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ELECTRODIAGNOSTIC PATTERNS IN NEUROMUSCULAR DISORDERS: A RETROSPECTIVE CROSS-SECTIONAL STUDY FROM A TERTIARY CARE HOSPITAL

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ABSTRACT

Electromyography (EMG) and nerve conduction studies (NCS) are essential for diagnosing neuromuscular disorders and differentiating various peripheral nervous system conditions. The objective of this study was to assess the prevalence and trends of neuromuscular disorders based on EMG/NCS findings in a tertiary care center in Pakistan.

Methods:
This retrospective cross-sectional study was conducted at the neurophysiology laboratory of Aga Khan University Hospital from 1st January 2023 to 31st December 2023. A total of 961 EMG/NCS records were analyzed, including both inpatient and outpatient cases. Data was extracted from the EMG registry, and findings were categorized into mononeuropathy, chronic sensorimotor axonal polyneuropathy, chronic inflammatory demyelinating polyneuropathy, Guillan Barre syndrome, plexopathy, radiculopathy, anterior horn cell disorders, myopathy, and neuromuscular junction disorders. Statistical analysis was performed using SPSS version 23.0.

Results: Among 961 patients, 651 (67.7%) had abnormal EMG findings. The most common diagnosis was radiculopathy (n=205; 21.3%), followed by mononeuropathies (171 cases, 17.8%), chronic sensorimotor axonal polyneuropathy (n=143; 14.9%), and myopathy (n=60; 6.2%). Carpal tunnel syndrome was the most frequent mononeuropathy, while lumbosacral radiculopathy was the predominant radiculopathy. Myopathies and neuromuscular junction disorders were less common. The 40–49-year age group was the most frequently affected.

Conclusion:
EMG/NCS plays a crucial role in diagnosing and classifying neuromuscular conditions, as evidenced by the high proportion of abnormal findings in our study. Expanding access to EMG/NCS and enhancing electrophysiology training for neurologists can further improve diagnostic accuracy and patient care.

Keywords: Electromyography, Nerve conduction studies, myopathy, neuromuscular, neuropathy, radiculopathy, EMG NCS

INTRODUCTION

Neurological disorders account for approximately 20% of global disease burden, with developing countries bearing much of this impact.[1] Clinical examination and thorough history-taking play a crucial role in distinguishing between central and peripheral nervous system (PNS) disorders. While central nervous system (CNS) disorders contribute significantly to this burden, PNS disorders, also have considerable prevalence. Studies indicate that around 2.4% of the general population is affected by peripheral nerve disorders, with prevalence increasing to 8% in older adults.[2]

Electromyography (EMG) and nerve conduction studies (NCS) are essential diagnostic tools for assessing nerve and muscle function, playing a key role in diagnosing PNS disorders, including mononeuropathies (e.g., carpal tunnel syndrome, radial/ulnar/peroneal neuropathy), peripheral neuropathies, anterior horn cell disorders, radiculopathy, myopathy, and neuromuscular junction disorders. However, these tests serve as additional tools to support clinical examination rather than being stand-alone diagnostic methods.

We conducted a comprehensive audit of EMG/NCS records at the electrophysiology laboratory of our center to evaluate

the prevalence and patterns of neuromuscular disorders in our population. In Pakistan, there is a shortage of trained neurologists and specialized testing facilities, especially outside major cities. By reviewing the patterns of neuromuscular disorders seen in our EMG/NCS lab, this study helps us understand what kinds of nerve and muscle conditions are most common in our population. It also highlights the need to improve access to these important diagnostic services and to train more healthcare professionals in this field.

METHODS

This retrospective cross-sectional study was conducted at the neurophysiology laboratory of Aga Khan University Hospital over one year (1st January 2023 to 31st December 2023). The study included both inpatients and outpatients who underwent EMG/NCS. The research was approved by the Ethical Review Committee of Aga Khan University Hospital.

A structured proforma was used to document key variables, including age, gender, reason for referral, and EMG findings. These proformas were completed by neurophysiology technologists and neurophysiologists performing the EMG/NCS studies.

EMG results were categorized into mononeuropathy, chronic axonal polyneuropathy, chronic inflammatory demyelinating polyneuropathy (CIDP), Guillain-Barré syndrome (GBS), plexopathy, radiculopathy, anterior horn cell disorders, myopathy, and neuromuscular junction disorders. All tests were conducted using the Nihon Kohden machine. Statistical analysis was performed using SPSS version 23.0. All NCS were performed by experienced technologists with two years of formal training, while all EMG studies were performed by a certified neurologist with a specialized fellowship training in neurophysiology or neuromuscular disorders.

