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Assessment of clinical and electrophysiological findings in axillary nerve injury

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ABSTRACT

Aims: This study investigated the association between clinical features and neurophysiological findings in patients with axillary nerve injury (ANI).

Methods: Patients with isolated ANI were included in the study. Muscle strength was evaluated using the Medical Research Council (MRC) scale. Axillary nerve compound muscle action potential (CMAP) amplitude and latency, as well as the presence of positive sharp waves (PSWs), fibrillation potentials, and motor unit action potentials (MUAPs) in the deltoid muscle, were assessed.

Results: Eleven patients with ANI were included in the study (7 male and 4 female). The causes of ANI were humeral fracture in two patients and shoulder dislocation in four patients. The remaining five patients had blunt trauma without any associated fracture or dislocation. A positive correlation was observed between axillary nerve CMAP amplitude and the deltoid muscle MRC score (p=0.016, r=0.700). A negative correlation was found between axillary nerve CMAP latency and the deltoid muscle MRC score (p=0.048, r=-0.670). All patients demonstrated PSWs, fibrillation potentials, or MUAP abnormalities in the deltoid muscle.

Conclusion: This study demonstrated an association between axillary nerve CMAP latency and amplitude and the deltoid muscle MRC score in patients with ANI. These results suggest that axillary nerve CMAP latency and amplitude are valuable neurophysiological measures for the diagnosis and follow-up of ANI. It should also be noted that ANI may occur even in the absence of a fracture or dislocation.

Keywords: Axillary neuropathy, electromyography, nerve conduction study

INTRODUCTION

Axillary nerve injury (ANI) may occur in isolation, most often as a result of shoulder fractures or dislocations.[1-3] It typically presents with weakness of shoulder abduction and sensory loss over the lateral aspect of the shoulder corresponding to the axillary nerve distribution.[1-5] Severe weakness of shoulder abduction can interfere with daily activities, so timely and accurate diagnosis is essential. Both clinical assessment and neurophysiological testing have an important role in diagnosis.[3-7]

On nerve conduction studies, abnormalities in axillary nerve compound muscle action potential (CMAP) latency or amplitude are significant diagnostic findings.[2,4,6] In addition, the presence of positive sharp waves (PSWs), fibrillation potentials, or neurogenic motor unit action potentials (MUAPs) in the deltoid or teres minor muscles provides further electrophysiological evidence of axillary nerve involvement.[5-7] In general, a markedly reduced CMAP amplitude or the absence of MUAPs on neurophysiological testing indicates a poor prognosis, whereas the opposite findings are associated with a favorable outcome.[8-12]

This study aimed to investigate the relationship between neurophysiological test results and clinical findings in isolated ANI in order to identify electrophysiological parameters that may reflect the underlying mechanism and predict clinical outcome.

METHODS

Ethics

This study was conducted with the approval of the Adana City Training and Researches Hospital Institutional Review

Board (Date: 25.09.2025, Decision No: 747). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patients

Patients with isolated ANI who were evaluated at the Clinical Neurophysiology Laboratory of Adana City Training and Research Hospital, University of Health Sciences, between September 2019 and September 2025 were included in the study. ANI was diagnosed in individuals presenting with deltoid muscle weakness and/or sensory abnormalities in the shoulder region corresponding to the sensory distribution of the axillary nerve, together with the presence of PSWs or fibrillation potentials, or MUAPs with neurogenic features in the deltoid muscle.[1,2,4,6] Muscle strength was assessed with the Medical Research Council (MRC) scale. Patients with neurodegenerative disorders or with clinical, neurophysiological, or imaging findings suggestive of brachial plexopathy or cervical radiculopathy were excluded.

Neurophysiological Tests

Nerve conduction studies and needle electromyography (EMG) were performed using a Cadwell Sierra Summit EMG system (Cadwell Laboratories, Kennewick, WA, USA). Neurophysiological assessments were conducted only when the limb temperature was above 32°C; otherwise, cold extremities were warmed prior to testing. For motor and sensory nerve conduction studies, the high- and low-frequency filters were set at 20 Hz-10 kHz and 20 Hz-2 kHz, respectively. Standard techniques were applied for median, ulnar, medial antebrachial cutaneous, lateral antebrachial cutaneous, and radial nerve conduction studies, with surface electrodes used for recording.[12,13]

