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## **An analysis of pattern and burden of patients Referred for nerve conduction study in a Tertiary care hospital in Pakistan**

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# AN ANALYSIS OF PATTERN AND BURDEN OF PATIENTS REFERRED FOR NERVE CONDUCTION STUDY IN A TERTIARY CARE HOSPITAL IN PAKISTAN

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## ABSTRACT:

**Background:** To analyze the trend and load of neurological diseases in a university medical center for referred electrophysiology.

**Methodology:** From January 2016 to December 2018, this retrospective study was carried out in department of Neurology, Pakistan Institute of Medical Sciences (PIMS) Islamabad. A total of 4527 patients were evaluated during this time period in neurophysiology lab through computerized data.

**Result:** A total of 4527 patients were evaluated. There were 2243(49.5%) male and 2284(50.45%) female patients. Carpel tunnel syndrome was the most prevalent disease (31.72%) trailed by Guillain Barre Syndrome with 6.88% (among 6.88%, 40.28% was diagnosed AMAN). Among chronic polyneuropathies, chronic inflammatory demyelinating polyneuropathy (CIDP) and sensory motor polyneuropathy were 1.15% and 5.30% respectively. Injection/ traumatic polyneuropathies were found in high percentage (3.80%). The most prevalent identified condition among anterior horn cell disorders were motor neuron disease (1.46%) and poliomyelitis (0.95%) in this study. 4.28% and 1.28% patients were under the umbrella of diseases of muscles and neuromuscular junction disease respectively. Plexopathy and radiculopathy accounted for 2.91% and 5.57%, respectively. NCS was done as part of workup in several diseases (e.g. stroke, cerebral palsy, myelopathy) observed in 1.86%. In 829 patients (18.31%) NCS and EMG were found to be normal.

**Conclusion:** Electrophysiological studies help in the diagnosis of many neurological and medical disorders. They also help to exclude many disorders. Clinical assessment before NCS and EMG will help to reduce the burden on electrophysiology laboratory as well as the discomfort of procedure to the patient. Wherever faculties and experts have the opportunity to diagnose and classify these cases, NCS/EMG may assist.

**Key words:** Nerve conduction study (NCS), electromyography (EMG).

## INTRODUCTION:

Neurological disorders are the second leading cause of death after heart disease with 9.0 million deaths and 16.5% of global deaths. It is the leading cause of disability with 276 million (247–308) disability adjusted life years (DALYs) and 11.6% (10.7–12.4) of global DALYs. The global disease burden is due to the growing number of individuals affected by neurological conditions as well as the longevity of individuals with disabilities.<sup>(1)</sup> Most neurological disorders in Pakistan have very few prevalence data due to lack of interest in epidemiological research. Most of the prevalence data available on neurological disorders are hospital-based or are collected

by physicians from their respective areas.<sup>(2)</sup> Clinical correlation always has more weightage than relying on investigations. A skilled clinician will always formulate his diagnosis based 90% upon history alone and a very little contribution shall be from investigations and examination of the patient. About 90% of neurological diagnosis usually made on history alone by experienced clinicians with lesser contribution from examination and investigation. Evaluation of structure (imaging) and functionality of structure (neurophysiology and functional neuroimaging) are usually part of all neurological investigations.<sup>(3)</sup> Neurophysiology can be seen differently

as the clinical examination. Electrodiagnostic techniques in the neurological laboratory include neurologist, physical medicine and recovery specialist (PM&R) trained in nerve conduction (NCS) and/or needle electromyography (EMG).

NCS includes the positioning of skin surface electrodes around muscles (motor nerves) and peripheral nerves (sensory nerves) and the collection of CMAP (compound muscle action potential) and SNAP (Sensory nerve action potential), respectively. CMAP is the sum of all the motor action potential for each nerve after the nerve stimulation activity. Electromyography (EMG) involves exclusively from the muscles the acquisition of motor unit action potential (MUAPs). Thin concentric needle electrodes are implanted and the output of individual motor units is stored in the muscle belly. <sup>(4)</sup> Well into the diagnosis of neurological disorders the electrodiagnostic tests are generally seen as prolonged clinical testing. Every textbook and report on NCS / EMG have previously clarified that the assessments do not override a patient's comprehensive diagnosis and assessment nor expand the clinical review. <sup>(5)</sup> In the absence of neurodiagnostic facilities and resources in the closest facility, patients are directly referred to the Pakistan Institute of Medical Sciences (PIMS) Islamabad.