RESULTS

A total of 1,277 EMGs were performed, of which 316 (24.7%) were excluded due to missing records and incomplete form submissions; with 961 (75.3%) studies included in our study for analysis. The male-to-female ratio was nearly equal, with a slight predominance of males (51.7% male, 48.3% female). EMG/NCS was conducted across all age groups (from infancy to >80 years), but most tests were performed on middle-aged and early elderly adults. The highest number of patients were in the 40–49 age group (n=153, 15.9%), followed by 60–69 years (n=150, 15.6%) and 30–39 years (n=143, 14.9%), indicating a higher prevalence of nerve and muscle disorders in these age groups.

The lowest number of cases was observed in patient group aged 80 years and above (n=21, 2.2%), likely due to fewer referrals or coexisting health conditions (see Figure 1). Similarly, adolescents and children (1–10 years, n=85, 8.8%), as well as infants (0–1 year, n=36, 3.7%), underwent fewer procedures.

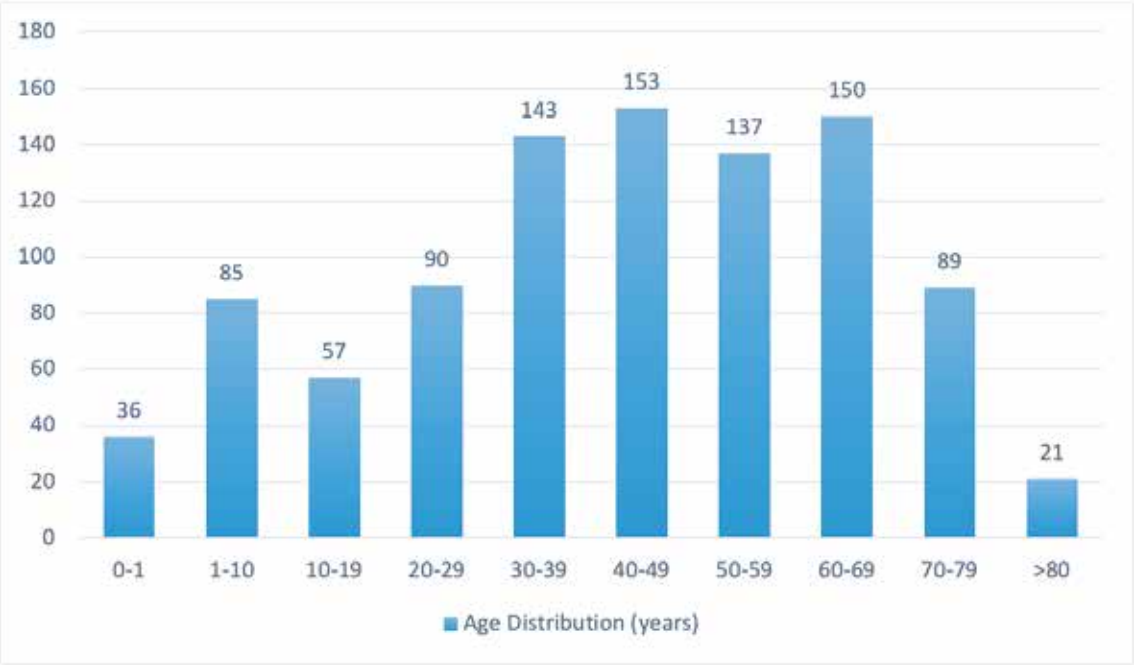

Figure 1: Age distribution of patients undergoing EMG/NCS

Among 961 cases, the most common reason for referral was lumbosacral radiculopathy, followed by mononeuropathies (most commonly carpal tunnel syndrome), chronic sensorimotor axonal polyneuropathy, myopathy, anterior horn cell dysfunction, Guillain-Barré syndrome (GBS), myasthenia gravis (MG), plexopathy, and other conditions (see Figure 2).

