INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com Volume-4, Issue-3, July-Sept-2013 Coden : IJABPT Copyrights@2013

ISSN : 0976-4550

Received: 12th June-2013 *Revised: 18th June-2013* *Accepted: 20th June-2013*

Research article

ELECTROPHYSIOLOGICAL CHANGES IN ACUTE GUILLAIN-BARRE SYNDROME

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ABSTRACT: Aim: To study the various electrophysiological changes in the motor conduction, sensory conduction and F wave latencies of acute Guillain-Barre Syndrome patients. **Methods:** Sixteen patients with acute GBS were included in this study. They were subjected to various nerve conduction studies (NCS) following standardized procedures. The mean values obtained for the various nerve conduction parameters were compared against the corresponding standardized values using Student's t-test. P value less that 0.05 was considered significant. **Results:** The results of NCS in GBS patients were as follows: 1.The motor nerve conduction velocity was significantly lower and the motor nerve conduction latency was significantly prolonged. 2. The sensory nerve action potential conduction velocity and amplitude remained normal in most of these individuals. 3. F wave latency was significantly prolonged. **Conclusion:** Acute Guillain-Barre Syndrome patients manifest with abnormal motor nerve conduction parameters and F wave latency. Electrophysiological studies would help the researchers to diagnose the disease at an early stage.

Key Words: Guillian-Barre syndrome, Motor nerve conduction, Sensory nerve conduction, F wave.

INTRODUCTION

Guillain-Barre Syndrome (GBS), an auto-immune disorder, also known as Landry's paralysis is one of the most common cause of acute non-trauma related paralysis. It is named after the French physicians Georges Guillian and Jean Alexandre Barre who described it in 1916. The syndrome affects children and adults of all ages and both sexes (Giovannoni G et al., 1996). GBS is a non-seasonal and non-epidemic disorder with a worldwide annual incidence rate of about 0.4 to 1.7 cases per 100,000 people (Maurice Victor et al., 2001). In about 60 percent of the cases, respiratory or gastrointestinal infections are known to precede the symptoms by 1 to 3 weeks. Among the various etiologies, Campylobacter jejuni has been found to be the most frequent causative organism causing the syndrome (Jacobs BC et al., 1996; Angelika F Hahn 1998; Richard AC Hughes et al., 2005). The other less common etiologies include prior surgical procedures (Walling AD et al., 2013), exposure to thrombolytic agents, Lyme disease and infections with various organisms such as Mycoplasma pneumonia, Epstein Bar Virus, Cytomegalovirus and Human immunodeficiency virus (Winer JB, 2001). The main feature of GBS involves segmental demyelination mainly involving the proximal roots close to the dorsal root ganglia. However, it also involves the distal portions of the motor and sensory fibers in addition to the autonomic nervous system. Depending upon the site of damage and type of nerve fiber involved, the clinical course and clinical expression of GBS varies from individual to individual. Patients suffering from GBS complain of symmetrical weakness affecting the lower limbs which then progresses towards the upper limbs. Sensory abnormalities such as numbness or tingling sensation affect the distal regions of lower limbs and upper limbs. In severe cases, signs of autonomic dysfunction such as hypotension or hypertension and cardiac arrhythmias are also seen. Involvement of lower cranial nerves may lead to bulbar weakness, oropharyngeal dysphagia and respiratory difficulties.

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Among the various diagnostic tools, Nerve conduction studies (Daniel Dumitru M.D et al., 2001) are a Gold Standard technique which aid in the early diagnosis of GBS. While a limited electrodiagnostic examination may reveal a normal report in the early stage of the disease, a detailed study involving measurement of late responses (F waves and H reflexes) would help to identify the disease as early as possible. Hence, this study was carried out on GBS patients to observe the various changes in their motor conduction, sensory conduction and in F wave study.

MATERIALS AND METHODS

The study was conducted at a Tertiary Care Hospital at Chennai after the approval by the Institutional Ethical Committee. Sixteen patients were diagnosed to be suffering from Acute Guillain-Barre syndrome based on Albers classification of GBS (Albers JW et al., 1985). Patients were enrolled in the study after getting a written informed consent. However, patients with electrolyte abnormalities such as hypokalemia and immunodeficiency disorders were excluded from the study. Patients underwent thorough clinical examination including history of preceding illness and their disability was graded according to a scale from 0-10 scale as follows (Hahn AF et al., 1996).