Previously no data was analyzed on the pattern and burden of disease seen in the electrophysiology laboratory of Pakistan Institute of Medical Sciences (PIMS), Islamabad. We therefore reviewed the nature of neurological diseases among patients referred to the PIMS electrophysiology lab.

## Methods:

We have retrospectively reviewed the electrophysiological laboratory records and observations at the Pakistan Medical Science Institute (PIMS), Islamabad, from January 2016 to December 2018. During this period, 4527 patients were assessed with the nerve conduction studies (NCS). PIMS is one of the largest referral facilities for any neurological disorder, and is a hospital with 592 beds having 22 medical and surgical specialties. There are 2 NCS/EMG machines, and 5 certified neurologists in the electrophysiology department. There is one postgraduate trainee of neurology to assist them. All patients, who were eligible for assessment in the electrophysiology laboratory. NCS and EMG have been recommended to identify the distribution and type of abnormalities of individual patients.

Nerve conduction specifications are obtained from the assignments of supra-maximally induced response waveforms based on a computer. The limb temperature was measured with a skin probe and test was performed above 32°C. Estimated parameters included distal motor

latency (DML), complex muscle action potential amplitude (CMAP) measured from baseline to negative peak, conduction velocity, mean F-wave latency (F-wave), distal sensory latency (DSL), measured for the negative peak and amplitude of the sensory nerve action potential (SNAP), measured from negative to positive peak. Measurement was deemed anomalous when, after accounting for the age and height of patients, it was beyond normal limits. The 97th latency percentile and the 3rd amplitude percentile in relation to disease-free controls are natural limitations. Percentiles are notified as borderline between 90 and 97 for latency and between 3 and 10 for amplitude. <sup>(6)</sup>

All nerve conduction parameters could not be obtained in every patient because of technical problems or patient-specific factors, including hemodynamic instability, patient reluctance and medical comorbid e.g. bleeding disorders or anticoagulation usage. The mean latency of the F-wave has been determined by calculating at least three F-wave responses. If enough F-wave responses were not available, then the mean F-wave latency was indicated as missing. Absence of reactions was found to be anomalous in terms of DML, CMAP and sensory nerve action potential and sensory latency (SNAP).

The demographic and clinical profile data was obtained using a questionnaire using a Google App<sup>®</sup>1 mobile app. Diseases are categorized under 7 specific captions, including peripheral nerve compression, polyneuropathy, plexopathy, radiculopathy, neuromuscular junction disorder, and muscle and anterior horn cell disorder, depending on where abnormalities are found. SPSS version 22.0 was used for research.

## Results:

Majority of patients (74.15%) presented after the age of 30 years. The highest number of patients (1119) was seen in 31-40 years of age group. The female patients (50.45%) predominated in study (Table-I). Carpal tunnel syndrome was the most common condition (31.72%) observed in the lab. Mononeuropathy was the most common (n=1861, 41.11%) presentation of peripheral nerve entrapment with 176 patients of ulnar nerve entrapment, 83 patients of sciatic nerve entrapment, and 44 patients of peroneal nerve entrapment. Different polyneuropathies named Guillain Barre Syndrome (GBS), sensory motor polyneuropathy, Chronic inflammatory demyelinating polyneuropathy (CIDP) and injection/traumatic neuropathies were found in 6.88%, 5.30%, 1.15% and 3.8% respectively. Acute Motor Axonal Neuropathy (AMAN) was commonest (127/316--40.28% of GBS) form of GBS, followed by acute inflammatory demyelinating polyneuropathy (AIDP)

in (117/316 – 36.97% of GBS).

**Table-I**

**Socio demographic profile of the patients (n=4527)**

Parameters		N	Percentage
Age	<10 Years	32	0.71
	11-20	397	8.77
	21-30	741	16.37
	31-40	1119	24.72
	41-50	1086	23.99
	51-60	567	12.52
	61-70	384	8.48
	>70	201	4.44
Sex	Male	2243	49.55
	Female	2284	50.45

Anterior horn cell disorders like Poliomyelitis, MND and SMA was found in 166 patients with motor neuron disease in 66 patients, 22 patients with Spinal Muscular Atrophy, 43 patients Poliomyelitis and others specialized disorders disorders were found in 35 patients. Radiculopathy is comparatively more prevalent than plexopathy (5.57% and 2.91% respectively).

