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RESEARCH ARTICLE
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SERUM ALBUMIN AS AN INDEPENDENT INDICATOR IN GUILLAIN–BARRE SYNDROME PATIENTS UNDERGOING PLASMAPHERESIS

Jehan Anjum[1], Muhammad Atiq Ur Rehman[2]*, Hamza Nazir[3], Mahwash Mengal[4], Tanni Jahan Dina[5], Dial Das[6]

[1]MBBS, FCPS General Medicine, Consultant Physician, Medical Specialist at Employees Social Security Institution Polyclinic Kohat Road Peshawar, Pakistan
[2]*Assistant Professor of Medicine, Aman Anayat Medical College Sheikhupura, Pakistan
[3]Post Graduate Resident, Department of General Medicine, Northwest General Hospital and Research Centre, Peshawar, Pakistan
[4]Assistant Professor, Department of Physiology, Bolan Medical College Quetta, Balochistan, Pakistan
[5]MBBS, Sheikh Hasina Medical College and Hospital, Tangail, Bangladesh
[6]Associate Professor, Department of Pharmacology, Chandka Medical College, Larkana, Sindh, Pakistan

***Corresponding Author:** Muhammad Atiq Ur Rehman
*Email: draliqaiser114@gmail.com

Abstract

Introduction: Guillain-Barré syndrome (GBS) is an immune-mediated neuropathy of acute onset. Early intervention and management was determined by the identification of readily available biomarkers to forecast the outcome in patients undergoing plasmapheresis.

Objective: To investigate the value of serum albumin as a sole prognostic indicator for GBS patients undergoing plasmapheresis, and its association with disease severity, treatment response, and short-term outcomes.

Materials and Methods: This was a prospective observational study conducted at Department of General Medicine, Northwest General Hospital and Research Centre, Peshawar, Pakistan in the duration from September, 2024 to February, 2025. Sixty GBS patients who met the inclusion criteria underwent measurement of serum albumin both before and after treatment, neurological evaluation, and outcome evaluation.

Results: Lower baseline albumin was found to have a significant relation to a higher Hughes Functional Grading Scale score, higher ICU admissions, need for mechanical ventilation, and poorer recovery. A reduction in serum albumin levels was found to be measurable with plasmapheresis.

Conclusion: Serum albumin is an easy, inexpensive, and meaningful prognostic biomarker in GBS patients undergoing plasmapheresis, which helps risk stratification and individual care of the patient.

Keywords: Guillain–Barré syndrome, serum albumin, plasmapheresis, prognostic marker, Hughes Functional Grading Scale, neurological outcomes.

INTRODUCTION

Guillain-Barré (GBS) is a rapidly worsening immune-mediated polyradiculoneuropathy that is also symmetrically weak and areflexic and is commonly followed by infection. It remains one of the commonest causes of acute flaccid paralysis globally with high morbidity and potentially, but largely avertable, mortality when promptly not diagnosed and treated (1). The pathogenesis is a form of autoimmune attack on peripheral nerve components, leading to either demyelination or axonal degeneration, or both, resulting in a defect in nerve conduction. Routine interventions, including intravenous immunoglobulin (IVIG) and plasmapheresis, have been shown to reduce recovery time and improve functional outcomes (1,2). Relevant comparative studies suggest that the two modalities are equally effective, as all of them may be beneficial. The treatment mode can be based on variables such as availability, cost, patient tolerability, and disease severity (2). Clinical and lab measures of plasma biomarkers (accompanied by their immune activation and metabolism change reflections, and oxidative stress) may be useful in enhancing understanding of illness processes and the implications of treatment (3).

Serum albumin is one of the biomarkers and since it is a transport protein, several significant roles have also been found in its many actions, including preservation of oncotic pressure in plasma, regulation of inflammations, and the sequestering of free radicals. It has already been established that both catastrophic and prolonged changes in redox status of albumin occur as a result of plasmapheresis, and these changes can eventually impact the biological activity and prognostic significance of the protein (4). Albumin test may prove to be critical in the case of GBS patients who have gone through the various sessions of plasmapheresis treatment as it enables one to determine the success of such treatment and the status of the patient. The serum albumin also depends on the hepatic clearance and nutrition known to be correlated together with the clinical outcome in severe GBS. Albumin can be used as a prognostic factor independently, since, according to recent multicentre studies, the dynamically changing metabolic components of hepatic metabolism are associated with the level of involvement of this disease, the need to use ventilatory support, and hospital stays (5). In order to forecast others who have an increased probability of unfavorable outcomes, prognostic scoring schemes have been developed, and many of them incorporate the use of biochemical indexes in addition to clinical variables (6).