Grade 0 = normal
Grade 1 = no disability, minor sensory signs or areflexia
Grade 2 = mild disability; ambulatory for >200 meters; mild weakness in one or more limbs and sensory impairment
Grade 3 = moderate disability; ambulatory for >50 meters without stick; moderate weakness Medical Research Council (MRC) grade 4 and sensory impairment

Grade 4 = severe disability; able to walk >10 meters with support of stick; motor weakness MRC grade 4 and sensory impairment

Grade 5 = requires support to walk 5 meters, marked motor and sensory signs
Grade 6 = cannot walk 5 meters, able to stand unsupported and able to transfer to wheelchair, able to feed independently
Grade 7 = bed ridden, severe quadriparesis; maximum strength MRC grade 3
Grade 8 = respirator and / or severe quadriparesis; maximum strength MRC grade 2
Grade 9 = on respirator and with quadriplegia
Grade 10 = dead

NERVE CONDUCTION STUDIES (NCS)

The nerve conduction studies were performed using NIHON KOHDEN NEUROPACK M1 NCS, EP & EMG machine, Nihon Kohden Corporation, Higashi Nakano, Nakano-ku, TKY, Japan**.** All the tests were performed at the Neurophysiology laboratory in an ambient atmosphere. Surface disc electrodes were used to obtain the compound muscle action potentials (CMAP) and sensory nerve action potentials (SNAP). The parameters which were considered for analysis under motor NCS were distal latency, conduction velocity and minimal F wave latency. Similarly, for sensory nerve conduction study, conduction velocity and amplitude of sensory nerve action potentials were assessed.

Statistical Analysis: The data was found to be normally distributed and the mean values obtained for the various parameters were compared against the corresponding standardized values using Student's t-test. P value less than 0.05 was considered significant.

PROCEDURE

Test for Motor Nerve Conduction

The motor conduction of both the upper limbs was tested by electrical stimulation of the median and ulnar nerves following standardized protocol (Jay A. Liveson et al., 1992). Similarly, the motor conduction of both the lower limbs was tested by electrical stimulation of the tibial and peroneal nerves. Distal latency, conduction velocity and minimal F wave latency were assessed for each of the recordings.

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Test for Sensory Nerve Conduction

The sensory nerve conduction studies were done following standardized protocol (Jay A. Liveson et al., 1992). For the upper limbs, the sensory conduction was tested by electrical stimulation of the median and ulnar nerves and for the lower limbs, sensory conduction was tested for sural and superficial peroneal nerves. Conduction velocity and sensory nerve action potential (SNAP) amplitudes were assessed for each of the recordings. The reference values (Table 1, 2) were standardized for the Neurophysiology laboratory by performing the nerve conduction studies on normal subjects at an ambient temperature of 25°C.

Standardized Laboratory Reference Values for Various Nerve Conduction Studies

Table 1: Motor Nerve Conduction Study

Nerves	Distal Latency (ms)	Conduction Velocity (m/s)	F Wave Latency (ms)
Median	2-3.8	40-65	20-33
Ulnar	1.8-3.8	40-65	20-33
Peroneal	2-4	42-60	30-53
Tibial	2-4.5	40-60	30-53

ms - milliseconds, m/s- meters/sec

Table2: Sensory Nerve Conduction Study

Nerves	Amplitude (µV)	Conduction Velocity (m/s)
Median	>20	40-60
Ulnar	>20	40-60
Superficial Peroneal	>5	40-60
Sural	>5	40-60

µV- microvolt, m/s- meters/sec

Sympathetic Skin Response (SSR)

Sympathetic skin response was recorded following standardized procedure (Michael J. Aminoff, 2005). The recordings were obtained simultaneously from hand and foot by placing the active electrode on the palm or sole and the reference electrode over the dorsum of the hand or foot. Results were expressed as SSR being present or absent.

