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Validity of Neurophysiological Study Inprediction of Severity of Guillain-Barre Syndrome and the Indication for Mechanical Ventilation

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Abstract
Background: *Guillain-Barre syndrome is clinically characterized by an acute monophasic, non-febrile post-infectious illness manifesting as ascending weakness, and areflexia. However, sensory, autonomicand brainstem abnormalities may also seen. It is one of the most common causes of acute motor paralysis. In addition to the clinical presentation, those patients may develop neurophysiological features suggestiveof demyelinating neuropathy. However, an axonal form had been reported.*
Objectives: *evaluate the neurophysiological study in prediction the severity of GBS, and find out whether the neurophysiological study of peripheral nerves can predict the indications formechanical ventilation.****Subjects and methods:*** *Two groups of patients of either sex were involved in the study. (22) Patients with GBS in the neuromedical wards and 18 patients in the respiratory care units (RCU). Each patient submitted to sensory and motor nerve conduction study (NCS) and electromyography (EMG) for both upper and lower limbs.****Results:****the results of this study revealed that prolongation of motor and F wave latencies and the reduction in compound motor action potential and conductive velocities are increase the risk of admission to the RCU in patient with GBS.*
Conclusion: *This study concluded that the neurophysiological study can predict the severity of Guillain-Barre syndrome mainly the prolongation of F wave and motor latencies. The peripheral neurophysiological findings are useful in prediction of respiratory muscles involvement by GBS depending on CMAP and conductive velocity.*
Keyword*: GBS: Guillain Barre syndrome. CMAP: compound motor action potential NCS: nerve conducting study. EMG: electromyogramSNCS: sensory nerve conduction study. DSL: distal sensory latencySNAP: sensory nerve action potential. MNCS: motor nerve conduction studyDML: distal motor latencyMNCV: motor nerve conductive velocityRCU: respiratory care unitROC: receiver operating characteristic curve*

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I. Introduction

GBS is an immune mediated, rapidly progressive, predominately motor polyneuropathy that often leads to bulbar and respiratory compromise. It is one of the most common of all neuromuscular emergencies. Although the overall prognosis is favorable in more than 80% of patients, the hospital course is frequently long, followed by prolonged recuperation. (1)GBScharacterized by flaccid areflexic paralysis and albumin-cytologic dissociation (2). Misdiagnosis is common and can be fatal because of the high frequency of respiratory failure, which contributes to the 10% mortality seen in prospective studies (3). Our understanding of the wide spectrum of the disease and its pathogenesis has increased enormously in recent years.

The incidence of GBS is 0.5-2 per 100000 and it affects the men slightly more than women (4, 5). It occurs during all season. The risk of developing GBS over the lifetime of an individual has been estimated to be less than 1 in 1000.(4).Approximately 50% of patients achieve maximum weakness by two weeks, 80% by 3 weeks and 90% by 4 weeks (6).GBS is an acute or sub-acute onset polyradiculoneuropathy that often follows an upper or lower respiratory illness or gastroenteritis by 10 to 14 days. Approximately 70% of patients can identify a preceding illness, although it is often benign and may be minimized or forgotten by the patient (4).Many patients progress to tracheos to my until the acute phase of the illness resolves. Autonomic involvement is common in GBS, with the most common manifestations being tachycardia, bradycardia, hypertension and hypotension, gastrichypomotility, and urinaryretention. Autonomic involvement may be the cause of death in some patients with GBS(4)

II. Subjects and methods

This study comprised forty patients of either gender (18 males and 22 females) with mean of age (47.15). The study involves two groups of patients, those with GBS in the neuromedical wards (22 patients) and those in the RCU under mechanical ventilation (18 patients). Electrophysiological study of both upper and lower limbs were performed in the second weeks after disease onset which consist of; sensory nerve conduction study (SNCS) for median, ulnar and sural nerves. Distal sensory latency (DSL) and sensory nerve action potential (SNAP) were performed for each nerve. Furthermore, motor nerve conduction study (MNCS) for median, ulnar, tibial and peroneal (fibular) were performed, which includes; distal motor latency (DML), compound motor action potential (CMAP), motor nerve conduction velocity (MNCV) and mean F wave latency. Needle EMG was performed for distal and proximal muscles involving: 1st dorsal interosseous muscleand Deltoid for the upper limb and Tibialis Anterior and Vastus Lateralis for the lower limb. Insertional activity, spontaneous activity, motor units action potential (duration, amplitude and polyphasia) were evaluated and considered for each muscle.

