ORIGINAL ARTICLE

An Outcome-Based Comparative Analysis between Variants of Guillain-Barre Syndrome Undergoing Plasmapheresis

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ABSTRACT

Objective: To compare functional outcomes among Guillain-Barre Syndrome (GBS) variants, acute demyelinating inflammatory neuropathy (AIDP) and acute motor axonal neuropathy (AMAN) treated with plasmapheresis.

Study Design: Prospective, single-center, comparative analysis.

Place and Duration of Study: Pediatric neurology department and critical care unit of Children's Hospital Lahore from January 2024 to January 2025.

Material and Methods: All pediatric GBS patients eligible for plasmapheresis were enrolled after informed consent. Outcome were assessed in terms of ICU transfer or mortality due to plasmapheresis and functional outcome at discharge and after 3 months, comparing AIDP and AMAN subtypes.

Results: A total of 31 GBS cases were included. Among these, 10 (32.3%) AIDP and 21 (67.7%) AMAN. In AIDP group, the mean Modified Rankin Score (MRS) was 4.80 ± 0.42 that was reduced to 3.70 ± 0.48 at the time of discharge and was further reduced to 2.40 ± 0.97 after 3 months. In AMAN group, the mean MRS was 4.86±0.36 that was reduced to 3.76 ± 0.62 at the time of discharge and was further reduced to 2.38 ± 0.80 after 3 months. The difference was calculated to be insignificant in both groups on all follow-up ($p>0.05$).

Conclusion: Plasmapheresis is a reliable and useful treatment choice for pediatric Guillain-Barré Syndrome, promoting notable functional improvement in both AIDP and AMAN cases. Although AMAN was the more common subtype in our group, the outcome for both types were similar.

Key Words: *Guillain-Barre syndrome, Acute inflammatory demyelinating polyradiculoneuropathy, Acute motor axonal neuropathy (AMAN), Plasmapheresis, Acute flaccid paralysis, Children*

INTRODUCTION

Guillain-Barre Syndrome (GBS), also known as post-infectious polyradiculoneuropathy is an acquired autoimmune condition that affects peripheral nervous system. The annual prevalence of GBS ranges from 0.4 to 2 cases per 100,000 populations, with Brazil has the lowest

rate of 0.40 per 100,000 persons–-years as compared to an extremely high rate of 2.5 per 100,000 persons-years in Curacao and Bangladesh.[1]

GBS presents in several variants, and the clinical course and outcome are influenced by antecedent events. It stands as a major cause of acute non-traumatic paralysis in healthy people, triggered by immune system response to viral agents (influenza, coxsackie, Epstein-Barr virus, or cytomegalovirus) or bacterial infective organisms *(Campylobacter jejuni, Mycoplasma pneumoniae).* GBS presents clinically as an ascending and progressive muscular weakness with areflexia, with progression over a few days to a few weeks. Progressive involvement of respiratory muscles and autonomic instability necessitates the intensive care unit management with an unpredictable and protracted recovery process.[2]

According to neurophysiological and histopathological basis peripheral nerve damage is divided into four distinct forms: acute inflammatory demyelinating polyradiculo-neuropathy (AIDP); acute motor axonal neuropathy (AMAN), acute motor and sensory axonal neuropathy (AMSAN); and Miller–Fisher syndrome (MFS).

So far, the treatment of GBS is with immunomodulation. In pediatric cases, the primary therapy involves the use of Intravenous immunoglobulin and/or plasmapheresis. It is worth noting that both these modalities are effective in treating GBS. Plasmapheresis is increasingly being used in the treatment of various pediatric immune-mediated neurological disorders, including GBS, as it is cost-effective.[3]

Plasmapheresis has been in use for immune-mediated neurological disorders and a recent study revealed that neurological diseases are second (31.9%) in number for which this modality is being used with minimal adverse reactions (4.39 %).[4]

In another study done in Pakistan to see the outcome and complications of plasmapheresis in the treatment of GBS, plasmapheresis was found to be an effective treatment for GBS with nominal side effects. Out of total 44 patients, 35 (79.5%) recovered, 10 (22.7%) had minor complications, 03 (6.8%) had to be shifted to ICU and 03 (6.8%) died.[5]

Treatment response depends on clinical presentation and subtype of GBS (AIDP vs AMAN). No precise local data highlights the importance of plasmapheresis effectiveness in variants of GBS. Through this study, we aim to determine the functional outcomes among different variants of childhood-onset GBS after plasmapheresis treatment. Furthermore, we will identify the factors that may be linked to a poorer treatment outcome.

