NÖRO PSİKİYATRİ ARŞİVİ
ARCHIVES OF NEUROPSYCHIATRY

RESEARCH ARTICLE

Arch Neuropsychiatry 2018;55:199–204
https://doi.org/10.5152/npa.2017.16996

Electrophysiological Subtypes and Prognostic Factors of Childhood Guillain-Barré Syndrome

Bahadır KONUŞKAN[1], Çetin OKUYAZ[2], Bahar TAŞDELEN[3], Semra HIZ KURUL[4], Banu ANLAR[1]
Turkish Childhood Guillan-Barre Syndrome Study Group*

[1]Department of Pediatric Neurology, Hacettepe University Faculty of Medicine, Ankara, Turkey
[2]Department of Pediatric Neurology, Mersin University Faculty of Medicine, Mersin, Turkey
[3]Department of Biostatistics, Mersin University Faculty of Medicine, Mersin, Turkey
[4]Department of Pediatric Neurology, Dokuz Eylül University Faculty of Medicine, İzmir, Turkey

ABSTRACT

Introduction: We assessed the clinical, epidemiologic, electrophysiological and prognostic characteristics of childhood Guillain-Barré Syndrome admitted to 13 pediatric neurology centers in Turkey.

Method: Using a standard data recording form age, sex, duration of symptoms, distribution of weakness at onset, cranial nerve involvement, cerebrospinal fluid findings, electrophysiological findings, duration of hospitalization, requirement of ventilation, treatment and clinical evaluation scale at onset, discharge and 1, 3, 6, and 12 months after discharge were recorded.

Results: Among the 236 children with a median age of 6.8 years there was a male to female ratio of 1.3. Based on the electrophysiological features; 84 patients were classified as acute inflammatory demyelinating polyrediculoneuropathy (AIDP), 61 as acute motor axonal neuropathy (AMAN), 21 as acute motor-sensory axonal neuropathy (AMSAN). The incidence of cranial nerve involvement was 16%, and was related to lower clinical scores at discharge and 6 months after discharge. Clinical scale scores between axonal and demyelinating subgroups did not show statistically significant difference except for admission ($p<0.05$).

Conclusion: Electrophysiological subtypes are not important in prognosis in our series. However, duration of weakness, duration of hospitalization and ventilation requirement can affect prognosis negatively.

Keywords: Guillain-Barré Syndrome, childhood, electroneuromyography

Cite this article as: Konuşkan B, Okuyaz Ç, Taşdelen B, Hız Kurul S, Anlar B. Electrophysiological Subtypes and Prognostic Factors of Childhood Guillain-Barré Syndrome. Arch Neuropsychiatry 2018;55:199-204. https://doi.org/10.5152/npa.2017.16996

INTRODUCTION

The Guillain-Barré syndrome (GBS) is an acute acquired inflammatory demyelinating polyradiculoneuropathy characterized by symmetrical ascending weakness, hyporeflexia, variable sensory complaints, and elevated cerebrospinal fluid (CSF) protein without pleocytosis. Since the incidence of poliomyelitis declined worldwide, GBS is considered the most frequent cause of acute flaccid paralysis with a reported incidence of 0.6–4 per 100,000 population per year (1).

The pathogenesis is autoimmune, involving both humoral and cell-mediated mechanisms. Approximately 50–70% of patients report preceding respiratory or gastrointestinal infection. The clinical and electrophysiological spectrum of GBS comprises acute inflammatory demyelinating polyneuropathy (AIDP), axonal neuropathy with or without sensory involvement, and other clinical variants such as Miller-Fisher syndrome. Some subtypes differ in geographic distribution (2, 3), and according to some reports, in outcome. Better prognosis has been reported for demyelinating compared to axonal GBS in adults; however, most studies on childhood GBS, except one from Argentina, show similar functional outcome at 12 months after onset (3–7). We assessed the clinical, epidemiologic and prognostic characteristics in our childhood GBS series, one of the largest published so far.

