



9-2020

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### Recommended Citation

wali, Ahmad; Khalid<sup>2</sup>, Ehtisham; Khan, Hazar; Nasir, Abdul; and Abdullah, Mr (2020) "Referral patterns and diagnoses at a single Neurophysiology Center in Quetta, Pakistan: An audit of 1600 Cases," *Pakistan Journal of Neurological Sciences (PJNS)*: Vol. 15 : Iss. 3 , Article 4.  
Available at: <https://ecommons.aku.edu/pjns/vol15/iss3/4>

# REFERRAL PATTERNS AND DIAGNOSES AT A SINGLE NEUROPHYSIOLOGY CENTER IN QUETTA, PAKISTAN: AN AUDIT OF 1600 CASES

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**Date of submission:** Feb 26, 2020 **Date of revision:** March 19, 2020 **Date of acceptance:** April 21, 2020

## ABSTRACT:

Neurophysiologic tests such as EEG, video EEG, Polysomnography (PSG), Nerve conduction studies (NCS) and electromyography (EMG) are the next steps after neurological examinations. These tests play a significantly important role in the decision-making and management of various neurological diseases. Data regarding the availability and frequency of these tests are not being compiled in Pakistan eventually resulting in a lack of awareness about these tests among physicians as well as patients. This motivated us to conduct a medical audit to assess frequencies, mode of referral, and final conclusion of these tests in detail. A total of 1600 tests were included. Among these, 677 were EEGs, 6 were VEEGs, 923 were NCS/EMGs, and 11 were PSGs. In EEGs 7% were of neonates, 58% were in children under age of 18 years and 35% were beyond 18 years. 65% were normal and 35% were with seizures. Among NCS/EMGs, 23% were normal, 15% were carpal tunnel syndromes, 7% were radiculopathies, 7% were sensory motor axonal polyneuropathies and 9% were mononeuropathies other than CTS. GBS and CIDP were 6.5% and 1% respectively. In the sleep studies 8 tests were positive for obstructive sleep apnea (OSA), 2 for the restless legs syndrome and 1 for the narcolepsy. In VEEG 2 studies demonstrated typical routine or habitual seizures, 3 were normal and 1 showed typical non epileptic psychogenic seizures. EMG/NCS referrals were highest followed by EEGs. EMG/NCS tests were mostly referred by orthopedic and neurosurgeons while EEGs were predominantly referred by pediatricians. The tendency for VEEG and sleep study was very uncommon among neurologists and physicians. Over all non neurologist referrals were more than neurologist's referrals.

**INTRODUCTION:** Neurophysiologic tests are the extension of a neurological examination which aid in reaching the diagnosis. The yield of these tests is best when accompanied with clinical findings and pretest probability is high for abnormality. These tests are mainly performed as a helping tool in the diagnostic work up of epilepsy, neuromuscular diseases, and central demyelinating disorders like multiples sclerosis and sleep disorders. In past much research has been done in humans and animals regarding specific area of neurophysiology e.g. electro diagnostic tests only. Measuring the frequencies of these tests is indirect measurement of the spectrum of neurological disorders for which the tests are performed. These tests also signify the correct approach for the diagnosis and treatment plan. In most of the cases these tests do have impact in changing the management and prognosis of the disease. In Pakistan there are few

centers that perform EEGs, Video EEG (VEEG), Polysomnography (PSG), Nerve conduction studies (NCS), electro diagnostic testing (EDX) and intra operating monitoring (IOM).<sup>(1)</sup> There is no proper institution except Aga Khan University and Shifa international hospital that have organized departments for these tests. There is also no proper mechanism of collecting and reporting data on these tests. A center established in Quetta the capital of Baluchistan province, since January 2017 works on this data. The population of Baluchistan is not dense yet; there is great diversity and an increasing number of neurological patients here as well as patients referred from neighboring countries like Afghanistan and Iran. While the spectrums of clinical neurological disease are well described in different tertiary care hospitals of Pakistan, the data of neurophysiology is scarce<sup>(2, 3)</sup>. To our knowledge there is little information about

neurophysiologic tests of these neurological problems. This is first analysis of its kind taking a large group of patients referred to this neurophysiology center. The aim of this audit was to present the pattern of referrals and results of the neurophysiological tests.

## METHODS:

A medical audit (Cross-sectional study) of referrals done to Sultan Tareen health care and transplant institute Quetta for neurophysiologic tests was carried out. The test records of 1600 patients, were included who were referred to this neurophysiology center from January 2017 to July 2019. A formal consent was taken from the patients. The procedures of EEG, VEEG, NCS and PSG were performed by a qualified technologist according to international protocol. The procedure of EEG was carried out as standard 16 channels scalp EEG with standard parameters. The occurrence of interictal epileptiform discharges in EEG was considered as abnormal. EMG and reporting was done by a trained neurophysiologist. A structured form was used to document referral and results of the tests which were categorized as normal, abnormal with either conclusive or inconclusive finding. Frequency and percentages were computed for variables like normal, seizure disorder, neuropathy, myopathy, radiculopathy, plexopathy and sleep disorder for gender and age. The variables of seizure disorder, neuropathy and myopathy and sleep disorders were subdivided into their specific types. SPSS version 19 (IBM Corp, Armonk, NY, USA) was used for data analysis. Mean and  $\pm$  standard deviation was computed. A p value of  $<0.05$  was taken as statistically significant.