MATERIAL AND METHODS

A prospective comparative analysis was conducted at the pediatric neurology ward and critical care unit of Children Hospital Lahore. The study spanned one-year duration from January 2024 to January 2025. The sample size was determined as 31 children for this study, considering a 2% prevalence of Guillain-Barre syndrome, a 5% margin of error (d), and a 95% confidence interval using WHO's sample size calculator. A non-probability consecutive sampling technique was used to enroll all the eligible patients during the study period.

The inclusion criteria comprised children aged 4 to 15 years diagnosed with GBS (Brighton criteria) who underwent plasmapheresis, and their functional outcomes (MRS score Annexure 3), along with complications of the procedure, were documented. Children with GBS who were able to walk independently were exempted from the study, along with those who had acute flaccid paralysis due to other causes, e.g., post-diphtheritic neuropathy, Bickerstaff encephalitis, and post-traumatic neuritis. The patients who had contraindications to plasmapheresis were not included in the study.[6]

The study was approval by the Ethical Review Committee of the Children's Hospital (letter No/758/CH-UCHS). All patients who met the inclusion criteria were included in the study after obtaining informed consent from their parents or guardians Data was systematically collected by the principal investigator using a structured questionnaire, which included information such as age, gender, duration of hospital stay, axonal and demyelinating type of GBS based on nerve conduction and electromyographic studies (NCS,

EMG Annex 1). Modified Rankin Score documented at admission, discharge and 3 months follow up (Annex 2). Erasmus GBS Respiratory Insufficiency Score (EGRIS) score was also documented to early label GBS patients at highest risk of developing respiratory insufficiency within the first week of admission (Annex 3), The Medical Research Council (MRC) sum score for Guillain-Barré syndrome (GBS) documents the total of the MRC scores for six muscle groups in the upper and lower limbs was also used (Annex 4), The confidentiality of the participants was rigorously maintained throughout the study. Acute outcome was labelled as patients shifted to the ward without any major event due to the plasmapheresis procedure or shifting to ICU or death during or soon after the procedure due to serious complication of the procedure but not due to underlying illness or any other cause. Functional outcome was assessed based on a modified Rankin Score for neurological disability (MRS) on a scale of 0-6.

Annex 1: Electrodiagnostic Criteria for AIDP and AMAN

	Ho et al. (1995)	Hadden et al. (1998)	Rajabally et al. (2015)
Criteria for AIDP	Must have one of the following in two nerves	Must have one of the following in two nerves	Must have one of the following in two nerves
Conduction velocity (CV)	<90% LLN (<85%, if distal amp <50% LLN)	<90% LLN (<85%, if distal amp <50% LLN)	<70% LLN
Distal motor latency (DML)	>110% ULN (>120%, if distal amp <LLN)	>110% ULN (>120%, if distal amp <LLN)	>150% ULN
Temporal dispersion (TD)	Unequivocal	Not considered	
Conduction block (CB)	Not considered	Proximal-to-distal amp ratio <0.5 and distal amp >20% LLN	Proximal-to-distal amp ratio <0.7 in two nerves (except tibial nerve), plus an additional parameter in one other nerve
F-wave latency	>120% ULN	>120% ULN	>120% ULN (>150%, if distal amp <50%) or F-wave absence in two nerves with distal amp ≥20% LLN, plus an additional parameter in one other nerve
Criteria for AMAN	No evidence of demyelination in the above nerves Distal amp <80% in two nerves	None of the above except in one nerve if distal amp <10% of LLN Distal amp <80% in two nerves	None of the above except in one nerve If distal amp <10% of LLN, one demyelinating feature allowed in one nerve, and at least one of the following: (1) Distal amp <80% in two nerves. (2) F-wave absence in two nerves with distal amp ≥20% LLN, with no demyelinating feature in any nerve. (3) Proximal-to-distal amp ratio <0.7 in two nerves (except tibial nerve). (4) F-wave absence in one nerve with distal amp ≥20% LLN or proximal-to-distal amp ratio <0.7 in one nerve (except tibial nerve), with distal amp <80% LLN in one other nerve.