METHODS

We retrospectively extracted the data of 236 patients from 13 pediatric neurology centers (listed at the end of this paper as the Turkish Childhood GBS Study group) using a standardized form during 2005–2008 according to declaration of Helsinki. Patients were diagnosed by pediatric neurologists according to diagnostic criteria of GBS (8). Patients with CSF pleocytosis, exposure to neurotoxins, or hereditary neuropathy were excluded, as were those with Miller-Fisher syndrome. Age, sex, duration of symptoms, antecedents (classified as: absent, upper respiratory tract infection, acute gastroenteritis, vaccination, lower respiratory tract infection, mumps, rash, other), distribution of weakness at onset (flaccid paresis, tetraparesis, and bulbar involvement), presence of pain, sphincter dysfunction, cranial nerve involvement, CSF findings, electrophysiological findings, duration of hospitalization, requirement of ventilation, and treatment were recorded.

Correspondence Address: Bahadır Konuşkan, Department of Pediatric Neurology, Hacettepe University Faculty of Medicine, Ankara, Turkey • **E-mail:** bahadirkonuskan@gmail.com
Received: 13.03.2016, **Accepted:** 14.08.2016, **Available Online Date:** 05.06.2018

Electroneuromyography (ENMG) was performed only if requested by the pediatric neurologist to confirm the diagnosis. ENMG results were recorded as acute inflammatory demyelinating polyneuropathy (AIDP), acute motor axonal neuropathy (AMAN), acute motor-sensory axonal neuropathy (AMSAN), or "unclassified" using specific criteria for demyelination and axonopathy (8).

The functional status was graded at disease onset, at discharge, and 1.3, 6, and 12 months after discharge according to a clinical scale: Grade 0 = normal, Grade 1 = minor signs and symptoms, Grade 2 = walks 5 meters without walker or support, Grade 3 = walks 5 meters with walker or support, Grade 4 = confined to bed or wheelchair, Grade 5 = requires assisted ventilation, Grade 6 = death (9).

Factors affecting clinical score were tested with the Mann-Whitney U test for univariate analysis, and factors found to be significant were subjected to multivariate analysis using generalized estimating equations (GEE) analysis by SAS version 9.0 GENMOD.

The subjects with incomplete data are not excluded from the analysis when using GEE method (10, 11). However, if the sample size is very small and the missing data mechanism is not missing completely random, GEE results can be biased and inconsistent (12). In this study, missing data constituted 18% of data at 3 months and 20% cumulatively at 6 months. However, the completely random missing of data allowed analysis of follow-up data with the GEE method.

RESULTS

There were 236 patients (134 male, 102 female, male/female ratio: 1.31). Clinical and laboratory features of the whole group and demyelinating and axonal subgroups are summarized in Table 1. Eighty four patients were classified as AIDP, 61 as AMAN, 21 as AMSAN, and 6 were "unclassified". Sixty-four patients had no ENMG examination. Among laboratory studies, CSF protein concentration was elevated in 79.9% of cases, with a mean level of 95.2 mg/dL.

At the time of diagnosis, 8.1% of patients were able to walk independently, 18.6% with help, and 58.9% were bed-bound. Follow-up data were available at one month in 168 patients, 3 months in 137 patients, 6 months in 133 patients and 12 months in 133 patients. At last follow-up, 85.6% children had normal neurological examination; 9% were able to walk 5 meters without aid, 3.8% with aid and 1.5% were bed-bound. Clinical and laboratory features were not different between demyelinating and axonal groups, except higher clinical score in the axonal type at admission (Table 1).

Non-parametric correlation tests showed patients with longer symptom duration before admission had higher scores on admission, at discharge and at 12 months' follow-up examination ($p < 0.05$). The duration of hospitalization was related to admission score and 1, 3, 6 month scores ($p < 0.01$). The score at admission varied between 2 and 5. Patients with cranial nerve involvement had higher scores at discharge and 6 months after discharge, but the difference was not significant. AMAN and AMSAN forms did not differ in clinical and laboratory features (Table 2).

