ORIGINAL ARTICLE

Correlation between Electrodiagnostic Findings and Cerebrospinal Fluid Changes in Children with Guillain-Barre syndrome

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ABSTRACT

Objectives

Guillain-Barré syndrome (GBS) involves the peripheral nervous system developed by infections or immune conditions. Cerebrospinal fluid (CSF) analysis and electrodiagnostic tests are essential diagnostic methods for GBS. However, limited data are available on how the findings from these methods relate to each other. This study aimed to evaluate changes in CSF analysis and electrodiagnostic tests in pediatrics with GBS.

Materials & Methods

The present study retrospectively evaluated electrodiagnostic tests and CSF changes in pediatrics with GBS who were admitted to Tabriz Hospital, Iran, from 2010 to 2020 due to CBS. Patients' data, including age, gender, CSF analysis, and electrodiagnostic test results, were recorded from the patients' files. Electrodiagnostic data included pace and amplitude of tibial, median, peroneal, sural, ulnar nerves, nerve conduction velocity (NCV), F-wave, and motor unit action potential (MUAP). The significance level was considered less than 0.05.

Results

The mean age of patients was 4.83±2.72 years, and 54.6% were boys. The most common type of GBS involvement was demyelinating type. No gender differences were found between involved nerves unless the ulnar nerve was significantly more involved in girls (P-value: 0.012). The obtained findings indicated no significant relationship between electrodiagnostic tests and CSF protein (P-value: 0.439).

Conclusion

No association was observed between electrodiagnostic results and CSF changes in pediatrics with GBS.

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Introduction

Guillain-Barré syndrome (GBS) is the most prevalent cause of acute flaccid paralysis and involves peripheral nerve system inflammatory disease. The incidence rate of GBS is about 1–2 cases in 100,000 people. The treatment expense of GBS is about 1.7 billion dollars yearly (1, 2). This disease is more common in men, but it involves any age (3).

Typical manifestations of GBS are ascending weakness starting from the legs and progressing to the arms, head, andneck muscles. GBS is diagnosed based on history, clinical or neurological examination, and electrophysiological and cerebrospinal fluid (CSF) evaluations (4-8). Notably, GBS manifestations are different in children. Refuse of walking, non-specific pain localization, and an abnormal gait are common clinical manifestations in pediatrics, and they increase the rate of delayed diagnosis (9-11). Respiratory failure, need for intubation, blood pressure instability, and cardiac arrhythmias are the main complications of GBS, and they can increase the mortality rate due to GBS, so early diagnosis is vital (12-14).

Although the diagnosis of GBS is based on clinical examination, electrodiagnostic study, and CSF analysis (including proteins in CSF), it is challenging, specifically in pediatrics in regions with poor diagnostic tools, such as low-income countries. Because pediatrics are presented with atypical manifestations, and electrodiagnostic parameters and CSF protein levels in GBS need more studies (15, 16). The current study aimed to evaluate changes in CSF proteins and electrodiagnostic tests in pediatrics with GBS involvement.

Materials & Methods

This retrospective cross-sectional study was performed on pediatrics admitted to Tabriz Hospital, Iran, from 2010 to 2020 due to GBS. In this study, the medical records of all these children were extracted from the hospital archives, and the required information was recorded in separate checklists. Cases with incomplete data were not included in the study.

The inclusion criteria were age below 18 years and a confirmed diagnosis of GBS by a pediatric neurologist. The exclusion criteria were age more than 18 years, incomplete medical records, and the occurrence of any underlying neurological and infectious disorders.

Patients' data, including age, gender, CSF analysis, and electrodiagnostic test results, were recorded from the patients' files. CSF samples were taken from all patients in the second week of the disease and sent to the hospital laboratory to analyze sugar, protein, pleocytosis, and culture. The electrodiagnostic tests were done on the first or second day of GBS involvement (5).

Electrodiagnostic data included the pace and amplitude of tibial, median, peroneal, sural, ulnar nerves, nerve conduction velocity (NCV), F-wave, and motor unit action potential (MUAP). All data were recorded in a researcher-made checklist.

Statistical analysis

All data were recorded and analyzed in SPSSv26 software. Mean, standard deviation (SD), range, frequency, and percentage were used to describe the data. The mean values were compared using the T-test, and proportions were compared using the Chi-square test. The odds ratio was calculated using logistic regression. The significance level was considered less than 0.05.

Ethical consideration

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences("ethical code").

Results

One hundred and eight patients were enrolled in the current study. The mean age was 4.83±2.72 years. Seventy patients (64.8%) were one to five yearsold, 33 patients (30.6%) were 5 to 10 yearsold, 4 patients (3.7%) had more than ten yearsold, and only one patient (0.9%) was in the under-one-yearold group. Fifty-nine patients (54.6%) were boys, and 49 (45.4%) were girls.

Results of CSF analysis

The data from the CSF analysis were assessed in patients' files. In the second week, the mean protein levels in patients were 63.2±50.3 milligrams/deciliter (mg/dl) with a maximum level of 290 mg/dl and a minimum level of 8 mg/dl. Fifty patients (46.3%) had more than 40 mg/dl of protein in the CSF. About glucose, it was found that the mean glucose level was 62.3±15.4 mg/dl with a maximum level of 130 mg/dl and a minimum level of 40 mg/dl.

