Original Article

Reduced amplitude in Peroneal Nerve in Nerve Conduction Study as a diagnostic tool in clinically suspected Guillain Barre Syndrome

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Abstract

Background: Guillain Barre syndrome (GBS) is an acute polyradiculoneuropathy with a variable presentation affecting all age groups. The diagnosis of GBS is based on clinical features, supported by features of electrophysiologic study, Mostly by Nerve Conduction study (NCS). Aim of the study was to evaluate Peroneal Motor Nerve involvement in NCS as a diagnostic aid to confirm GBS.

Patients and methods: Sixty three patients fulfilling Brighton diagnostic criteria for GBS were enrolled in this study. Patients Referred from different Institutes to Department of Neurophysiology of Mount Adora Hospital for NCS with clinical diagnosis of GBS were included. Pre-existing neuropathy, diabetes, alcoholism, myopathy, motor neuron disorders, peripheral vascular disorders excluded. NCS was performed with Cadwell EMG machine. The test was performed on 7th day of onset of disease symptoms.

Results: Three categories of GBS were identified: Acute Inflammatory Demyelinating Polyneuropathy (AIDP), Acute Motor Axonal Polyneuropathy (AMAN), Acute Motor Sensory Axonal Polyneuropathy (AMSAN). There were 39 male, 24 female patients. Maximum patient (19) admitted on 3rd day, and only one patient came on 6th day. Maximum patients were AMAN (39) followed by AMSAN (21) and AIDP (3). Notifiable change observed in Peroneal motor nerve, both Fibular head and Popliteal parts. Mean amplitude were reduced significantly ($p < 0.0001$) from the normal values where latency were statistically within normal level. In AMAN, common peroneal nerve involvement only found in 18 cases, while Peroneal with other nerve involvement occurred in 21 cases. On the other hand, in AMSAN, Common Peroneal and Sural nerve involvement only found in 12 cases, and multiple nerves involvement observed in 9 case. Odd ratio for the Peroneal nerve involvement in AMAN only was 1.5556 and in AMSAN was 1.3333.

Conclusion Peroneal Neuropathy may be the only NCS abnormality aiding towards diagnosing GBS.

Keywords: Guillian Barre Syndrome (GBS), Nerve Conduction study (NCS), Acute Inflammatory Demyelinating Polyneuropathy (AIDP), Acute Motor Axonal Neuropathy (AMAN), Acute Motor Sensory Axonal Neuropathy (AMSAN), Conduction block (CB), Sensory Nerve Action Potential (SNAP), Compound Motor Action Potential (CMAP).

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Introduction

The Guillain-Barre syndrome is an acute polyradiculoneuropathy with a variable presentation.[1] It is autoimmune condition consisting of demyelinating and axonal subtypes. It is sometimes known as

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Landry's ascending paralysis, French polio, acute idiopathic polyneuritis, or acute idiopathic polyradiculoneuritis.[2] Diagnosis remains based of clinical characteristics and ancillary laboratory investigations.[1] Complaints of symmetrical weakness, increasing over the course of days, and absence of deep tendon reflexes on examination would make most physicians think of GBS.[2] The clinical diagnosis of GBS is further established by cerebrospinal fluid (CSF) analysis and nerve conduction studies (NCS). Nerve conduction studies are useful to confirm the GBS diagnosis as well as to differentiate between the different subtypes, assess severity, and analyze prognosis.[3] GBS progress over a two-week period in 50 percent of patients, and over four weeks in another 40 percent of patients.[4] One-third of patients may require ventilator support due to respiratory paralysis of.[5] Dysautonomia (hypotension, hypertension, arrhythmias, and urinary retention) occur in about 70 percent of patients.[2]

GBS has three major subtypes: (i) Acute Inflammatory Demyelinating Polyneuropathy (AIDP), (ii) Acute Motor Axonal Neuropathy (AMAN), and (iii) Acute Motor Sensory Axonal Neuropathy (AMSAN).[4] Conduction block (CB) is one of the most common electrophysiological features in both subtypes, with different pathophysiological mechanisms.[5] In AMAN, CB could be reversible in some cases.[6] Some previous works tried to establish relationship between CB and prognosis in types of GBS, and found no relationship, while other works found that CB of the common Peroneal nerve was a good dichotomizing parameter to identify subtypes of GBS.[7,8] The goal of this study to determine if Peroneal axonopathy in study in Nerve Conduction Study can be used as a diagnostic tool in clinically suspected Guillain Barre Syndrome.

