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Research Article

Anatomical Correlation between Ulnar Neuropathy and Triceps in Electrodiagnostic Studies

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Abstract

Introduction: Nerve conduction studies (NCV) and electromyography (EMG) are key diagnostic tools for identifying mononeuropathy and radiculopathy. Triceps denervation has traditionally been attributed to C7 radiculopathy or radial neuropathy. However, recent studies suggest possible ulnar innervation of the triceps muscle, introducing ambiguity in interpreting EMG findings, particularly in patients with ulnar neuropathy. We aimed to evaluate the prevalence of tricep denervation in patients with and without ulnar neuropathy.

Methods: This case-control study included patients who underwent EMG at the Progressive Neurology and Sleep Center between January and August 2024. Data were analyzed using STATA software. The prevalence of triceps denervation changes was compared between patients with and without ulnar neuropathy using chi-square tests and logistic regression.

Results: The study included 295 patients: 146 with ulnar neuropathy and 149 without. Triceps denervation was present in 41 patients (28%) with ulnar neuropathy and in 46 patients (31%) without ulnar neuropathy. Prevalence was not significantly different between the groups. Logistic regression showed an odds ratio of 0.42 ± 3.51 ($p = 0.3$) for triceps denervation in patients with ulnar neuropathy after adjusting for confounding factors.

Conclusion: Difference in the prevalence of triceps denervation between patients with and without ulnar neuropathy was not significant. These findings support the current interpretation of triceps denervation patterns in EMG studies.

Keywords: *Ulnar Neuropathy, Triceps, Electromyography (EMG), Anatomy, Ulnar Innervation*

Introduction

An estimated 1.8–5.9% of the general population is affected by ulnar neuropathy, making it the second most common upper limb peripheral neuropathy[1]. Common symptoms include numbness in the little and ring fingers, along with hand weakness.

Cervical radiculopathy, commonly referred to as a "pinched nerve" in the neck, also has a relatively high prevalence, affecting 1.21 to 5.8 per 1000 individuals [2]. Among cervical radiculopathies, C7 involvement is the most common [3].

Nerve conduction studies and needle electromyography (EMG) are widely used to diagnose upper-limb neuropathies and radiculopathies [4]. Denervation patterns observed via needle EMG can help differentiate between affected nerve roots and peripheral nerves, facilitating accurate diagnosis. Thus, understanding the nerve root and innervation of each muscle is essential.

Recent studies suggest the possibility of ulnar innervation of the triceps muscle. Several cadaveric studies have raised the question of the potential branch of the ulnar nerve that innervates the medial head of the triceps [5,6,7].

Commonly evaluated muscles in needle EMG for suspected C7 radiculopathy include the triceps, pronator teres, and extensor digitorum communis. Typically, any denervation found in the triceps is interpreted as indicating C7 radiculopathy or, in some instances, radial neuropathy, depending on the clinical presentation. However, reports on triceps innervation by the ulnar nerve raise questions about the specificity of such interpretations, especially in patients with ulnar neuropathy.

We aimed to evaluate the prevalence of tricep denervation in patients with and without ulnar neuropathy.

Methods

This was a case-control study approved by the BRANY IRB as an exempt study. All patients who underwent NCV and EMG studies of any upper extremity at the Progressive Neurology and Sleep Center between January 2024 and August 2024 were included. Data were extracted using an IRB-approved form; no patient identifiers were collected. Cervical spine MRI findings, when available, were used to evaluate for foraminal stenosis associated with cervical radiculopathy. Inclusion criteria comprised all patients undergoing nerve conduction studies between January and August 2024. Pregnant patients were not present in the cohort. Patients diagnosed with motor neuron disease or inflammatory neuropathies, such as chronic inflammatory demyelinating polyneuropathy, were excluded.

Data were analyzed using STATA. The prevalence of triceps denervation changes was compared between patients with and without ulnar neuropathy using chi-square tests. Additional subgroup analyses were performed for patients without denervation changes in other C7-innervated muscles (e.g., pronator teres) and those without C7 foraminal stenosis on MRI.

Results

A total of 295 patients were included: 149 without ulnar neuropathy and 146 with ulnar neuropathy. The mean age was 52.3±13.5 years in the non-ulnar neuropathy group and 56.8±13.5 years in the ulnar neuropathy group, with no significant difference in the ages (Table 1). Overall, 71% were women, and 29% were men. Ulnar neuropathy was more common among men (66%) than women (42%).

Table 1. Demographics and other factors between patients with and without ulnar neuropathy.