Table 1. Clinical and laboratory features of demyelinating and axonal groups

	All Cases	Electrophysiological subtypes		p (axonal/ demyelinating groups)
		Demyelinating	Axonal	
Age (year)	6.8±4.2 y	7.5±4.2 y	6.3±4.3 y	NS
M/F	1.3	1.0	1.7	NS
Duration of weakness (days)	7.7±7.8	7.3±6.8	8.2±8.7	NS
Duration of hospitalization (days)	15±19.6	13.4±8.4	17.0±23	NS
Antecedent infection (%)	64.0	66.7	61.3	NS
Distribution of weakness % of cases				**<0.001**
Flaccid paresis	52.8	54.2	41.5	
Tetraparesis	32	32.5	40.2	
Tetraparesis + bulbar	15.2	13.3	18.3	
Sensory signs%	25	25.3	17.3	NS
Sphincter involvement%	2.6	3.6	1.2	NS
Cranial nerve involvement%	15.7	18.1	20.3	NS
Ventilation requirement%	9.7	9.5	12.7	NS
CSF protein mg/dl	95.2±63.6	94.0±59.0	94.2±61.7	NS
Treatment				
No treatment	24.1	22.6	26.8	
IVIg	61.2	57.1	57.3	
Plasmapheresis	1.3	1.2	1.2	NS
Steroid	0.9	1.2	1.2	
IVIg+Plasmapheresis	10.8	15.5	13.4	
IVIG+steroid	1.7	2.4	-	
Median (interquartile range) clinical score at				
admission	4 (3–4)	4 (3–4)	4 (4–4)	**p=0.022**
discharge	3 (2–4)	3 (2–3)	3 (2–4)	NS
1 month	1 (0–3)	0 (0–1)	1 (0–3)	NS
3 months	1 (0–2)	1 (0–1)	1 (0–2.5)	NS
6 months	0 (0–1)	0 (0–0.5)	0 (0–1)	NS
12 months	0 (0–1)	0 (0–1)	0 (0–1)	NS

Table 2. Clinical and laboratory features of AMAN and AMSAN groups

	All Cases		Axonal subtypes				p (AMAN/ AMSAN)
			AMAN n=61		AMSAN n=21		
M/F	1.79		1.77		1.85		NS
Most common antecedent infection (%)	URTI (62.9)		URTI (63.9)		URTI (60)		NS
Cranial nerve involvement%	20		21		18.7		NS
Ventilation requirement%	12.8		8.6		25		NS
	Min-Max	Median (iq range*)	Min-Max	Median (iq range)	Min-Max	Median (iq range)	
Duration of weakness (days)	1–60	6 (3–10)	1–60	6 (3.25–9)	2–30	7 (3.5–10)	NS
CSF protein mg/dl	13–323	83 (48.5–23.5)	13–323	78 (50–122)	15–202	98 (34.5–117)	NS
Duration of hospitalization (days)	2–140	10 (8–16.5)	2–100	11 (8–18)	3–140	9.5 (6.75–17)	NS
Clinical score							
admission	2–5	4 (3–4)	2–5	(4–4)	3–5	4 (3–5)	NS
discharge	0–5	3 (2–4)	0–4	3 (2–4)	1–5	3 (2–4)	NS
1 month	0–5	1 (0–3)	0–4	2 (0–3)	0–5	1 (0–2.5)	NS
3 months	0–5	1 (0–2)	0–4	1 (0–2.5)	0–5	1 (0–2.5)	NS
6 months	0–5	0 (0–1)	0–3	0 (0–1)	0–5	0 (0–4)	NS
12 months	0–5	0 (0–1)	0–3	0 (0–1)	0–5	0 (0–3)	NS

*interquartile range; URTI, Upper respiratory tract infection.

Patients requiring ventilatory assistance had higher scores at admission, discharge, and 6 and 12 months after discharge (p <0.001) (Table 3). When demyelinating and axonal groups were assessed separately, AIDP patients who needed ventilation had higher scores on admission (p=0.001) but not at discharge and thereafter, while the axonal group had mean score of 3 up to 12 months: none reached a score of 0 at 3–6 months (Table 3).