Statistical analysis:

Independent t-test (two tailed) was used to compare the continuous variables among study groups accordingly. ROC curve which represents sensitivity, specificity and cutoff point of different neurophysiological tests to differentiate between study groups was done. A level of P – value less than 0.05 was considered significant.

III. Results

A total of 40 patients were admitted to the hospital diagnosed as GBS during the study period. The studied patient's age was ranging from 18 to 88years with a mean of (47.15) years and standard deviation (SD) of ± 24.81 years.Patients were 54.5% (n=22) female and 45.5% (n=18) male. Figure (1) shows the distribution of studied patients by sex. The most frequent age groups affected were (less than 30) years (35.2%) and (above 50) years (39.8%), while the group between (30-50) years was (25%). Figure (2) shows the distribution of studied patients by age.

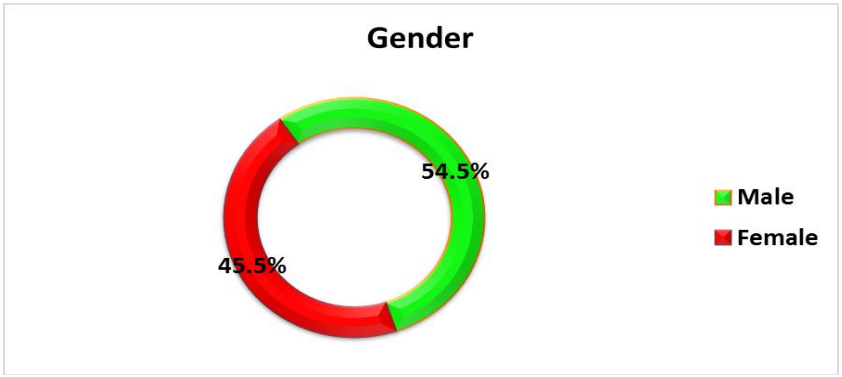

Figure (1); the distribution of studied patients by sex

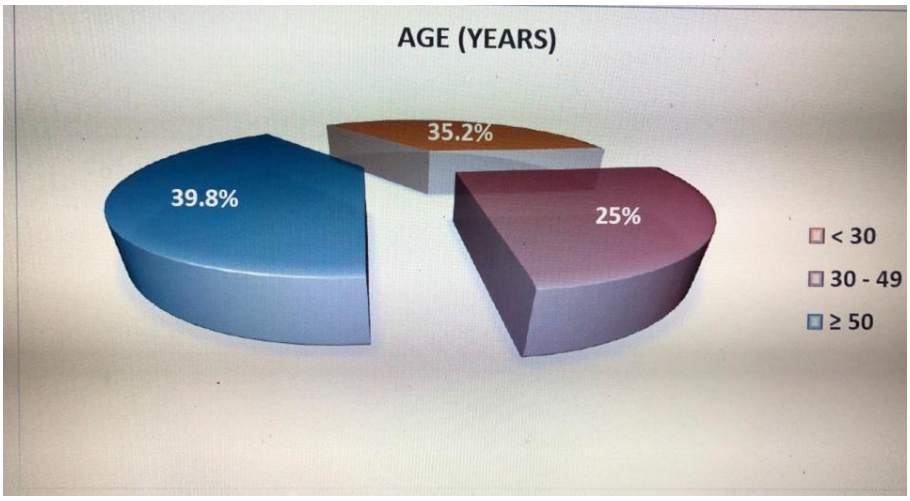

Figure (2) the distribution of studied patients by age

The comparison of neurophysiological parameters of left median nerves between study groups is shown in table (1). In this study, the means of motor and F-Wave latencies in respiratory care units (RCU) patients were significantly higher than that in Ward group (9.19 versus 6.52, P= 0.002; 57.57 versus 49.87, P= 0.033 respectively).

