ORIGINAL ARTICLE

NERVE CONDUCTION STUDY PATTERNS IN EARLY GUILLAIN BARRÉ SYNDROME

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Background: Nerve conduction studies (NCS) in early Guillain-Barré Syndrome (GBS) help differentiate demyelinating from axonal subtypes, though findings may be subtle or normal initially. Objective of this study was to explore the NCS findings in patients presenting with early GBS. **Methods:** This cross-sectional study was conducted at Department of Physiology, Shaheed Zulfiqar Ali Bhutto Medical University, and Department of Neurology, Pakistan Institute of Medical Sciences, Islamabad from May 2023 to February 2024. Data was collected from 94 patients after written informed consent and analysed using SPSS-23. Chi-square test was applied taking $p \leq 0.05$ as significant. **Results:** Twenty-one 21 cases had normal Nerve Conduction Study, 73 NCS cases showed abnormal findings out of which 13.7% cases had normal motor conduction velocities and 86.3% had abnormal conduction velocities. Moreover, 20.5% cases had normal while 79.5% cases had abnormal distal motor latencies; 15.1% cases out of the abnormal NCS cases had normal and 84.9% cases had abnormal F-waves. Out of 74 abnormal NCS, 28.8% had normal compound motor action potential and 71.2% had abnormal compound motor action potential ($p=0.0001$). There was significant association ($p \leq 0.05$) between NCS and electrophysiological parameters. **Conclusion:** GBS is common in 13–65 years age group with male predominance. NCS findings were abnormal in 77.7% of cases presenting early. Early electrophysiological parameters in NCS, elucidate their diagnostic significance and offer insight into pathophysiology of nerve disorders.

Keywords: Guillain-Barré syndrome, Nerve conduction study, Electrophysiological studies

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INTRODUCTION

Guillain-Barré Syndrome (GBS) is an uncommon yet severe post-infectious immune-mediated neuropathy characterized by the autoimmune attack on nerves within the peripheral nervous system. This leads to symptoms like numbness, tingling, and weakness, which may escalate to paralysis.[1]

Nerve conduction studies (NCS) serve as a critical electrophysiological tool for evaluating the functionality of both cranial and peripheral nervous systems. They play a pivotal role in diagnosing and characterizing disorders affecting nerve roots, peripheral nerves, muscles, and neuromuscular junctions.[2] NCS enables the assessment of motor, sensory, or mixed nerve functions. These studies involve nerve stimulation with recording electrodes placed over distal muscles, cutaneous sensory nerves, or entire mixed nerves, providing comprehensive diagnostic information.[2] There are several parameters of NCS including motor conduction velocities (MCV), F-waves, Distal Motor Latency (MDL) and Compound Motor Action potential (CMAP) and Sensory nerve action potential (SNAP).[3,4]

F-wave studies are commonly employed to assess nerve conduction velocity, especially for detecting conduction issues in proximal nerve regions. The F-wave refers to a compound action potential elicited by supramaximal antidromic stimulation of a motor nerve. The absence or slowing of F-waves can indicate an isolated conduction abnormality, particularly in the early stages of GBS.[4] This observation underscores the importance of F-wave studies as a sensitive tool for detecting early nerve conduction abnormalities.[4,5]

The motor conduction velocity (MCV) test determines the speed of electrical impulses along a nerve, aiding in the detection of nerve damage.[6] The latency refers to the time delay between the initial stimulation from the first electrode and the detection by the downstream electrode.[7] A compound muscle action potential (CMAP) is the combined action potential recorded from a muscle during a motor nerve conduction study. It occurs when stimulation at any point along the motor pathway is adequate to activate some or all of the muscle fibbers in that muscle. The compound muscle action potential (CMAP) involves stimulating a nerve fibre and observing the corresponding muscle response. In cases of peripheral neuropathies, alterations in the CMAP signal are commonly observed.[8]

Various electrophysiological characteristics exist to categorize different variants of GBS.[9] Accurate diagnosis of each variety requires electrophysiological testing; however this can only be done if it is performed soon after the onset of symptoms.[10] Cranial nerves involvement is also common in GBS.[11] There may be single or multiple cranial nerves involvement and this also indicate severity of disease.[11] There are two approved methods to treat GBS, i.e., plasma exchange

(PLEX)/intravenous immunoglobulins (IVIGs).[12,13] Few data is available on NCS findings in early GBS. Our study aims to focus on changes in electrophysiological studies during early presentation of GBS.