RESULT

The present study was undertaken to evaluate the electrophysiological changes in acute GBS patients. Sixteen patients, 10 males, 6 females with a mean age of 46.37±15.14 years, suffering from acute GBS were taken for the study.

Motor Nerve Conduction Study

The motor conduction of Median, Ulnar, Peroneal and Tibial nerves was studied in these patients. Motor conduction response was absent in 4 out of 16 patients on stimulation of the right median nerve and in 5 out of 16 patients on stimulation of the left median nerve. Similarly, the response was absent in 1 out of 16 patients and in 3 out of 16 patients on stimulation of the right and left ulnar nerves respectively. In the lower limb, the motor conduction response was absent in 5 out of 16 patients on stimulation of the right and left peroneal nerves. The response was also absent in 3 and 2 out of 16 patients on stimulation of the right and left tibial nerves (Table 3). The mean latency (ms) and mean conduction velocity (m/s) obtained from the patient group was compared against the corresponding mean of the standardized laboratory value. Comparison of the mean latencies, revealed a significantly prolonged latency for the right and left median, ulnar, peroneal and tibial nerves in these patients (Table 3). The mean conduction velocities of the right ulnar and right and left peroneal and tibial nerves were significantly lower on comparison with the mean of the standardized laboratory value (Table 4).

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Table 3: Result of Motor nerve conduction latency

Nerves	Sample Size (n)		Standardized mean latency of the normal population (ms) Mean ± SD	Sample mean latency (ms) Mean ± SD		t value	
	Right	Left		Right	Left	Right	Left
Median	12	11	2.90±0.45	5.91±2.65	5.45±2.68	3.76*	3.00*
Ulnar	15	13	2.80±0.50	4.01±1.28	4.04±1.25	3.54*	3.44*
Peroneal	11	11	3.00±0.50	6.9±2.22	6.29±1.55	5.57*	6.71*
Tibial	13	14	3.25±0.62	7.26±2.19	6.95±2.15	6.37*	6.17*

*Statistically significant ($p<0.05$)

Table4: Result of motor nerve conduction velocity

Nerves	Sample Size (n)		Standardized mean conduction velocity of the normal population (m/s) Mean ± SD	Sample mean conduction velocity (m/s) Mean ± SD		t value	
	Right	Left		Right	Left	Right	Left
Median	12	11	52.50±6.25	48.93±8.51	46.98±11.52	1.39	1.51
Ulnar	15	13	52.50±6.25	45.71±10.74	46.33±10.84	2.37*	1.97
Peroneal	11	11	51.00±4.50	40.13±6.26	40.99±7.00	5.49*	4.50*
Tibial	13	14	50.00±5.00	41.71±6.43	41.28±5.72	4.46*	5.52*

*Statistically significant ($p<0.05$)

F Wave Study

F wave in GBS patients was recorded to assess the proximal involvement of the neurons. The response was absent for 8 patients on the right median nerve and for 11 patients in the left median nerve. Similarly, F wave was absent for 9 and 10 patients respectively on stimulation of the right and left ulnar nerves. In the lower limbs, F waves was absent in 11 out of the 16 patients on stimulation of right and left peroneal nerves. On stimulation of tibial nerve, F wave was absent for 9 patients on the right side and for 7 patients on the left side.

In the remaining number of patients, the mean F wave latency obtained with stimulation of right and left median, ulnar, peroneal and tibial nerves were significantly prolonged in comparison with their corresponding mean of standardized laboratory value (Table 5).

Table 5: Result of F wave study

Nerves	Sample Size (n)		Standardized mean latency of the normal population (ms) Mean ± SD	Sample mean Latency (ms) Mean ± SD		t value	
	Right	Left		Right	Left	Right	Left
Median	8	5	26.50±3.25	35.13±6.39	35.12±4.19	3.56*	4.12*
Ulnar	7	6	26.50±3.25	36.18±5.60	33.94±4.15	4.23*	4.02*
Peroneal	5	5	41.50±5.75	61.43±6.52	63.15±6.02	6.11*	7.19*
Tibial	7	9	41.50±5.75	59.09±7.88	59.72±7.85	5.46*	6.58*