The axillary nerve conduction study was performed using standard methodology.[14] Stimulation was delivered at Erb's point with surface electrodes, and recordings were obtained from the deltoid muscle using a concentric needle electrode (length: 50 mm, diameter: 0.46 mm; Bionen Medical Devices, Florence, Italy; or 26 G, Natus, Galway, Ireland). The distance between the stimulation and recording sites was measured with a caliper. The upper limit of normal for latency, depending on this distance, ranged from 5.1 to 5.3 ms.[14] The concentric needle electrode was secured with adhesive tape. Following Erb's point stimulation, the position of the electrode was checked during arm movement to ensure that it had not shifted. Three to five CMAPs were recorded. If the CMAPs varied, the test was repeated, and a consistent CMAP was accepted. In cases where no CMAP could be obtained, latency measurements were not included in the analysis, whereas amplitude values were included.

Needle EMG was performed visually using a concentric needle electrode (length: 50 mm, diameter: 0.46 mm; Bionen Medical Devices, Florence, Italy; or 26 G, Natus, Galway, Ireland). The filter settings were 10 Hz-10 kHz. In the clinical neurophysiology laboratory, the deltoid, biceps brachii, triceps, abductor pollicis brevis, and first dorsal interosseous muscles were routinely examined. When tolerated, the cervical paraspinal muscles were also evaluated. The presence of PSWs and fibrillation potentials at rest was carefully noted. MUAPs with amplitudes >3 mV and durations >15 ms were considered neurogenic.

Statistical Analysis

Categorical variables were expressed as frequencies and percentages, whereas numerical variables were presented as mean±standard deviation and range. Correlations between variables were assessed using Spearman's rank correlation test. The strength of the correlation was interpreted according to the correlation coefficient (r) as follows: $r \geq 0.9$ or $r \leq -0.9$, very strong; $0.7 \leq r < 0.9$ or $-0.9 < r \leq -0.7$, strong; $0.5 \leq r < 0.7$ or $-0.7 < r \leq -0.5$, moderate; $0.3 < r \leq 0.5$ or $-0.5 \leq r < -0.3$, weak; and $r < 0.3$ or $r > -0.3$, negligible (15). A p-value <0.05 was considered statistically significant.[15]

RESULTS

The study included 11 patients (seven male, four female) with a mean age of 48.9±17.1 years (range, 24-76). One patient had diabetes mellitus, while the remaining patients had no chronic illnesses. Among the eleven patients with ANI, two injuries were due to humeral fracture and four were related to shoulder dislocation, whereas the remaining five cases were attributed to blunt trauma without any accompanying fracture or dislocation. The mean duration of symptoms was 131.6±129.0 days (range, 38-365). Five patients had right-sided ANI. The mean MRC grade of the deltoid muscle was 1.8±1.3 (range, 0-4). The number of patients with MRC scores of 0, 1, 2, 3, and 4 was 3, 0, 5, 2, and 1, respectively. Five patients had sensory abnormalities in the shoulder area innervated by the axillary nerve.

Axillary nerve CMAPs could not be obtained in two patients. The mean axillary nerve CMAP latency was 11.6±7.7 ms, and the mean amplitude was 0.9±1.1 mV. The number of patients with abnormal neurophysiological findings is summarized in Table 1. Table 2 presents the correlations between clinical and neurophysiological findings. Figure illustrates the positive correlation between the deltoid muscle MRC grade and the axillary nerve CMAP amplitude.

Table 1. The number of patients with abnormal neurophysiological findings

Neurophysiological feature	Number of patients (%)
Abnormal latency*	8 (89)
Absence of axillary nerve CMAP	2 (18)
PSW and/or fibrillation potentials	8 (73)
Neurogenic or absent MUAP	3 (27)
PSW-fibrillation potentials and/or Neurogenic MUAP	11 (100)

In two patients, latency could not be measured as no axillary nerve CMAP was obtained. CMAP: Compound muscle action potential, PSW: Positive sharp wave, MUAP: Motor unit action potential

Table 2. The correlations between clinical and neurophysiological findings

Clinical feature	Latency (ms)	Amplitude (mV)
Age (years)	p=0.949, r=0.025	p=0.245, r=-0.383
Symptom duration (days)	p=0.258, r=-0.422	p=0.352, r=0.311
MRC score of the deltoid muscle	p=0.048, r=-0.670	p=0.016, r=0.700

MRC: Medical Research Council

DISCUSSION

This study examined the association between clinical features and neurophysiological findings, including axillary nerve CMAP latency and amplitude, in patients with ANI.