Multivariate analysis using GEE with and without covariates confirmed these associations and showed elevated CSF protein was associated with lower scores at onset: patients with CSF protein <70 mg/dL had a mean score of 3.78 at admission, and those with protein level >70 mg/dL, 3.59 (p <0.05).

According to GEE analysis with all covariates, age, sex, antecedent infection and cranial nerve involvement had no effect on clinical scores

Table 3. Median scores of patient groups in relation with ventilatory assistance

Clinical score (iq range*)	All patients		Demyelinating		Axonal	
	Non-ventilated	ventilated	Non-ventilated	ventilated	Non-ventilated	ventilated
Admission	4 (3–4)	5 (4–5)	4 (3–4)	5 (4.25–5)	4 (3–4)	5 (5–5)
Discharge	3 (2–3)	4 (3–4)	3 (2–3)	3.5 (2.25–4)	3 (2–4)	4 (3.75–5)
1 month	1 (0–3)	1.5 (0–4)	1 (0–2)	0.5 (0–1.5)	1 (0–3)	4 (0–5)
3 months	1 (0–2)	1 (0–3.5)	1 (0–2)	0.5 (0–1.25)	0 (0–2)	3.5 (1.5–5)
6 months	0 (0–0)	2 (0–3.5)	0 (0–0.5)	0 (0–2.5)	0 (0–0.75)	3 (1–5)
12 months	0 (0–1)	1.5 (0–3)	0 (0–1)	0 (0–2)	0 (0–1)	3 (1–5)

*interquartile range

Table 4. Factors affecting clinical scores

	OR	95% CI		P
Age	0.999	0.994	1.003	NS
Sex	1.183	0.902	1.555	NS
Duration of weakness	0.982	0.966	0.999	**0.0345**
Distribution of weakness	1.262	1.026	1.555	**0.0275**
Cranial nerve involvement	1.287	0.889	1.858	NS
CSF protein level	0.998	0.996	1.001	NS
Ventilation	3.184	1.788	5.682	**<0.0001**
Duration of hospitalization	1.047	1.037	1.057	**<0.0001**
Antecedent infection	1.203	0.902	1.605	NS

(p>0.05). On the other hand, duration of hospitalization, requirement of ventilation, duration of weakness and distribution of weakness had significant effect on clinical scores (Table 4).

Clinical scores improved in all groups during follow-up. However, 6 and 12 month scores were not significantly different.

Treatment decisions were made at physician's discretion in all centers. As included in Table I, methods were similar in all groups. Most patients received intravenous immunoglobulin (IVIG) at a dosage of 0.4 mg/kg/day for 5 days. Those treated with IVIG had a mean score of 3.8 at admission and were discharged with a mean score of 2.7; those who did not receive any specific treatment had scores of 3.3 and 2.4 respectively.

DISCUSSION

The present series comprises one of the largest studies about the subtypes and prognosis of childhood GBS. The young age (median 6.7 years) and 1.3/1 male predominance in this series agrees with previous reports of peak incidence of 6 years and male/female ratio of 1.2–1.3/1 (6, 13).

The frequency of GBS subtypes varies considerably between geographical regions. While 70–90% of GBS cases are AIDP in Western Europe and USA, AMAN constitutes 65% of cases in China (14, 15). Previous studies revealed higher rates of AIDP up to 70.2% in Turkey (3, 16); however, our series contained equal percentages of AMAN and AIDP. Among axonal variants, AMAN was 2.9 times more common than AMSAN (61 vs. 21 cases). This is consistent with previous studies on childhood GBS from Turkey, China and Korea (3, 17, 18).

The major clinical feature of GBS is ascending paralysis. In this study flaccid paresis was the most frequent pattern (53%) probably reflecting early referral of patients, before upper limb weakness. Sensory involvement was observed in only 23.9% of cases, with no significant difference observed between AIDP and AMAN. Sensory symptoms may be underreported in young children. The incidence of cranial nerve involvement, 16%, is in the lower range of the published rates of 15–46% (19); however our series excluded Miller-Fisher syndrome.