Methods

The worldwide incidence of GBS is 1.1/1,00,000/ year [9]. Our target population was the people of Sylhet division. The population of Sylhet division is 12.1 million and expected to get 132 patients / year. The population of Sylhet district is 5 million and expected to get 44 patient / year according to the international incidence rate.

This cross sectional descriptive study was conducted in the Electrophysiology laboratory of Mount Adora Hospital between 12/10/2018 and 31/12/2019. Sample size was 63. NCS was done in patients with clinically suspected cases of GBS, who were sent for Nerve conduction study. Patients fulfilling Brighton Diagnostic criteria were included. Inclusion criteria was (a)Bilateral and flaccid weakness of limbs, (b) Decreased or absent tendon reflexes in weak limbs. Exclusion criteria was (a) Bowel or bladder dysfunction at onset, (b) Sharp sensory level, (c) Fever at onset, (d) Altered mentation, (e) Progression more than 4 weeks, (f) Hypokalemic patients, (g) Patients with pre-existing neuropathy, diabetes, alcoholism, myopathy, motor neuron disorders, peripheral vascular disorders. CSF studies and Serum electrolytes were present in all cases excluding infectious and metabolic differentials respectively. All demographic, clinical, laboratory and electrophysiological data was recorded accordingly.

NCS was performed with a Cadwel EMG machine. The test was performed after 7th day of onset of disease symptoms. Motor NCS were performed in all subjects on the Median, Ulnar, Fibular, and Tibial nerves with percutaneous supramaximal nerve stimulation while recording the CMAPs with 10-mm disk electrodes. Bilateral nerves were studied in all cases. Antidromic sensory NCS were performed on Median, Ulnar, Sural nerves. The room temperature was maintained to ensure that the skin temperature remained above 31^{o}c. Three categories of GBS were identified according to the standard protocol.

Statistical analyses: After collecting data in data collection sheet they were spreaded in SPSS. Descriptive statistics were presented as the mean ± standard deviation for continuous variables, and frequency with percentage for the categorical variables. Statistical Package for Social Sciences (SPSS), version-22, was used to analyzing the data; appropriate statistical methods were followed. All tests were two sided with a significance level of at least 0.05. Tests done in

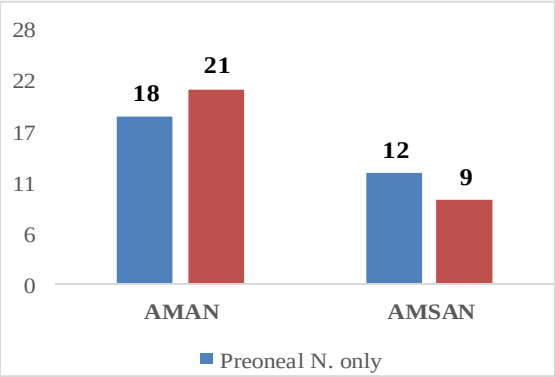
our study was One sample t test for comparing Patient latency and P-T amplitude of NCS result with normal value (two means), One sample ANOVA with post hoc Tukey test was done to analyze p value in NCS Latency and P-T amplitude of Peroneal nerves in three different types of GBS (as there were more than two means).

Hypothesis was: Reduced amplitude in Peroneal Nerve in Nerve Conduction Study as a diagnostic tool in clinically suspected Guillain Barre Syndrome.

Results

A total of 63 patients included in this study. Baseline demographic characteristics showed in table no. 1. There were 39 male and 24 female patients, mean age was 22.16±6.31 years. Maximum number of patients (36) came from 20 to 29 age groups, followed by <20 years age group (23) and >30 years age group (4). Patient's age ranging from 12 years to 47 years. Days gap between onset of disease symptom and admission also showed. Maximum patient (19) came to admit on 3rd day, and only one patient came on 6th day. Mean period was 2.79±1.23 days. Distribution of different types of GBS showed in table no. 2. Maximum numbers of patients belong to AMAN (39) followed by AMSAN (21) and AIDP (3).

Figure 1: Distribution of nerve involvements between the AMAN and AMSAN



Patients NCS results (Latency and P-T amplitude) showed in table no. 2. Mean of nerve latency and P-T amplitudes were within normal limits in sensory components of both upper and lower limbs and motor components in upper limb only. Notifiable change observed in Peroneal motor nerve, both Fibular and Popliteal parts. Patients means P-T amplitude reduced far from the normal values (p <0.0001) while significant change did not observe in nerve latency.