Annex 2: Modified rankin scale for disability

Score	Description
0	No symptoms
1	No significant disability. Able to carry out all usual activities, despite some symptoms.
2	Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities.
3	Moderate disability. Requires some help, but able to walk unassisted.
4	Moderately severe disability. Unable to attend to own bodily needs without assistance, and unable to walk unassisted.
5	Severe disability. Requires constant nursing care and attention, bedridden, incontinent.
	Dead

Annex 3: Egris score

	Categories	Score
Days between onset of weakness and hospital admission	> 7 days	0
	4 – 7 days	1
	≤ 3 days	2
Facial and/or bulbar weakness at hospital admission	Absence	0
	Presence	1
MRC sum score at hospital admission	60 – 51	0
	50 – 41	1
	40 – 31	2
	30 – 21	3
	≤ 20	4

Annex 4: Medical research council score for power

Score	Description
0	No contraction
1	Flicker or trace of contraction
2	Active movement, with gravity eliminated
3	Active movement against gravity
4	Active movement against gravity and resistance
5	Normal power

Statistical analysis was performed using the Statistical Package for Social Sciences version 25.0 (SPSS-25.0). Frequencies were described as percentages for quantitative variables. Pearson chi-square was used for assessing the association between functional outcome and treatment (plasmapheresis) as well as type of GBS (electrophysiological). One-way analysis of variance (ANOVA) was conducted with the functional status of the child at discharge and 3 months follow-up as the dependent variable, with cranial neuropathy, dysautonomia, need for ventilation, and level of protein in CSF being the explanatory variable while keeping significance at <0.05.

RESULTS

In this study we observed that out of 31 cases of GBS, 10 (32.3%) were diagnosed to have AIDP while 21 (67.7%) were diagnosed to have AMAN (fig 1).

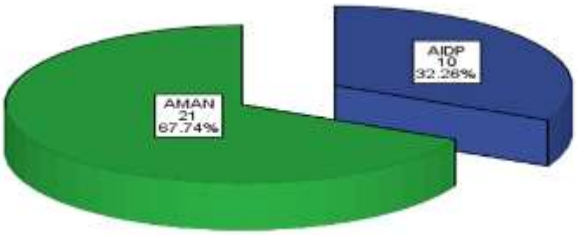

Fig 1: Diagnosis made based on Electrophysiological findings

The mean age of children was 6.55 ± 3.97 years in AIDP and mean age of children in AMAN group was 8.02 ± 2.75 years. In AIDP group, there were 5 (50%) males and 5 (50%) females. In AMAN group, there were 11 (52.4%) males and 10 (47.6%) females. At the time of presentation, the mean EGRIS score was 4.40 ± 1.35 in AIDP group and 4.76 ± 1.55 in AMAN group. The mean duration between hospital admission and onset of weakness was 5.90 ± 5.55 days in AIDP group and 3.76 ± 3.40 days in AMAN group. Facial and/or Bulbar weakness at hospital admission was noted in 5/10 (50%) cases in AIDP group and in 10/21 (47.6%) in AMAN group. The mean MRC at the time of admission was 28.20 ± 9.31 vs. 30.38 ± 7.97, respectively. Preceding antecedent infection was noted in 2 (20%) vs. 12 (57.1%). Dysautonomia were noted in 7 (70%) vs. 19 (19.5%), respectively. Ocular neuropathy (ophthalmoplegia) was noted in 1 (4.8%) child in AMAN group. The mean protein level in CSF was 87.30 ± 19.77 in AIDP group and 122.81 ± 101.17 in AMAN group. Mechanical ventilation was required in 9 (90%) vs. 13 (61.9%), respectively. The mean duration of ventilation was 28.33±11.01 days vs. 28.00 ± 14.71 days, respectively in both groups (table 1).