	Patients with ulnar neuropathy (n=146)	Patients without ulnar neuropathy (n=149)	P-value
Age	56.81±13.5	52.29±13.5	0.99**
Male: Female	57:89	29:120	<0.05^
Denervation in triceps	41 (28%)	46 (31%)	0.59^
Denervation in pronator teres	29 (19.5%)	21 (14.4%)	0.25^
C6-7 stenosis on MRI	18 (n1=47)*	19 (n1=61)*	0.44^

*n1 is the number of participants who underwent MRI

**derived from t-test statistics

^derived from chi-square statistics

Triceps denervation was observed in 41 of 146 patients with ulnar neuropathy (28%) and in 46 of 149 patients without ulnar neuropathy (31%), with no significant difference in the prevalence between the two groups.

In patients with C7 radiculopathy, denervation changes are also expected in the pronator teres and triceps muscles, and C7 foramen stenosis may be observed on MRI. To eliminate confounding factors, subgroup analyses were conducted in patients without denervation in other C7-innervated muscles and without C7 foraminal stenosis. Even within this refined subgroup, the prevalence of triceps denervation between patients with and without ulnar neuropathy did not significantly differ.

Due to the observed sex differences, further subgroup analysis by sex revealed no significant association between sex and triceps denervation.

A logistic regression model showed an odds ratio of 0.42 ± 3.51 for triceps denervation in patients with ulnar neuropathy versus those without, after adjusting for potential confounders ($p = 0.3$).

Discussion

Nerve conduction studies remain the cornerstone for diagnosing mononeuropathies and radiculopathies. A sound understanding of neuroanatomy–particularly muscle innervation–is essential for accurate interpretation of needle EMG. Based on the pattern of muscle denervation observed on needle EMG, clinicians can distinguish between radiculopathy, which typically affects specific myotomes, and mononeuropathy, which affects the distribution of individual peripheral nerves. Alternatively, severe radiculopathy can result in axonal loss in peripheral nerves that receive motor innervation from the affected nerve roots, which may lead to slowed conduction and be misinterpreted as mononeuropathy.

In ulnar neuropathy, denervation affects muscles innervated by the ulnar nerve distal to the site of compression. As previously discussed, there are reports suggesting that the ulnar nerve may contribute to the innervation of the medial head of the triceps. In such cases, if a patient with ulnar neuropathy shows triceps denervation, it will be difficult to ascertain whether these changes are related to ulnar neuropathy or coexisting C7 radiculopathy.

If ulnar innervation of the triceps were common, one would expect a higher prevalence of triceps denervation in patients with ulnar neuropathy. However, the findings of this study showed no significant difference in the prevalence of triceps denervation between patients with and without ulnar neuropathy. This supports the prevailing interpretation that triceps denervation is more likely due to C7 radiculopathy rather than ulnar neuropathy. Thus, ulnar innervation of the triceps appears to be an anatomical variant rather than a norm.

There is a longstanding debate over whether the ulnar nerve innervates the medial head of the triceps brachii muscle. In another study, using histological analysis of 15 fetal arms and immunohistochemistry on adult specimens, researchers found that the medial head is consistently innervated by the radial nerve, not the ulnar nerve. Apparent ulnar nerve branches are actually radial nerve fibers that temporarily travel within the ulnar nerve sheath due to a proximal connection [8]. This could provide an alternate explanation of our findings as well.

Nevertheless, this study had some limitations. It was a retrospective case-control study, and the data were obtained from existing medical records. The nerve conduction studies were not specifically designed to assess ulnar innervation of the triceps. Although all studies were conducted by the same neurophysiologist–ensuring consistency and eliminating interrater reliability–there was no secondary reviewer to confirm the interpretations. Additionally, needle EMG in this study may not have targeted the medial head of the triceps specifically, and as a result, could have missed denervation changes arising from ulnar neuropathy.

Conclusion

This study supports the current clinical practice of interpreting triceps muscle denervation on EMG as indicative of C7 radiculopathy or radial neuropathy, rather than ulnar neuropathy. Although there are isolated reports of ulnar innervation to the triceps, these appear to be uncommon. In most individuals, the triceps is primarily innervated by the radial nerve, with dermatomal input from C7. Therefore, triceps denervation should continue to be interpreted as reflecting C7 or radial nerve involvement. However, clinicians should consider evaluating additional C7-innervated muscles–such as the pronator teres–to confirm C7 involvement, and other radial nerve-innervated muscles if radial neuropathy is suspected. Further prospective studies specifically targeting the medial head of the triceps with needle EMG are warranted.

Author Contributions

Dhanvi Sheth: conceptualization, investigation, validation, software, formal analysis, methodology, writing – original draft.

Soham Sheth: conceptualization, investigation, data curation, writing – original draft, writing – review and editing, formal analysis, project administration, resources.

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