During the second week, 21 CSF analyses were performed, revealing the presence of blood cells. However, tests for VDRL, RF, lactate dehydrogenase, electrolytes, and culture were not requested for any specimens during this time.

Results of electrodiagnostic tests

This research assessed the electrodiagnostic tests conducted on the studied patients. The findings regarding nerve amplitude, both overall and

Table 1. The results of electerodiagnostic tests based on nerves

Nerve amplitude	Total (mean±SD) (mV)	boy (mean±SD) (mV)	Girl (mean±SD) (mV)	Gender difference (P-value*)	Patients with more than 80% depression in amplitude or undetected (percent)	Boys with more than 80% depression in amplitude or undetected (percent)	Girls with more than 80% depression in amplitude or undetected (percent)	Gender difference (P-value**)
Deep peroneal (motor)	0.78±0.59	0.91±0.73	0.55±0.42	0.063	93 (86.1%)	49 (83.1%)	44 (89.8%)	0.313
Tibial (motor)	2.48±2.38	2.54±2.18	2.63±2.42	0.808	71 (65.7%)	36 (61%)	35 (71.4%)	0.256
Ulnar (motor)	2.36±2.22	2.66±0.42	1.73±0.31	0.036	75 (62.4%)	35 (59.3%)	40 (71.6%)	0.012
Median (motor)	2.69±2.30	2.55±0.4	1.92±0.35	0.310	76 (70.4%)	39 (66.1%)	37 (75.5%)	0.286
Median (sensory)	21.88±17.80	18.89±2.48	18.87±2.72	0.705	31 (28.7%)	15 (25.4%)	16 (32.7%)	0.408
Sural (sensory)	13.20±10.60	11.38±1.48	9.38±1.38	0.641	25 (23.1%)	14 (23.7%)	11 (22.4%)	0.875

* based on T-test

** based on Chi-square test

categorized by gender across various nerves, are presented in Table 1. The motor amplitude of the ulnar nerve exhibited a significant difference between male and female patients (P-value: 0.036), while the amplitudes and depressions of other nerves showed no significant differences between the genders (P-values>0.05). Distal latency, nerve conduction velocity (NCV), and F-wave were evaluated in patients. The related data are described in Table 2.

Electromyography (EMG) evaluations were performed for the patients and results of MUAPs, positive sharp waves (PSW), and fibrillation waves based on the assessed nerves are illustrated in Table 3. Spontaneous activity (presence of fibrillation waves and PSW) were found in 18 patients (16.7%). Absence of MUAP in both muscles was found in 16 patients (14.8%).

The patients were divided into four groups based on electrodiagnostic findings, including normal, demyelinating, axonal, and mixed groups. The most prevalent type of GBS involvement was demyelinating, which was observed in 51 patients (47.2%), followed by axonal in 43 patients (39.8%), mixed in nine patients (8.3%), and normal findings in five patients (4.6%), respectively. No significant differences was found between all groups regarding gender (P-value: 0.190).

The present study assessed the relationship between

Table 2. Description of data of distal latency, NCV, and F-wave based on assessed nerve

Nerve amplitude	Distal latency (mean±SD)(millisecond)	NCV (meter/second)	Normal F-wave (percent of patient)	Unmeasurable F-wave (percent of patient)	Absent F-wave (percent of patient)
Deep peroneal	5.45±4.75	27.39±20.71	17.4%	57.4%	12.5%
Tibial	6.20±5.78	30.87±15.82	22.8%	52.8%	11.4%
Ulnar	4.02±3.36	35.91±18.48	20%	52.8%	14.2%
Median (motor)	6±5.21	39.84±14.37	24.8%	48.5%	15.7%
Median (sensory)	1.53±1.04	35.15±22.32	-	-	-
Sural (sensory)	1.45±0.91	35.68±18.67	-	-	-

Table 3. The data of EMG based on the nerves

Nerve EMG	Absence of MUAP (number of patients (percent))	Fibrillation waves (number of patients (percent))	PSW (number of patients (percent))
Anterior tibialis muscle	20 (18.5%)	17 (15.7%)	16 (14.8%)
Quadriceps	19 (17.6%)	19 (17.6%)	18 (16.7%)

Table 4. Relationship between CSF protein and electrodiagnostic findings

	Type of GBS				
	Axonal	Demyelinating	Mixed	Normal	P-value
CSF protein level (mg/dl)	54.6±41.9	71±85.9	56.3±35.6	69.2±40.8	0.439

CSF protein and electrodiagnostic findings. The lowest CSF protein level was observed in the axonal group (54.6±41.9 milligram/deciliter). CSF protein levels in demyelinating, mixed, and normal groups were 71±85.9, 56.3±35.6, and 69.2±40.8 milligram/deciliter, respectively. There were no differences between CSF protein levels and electrodiagnostic findings (P-value: 0.439). The data are depicted in Table 4.