MATERIAL AND METHODS

We conducted this cross sectional study at the Neurology unit of Pakistan Institute of Medical Sciences (PIMS), Islamabad from May 2023 to February 2024 after obtaining approval from the ethical review board of Shaheed Zulfiqar Ali Bhutto Medical University (SZABMU). Study was approved by AS&RB of SZABMU. Sample size of 94 was calculated using WHO sample size calculator. Both male and female patients provisionally diagnosed with GBS with the age range of 13 to 65 years were included for this study by using non-probability consecutive sampling technique after taking written consent. The patients with diabetes mellitus, renal impairment, peripheral nerve disease, and myopathy were excluded from the study.

After recording patients' demographic details and physical examination suspected GBS cases NCS evaluation was done by Neuro-physician by using Nicolet Natus EDX 1000 NCS/EMG/EP Machine. Following parameters were measured, i.e., Motor conduction velocities (MCV), MDL, F-wave, Compound Motor Action potential (CMAP) of peripheral nerves including median, ulnar and radial nerves in upper limbs whereas tibial, peroneal and sural nerves of lower limbs. Other parameters including types of GBS, Ventilator support, cranial nerves involved and treatment options [plasma exchange (PLEX)/ intravenous immunoglobulins (IVIGs)] also studied.

The data was analysed in SPSS-23. Mean±SD were determined for age of the patients. Frequency and percentages were determined as categorical data such as gender, NCS, i.e., motor conduction velocities (MCV), distal motor latency (MDL), F-wave, compound motor action potential (CMAP), types of GBS, Ventilator support ,cranial nerves involved and treatment options. Patients were broadly divided into two groups, i.e., Group A comprised of patients with normal NCS and Group B of patients with abnormal NCS. Chi square test of association was applied taking $p \leq 0.05$ as significant and with a confidence interval of 95%.

RESULTS

There were 50 males and 44 females with mean age of 39.77±16.43. Table-1 is showing GBS types according to demyelination or axonal pattern on NCS. In our study there 30 cases (32.0%) of Acute inflammatory demyelinating polyneuropathy (AIDP), 25 cases (26.6%) of Acute motor axonal neuropathy (AMAN), 18 cases (19.1%) of acute motor sensory axonal neuropathy (AMSAN) variant and there were 21 cases (22.3%) having normal NCS.

We also did association of NCS with electrophysiological findings showing that 21 (100.0%) cases were having normal motor conduction velocities, distal motor latencies, F-waves and compound motor action potential with respect to normal NCS in all these 21 cases. Whereas with respect to abnormal NCS 73 cases, 10 (13.7%) cases were having normal motor conduction velocities and 63 (86.3%) had abnormal conduction velocities. Out of abnormal 73 NCS cases 15 (20.5%) cases had normal and 58 (79.5%) cases had abnormal distal motor latencies respectively. Out of abnormal 73 NCS cases 11 (15.1%) cases had normal and 62 (84.9%) cases had abnormal F-waves respectively. We found that out of 74 abnormal NCS, 21 (28.8%) had normal compound motor action potential and 52 (71.2%) had abnormal compound motor action potential. (p=0.0001). (Table-2).

Table-3 shows Association of NCS with respect to ventilator support showed that out of 94 cases 21 patient which were having normal NCS showed 4 (19.1%) required ventilator and 17 (80.9%) had not required ventilator. Whereas 73 patients which were having abnormal NCS showed 17 (23.3%) required ventilator and 56 (76.7%) had not required ventilator. Association of NCS with cranial nerves involvement showed that out of 94 cases 21 patients which were having normal NCS showed 8 (38.1%) with single cranial nerve involvement, 2 (9.5%) cases with multiple and 11 (52.4%) without cranial nerve involvement. Whereas 73 patients which were having abnormal NCS showed 23 (31.5%) with single cranial nerve involvement, 10 (13.7%) cases with multiple and 40 (54.8%) without cranial nerve involvement. Out of 94 cases 88 (93.6%) opted for plasmapheresis, i.e., PLEX whereas only 6 (6.4%) opted IVIGs as treatment option.