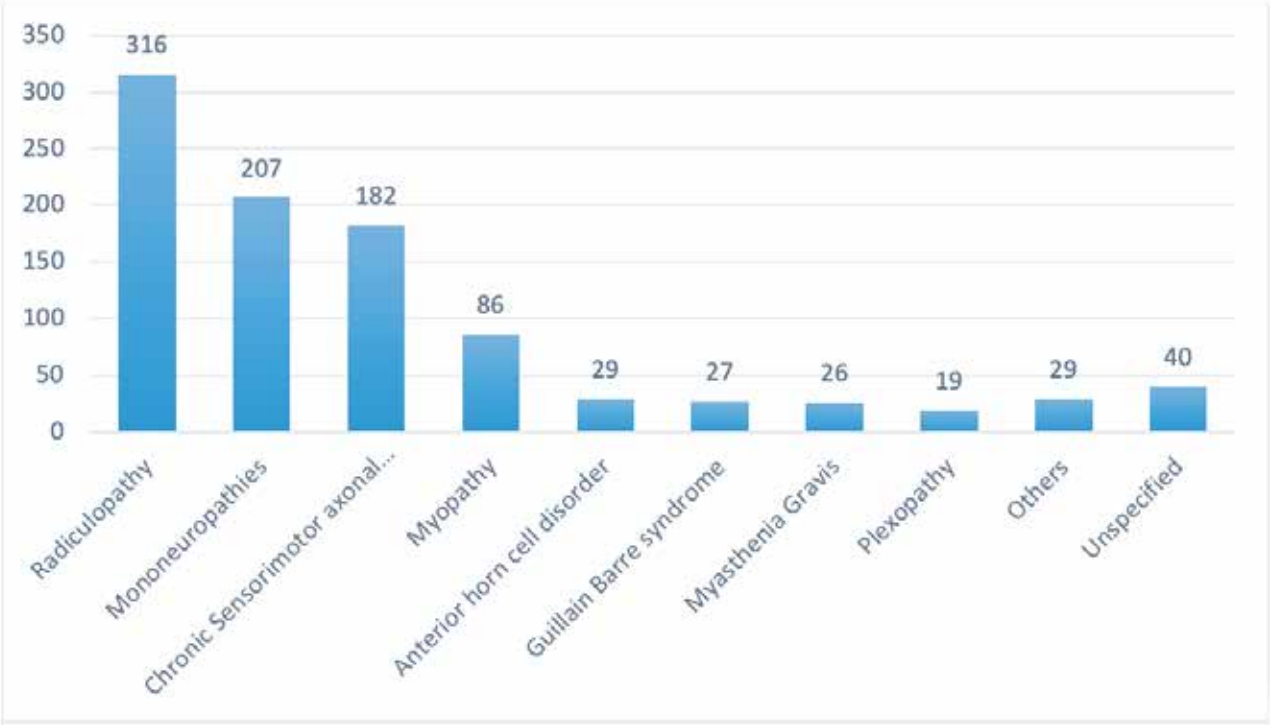

Figure 2: Distribution of referral reasons for EMG/NCS.

Among 961 EMG/NCS studies, 310 (32.3%) were normal, while 651 (67.7%) showed abnormalities. Radiculopathy was the most common abnormal finding (n=205), followed by mononeuropathy (n=171), chronic sensorimotor axonal polyneuropathy (n=143), myopathy (n=60), motor neuron disease (MND, n=19) (predominantly in adults, with a few pediatric cases of spinal muscular atrophy (SMA), GBS (n=20), MG (n=13), plexopathy (n=13), and CIDP (n=7). Among patients with radiculopathy (n=205), lumbosacral involvement was the most frequent (53.7%), followed by cervical radiculopathy (34.1%) and combined cervical and lumbosacral involvement (12.2%).

In cases of mononeuropathy (n=171), carpal tunnel syndrome (CTS) was the most common, identified in 145 patients (84.8%). Other mononeuropathies included facial nerve involvement (n=6, 3.5%), peroneal neuropathy (n=5, 2.9%), ulnar neuropathy (n=4, 2.3%), sciatic neuropathy (n=4, 2.3%), radial neuropathy (n=3, 1.8%), and combined ulnar and median neuropathies (n=4, 2.3%). Among patients with chronic sensorimotor axonal polyneuropathy (n=143), 21 (14.7%) had coexisting CTS, and 2 (1.4%) had underlying ulnar neuropathy.

In patients with myopathy (n=60), 21 (35%) had non-necrotizing myopathy, 19 (31.7%) had necrotizing myopathy, and in 20 cases (33.3%), spontaneous activity could not be assessed. Most of these latter cases involved pediatric patients, either due to a low pain threshold or technical difficulties encountered in ICU settings (see Table 1). Despite the technical challenges and discomfort associated with the procedure in children, we were able to provide a definitive diagnosis in the majority of pediatric cases, highlighting the clinical value of these studies even in younger age groups.

Table 1: Distribution of EMG/NCS Findings		
EMG/NCS Findings	**n = 961**	**Percentage (%)**
Normal	310	32.3
Radiculopathy	205	21.3
- Lumbosacral	110	-
- Cervical	70	-
- Combined (Cervical + Lumbosacral)	25	-
Mononeuropathies	171	17.8
- Median (Carpal Tunnel Syndrome, CTS)	145	-
- Facial	6	-
- Peroneal	5	-
- Sciatic	4	-
- Ulnar	4	-
- Mixed (Median + Ulnar)	4	-
- Radial	3	-
Chronic sensorimotor Axonal Polyneuropathy	143	14.9
Myopathy	60	6.24
- Non-necrotizing	21	-
- Necrotizing	19	-
- Difficult to assess spontaneous activity	20	-
Anterior Horn Cell Disorder (MND)	19	1.98
Guillain-Barré Syndrome (GBS)	20	2.08
Myasthenia Gravis (MG)	13	1.35
Plexopathy	13	1.35
- Brachial	10	-
- Lumbosacral	3	-
Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)	7	0.73

DISCUSSION

Our findings highlight the substantial impact of neuromuscular disorders, with nearly 68% of EMG/NCS studies revealing abnormalities. This highlights the vital role of electrodiagnostic testing in evaluating patients with suspected neuromuscular conditions. However, despite the high prevalence of neurological disorders, access to neurophysiological testing remains limited in Pakistan, with EMG/NCS services available only in a few major cities and a shortage of trained neurophysiologists. Our study is one of the most comprehensive audits conducted in Karachi, providing valuable insights into the prevalence and patterns of neuromuscular disorders in local population.