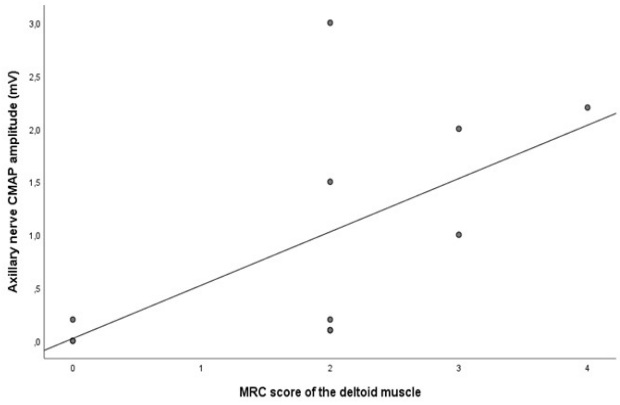

Figure. Correlation between deltoid MRC grade and axillary nerve CMAP amplitude
MRC: Medical Research Council, CMAP: Compound muscle action potential

A significant link was observed between CMAP parameters and muscle strength grades.

A reduced CMAP amplitude is a key finding, as it may indicate axonal degeneration.[8,9,11,12] Previous reports have shown that axonal degeneration is often associated with a poor prognosis. In the present study, a positive correlation between the deltoid muscle MRC score and axillary nerve CMAP amplitude was both expected and significant. Thus, a low axillary nerve CMAP amplitude appears to be a meaningful marker of axonal degeneration and may serve as an important clue for predicting clinical outcome.[5-7,11,12]

Unlike CMAP amplitude, conduction block and slowed nerve conduction velocities may suggest demyelination, which can occur either alone or together with axonal injury.[10,12] In contrast to axonal degeneration, demyelination is generally associated with a more favorable prognosis in nerve injuries.[8-12] In this study, a borderline negative correlation was observed between axillary nerve CMAP latency and the deltoid muscle MRC score. This finding implies that axillary nerve latency may be partly related to muscle strength, although CMAP amplitude seems to have greater clinical relevance in ANI. Nonetheless, the results indicate that axillary nerve CMAP latency, together with CMAP amplitude, can be useful for monitoring the course of ANI.

Isolated ANI most often develops after trauma. Shoulder dislocations and shoulder or humeral fractures account for a considerable proportion of these injuries.[1-3] In the present study, most patients had either shoulder or humeral fractures or shoulder dislocations. However, the occurrence of isolated ANI in some patients without a history of fracture or dislocation is noteworthy, as it indicates that ANI can develop even in the absence of radiologically or clinically evident bone injury.[16,17] The lack of a detectable fracture or dislocation in the shoulder or arm region does not exclude the possibility of ANI. Therefore, ANI should be considered in shoulder trauma accompanied by weakness of shoulder abduction to ensure appropriate evaluation and management.[16,17]

Limitations

Apart from the retrospective design, this study has several limitations. The sample size was relatively small. In addition, the teres minor muscle was not examined with needle EMG, and an axillary nerve sensory conduction study was not performed. It should be noted, however, that sensory conduction studies in the shoulder region are technically challenging. Future studies involving a larger number of patients with ANI, and incorporating needle EMG of the teres minor muscle as well as axillary sensory nerve conduction studies, may provide a clearer understanding of the underlying mechanisms of ANI and contribute to improved management strategies. Conduction block not be assessed because stimulation was not performed at two different sites, which may be considered a limitation of the study. Despite these limitations, the study is valuable in that axillary nerve conduction was assessed using the concentric needle electrode technique, which may have allowed for the identification of meaningful associations between clinical and neurophysiological findings.

CONCLUSION

The results indicate that axillary nerve CMAP amplitude and latency may be associated with the deltoid muscle MRC score. These findings suggest that both indicators may have potential utility as neurophysiological measures in the assessment of ANI. Furthermore, the observation that isolated ANI occurred in all patients following trauma involving blunt trauma, shoulder or humeral fractures, or dislocations supports the view that trauma is a major contributing factor, and also highlights that such nerve involvement may develop even in the absence of overt fracture or dislocation.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was conducted with the approval of the Adana City Training and Researches Hospital Institutional Review Board (Date: 25.09.2025, Decision No: 747).

Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained. This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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Author Contributions

Concept: ŞB, HF; Design: ŞB, HF; Control: ŞB, HF; Data Collection and/or Processing: ŞB, HF; Analysis and/or Interpretation: ŞB, HF; Literature Review: HF; Article Writing: ŞB; Critical Review: ŞB, HF.

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