Mean duration of hospitalization was 14.7 days, with no difference between groups. One study from USA reported shorter hospitalization (interquartile range: 5–13, median: 7 days) (20) while another from Oman had longer hospital stays (range: 5–116, mean: 20.4 days) (19). Interestingly, our hospital stays were not related to the clinical score at the time of diagnosis but at 1, 3 and 6 months, suggesting duration of hospital stay is not predictable at onset and clinical progression is the main determinant. Only 9.2% of our patients required mechanical ventilation. In the literature, the requirement for respiratory assistance ranges from 6% to 32%. Our result is consistent with two studies from Turkey and China where 9.6% and 9.5% required ventilation (16, 18).

Previous studies show an association between cranial nerve involvement and respiratory assistance. We could not find such an association, probably because of the lower rate of cranial nerve involvement in our series. As expected, patients who needed ventilation had higher scores on admission, and, in the axonal group, afterwards. In other words, an AIDP patient who needed ventilation was not candidate for worse functional status at discharge or thereafter, while patients with axonal forms could do worse for up to months after discharge. Otherwise the axonal and demyelinating forms did not differ in clinical and laboratory features, and notably, outcome, despite higher initial clinical scores in the axonal group. The absence of any difference in outcome suggests the differentiation based on electrophysiological findings has modest clinical importance in children with GBS. Between the AMSAN and AMAN groups, a higher rate of respiratory assistance compared to AMAN was observed (25% and% 8.6 respectively) however this was not statistically significant (0.1>p >0.05).

The literature shows excellent recovery in 85–95% of children (6, 21). In our study the ratio of patients with lower clinical scores at 12 months follow up was 5.2%, meaning 94.8% of excellent recovery. Our mortality rate was 1.3%, consistent with the literature where mortality in children is reported to be lower than adult rates of 2–11% (20, 22, 23). Interestingly, 6-and 12-month scores were not different, suggesting outcome and treatment results can be predictable at 6 months.

Acute motor axonal neuropathy and AMSAN forms did not differ in clinical and laboratory features. Notably, they did not differ in outcome but only by higher initial clinical score in the axonal group. The absence of any difference in outcome suggests the differentiation based on electrophysiological findings has modest clinical importance in children with GBS. Although the AMSAN group had higher rate of respiratory assistance compared to AMAN (25% and% 8.6 respectively) this was not statistically significant (0.1>p >0.05).

Cerebrospinal fluid protein level was negatively correlated with clinical score at onset (p <0.05) meaning higher CSF protein levels were associated with lower scores or milder symptoms. Nearly all studies about prognostic significance of CSF protein level were performed in

adults and revealed no relation. A few studies in adult cases and two studies in children showed positive correlation between CSF protein and prognosis, higher protein level being related to poor prognosis (6, 24). Our result contradicts this finding. Although elevated CSF protein is associated with demyelination rather than axonal damage, demyelinating and axonal mechanisms are frequently together in GBS (21). Another explanation may be related to the time of lumbar puncture, milder cases being admitted and investigated later, and therefore showing higher protein.

Treatment was not standard due to the retrospective nature of the study, but varied little between centers. Most patients received IVIG. The mean scores at admission and discharge were higher in the IVIG-treated than the untreated group, indicating clinicians' choice of treating more severely presenting cases, as recommended (25). IVIG is preferred to plasmapheresis in childhood series because of ease of application and usually minor adverse effects (6, 21, 26). Their therapeutic efficacy is similar in adults. Only one childhood study demonstrated better success rate with plasmapheresis (26). Our plasmapheresis group is small, not allowing comparison of efficacy.

The limitations of our study are its retrospective nature, lack of nerve conduction studies in 27% of cases. We analysed the patients with no ENMG and those performed EMG and can't find any difference between them at ventilation requirement, age, gender and clinical scores at admission, 3, 6 and 12'th months of follow up. But cranial nerve involvement and clinical scores at 1 months of follow up are significantly different. These two parameters are higher at those performed EMG this bias may be due to clinicians' choice of performing EMG to severe patients.