In our study, majority of the patients undergoing EMG/NCS testing were middle aged or older, consistent with findings from a study conducted in Bangladesh, where 67.6% of patients presented after the age of 40, with the highest number (n=349) in the 41–50 age group and a male predominance (55.2%).[3] This trend suggests that neuromuscular disorders are more common in middle-aged and older adults, likely due to the increased prevalence of peripheral neuropathies and radiculopathies in this age group.

Our data also revealed that only 40 cases had an unknown referral reason, contrasting with a 2013 study conducted at

a tertiary care rehabilitation center, which reported a significantly higher proportion of unspecified referrals. This suggests an improvement in physician awareness, leading to more targeted use of electrodiagnostic testing in our setting.[4]

In terms of abnormal findings, our study identified lumbosacral radiculopathy as the most common abnormality, followed by mononeuropathies, with carpal tunnel syndrome (CTS) being the most frequent among them. This is in contrast to a study conducted in Ethiopia, where polyneuropathy (19.8%), CTS (12.1%), and lumbosacral radiculopathy (9.9%) were the most common reasons for referral, with polyneuropathy being the most frequent electrodiagnostic finding .[5] Another study done in turkey showed polyneuropathy (29%) to be the most common electrodiagnostic finding, followed by carpal tunnel syndrome.[6] These differences may reflect not only regional variations in the prevalence of neuromuscular disorders but also differences in referral patterns and diagnostic practices among neurologists in different settings. The higher prevalence of radiculopathy in our study may reflect local referral trends or a greater clinical suspicion of spinal pathology in our setting, whereas polyneuropathy's prominence in Ethiopia and Turkey may be influenced by other demographic or environmental factors.[7]

Additionally, a study from Quetta, Pakistan, which included 923 patients undergoing EMG/NCS over 2.5 years, found that lumbosacral radiculopathy was the most common abnormal finding, followed by CTS and other mononeuropathies.[8] These results closely resemble the findings of our study, further emphasizing the regional consistency in the pattern of neuromuscular disorders in Pakistan.

Mononeuropathies, especially carpal tunnel syndrome, were also frequently observed, likely influenced by occupational and lifestyle factors. EMG/NCS played a key role in assessing severity and guiding surgical decisions for both CTS and radiculopathy.

The prevalence of myopathy, anterior horn cell disorders, myasthenia, and plexopathies in our study was low, likely because of their lower prevalence, limited clinical suspicion by referring physicians, and the need for specialized diagnostic approaches. Similar trends were reported in regional studies. A study from Islamabad found that anterior horn cell disorders, including motor neuron disease and poliomyelitis, made up a small fraction of neurophysiological evaluations (3.68%).[9] Another study on pediatric populations in Pakistan reported that myopathies and neuromuscular junction disorders were among the least diagnosed conditions in electrodiagnostic testing.[10]

These comparisons between our study and others from different regions highlight the variations in the types of neuromuscular disorders and the importance of conducting localized studies to improve diagnostic practices.

A few limitations of our study include its retrospective design, which may have been affected by incomplete documentation or missing data. Approximately 24.7% of EMG/NCS studies were excluded due to incomplete forms, potentially introducing selection bias. As this was a single-center study conducted at a tertiary care hospital, the findings may not be generalizable to other regions of Pakistan, particularly rural or underserved areas. Pediatric cases were relatively few, and technical difficulties in this group may have limited the diagnostic yield.

CONCLUSION

Electrodiagnostic study plays a crucial role in diagnosing and localizing neuromuscular conditions, guiding appropriate management. The increased specificity in referrals over the past decade suggests growing physician awareness of neurophysiological testing. Expanding access to electrophysiological services through the development of more diagnostic centers, fellowship-trained specialists, and better-structured training programs across the country can enhance the diagnosis and management of neuromuscular disorders.

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Ayisha Farooq Khan: Concept, Data analysis and interpretation, manuscript writing
Sajid Hameed: Data collection and analysis, manuscript writing
Dureshahwar Kanwar; Data analysis, Manuscript revision
Sara Khan; Data analysis, Manuscript revision

All the authors have approved the final version to be published and agree to be accountable for all aspects of the work.