Means of sensory nerve action potential (SNAP), compound motor action potential (CMAP) and conductive velocity (CV) were significantly lower among patients of RCU than those patients in the wards (13.69 versus 7.23, P= 0.012; 2.74 versus 1.77; P= 0.026; and 38.66 versus 24.75, P= 0.002 respectively).

Whereas, there was no statistical significant difference ($P \geq 0.05$) between RCU and ward patients regarding sensory latency.

ROC curve and determination of cut point of SNAP, motor latency, compound motor action potential (CMAP), F-Wave and conductive velocity values for left median nerve was done as shown in table (2) as the following:

- Motor latency value was (4.8), and F Wave value was (65), so any value more than these values is considered as warning sign and indicator for RCU admission.
- SNAP value was (17.0), CMAP value was (3.4), and conductive velocity value was (25.6), so any value less than these values is considered a warning sign for RCU admission.

Table 1: Comparison between neurophysiological parameters studied on left median nerve

Neurological Test of Left Median Nerve	Study Group		P – Value
	RCU Mean ± SD	Ward Mean ± SD	
Sensory latency (msec)	4.29 ± 0.98	3.93 ± 1.01	**0.128**
SNAP(UV)	7.23 ± 10.86	13.69 ± 16.52	**0.012**
Motor latency(msec)	9.19 ± 4.19	6.52 ± 3.3	**0.002**
CMAP (mV)	1.77 ± 1.04	2.74 ± 2.27	**0.026**
F-Wave(msec)	57.57 ± 13.08	49.87 ± 15.2	**0.033**
Conductive velocity(m\sec)	24.75 ± 10.7	38.66 ± 16.16	**0.002**

Table 2: Cutoff points of neurophysiological parameters on left median nerve

Neurological Test of Left Median Nerve	Cut of point
SNAP(UV)	17.0
Motor latency(msec)	4.8
CMAP(mV)	3.4
F-Wave(msec)	65.0
Conductive velocity(m\sec)	25.6

The comparison of neurophysiological parameters between studies on right common peroneal nerve is shown in table (3).Means of motor and F-Wave latencies in RCU group were significantly higher than that in ward group (17.31 versus 10.84, P=0.001 and 113.57 versus 96.95, P=0.017 respectively).

Means of CMAP and conductive velocity were significantly lower among patients of RCU group than those in the ward group (1.24 versus 0.55, P=0.008 and 29.06 versus 24.76; P=0.015 respectively).

ROC curve and determination of cutoff point of motor latency, CMAP, F-Wave latency and conductive velocity values for right common peroneal nerve was done as the following: (As shown in table 4).

Motor latency value was 7, and F-Wave value was 80, so higher values were considered as warning sign for RCU admission.

CMAP value was 1.22, and conductive velocity value was 31.6, so lower values were considered as warning sign for RCU admission.

Table (3): Comparison between study groups neurophysiological parameters studied on right common peroneal nerve

Neurological Test of Right Common Peroneal Nerve	Study Group		P- Value
	RCU Mean ± Std. Dev	Ward Mean ± Std. Dev	
Motor Latency(msec)	17.31 ± 3.52	10.84 ± 6.85	**0.001**
CMAP(mV)	0.55 ± 0.54	1.24 ± 1.37	**0.008**
F-Wave(msec)	113.57 ± 14.67	96.95 ± 31.33	**0.017**
Conductive Velocity(m\sec)	24.76 ± 6.63	29.06 ± 8.0	**0.015**