Table 1: Demographic characteristics

Denominator	Frequency	Percentage
Sex		
Male	39	61.9%
Female	24	38.1%
Age groups (years)		
<20	23	36.50%
20-29	36	57.16%
>30	4	6.34%
Mean age	22.16±6.31	
Minimum age	12 years	
Maximum age	47 years	
The period between onset of symptom and date of admission		
1 day	12	19.04%
2 day	9	14.28%
3 day	19	30.17%
4 day	16	25.40%
5 day	6	9.52%
6 day	1	1.59%
Mean period	2.79±1.23	
Minimum period (day)	1	
Maximum period (day)	6	
Sub-types of GBS		
AIDP	3	4.76%
AMAN	39	61.91%
AMSAN	21	33.33%

NCS Latency of Peroneal nerve in three different types of GBS showed in Table no. 3. One-way ANOVA followed by Tukey HSD was used to compare the means values. Statistically significant differences observed in Peroneal motor nerve latency at Fibular head (p = 0.05) and Peroneal motor nerve P-T amplitude at Fibular head (p = 0.02). More specifically, Peroneal motor nerve latency, significant difference found between AIDP and AMAN (p=0.004), and between AMAN and AMSAN (p=0.05); no difference between AIDP and AMSAN (p=0.61). In case of Peroneal motor P-T

amplitude, significant difference found between AIDP and AMAN (p=0.001), and between AIDP and AMSAN (p=0.001), but no difference between AMAN and AMSAN (p=0.09). Mean P-T amplitude of both AIDP and AMAN is significantly higher than the AMSAN; p values were 0.03 in both cases. However, mean values in AIDP and AMSAN were slightly higher and in AMAN was slightly lower than the normal values; normal values were ≤4.2 for fibular head and ≤5.7 for popliteal. However, such differences were not statistically significant. On the other hand, in case of P-T amplitude, all the results were below the normal value (≤3) and differences were significant.

Table no. 2: Patient latency and P-T amplitude of NCS result with normal value

Nerve	Latency	Normal value	p-value	P-T amplitude	Normal value	p-value
Sensory – upper limb						
Median nerve	3.20±0.35	≤3.6	<0.001	8.01±1.38	≤10	<0.001
Ulnar nerve	3.06±0.55	≤3.7	<0.001	12.18±1.92	≤15	<0.001
Sensory – lower limb						
Sural nerve	3.14±0.45	≤4	<0.001	4.31±0.63	≤5	<0.001
Motor – upper limb						
Median nerve – wrist	3.64±0.54	≤4.2	<0.001	4.14±0.55	≤5	<0.001
Median nerve – elbow	3.74±0.29	≤4.2	<0.001	4.04±0.57	≤5	<0.001
Ulnar nerve – wrist	3.20±0.39	≤4.2	<0.001	2.43±0.28	≤3	<0.001
Ulnar nerve – elbow	3.60±0.38	≤4.2	<0.001	2.32±0.39	≤3	<0.001
Motor – lower limb						
Peroneal nerve – fibular head	4.85±3.57	≤4.2	0.09	1.30±1.07	≤3	<0.001
Peroneal nerve – popliteal	5.51±2.38	≤5.7	0.47	1.18±0.80	≤3	<0.001
Tibial nerve – ankle	5.25±3.03	≤6.1	0.01	2.88±2.99	≤3	0.70
Tibial nerve – knee	5.44±0.44	≤6.1	<0.001	2.33±0.59	≤3	<0.001

Table 3: NCS Latency and P-T amplitude of Peroneal nerves in three different types of GBS

Nerve	AIDP	AMAN	AMSAN	p-value
Latency				
Peroneal Motor – Fibular Head	4.70±0.28	4.30±2.89	5.90±4.67	0.16
Peroneal Motor – Popliteal	7.33±0.45	4.99±1.26	6.24±3.61	0.02
P-T amplitude				
Peroneal Motor – Fibular Head	2.60±0.12	1.39±1.16	0.93±0.74	0.006
Peroneal Motor – Popliteal	1.65±0.33	1.32±0.86	0.86±0.63	0.02

Distribution of nerve involvements between the AMAN and AMSAN showed in figure no 1. Total number of AMAN was 39 (65%) and AMSAN was 21 (35%) from 60 GBS cases. In AMAN, common peroneal nerve involvement only found in 18 cases, while peroneal with other nerve involvement occurred in 21 cases. On the other hand, in AMSAN, common peroneal nerve involvement only found in 12 cases, and common peroneal with other nerve involvement observed in 9 case. Odd ratio for the common peroneal nerve involvement in AMAN only was 1.5556 (95% Confidence Interval: 0.534 to 4.5317). Risk ration for the common peroneal nerve involvement in AMAN only was 1.3333 (95% Confidence Interval: 0.6617 to 2.6867). However, distribution did not show significant difference (c^2=0.6593, p = 0.416793).

