene. Further, distal dissection demonstrated no injury in the infraclavicular plexus proximal to the medial and lateral cord contributions to the median nerve.

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Fig. 1 **a** Neuroma discovered in median nerve. **b** 6-cm defect noted

Suspecting a more distal lesion, the median nerve was explored at the level of the pronator teres. The nerve was identified and found to have no apparent injury. Cortical evoked potentials (CEPs) demonstrated no response with stimulation of this portion of the median nerve. Returning to the infraclavicular area, no distal response was elicited by stimulation of the distal medial and lateral cords leading down to the median nerve; however, CEPs were positive with stimulation. Next, the median nerve was explored more distally along the proximal humerus, revealing a large neuroma of the median nerve approximately 2 cm in length at the level of the midshaft of the humerus (Fig. 1). Stimulation demonstrated no distal motor response (Fig. 2). Further dissection demonstrated a 6-cm defect in the median nerve (Fig. 1). A dynamic elbow external fixator (Orthofix, Henderson TX) was applied and the elbow was placed in 130° of flexion. The neuroma was resected and primary group fascicular repair was accomplished using an operating microscope; two Neuragen® tubes (Integra LifeSciences, Plainsboro NJ) were applied to the coaptation site. The fixator was left static for 4 weeks and gradually extended over the next 8 weeks.

At the final follow-up at 36 months post surgery, 41 months after original injury, the patient's pain had diminished and was controlled with oral analgesics. Tinel sign had migrated

distally to the mid forearm indicating sensory axon regeneration. Two-point discrimination in the median nerve distribution was noted to be 8 mm. FCR function was present, and active flexion of the MP and PIP joints of the index finger were to 60 and 20, respectively, and active flexion of the PIP joint of the long finger was to 70. Thumb IP motion was limited to 10°.

Discussion

Median nerve injury due to elbow trauma has been reported; however, closed rupture of the median nerve in association with elbow dislocation has not been previously described. One large series of 1,540 patients presenting with elbow dislocations and fractures described only 21 (1.4 %) cases of associated peripheral nerve injury. Of the 187 dislocations of the elbow in this series, concomitant median nerve injury was not noted [3].

The location and nature of damage to the median nerve in this report is unique for a stretch-related injury. A review of 250 acute median nerve injuries over 30 years reported 22 stretch or contusion injuries at the arm and elbow level. Of the 11 patients explored at the elbow level, all were found to have the nerve in continuity [7]. Thus, while median stretch injuries at the elbow and arm in general have been shown to be repairable with excellent results, damage is not usually as extensive or difficult to suspect based on clinical picture as seen in the current case.

Optimal management in the instance of closed rupture of the median nerve in association with elbow trauma has not been defined. It is established that primary repair as early as the extent of the lesion can be determined provides the best likelihood of recovery—motor function is lost without neurotization at 18 months after disruption of peripheral nerves, though sensory function can be restored up to years later [1].

Fig. 2 Intraoperative nerve conduction study

Decision for surgical intervention in closed peripheral nerve injury is made based upon assessment of severity of injury and determination of potential for recovery. These injuries are categorized into neurapraxia (focal demyelination with no axonal disruption), axonotmesis (axon fiber disruption with connective tissue and myelin sheath preservation), and neurotmesis (full disruption of axonal continuity with partial to full disruption of the connective tissue and myelin sheath) [2]. Electrodiagnostic studies are used to distinguish these injuries and to help choose appropriate treatment. Initially, regardless of the type of injury, since Wallerian degeneration has not yet occurred, studies like compound muscle action potentials (CMAP) can only be used to localize the lesion [10]. However, electrodiagnostic studies as early as the first 1–2 weeks can be used to distinguish neurapraxia, in which the nerve distal to the lesion continues to conduct upon stimulation, from axonotmesis/neurotmesis in which the distal stump does not [1]. Current management of peripheral nerve injuries involves electrodiagnostic testing 3–4 months after injury to allow resolution of neurapraxia and spontaneous regeneration after more severe injuries [10]. A high index of suspicion for nerve rupture or axonal disruption is necessary in persistent nerve dysfunction after high-energy mechanisms of upper extremity trauma.

Lastly, in addition to preoperative testing, if surgical exploration is indicated, this case report underscores the importance and utility of intraoperative electrophysiological testing for localization of nerve lesions.

We report a closed rupture of the median nerve associated with elbow trauma in a 43-year-old male. Surgical exploration 5 months post injury revealed a lesion at the level of the mid humerus. The nerve was repaired primarily with a group fascicular technique. A dynamic external fixator was applied to the elbow to minimize tension at the repair. The patient demonstrated partial recovery of motor function and sensory function in the left hand. This case describes a previously unreported type of median nerve injury after elbow dislocation and underscores the importance of pre and intraoperative electrodiagnostic techniques to optimize the localization of the lesion. Early, post injury nerve conduction and EMG

studies may be warranted to facilitate earlier surgical intervention for lesions of this variety.

Conflict of Interest Sendhilnathan Ramalingam declares that he has no conflict of interest.

Suhail K. Mithani declares that he has no conflict of interest.

Baek Jong-Ryoon declares that he has no conflict of interest.

David S. Ruch declares that he has no conflict of interest.

Statement of Human and Animal Rights All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent Informed consent was obtained from all patients for being included in the study. As a single retrospective chart review with a high degree of anonymity and no patient contact for the purposes of the study, informed consent was not required.

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