Table (4): Cutoff points of neurophysiological parameters studied on right common peroneal nerve

Neurological Test of Right Common Peroneal Nerve	Cut of point
Motor latency	7.0
CMAP(mV)	1.22
F-Wave(msec)	80.0
Conductive velocity(m\sec)	31.6

IV. Discussion

In this study, females were predominant and the ratio of the females over males was (1.22:1). This was inconsistent with most of studies like (Gonzalo, et al., 2008) (11) that showed male predominance and inconsistence with Ted 2008 (12) who showed equal numbers of female and male

This study is consistent with Anis et al. (13) .who had found female predominance over male. This could be due small sample size, female is more than male in our society or due to immunobiological differences between male and female.

Regarding the age distribution of this study, 35% of patients were below 30 years old and 40% were above 50 years old. 25% were between ages of 30 to 50 years.

The majority of patient of GBS in this study were <30yrs and >50years (75%) and this is consistent with D.Rebecca and Roland, 1997 (14)

Also in this study, 18 patients were conducted from RCU department, 8 patients were below 30 years old, 7 patient were above 50 years old and only 3 patient were between 30 and 50 years

This is could be explained by immature immune system in early adulthood and deteriorations of immune system in elderly as Rebecca and Roland reported (14).

The significant differences of F wave latencies between two studies groups in (left median and right peroneal nerves), this render F-wave considered as a predictor for the severity of GBS and this is consistent with Fisher (15) who reported that F wave studies are most sensitive in detecting GBS, in which may be prolonged or absent.

The neurophysiological findings of motor responses (CMAP) show significant differences between two studied groups in(left median and right peroneal nerves).this is give CMAP importance in prediction of severity of GBS and the need of admission to the RCU. This is corresponding toCornbalth et al 1988 (15) who found that CMAP less than 20% of normal are associated with poor prognosis of GBS. Furthermore, Miller et al (15)found that poor prognosis of GBS are related to CMAP amplitudes less than 10% of the normal. In addition, Feasy et al (16) studied median, ulnar and peroneal nerves of 25 patients prospectively and concluded that CMAP amplitude of 10% of control mean of at least one nerve had a poorer outcome. The explanation of relationship between CMAP and severity of GBS is that the reduction in CMAP could be secondary to severe demyelination or due to axonopathy and both are associated with rapid onset and progression of the disease.

Regarding conductive velocities, the majority of patients with GBS involved in the study, the reduction in conductive velocity (CV) are proportional in proximal and distal portions of the nerve. This suggests that the disease is a diffuse process.

Moreover, patients with reduced CV or conduction block in at least one nerve were at risk of admission to the RCU and this is similarto Tang X.F 2003(17) who found that conductions block or reduction in conduction velocity are helpful in classifying the severity of the illness and the need of mechanical ventilation. These findings could indicate that the demyelination is more in proximal segment. Although proximal segments are longer than the distal segments and would be more likely to show reduction in overall conduction velocity as a result of a random process of demyelination and this is extremely like David and Peter, 1976 (18) who showed that reduction in CV is proportional in distal and proximal portion of the nerves.

Other else, by studying sensory abnormalities which including either prolonged latencies, reduced or absent sensory responses or both. Sensory neurophysiological studies show significant differences between the two studied groups in left median. This is explained by abnormal sensory study could be due to secondary axonal degeneration and conductions block. As published by Amato, 2002 (19) who said that reduced SNAP are a result of conductions block and axonal involvement. And this explains how sensory involvement of upper limbs can predict the severity and prognosis of GBS. Upper limb sensory involvement in GBS particularly median nerve is more severe and affected more early than almost normal sural in GBS. This is explained by preferential, early involvement of the smaller myelinated fibers (median) in GBS while the sural sensory fibers are larger and have more myelin than median and ulnar sensory fibers. This large diameter of myelin makes sural nerve more resistant to early inflammatory and demyelinating processes (20).

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