*Statistically significant ($p<0.05$)

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Sensory Nerve Conduction Study

On testing for conduction velocity and amplitude of sensory nerve action potential (SNAP) in the 16 GBS patients, the response was totally absent in 12.50% of individuals for both the upper and lower limb nerves. In the remaining patients, except for the right median nerve, the mean conduction velocities of all other nerves were within their normal range when compared to their mean standardized laboratory values (Table 6). The sensory nerve action potential amplitudes obtained on stimulating median and ulnar nerves was normal in 60.94% and decreased in 26.56% of the individuals. In the case of superficial peroneal and sural nerves, the SNAP amplitudes were normal in 84.37% and decreased in 3.12% of the individuals.

Table 6: Result of sensory nerve conduction velocity

Nerves	Sample Size (n)		Standardized mean conduction velocity of the normal population (m/s) Mean ± SD	Sample mean conduction velocity (m/s) Mean ± SD		t value	
	Right	Left		Right	Left	Right	Left
Median	14	14	50.00±5	55.31±8.53	54.80±8.18	2.25*	2.10
Ulnar	14	14	50.00±5	56.46±15.11	55.03±17.81	1.54	1.02
Peroneal	14	14	50.00±5	52.86±6.46	52.78±7.66	1.59	1.31
Tibial	14	14	50.00±5	51.57±7.00	52.34±7.09	0.81	1.19

*Statistically significant ($p<0.05$)

Sympathetic Skin Response:

The autonomic status of the GBS patients was assessed by performing the Sympathetic Skin Response. In 7 out of the 16 patients, SSR was present in both the upper and lower limbs. It was totally absent in 6 patients in the upper and lower limbs whereas in 3 patients, SSR was present in the upper limb while absent in the lower limb. Sinus bradycardia, also a feature of autonomic involvement was observed in 4 patients.

DISCUSSION

The present study was undertaken to evaluate the electrophysiological changes in Guillian-Barre syndrome patients. The standardized values for the different nerve conduction parameters were established at the departmental electrophysiology laboratory following standardized protocols. In this study, the disease was found to be more common among the males (n=10) when compared to that of females (n=6) which coincides with the observations of previous studies (Kornberg AJ et al., 1994; Jacobs BC et al., 1996; J B Winer, 2001; Kundu NC, 2006). The age distribution curve showed that 43.75% of patients were less than 50 years and 56.25% of patients were more the 50 years of age. Sympathetic skin response, a measure of sudomotor activity was absent in 37.5% of patients and these results are in line with that of previous study by Taly AB et al., 1995. The motor nerve conduction study showed a significantly prolonged latency for both the upper and lower limb nerves. Similarly, the conduction velocities of right ulnar, right and left peroneal and tibial nerves were significantly reduced when compared to their mean standardized laboratories values. Hence, in GBS patients, the motor conduction velocities and latencies are affected to a greater extent as shown by previous studies (J Kalita et al., 2008; Alberti MA et al., 2001; Oh SJ et al., 2001). The results of our F wave study were similar to those by Arthur K. Asbury et al., 1990; Hiraga et al., 2005; and UK Misra et al., 2006; J Kalita et al., 2008 who have also proved that F wave latency is prolonged in patients with GBS. This denotes the involvement of proximal roots of the neurons in these patients. The sensory nerve action potential amplitude obtained on stimulating median and ulnar nerves was normal in 60.94%, absent in 12.50% and decreased in 26.56% of individuals. Similarly, the sensory nerve action potential amplitude of the superficial peroneal and sural nerves was normal in 84.37%, decreased in 3.12% and absent in 12.50% of the individuals. This finding also coincides with previous study by Oh SJ et al., 2001. The mean conduction velocities of sensory nerve action potential of median, ulnar, superficial peroneal and sural nerves were within the normal range of the mean standardized laboratory value.

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CONCLUSION

The results of our study have shown that Acute Guillain-Barre Syndrome manifests with abnormal motor nerve conduction and prolonged F wave latency. However, features of sensory and autonomic nervous system involvement were seen only in few individuals. Thus, electrophysiological studies would aid the researchers to diagnose and manage the disease at an early stage.

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