Another limitation of the study is limited follow-up in some patients. This is not unusual considering the mutlicentric nature, the time window, and the high horizontal population movement in Turkey. However, we compare patients with positive last follow-up and lost ones. We couldn't find any difference between them about age, gender, cranial nerve involvement, ventilation requirement. If we consider only patients with positive last follow-up data clinical and laboratory features were not different between demyelinating and axonal groups, except higher clinical score in the axonal type at 1 months of follow-up.

We are unable to describe the etiological agents responsible for GBS in Turkey because a standard, uniform microbiological test panel was not applied. Most cases followed an upper respiratory tract infection, consistent with previous data (17). Our findings demonstrate childhood GBS is clinically heterogeneous, but little difference can be attributed to ENMG subtypes. Clinical severity, duration of symptoms at admission, and elevated CSF protein are related to short-term course while long-term outcome is affected only in severe axonal forms with respiratory involvement.

***The Turkish Childhood GBS Study Group**

İstanbul Hamidiye Şişli Etfal Training and Research Hospital, Pediatric Neurology: Gülşen Köse
Atatürk University Faculty of Medicine, Pediatric Neurology: Hüseyin Tan
Çukurova University Faculty of Medicine, Pediatric Neurology: Faruk İncecik
Ege University Faculty of Medicine, Pediatric Neurology: Gül Serdaroğlu
Gazi University Faculty of Medicine, Pediatric Neurology: Ayşe Aysima Özçelik
Turgut Özal University Faculty of Medicine, Pediatric Neurology: Müjgan Sönmez
Mersin University Faculty of Medicine, Pediatric Neurology: Çetin Okuyaz
Marmara University Faculty of Medicine, Pediatric Neurology: Yüksel Yılmaz
Osmangazi University Faculty of Medicine, Pediatric Neurology: Coşkun Yarar
Ondokuz Mayıs University Faculty of Medicine, Pediatric Neurology: Ömer Faruk Aydın
Sami Ulus Children Hospital Pediatric Neurology: Deniz Yüksel

Study Group Contributions: Collection of data at the center where he is located.

Ethics Committee Approval: This study is designed according to decleration of Helsinki.