Discussion

This research conducted a retrospective analysis of electrodiagnostic assessments and alterations in CSF among pediatric patients diagnosed with GBS. The findings indicated that the demyelinating variant of GBS is the most commonly observed type. Gender differences were not noted in the affected nerves, except the ulnar nerve, showing a significantly higher involvement in female patients. The results suggest no significant correlation between the electrodiagnostic tests and the changes observed in CSF. In the current study, the mean age of patients was 4.83±2.72 years, and 54.6% were boys. Karimzadeh et al. performed a study on 33 patients with GBS, and they found that the mean age of patients was 5.4 years, and 63.6% of patients were boys (17). This difference between the two studies may come from differences in the understudied population. The present study was conducted on 108 patients, but Karimzadeh et al.'s study was done on 33 patients , which was one of this study's advantages. Das et al. evaluated 50 patients with GBS. They found that the most common electorphysiological pattern in these patients was demyelinating polyneuropathy, with a prevalence of 50%, and axonal neuropathy occurred in 42% (18). The current study found that the most prevalent type of GBS involvement was demyelinating polyneuropathy (47.2%) and then, axonal neuropathy (39.8%). The results of the current study were similar to those of Das et al.'s study.

GBS is an autoimmune disorder recognized with cranial or limb nerve involvement and absent or decreased deep tendon reflexes (DTRs) (19). Data showed that CSF proteins are changed in GBS. Wang et al. mentioned that CSF proteins increased during GBS, and the main cause is damage to the blood-cerebrospinal fluid barrier (20). The current study found that the mean protein levels in patients were 63.2±50.3 mg/dl with a maximum level of 290 mg/dl. Fifty patients (46.3%) had more than 40 mg/dl of protein in the CSF. The normal protein level of CSF is 20-40 mg/dL (21). This study's findings were similar to Wang et al.'s study regarding the change in the protein level of CSF, and both studies demonstrated that CSF protein increases during GBS.

DiCupua et al. found an association between demyelinating electrophysiologic results and the protein level of CSF (22). This research indicated that while the CSF protein levels were elevated in the demyelinating variant of GBS, no correlation was observed between the CSF protein levels and the electrophysiological results. Consequently, the findings of these studies diverged. This discrepancy may be attributed to the varying sample sizes utilized in the studies; this particular study involved 108 patients, whereas the study by DiCapua et al. included only 38 patients. Bourque et al. evaluated 173 patients with GBS and discovereda weak correlation between CSF protein levels and electorphysiological patterns (23). The current study uncovered no association between the electrophysiological pattern and CSF protein level. These findings were different between the two studies. Notably, Bourque et al. mentioned that the correlation between protein level of CSF and the electrophysiological pattern is weak in the patients with the GBS variant and it was the difference between Bourque et al.'s study and the current study because this study was conducted on general GBS. This issue demonstrated that further studies should be done to evaluate the association between CSF protein levels and electrophysiological patterns because the data are controversial.

Das et al. mentioned that the findings of CSF analysis had no association with electrophysiologic results. They also found that CMAP amplitude in the axonal was less than 80% of the normal range, at least in two motor nerves. Prolonged F-wave of more than 80% was found in 40% of patients with demyelinating polyneuropathy (18). The present study did not assess the co-occurrence of prolonged F-wave in nerves. Still, we found that unmeasurable F-wave in deep peroneal, tibial, ulnar, and median nerves in 57.4%, 52.8%, 52.8%, and 48.5%, respectively. Absences of F-wave in these nerves occurred in 12.5%, 11.4%, 14.2%, and 15.7% of cases, respectively.

Jawaid et al. assessed the relationship between CSF protein levels and electrophysiologic abnormalities in GBS (acute inflammatory demyelinating polyradiculoneuropathy variant). They demonstrated that the mean CSF protein level was 37.41±3.69 mg/dl, and a significant relationship was observed between CSF protein level and the degree of demyelination (24). The present investigation observed that the average CSF protein concentration in the demyelinating variant of GBS was 71±85.9 mg/dl. Furthermore, no significant correlation was identified between the results of electrodiagnostic tests and CSF protein levels. The outcomes of these two studies exhibited discrepancies, primarily due to differences in the populations examined. This study encompassed all variants of GBS, whereas the research conducted by Jawaid et al. focused specifically on the acute inflammatory demyelinating polyradiculoneuropathy variant, which may have influenced the findings of both studies.

In Conclusion

The study concludes no significant relationship exists between electrodiagnostic findings and CSF modifications in children suffering from GBS. The most frequently observed electrodiagnostic result was demyelinating polyneuropathy. Furthermore, a notable gender difference was identified, as ulnar neuropathy was more prevalent among girls diagnosed with GBS.

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Author's Contribution

Maryam Noory, Mohammad Barzegar, and Armen Malekiantaghi conceptualized
and designed the study, collected data, analyzed and interpreted the results,
prepared the draft manuscript, and revised the manuscript. Kambiz Eftekhari and
Hosein Shabani-Mirzaee conceptualized and designed the study, analyzed and
interpreted the results, prepared the draft manuscript, and revised the manuscript
All authors approved the final version of the article.

Conflict of interest

Authors reported no financial or non-financial conflict of interest.

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