Table-1: Types of GBS

GBS Type	Frequency	Percentage
AIDP	30	32.0
AMAN	25	26.6
AMSAN	18	19.1
None	21	22.3

Table-2: Association of NCS with electrophysiological parameters

Electrophysiological findings	Normal		Abnormal		p
	n	%	n	%	
Motor Conduction Velocities (MCV)					
Normal	21	100.0	10	13.7	0.0001
Abnormal	0	0.0	63	86.3	
Distal Motor Latency (MDL)					
Normal	21	100.0	15	20.5	0.0001
Abnormal	0	0.0	58	79.5	
F-wave					
Normal	21	100.0	11	15.1	0.0001
Abnormal	0	0.0	62	84.9	
Compound Motor Action potential (CMAP)					
Normal	21	100.0	21	28.8	0.0001
Abnormal	0	0.0%	52	71.2	

Table-3: Association of NCS with ventilator support and cranial nerves involved

Characteristics	Normal (n=21)	Abnormal (n=73)	*p*
Ventilator support			
Required	4 (19.0%)	17 (23.3%)	0.17
Not required	17 (81.0%)	56 (76.7%)	
Cranial Nerves Involved			
Single	8 (38.1%)	23 (31.5%)	0.46
Multiple	2 (9.5%)	10 (13.7%)	
None	11 (52.4%)	40 (54.8%)	

DISCUSSION

Average age of patients diagnosed with Guillain-Barré Syndrome (GBS) in our study was found to be 39.77±16.42 years which was closely near to a study conducted in Pakistan showing mean age of 41.27 years.[14] In our study it was observed that 50 individuals (53.2%) were males, while the remaining 44 (46.8%) were females. This was comparable to other studies.[14,15] We found that NCS test was abnormal in 73 (77%) patients, which is in agreement to a study which reported abnormal NCS in 80.64% patients.[16]

We observed that MCV was abnormal in 86.3% patients, distal motor latency (MDL) was abnormal in 79.5% patients, about 84.9% patients showed abnormal F-wave, and 71.2% patients showed abnormal Compound Motor Action Potential (CMAP). Our findings are almost similar to Brohi H *et al*[16]. Another study[17] reported that CMAP was abnormal in 41.75% of their subjects which is lower than our findings. Most prevalent variant in our study was AIDP which is in contrast to a study conducted in Pakistan[15] in which most common was AMAN variant.

Ventilator support in our patients was needed by 22.3% patients. These values were comparable to a study conducted in Pakistan[18] in which 13% cases required ventilator support which is lower than our study. Shang P *et al*[19] showed that 30% patients needed mechanical ventilation in their study which is quite high as compared to our study. Another study[20] showed that 22% patients required mechanical ventilation which is in agreement to our study.

Out of 94 cases 54.2% showed no cranial nerve involvement, 33.0% showed single cranial nerve involvement, and 12.8% showed multiple affected cranial nerves. A study[21] showed that 34% patients showed cranial nerves involvement which is lower as compared to our study. Another study[11] showed 62.3% showing cranial nerves involvement (21% with single whereas 41% showed multiple cranial nerve involvement) whereas 38% with no cranial nerve involvement which is lower than our study.

There are 2 approved treatment options available for treatment of GBS, i.e., IVIGs and plasmapharesis. In our study, 93.6% cases opted for plasmapharesis, i.e., PLEX, whereas only 6.4% opted IVIGs as treatment option. Our results were in contrast to studies conducted in India where 50% cases opted for PLEX.[21,22] We found significant association of NCS with MCV, Distal Motor Latency (MDL), F-wave, Compound Motor Action Potential (CMAP), and NCS with GBS Type. However we could not finds any significant association of ventilator support and cranial nerves involvement. These results are different from another study conducted in Pakistan[16] in which there was no significant association of NCS with electrophysiological parameters.

CONCLUSION

GBS is common in 13–65 years age group with male predominance. NCS findings were abnormal in 77.7% of cases presenting early. Early electrophysiological parameters in NCS, elucidate their diagnostic significance and offer insight into pathophysiology of nerve disorders.

LIMITATIONS & RECOMMENDATIONS

Since we conducted this study in a single centre, it is recommended that such studies must be conducted at multiple centres with Neurology Departments to further explore the diagnostic options along with electrophysiological parameters for diagnosis of GBS.

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