TABLE I: Baseline features of children enrolled in the study (n=31)

Characteristics	Diagnosis	
	AIDP	AMAN
	Frequency (%)	
	n=10	n=21
Gender		
Male	5 (50.0)	11 (52.4)
Female	5 (50.0)	10 (47.6)
Facial and/or Bulbar weakness at hospital admission	5 (50.0)	10 (47.6)
Any preceding antecedent infection	2 (20.0)	12 (57.1)
No	8 (80.0)	9 (42.9)
Cough & flu	0 (0.0)	5 (23.8)
Diarrhea	2 (20.0)	3 (14.3)
Gastritis	0 (0.0)	1 (4.8)
URTI	0 (0.0)	3 (14.3)
Dysautonomias	7 (70.0)	19 (19.5)
None	3 (30.0)	2 (9.5)
Hypertension	3 (30.0)	0 (0)
Tachycardia	2 (20.0)	15 (71.4)
Hypertension with tachycardia	2 (20.0)	4 (19.0)
Sensory symptoms	0 (0.0)	0 (0.0)
Ocular neuropathy	0 (0.0)	1 (4.8)
Need for Mechanical ventilation	9 (90.0)	13 (61.9)
Characteristics	**Mean ± Standard deviation**	
EGRIS at presentation	4.40±1.35	4.76±1.55
Days between hospital admission and onset of weakness	5.90±5.55	3.76±3.40
MRC at the time of admission	28.20±9.31	30.38±7.97
Duration of ventilator (days)	28.33±11.01	28.00±14.71
Protein level in CSF	87.30±19.77	122.81±101.17

TABLE 2: Comparison of GMFCS and MRS during follow-up using independent sample t-test

Functional outcome	Diagnosis		p-value
	AIDP	AMAN	
	n=10	n=21	
GMFCS.1	4.70±0.48	4.86±0.36	0.317
GMFCS.2	3.80±0.79	3.76±0.62	0.885
GMFCS.3	2.30±0.95	2.38±0.80	0.806
MRS.1	4.80±0.42	4.86±0.36	0.698
MRS.2	3.70±0.48	3.76±0.62	0.785
MRS.3	2.40±0.97	2.38±0.80	0.954

In AIDP group, the mean GMFCS was 4.70±0.48 that was reduced to 3.80 ± 0.79 at the time of discharge and was further reduced to 2.30 ± 0.95 after 3 months. In AMAN group, the mean GMFCS was 4.86 ± 0.36 that was reduced to 3.76 ± 0.62 at the time of discharge and was further reduced to 2.38 ± 0.80 after 3 months. The difference was calculated to be insignificant in both groups on all follow-up ($p>0.05$). Similarly, in AIDP group, the mean MRS was 4.80 ± 0.42 that was reduced to 3.70 ± 0.48 at the time of discharge and was further reduced to 2.40 ± 0.97 after 3 months. In AMAN group, the mean MRS was 4.86 ± 0.36 that was reduced to 3.76 ± 0.62 at the time of discharge and was further reduced to 2.38 ± 0.80 after 3 months. The difference was calculated to be insignificant in both groups on all follow-up ($p>0.05$). Fig 2 & 3 showing the pattern of change in GMFCS and MRC score (table 2)

All the children in both groups were shifted to the wards without any complication (100%) and No children was shifted to ICU or had to be retained in ICU due to complications of plasmapheresis.

During stay in neurology ward hypotension was noted in 2 (95%) children in AMAN group, urticarial rash in 3 (14.3%) cases, muscle cramps in 2 (9.5%) cases. Only 1 (10%) child had lightheadedness in AIDP group. No mortality occurred in any group (table 3).