**Table -II**

**Major Diagnostic Categories of Audit**

No	Major Diagnostic Category	Number	Percentage
1	Peripheral Nerve Entrapment	1861	41.11
2	Polynuropathies	951	21
3	Plexopathy	132	2.91
4	Radiculopathy	252	5.57
5	Neuromuscular Diseases	58	1.28
6	Muscle Diseases	194	4.28
7	Anterior Horn Cells Disorder	166	3.68
8	Others (As part of Work up)	84	1.86
9	Normal NCS/EMG	829	18.31
10	Total	4527	100

Among patients with muscle disorders, the most frequent diagnosis was muscular dystrophy (68 cases), followed by non-inflammatory myopathy (56 cases) and inflammatory myopathy (49 cases). Other conditions were noted in 1.86 percent (e.g. stroke, cerebral palsy, myelopathy). In 829 patients (18.31%), NCS and EMG were found to be normal.

**Table-III**

**Findings at electrophysiology lab**

No.	Disease Type	Diagnosis	Subtypes	Number	Percentage of disease type	
1	Peripheral Nerve Entrapment (n=1861)	CTS		1436	77.16	
			Mononeuropathies	Peroneal	44	2.36
				Ulnar	176	9.46
				Sciatica	68	3.65
				Facial	52	2.80
		Lateral Cutaneous	28	1.50		
		Others	57	3.07		
2	Polynuropathy (n=951)	GBS		316	33.33	
			AMAN	127	40.28	
			AIDP	117	36.97	
			AMSAN	57	18.01	
			MFS	8	2.53	
			Pharyngeal-cervical Brachial Variant	7	2.21	
			Polyneuropathies Other than GBS	635	66.7	
			CIDP	52	8.18	
			MAMA	9	1.42	
			Sensory Motor Polyneuropathy	240	37.79	
			Sensory Neuropathy	8	1.26	
			Mononeuritis Multiplex	20	3.15	
			Hereditary Neuropathies	70	11.02	
			Traumatic Neuropathy/ Injection Neuropathy	172	27.09	
					MMCB	10
		Others	54	8.50		
3	Plexopathy (n=132)	Brachial Plexopathy		102	77.27	
			Lumbosacral Plexopathy	30	22.73	
4	Radiculopathy (n=252)	Radiculopathy (n=252)		70	27.78	
			Lumbar radiculopathy	182	72.22	
5	Anterior Horn Cell Disorders/Specialized Disorders (n=166)	MND		66	39.76	
			Poliomyelitis	43	25.90	
			Spinal Muscular Atrophy	22	13.25	
			Others	35	21.09	
6	Muscle Disorder (n=194)	Non-inflammatory myopathy		56	28.87	
			Inflammatory Myopathy	49	25.26	
			Muscular Dystrophy	68	35.05	
7	Others (As part of Workup) (n=84)	Cerebral Palsy		12	14.29	
			Myelopathy	28	33.33	
			Adhesive Capsulitis	34	40.48	
			Stroke with complication	10	11.90	
10	Total (excluded NMJ Disorders and Normal without Subcategories)			3640		

## Discussion:

Clinical experience and analysis are an extension of nerve conduction studies. For the sake of effective cranial and peripheral neuromuscular disease management and diagnosis NCS is essential. In addition to finding the appropriate pathological methods, NCS can be quite effective in locating the lesions. This research was performed in the department of neurology PIMS to assess the patient burden and trend of various sorts of neuropathy and myopathy.

A predominant trend is the growth of neurological diseases in ages and in women, which is also seen in PIMS research. Electrophysiological evaluation requires a significant understanding of all these particular diseases. Polyneuropathy (PN), often associated with pain or weakness in the peripheral nerves, is indicative of symmetrical distal tingling and paresthesia. The cumulative polyneuropathy tends to be about 1% in the population and up to 7% in the elderly. Polyneuropathy tends to be more common in Western nations than in developing countries, and it is clear that women are more affected than men quite often. <sup>(7)</sup> In order to treat the PN, the neurophysiological studies in the best possible experienced hands may be used as the anchor board for diagnosis. <sup>(8)</sup>

CTS has been a very consistent finding in nerve conduction in our compressive neuropathy series. Carpal Tunnel Syndrome (CTS) is America's most severe focal neuropathy. <sup>(9)</sup> The need for electrophysiology in carpal tunnel syndrome has been widely discussed. Before the operation electrophysiology must usually be performed. <sup>(10)</sup> NCS is well known internationally as being of benefit for such a disease, including the independent verification and severity of the suspected carpal tunnel. <sup>(11)</sup> Peroneal neuropathy in the lower limb is the most common focal neuropathy <sup>(12)</sup>, with ulnar neuropathy in the upper limb being the second most prevalent. <sup>(13)</sup> This study has shown a higher number of peroneal neuropathies. Electro-diagnostics can play a vital role in determining such neuropathies. In one of the various areas of the hand, wrist or elbow the lesion can be identified. Plexopathy, radiculopathy, polyneuropathy and motor neuronal disorder can be distinguished from mononeuropathy. Electrophysiology studies can also provide predictions for diagnosis and lesion severity and location. The best prognosis is for acquired demyelinating lesions and prognosis is worst for axonopathies.