Informed Consent: Due to retrospective nature of the study we didn't signed inform consent form to patients.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - BK, ÇO; Design - BK, ÇO, SK; Supervision - BK, ÇO, SK; Data Collection and/ or Processing - BK, ÇO, SK; Analysis and/or Interpretation - BK, ÇO, BT, BA; Literature Search - BK, ÇO, SK; Writing - BK, ÇO, SK; Critical Reviews - BK, BA.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Ropper AH. The Guillain-Barré syndrome. N Engl J Med 1992;326:1130–1136. [CrossRef]
2. Nagasawa K, Kuwabara S, Misawa S, Fujii K, Tanabe Y, Yuki N, Hattori T, Kohno Y. Electrophysiological subtypes and prognosis of childhood Guillain-Barré syndrome in Japan. Muscle Nerve 2006;33:766–770. [CrossRef]
3. Tekgul H, Serdaroglu G, Tutuncuoglu S. Outcome of axonal and demyelinating forms of Guillain-Barré syndrome in children. Pediatr Neurol 2003;28:295–299.
4. Feasby TE, Gilbert JJ, Brown WF, Bolton CF, Hahn AF, Koopman WF, Zochodne DW. An acute axonal form of Guillain-Barré polyneuropathy. Brain 1986;109 (Pt 6):1115–1126.
5. Yuki N, Tagawa Y, Irie F, Hirabayashi Y, Handa S. Close association of Guillain-Barré syndrome with antibodies to minor monosialogangliosides GM1b and GM1 alpha. J Neuroimmunol 1997;74:30–34.
6. Korinthenberg R, Schessl J, Kirschner J. Clinical presentation and course of childhood Guillain-Barré syndrome: a prospective multicentre study. Neuropediatrics 2007;38:10–17. [CrossRef]
7. Paradiso G, Tripoli J, Galicchio S, Fejerman N. Epidemiological, clinical, and electrodiagnostic findings in childhood Guillain-Barré syndrome: a reappraisal. Ann Neurol 1999;46:701–707.
8. Asbury AK, Cornblath DR. Assessment of current diagnostic criteria for Guillain-Barré syndrome. Ann Neurol 1990;27 Suppl:S21–S24.
9. The Guillain-Barré syndrome Study Group. Plasmapheresis and acute Guillain-Barré syndrome. Neurology 1985;35:1096–1104.
10. Twisk J, de Vente W. Attrition in longitudinal studies. How to deal with missing data. J Clin Epidemiol 2002;55:329–337.
11. Li X, Mehrotra DV, Barnard J. Analysis of incomplete longitudinal binary data using multiple imputation. Stat Med 2006;25:2107–2124. [CrossRef]
12. Tasdelen B, Temel GO. The Results of Generalized Estimating Equations in the Presence of Monotone Missing Patterns. Turkiye Klinikleri J Biostat 2013;5:1–7.
13. Hughes RA, Newsom-Davis JM, Perkin GD, Pierce JM. Controlled trial prednisolone in acute polyneuropathy. Lancet 1978;2:750–753.
14. Hadden RD, Cornblath DR, Hughes RA, Zielasek J, Hartung HP, Toyka KV, Swan AV. Electrophysiological classification of Guillain-Barré syndrome: clinical associations and outcome. Plasma Exchange/Sandoglobulin Guillain-Barré Syndrome Trial Group. Ann Neurol 1998;44:780–788. [CrossRef]
15. Asbury AK. New concepts of Guillain-Barré syndrome. J Child Neurol 2000;15:183–191. [CrossRef]
16. Soysal A, Aysal F, Caliskan B, Dogan Ak P, Mutluay B, Sakalli N, Baybas S, Arpaci B. Clinico-electrophysiological findings and prognosis of Guillain-Barré syndrome –10 years' experience. Acta Neurol Scand 2011;123:181–186. [CrossRef]
17. Lee JH, Sung IY, Rew IS. Clinical presentation and prognosis of childhood Guillain-Barré syndrome. J Paediatr Child Health 2008;44:449–454. [CrossRef]
18. Tang J, Dai Y, Li M, Cheng M, Hong S, Jiang L, Cai F, Zhong M. Guillain-Barré syndrome in Chinese children: a retrospective analysis. Pediatr Neurol 2011;45:233–237. [CrossRef]
19. Koul RL, Alfutaisi A. Prospective study of children with Guillain-Barré syndrome. Indian J Pediatr 2008;75:787–790. [CrossRef]
20. Alshekhlee A, Hussain Z, Sultan B, Katirji B. Guillain-Barré syndrome: incidence and mortality rates in US hospitals. Neurology 2008;70:1608–1613. [CrossRef]

21. Kalra V, Sankhyan N, Sharma S, Gulati S, Choudhry R, Dhawan B. Outcome in childhood Guillain-Barré syndrome. Indian J Pediatr 2009;76:795–799. [CrossRef]
22. The Italian Guillain-Barré Study Group. The prognosis and main prognostic indicators of Guillain-Barré syndrome. A multicentre prospective study of 297 patients. Brain 1996;119 (Pt 6):2053–2061.
23. Roodbol J, de Wit MC, Aarsen FK, Catsman-Berrevoets CE, Jacobs BC. Long-term outcome of Guillain-Barré syndrome in children. J Peripher Nerv Syst 2014;19:121–126. [CrossRef]
24. Eberle E, Brink J, Azen S, White D. Early predictors of incomplete recovery in children with Guillain-Barré polyneuritis. J Pediatr 1975;86:356–359.
25. Patwa HS, Chaudhry V, Katzberg H, Rae-Grant AD, So YT. Evidence-based guideline: intravenous immunoglobulin in the treatment of neuromuscular disorders: report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. Neurology 2012;78:1009–1015. [CrossRef]
26. Hicks CW, Kay B, Worley SE, Moodley M. A clinical picture of Guillain-Barré syndrome in children in the United States. J Child Neurol 2010;25:1504–1510. [CrossRef]