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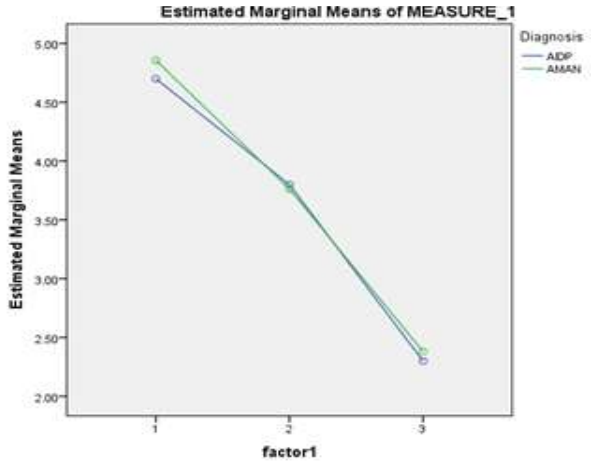

Fig 2: GMFCS score during follow-up (baseline, at discharge and after 3 months), Repeated measures ANOVA = 0.099, p-value = 0.756

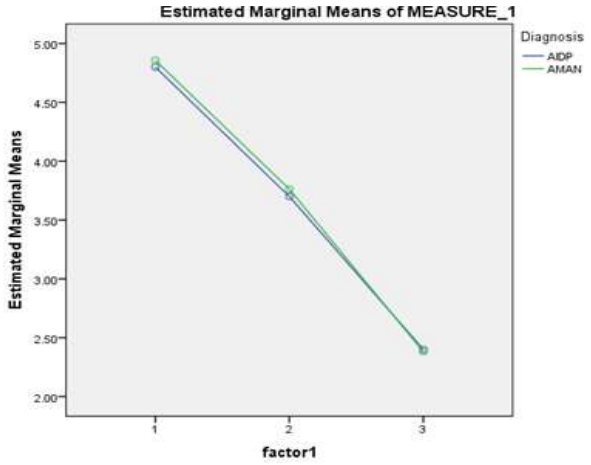

Fig 3: MRS score during follow-up (baseline, at discharge and after 3 months), Repeated measures ANOVA = 0.028, P-value =0.869

TABLE 3: Outcomes of plasmapheresis in both groups using chi square test

Outcomes	Diagnosis		p-value
	AIDP	AMAN	
	n=10 (%)	n=21 (%)	
Shifted to the wards without complication	10 (100.0)	21 (100.0)	NA
Shifted to ICU because of complication	Nil	Nil	NA
Complications included			
Hypotension	0 (0.0)	2 (9.5)	0.313
Hypocalcemia	Nil	Nil	NA
Urticarial	0 (0.0)	3 (14.3)	0.209
Muscle cramps	0 (0.0)	2 (9.5)	0.313
Lightheadedness	1 (10.0)	0 (0.0)	0.141
Others	0 (0.0)	0 (0.0)	NA
Mortality	0 (0.0)	0 (0.0)	NA

DISCUSSION

This study provides an outcome-based comparative analysis of the effectiveness of plasmapheresis in treating Guillain-Barré Syndrome (GBS) subtypes acute inflammatory demyelinating polyradiculoneuropathy (AIDP) and acute motor axonal neuropathy (AMAN) among pediatric patients. Our findings elucidate key differences in clinical presentation, therapeutic outcomes, and complications between these two electrophysiological subtypes, while also reinforcing the safety and efficacy of plasmapheresis as a treatment modality.

AMAN emerged as the predominant GBS subtype in our cohort, accounting for 67.7% of cases, with AIDP comprising 32.3%. This observation is consistent with regional studies indicating a higher prevalence of AMAN in Asian countries, as opposed to AIDP dominance in Western populations.[7] This geographical variability has been attributed to genetic predisposition and environmental factors, including higher exposure to *Campylobacter jejuni* infections, which were

more frequently seen in the AMAN group (57.1%) compared to the AIDP group (20%). These findings align a study, who reported a strong association between antecedent infections, particularly diarrhea, and AMAN.[8]

The mean age at presentation was slightly higher in the AMAN group (8.02 ± 2.75 years) than in the AIDP group (6.55 ± 3.97 years). Although this difference was not statistically significant, it corroborates the findings of a study, who documented a marginally older age distribution in AMAN cases.[9] Gender distribution in our cohort was nearly equal, contrasting with a study, which reported a slight male predominance.[10]

The mean time from symptom onset to hospital admission was shorter for AMAN (3.76 ± 3.40 days) than for AIDP (5.90 ± 5.55 days), suggesting a more rapid disease progression in AMAN. A study similarly highlighted the acute onset and rapid progression typical of AMAN.[11]