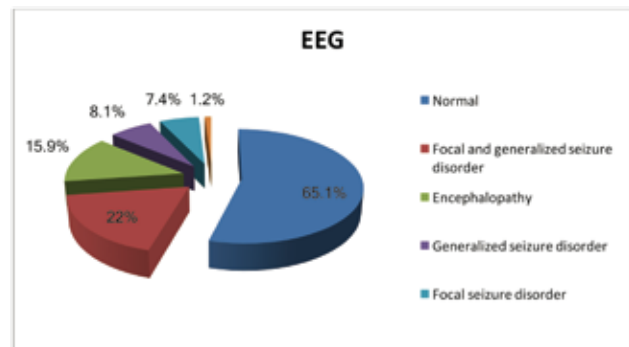
## RESULTS

A total of 1600 tests were included. Total EEGs were 677. In electro diagnostic procedures, 923 tests were done. Polysomnography were 11 and VEEG were 6 in total. Table.1 and Fig 1 show 677 samples of EEG, among these 7% were neonates, 58% were children and 35% were adults. For the history 40.3% found with fits of any type, 3.4% with myoclonic jerks, 2.2% with delayed milestones and 54% with other symptoms. Duration of the symptoms were more than 2 weeks in 82.7% and 17.2% were within 2 weeks. EEG results showed 65.1% as normal, 22% were having focal and generalized seizure disorder and 15.9% were encephalopathy as common type. **Table 1, Fig 1.** Among NCS/EMGs, 23% were normal, 15% were carpal tunnel syndromes, 7% were radiculopathies, 7% were sensory motor axonal polyneuropathies and 9 % were mononeuropathies other than CTS. GBS and CIDP were

6.5% and 1 % respectively. In the sleep studies 8 tests were positive for obstructive sleep apnea (OSA), 2 for the restless legs syndrome and 1 for the narcolepsy. In VEEG 2 studies demonstrated typical routine or habitual seizures, 3 were normal and 1 showed typical non epileptic psychogenic seizures. **Table 2, Fig 2.**

**Table 1: Demographics of the clinical characteristics and final conclusions of EEG patients. (n = 677)**

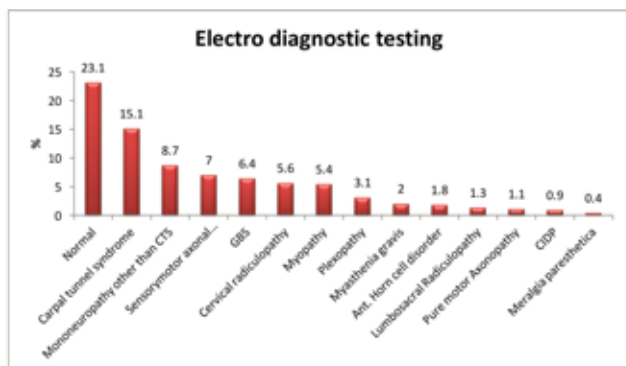
Variables	n (%)	
Age group (years)	Neonate	49 (7.2)
	01 Month to 18 years	392(57.9)
	19 years and above	236 (34.8)
History	Fits of any type	273 (40.3)
	Myoclonic jerks	23 (3.4)
	Delayed milestones	15 (2.2)
	Other symptoms	366 (54.1)
Duration of symptoms	Within 2 weeks	117(17.2)
	More than 2 weeks	560 (82.7)
Final conclusion	Normal	441 (65.1)
	Focal seizure disorder	50 (7.4)
	Generalized seizure disorder	55 (8.1)
	Both focal and generalized seizure disorder	15 (2.2)
	Encephalopathy	108 (15.9)
SSPE	8 (1.2)	



**Figure 1: Showing the detailed outcomes of EEGs.**

**Table 2: Demographics of final conclusions of electro diagnostic testing (NCS/ EMG) (n = 923)**

Outcomes	n (%)
Normal	213 (23.1)
Sensory motor axonal polyneuropathy	64 (7)
Lumbosacral Radiculopathy	178 (1.3)
Carpal tunnel syndrome	139 (15.1)
Cervical radiculopathy	52 (5.6)
GBS	59 (6.4)
CIDP	8 (0.9)
Myasthenia gravis	18 (2)
Myopathy	50 (5.4)
Ant. Horn cell disorder	17 (1.8)
Mononeuropathy other than CTS	80 (8.7)
Plexopathy	29 (3.1)
Pure motor Axonopathy	10 (1.1)
Meralgia paresthetica	4 (0.4)