Discussion

GBS is a widely distributed disease throughout the world. It affects all the ethnic and age groups, with male predominance. Male are 1.5 times more likely to be affected. Incidence is increases with age.[10] In this study, male female ratio was 1.625:1; highest patients came from 20 to 29 age groups, mean age was 22.16, ranging from 12 years to 47 years.

The worldwide incidence of GBS is 1.1/1,00,000/ year [9]. Our target population was the people of Sylhet division. The population of Sylhet division is 12.1 million and expected to get 132 patients / year. The population of Sylhet district is 5 million and expected to get 44 patient / year according to the international incidence rate. There was no known incidence of GBS in adults in Bangladesh. This study was a time-framed study and we have included all the GBS patients coming for NCS study in Mount Adora Hospital, Sylhet, Bangladesh during this time. We found 63 cases in our time frame, which is more than expected. This may be due to higher rate of GBS in this region, which needs further validation by Randomized controlled trials.

Predominant electrophysiological subtype of GBS may differ geographically. One study showed that AIDP is the major subtype of GBS in Iran[4]. This study was done in Tehran and subjects were referred from different areas which could be a fair representative of the whole country. Supplemental study in Iran reported demyelination in 60.5%, axonal in 25% and mixed pattern in 14.5% of patients with mean annual incidence of 2.11/100,000 populations[11].

On the other hand the axonal variants of GBS are predomidant in East of Asia, Japan which have reported AMAN in 45-48% of their patients with GBS [12,13,14] than North America and Europe which include only 5% of GBS and less common than In our study axonal variant comprised 95.2%.

Electro-diagnostic studies are helpful in diagnosis and differentiating varieties of GBS [15]. Electro-physiological features of myelin involvement include prolonged distal motor latencies, prolonged or absent F wave latencies, conduction block, and abnormal upper extremity sensory nerve action potential. F wave is the most sensitive diagnostic test for early GBS in AIDP. In this study, motor conduction velocity was low and noticed mainly in the lower limbs. The above results are similar with others[16,17,18].

In a study done by Ropper et al[19]. Among 41 patients of GBS, NCS studies within a week of onset of symptoms, 16 patients had abnormalities of compound muscle action potentials, delayed latency, low amplitude, conduction velocity slowing, conduction block or abnormal F-waves. Similar results have been quoted by Clouston et al[20]. However all our cases were done after 7 days and showed propensity to reduced amplitude of Peroneal nerves.

Reduced SNAP amplitudes can be the result of secondary axonal degeneration and conduction block [22]. The findings were more evident was maximal in the terminal segment in the upper and lower limbs, more so in the lower limb. These findings were consistent with those of Brown [21]. He proposed attribution of relative deficiency of the blood nerve barrier. However findings in sensory nerves were not significant in our study.

The result of this study indicated that there was more involvement of both lower limbs, and there was changes in the CMAP, SNAP amplitude, Motor and Sensory Nerve Conduction Velocity of the common peroneal nerve. Findings are influenced by Study conducted by Sunil et al[23]. on motor nerve conduction of common peroneal nerve in young adult obtaining the normal value of distal latency, amplitude and motor nerve conduction velocity of common peroneal nerve.

The study conducted by Arthur K. Asbury[10] reported in the literature saw motor fibers clinically involved more than sensory fibers. In one study, 90% of GBS patients had motor involvement, this is common in the first two weeks of illness and this figure rises to 96% by the third week of illness. Though we could not follow up with patients, as it was a cross sectional study, we could not avail serial NCS .

The results of present study are supported by a study conducted by Taly AB et al[24] , showing reduced amplitude of right and left peroneal nerves were significantly reduced when compared to their mean standardized laboratories values.

Conclusion

Findings of this study showed that NCS is diagnostic for GBS but the features may only be evident as Peroneal Motor Neuropathy.In our study our hypothesis was accepted as it was statistically significant. Reduced amplitude in Peroneal motor study in Nerve Conduction Study may be used as a diagnostic tool in clinically suspected Guillain Barre Syndrome. Further evaluation should ensue in randomized control trials.

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Conflict of Interest: The authors declare no conflict of interest in this study.

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