Dysautonomia, primarily tachycardia, was prevalent in both groups, affecting 71.4% of AMAN cases and 70% of AIDP cases. These findings are consistent with retrospective review of patients admitted to the Mayo Clinic in Rochester, who emphasized the significance of dysautonomia as a common feature in both subtypes.[12]

Plasmapheresis proved to be an effective treatment modality for both AIDP and AMAN. Functional improvement, assessed through GMFCS and MRS scores, was significant in both groups. In the AIDP group, the mean GMFCS score improved from 4.70 ± 0.48 at admission to 2.30 ± 0.95 at three months, while in the AMAN group, it decreased from 4.86 ± 0.36 to 2.38 ± 0.80. Similarly, the mean MRS score in AIDP improved from 4.80 ± 0.42 to 2.40 ± 0.97, while in AMAN, it reduced from 4.86 ± 0.36 to 2.38 ± 0.80. These findings mirror those of a study in Pakistan which demonstrated comparable recovery trajectories between the subtypes when treated with plasmapheresis.[13]

Notably, mechanical ventilation was required in 61.9% of AMAN cases and 90% of AIDP cases, with a mean duration of approximately 28 days in both groups. This aligns with prospective study from North India, which reported higher ventilation requirements in AIDP due to significant respiratory muscle involvement.[14] While AIDP patients demonstrated more severe respiratory involvement at presentation, the overall recovery in motor function and respiratory support needs was comparable between the groups.

Complications during plasmapheresis were minimal, with no mortality reported in our cohort. Hypotension, urticaria, and muscle cramps were slightly more common in the AMAN group but were easily managed without the need for intensive care escalation. These findings are consistent with those reported by a study which documented a complication rate of 10-15% in undergoing plasmapheresis.[15]

CSF protein levels, indicative of albumin cytological dissociation, were elevated in both groups but were higher in AMAN (122.81 ± 101.17 mg/dL) compared to AIDP (87.30 ± 19.77 mg/dL). This observation aligns with the study at Medical University of Innsbruck, which emphasized the diagnostic utility of CSF analysis in differentiating GBS subtypes.[16]

Our findings corroborate recent international studies in several respects. Many other studies reported a higher prevalence of AMAN in Asian pediatric populations, with a significant association between antecedent *Campylobacter jejuni* infections and AMAN.[17,18]

However, certain discrepancies exist. For instance, the equal gender distribution in our study contrasts with the slight male predominance reported in studies by other studies.[10]

Additionally, while AMAN is often described as more severe in terms of motor deficits, our findings suggest comparable severity between the subtypes, as evidenced by similar EGRIS scores and recovery outcomes.

Implications and Limitations: This study underscores the efficacy and safety of plasmapheresis in treating pediatric GBS, with significant functional improvement observed in both AIDP and AMAN. This study contributes to limited local data by comparing functional recovery outcome in electrophysiological subtypes of GBS. The comparable improvement in GMFCS and MRS scores between AIDP and AMAN subtypes indicate that plasmapheresis may be equally effective among these variants in pediatric populations despite their different

pathophysiological profiles. The findings also highlight the significance of early diagnosis and treatment initiation, particularly in resource-limited settings where access to intravenous immunoglobulin (IVIG) may be constrained.[19,20]

However, the study has limitations. As it was single center study with small data size so we cannot generalize the findings. Additionally, the lack of long-term follow-up precludes an assessment of sustained recovery or recurrence rates. Future multicenter studies with larger cohorts and extended follow-up periods are needed to validate these results and explore the pathophysiological differences between AIDP and AMAN.[21]

CONCLUSION

In conclusion, plasmapheresis is a safe and effective therapeutic option for pediatric GBS, facilitating significant functional recovery in both AIDP and AMAN. While AMAN was the predominant subtype in our cohort, comparative analysis showed no statistically significant difference in functional outcomes (GMFCS and MRS scores) between the two variants. This highlights the potential of plasmapheresis to yield similar recovery outcomes across different electrophysiological subtypes, supporting its utility as standardized treatment modality in pediatric GBS. Continued research is essential to refine diagnostic and therapeutic strategies and address the unique challenges of managing pediatric GBS in resource-limited settings.

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Conflict of interest: None to declare

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