**Figure 2: Bar diagram showing the detailed outcomes of NCS / EMG in descending order.**

### Discussion:

Despite prevalence of many neurologic conditions, the availability of neurophysiologic testing is limited to a few of the major cities in Pakistan. (1) Most cases are referred by neurologists followed by internal physicians and pediatricians as only a few neurologists can perform and interpret these tests. Majority of the EEG referrals (40%) were done due to a history of fits of any type and some (3.4 %) had history of specific myoclonic jerks. Rests of the referrals were done for miscellaneous causes. Table 1. The need for EEG was mostly sought in the ages between 1 month and 18 years of the age. This finding indirectly indicates that epilepsy is predominantly present in children and adolescents. Our study is similar to the previous study done by Sanam et al, showing majority EEG referrals (58%) were under the age of 18 years. Most of EEGs (83%) were done after 2 weeks of the of the first seizure. (4) This also shows that either parents or the treating physicians have more inclination and anxiety about diagnosing and treating this vulnerable group of the society. (5) The data shows that most of the EEGs performed yielded normal results (65.1%). Table 1 and Fig 1. Taken this in view, the idea of considering a normal EEG for a given recoding or giving benefit of doubt is true. On the other hand a single normal EEG cannot exclude an underlying seizure disorder. The reason is a first EEG can only be positive in 50-80% of the cases. (6, 7) .There was 7.4 % of the patients with focal seizures, 8.1 % generalized and 22% with both focal and generalized seizures. The ratio of electrographic versus clinical prevalence of seizure types is much less in this study as compared to previous studies (8). In this study a large proportion of the EEG shows encephalopathic conclusion. This signifies the low suspicion threshold of a physician for the underlying seizure disorder in a drowsy patient. These referrals were mostly from internal medicine.

Perhaps the most alarming aspect of this study is the EEG of 8 patients with typical findings of SSPE. All of these 8 patients had positive anti-measles antibodies showing 100 % match between serology and EEG findings. This match was found as 64 % in study done in South India in 2007. (9). In a Pakistani study by Tariq et al the prevalence of clinical SSPE was 12% with confirmed serum and CSF anti-measles antibodies. (10) In recent past, SSPE has been observed quite frequently by pediatricians and neurologists. (11) Children with this disease were mostly from rural areas of Baluchistan or neighboring country Afghanistan. Nerve conduction studies and electromyography are the main procedures that were included as the electro diagnostic tests of this study. Perhaps this area of electrophysiology is the most that needs expertise and proper training of both the technologists as well as neurologists in Pakistan which is really scarce. A total of 923 patients were sent for the NCS and EMG. Most of the referrals were sent from neurosurgeons, orthopedic surgeons, neurologists and pediatricians respectively. 23% of the tests were normal. Table 2 and Figure 2. The most prevalent diagnosis was CTS 15.1%. CTS were also prevalent (31%) in all previous studies. (12) Almost all CTS cases were sent by neurosurgeons and orthopedic surgeons. Over all non neurologist referrals were more than neurologist's referrals. GBS was seen 6.4% while CIDP was 0.9%. This is almost 3 fold higher to its clinical prevalence that is 1.8% in this region. (3) GBS and CIDP diagnoses in EMG/NCS were almost similar 6.88% and 1.15% respectively seen by Zakir et al in 2019. (12) Other common neuropathy was sensory motor axonal neuropathy (7%). Myopathy and Myasthenia gravis were 5.4% and 2% respectively. Compared to their clinical prevalence of neuropathy and myopathies, the frequencies of ordering their electrophysiological tests were much less. The reason is these tests are not widely available in public sector hospitals. Secondly, these tests are not conducted in private facilities due to financial constraints. According to this study the results of the electro diagnostic tests had a significant impact on the decision making process of physicians. In cases like CTS, the decision of surgery of mild vesus severe cases was helped by the results of the tests. Overall the frequency of electro diagnostic tests was higher than EEGs. In contrary to the EEG and electro diagnostic tests, PSG and VEEG were quite less in number. A total of 11 sleep studies and 6 VEEGs were done. In the sleep studies 8 tests were of OSA, 2 for the restless legs syndrome and 1 for the narcolepsy. In the VEEG 2 studies demonstrated habitual seizures thus helping localizing the lesion and type of epilepsy, 3 were normal and 1 VEEG showed

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typical non epileptic psychogenic seizures. The tendency for VEEG and sleep study was very uncommon among neurologists and physicians. Doing only 6 VEEGs shows that either patients or physicians are not willing to carry out these lengthy procedures in Quetta unless they were strongly motivated to do so. In general patients of this region prefer to go larger city such as Karachi for higher medical care or when they think their disease is difficult.

### **Limitations**

Since this is a single private neurophysiology center in the Quetta/town reported by a single neurophysiologist, the chances of clinical as well as electrophysiological bias is always there.

The services for Evoked potential were not available as there were only 2 referral during the period of 2 years. Limited number of PSGs and VEEGs were done due to less referral from physicians.

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**Conflict of interest:** There is no conflict of interest..

**Funding disclosure:** Nil

**Author's contribution:**

**Dr. Ahmad wali;** Data collection, data analysis, manuscript writing, manuscript review

**Dr. Ehtisham Khalid;** manuscript review

**Dr. Hazar Khan;** manuscript writing, manuscript review

**Mr. Abdul Nasir;** Data collection, Data analysis, manuscript writing

**Mr. Abdullah;** Data collection, Data analysis, manuscript writing