The overall prevalence of Guillain Barre syndrome (GBS) ranges from 1.1 to 1.8/100,000/. GBS is increasing with 50 years of age, from 1.7/100.00/year to 3.3/100,000/year. <sup>(14)</sup> Electrodiagnostic tests can be beneficial to identify, distinguish and classify a number of

GBS, as well as their reactions to treatment and risk estimation. <sup>(15)</sup> The test results obtained at the early stage of the illness may typically be difficult to recognize the subtype and therefore the systematic serial studies of the nerve conduction are essential in order to identify the subtype accurately. <sup>(16)</sup> Sensory motor axonal polyneuropathy is quite widespread in our sample due to the increase in diabetes prevalence. In Pakistan, injections are overprescribed and frequently injected regardless of the patient's main complaint. <sup>(17)</sup> A prescription rate of 6.5-15 injections per person per year is plotted in the country and 21 injections every year are expected to be received by children younger than 5 years of age. <sup>(18)</sup> Recent domestic studies have shown that these injections are unnecessary and risky. <sup>(19)</sup> This malpractice is prevalent in the periphery of this state, as shown in our analysis by a large number of injections and traumatic neuropathy (127 cases).

The electrophysiology can recognize LMN symptoms of MND and thus assist in a correct diagnosis both in medically affected and yet still clinically silent zones. Active denervation testing (positive, sharp waves, fibrillation potential, fasciculation potential) and chronic denervation demonstrated by the presence of the large motor unit are the standard electromyographic characteristics of MND. <sup>(20)</sup>

The results of distinctive therapeutic activities on myasthenic patients among those with muscle fatigue are very significant in neurophysiology. <sup>(21)</sup> Therefore, the neuromuscular junction can be examined with electromyography. Generally, the active muscle amplitude is not decreased by repetitive nerve stimulation (RNS) with electrical impulses at 2-5 Hz. However, this reduction in myasthenia gravis offers one of the most important diagnostic properties. Anomalies in the form and size of muscle potential may also assist in differentiating between primary muscle disease and systemic muscle disease. Myopathies triggered by metabolic abnormalities (causing electromechanical dissociation rather than fiber structure loss) usually do not cause any significant modifications to needle EMG. Muscle potential differences in type and volume may also help to distinguish between primary and systemic muscle diseases. Metabolic abnormalities (which cause electromechanical dissociation instead of losing the fiber) typically cause no substantial changes in EMG. This is because the MUAP morphology evaluation on EMG needle is limited to the fiber type 1 analysis. Since type 2 fibers are mostly affected by metabolic myopathy, their initial recruitment type I counterparts do not allow them to detect abnormal MUAPs. These monitoring can also report irregular spontaneous behavior from resting muscle, such as fibrillations and positive sharp waves (PSW) or myotonic discharges.

We had a few deficiencies in this project. Next, only the large, myelinated fibers of the nerve were examined. This limits the effectiveness of this analysis in detecting small fiber neuropathies (i.e. pain, temperature, and autonomic functions). In these cases, a particular autonomic function test and other non-electrodiagnostic studies (e.g. epidermal skin biopsy) can assist in the diagnosis. However, this work does not provide any idea of Pakistan's allocation of neurological disorder.

### Conclusion:

Neurophysiology studies not only the distribution, but also the type of defects identified in the study of nerve conduction and EMG. It is equally important that the neurologist or other referring physician make sure that the clinical questions asked are answered as much as possible based on electrophysiological studies. This will help reduce the load on time and skills of investigators, as well as save the patient from unpleasant procedures.

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**Zakir Jan;** concept, data collection, data analysis, manuscript writing, manuscript review

**Muhammad Hassan;** data collection, data analysis, manuscript writing, manuscript review

**Farzana Salman;** concept, data analysis, manuscript writing, manuscript review

**Waleed Shahzad;** concept, data analysis, manuscript writing, manuscript review

**Ramal Zarminahil;** concept, data analysis, manuscript writing, manuscript review

**Mazhar Badshah;** concept, data analysis, manuscript writing, manuscript review