GBS may sometimes require intensive care producing the necessity to have prognostic indicators that would be known at an earlier stage so that the care can be intensified (7). The comparison of hyperglycemia with more severe cases and the establishment of a negative outcome and short-term paralysis have also supported the relation between metabolism pathologies and the severity of GBS further (8). Other biomarkers, including platelet-to-lymphocyte ratios and inflammatory cytokines, have shown promise in distinguishing GBS from other similar conditions and predicting it as well (9). Recent technology advances in machine learning have allowed such individual biomarkers (albumin is one) to be incorporated into a predictive model with encouraging accuracy (10). Such methods confirm the necessity of incorporating biochemical information into clinical practice to effectively manage GBS. GBS varies in clinical severity, including slight weakness to fulminant paralysis with extensive periods of necessary mechanical ventilatory support. In critical situations, it leads to admission to the ICU, and some of the management issues are to prevent complications, including infections, autonomic instability, and thromboembolism (11).

Another common treatment measure, plasmapheresis, has also been used effectively to treat several neurological conditions, notably GBS, where its potential to yield effective outcomes has been observed in decreasing the rate of progression and improving recovery (12). An inflammatory marker, the neutrophil-to-lymphocyte ratio (NLR), has also been linked to GBS prognosis, further promoting the use of readily accessible laboratory tests to inform prognosis (13). Predictive models are built by integrating clinical and biomarker data to predict the need for mechanical ventilation and the likelihood of long-term disability, thereby addressing resource allocation and differentiating care (14,15). The dosage of plasmapheresis sessions may also have an impact on clinical outcomes, similar to studies of other severe conditions, indicating a dose-response relationship in cases of neurological diseases (16,17). COVID-19 caused a resurgence of interest in GBS because SARS-CoV-2 infection

was found to be a possible causative factor of the syndrome. Post-infectious GBS in COVID-19 patients described in a case series brought up the concern of immune-mediated pathogenicity and prognostic implications (18).

More generally, recent reviews have highlighted progress in elucidating the pathophysiology of GBS, including the interrelationships between immune malfunction, oxidative stress, and metabolic imbalances, which may underlie the prognostic importance of serum albumin (19). It is in this backdrop that the current research aims at studying serum albumin as a standalone prognostic biomarker in GBS patients undergoing plasmapheresis. The reasoning is that, in addition to its known functions as a natural and hepatic functional parameter, albumin also indicates inflammatory status, the balance of oxidative stress, and biochemical alterations associated with treatment. Since plasmapheresis directly alters albumin levels and the redox state, its concentration may be a clinically useful measure of disease progression and therapy responsiveness.

Objective: To determine the value of serum albumin as an independent prognostic factor in Guillain-Barré syndrome patients undergoing plasmapheresis, evaluating its relationship with disease severity, response to treatment, and short-term clinical outcomes.

MATERIALS AND METHODS

Study Design: Prospective Observational Study.

Study Setting: The study was carried out at the at Department of General Medicine, Northwest General Hospital and Research Centre, Peshawar, Pakistan.

Duration of the Study: From September, 2024 to February, 2025.

Inclusion Criteria: Patients were recruited regardless of gender, aged 18 years or older, with a GBS diagnosis based on both clinical and electrophysiological criteria, and admitted to receive plasmapheresis. Informed consent was obtained from each patient, and a level of serum albumin was measured before the initial plasmapheresis.

Exclusion Criteria: Patients with a history of chronic liver disease, Nephrotic syndrome, severe malnutrition, or those who had received albumin supplementation before admission were excluded. Patients with incomplete medical files, or those who did not agree to participate, were also excluded.

Methods

All selected potential patients who met the inclusion criteria underwent extensive clinical evaluation, including a comprehensive neurological examination, baseline laboratory testing, and electrophysiological tests, to facilitate a diagnosis of GBS. Serum albumin levels were assessed before the initiation of plasmapheresis and after the specified (planned) number of treatment sessions had been applied. There were several exchanges (4-5) with a standard protocol, carried out over 7-10 days, in which plasma was replaced with fluid containing albumin, a standard practice in hospitals. At admission, following the completion of the last plasmapheresis session and at the time of discharge, clinical severity was measured as the Hughes Functional Grading Scale (HFGS). The demographic properties, comorbidities, time of illness before treatment, and the duration of stay in the ICU were also noted. Treatment complications were observed among patients, such as hypotension, electrolyte disturbance, and infection. The interaction between serum albumin levels, clinical improvement, and short-term outcomes was reported. The Institutional Review Board has approved the study of the hospital, and informed consent was obtained from all participants.

RESULTS

Sixty patients with Guillain-Barré syndrome (GBS) who received a plasmapheresis treatment were selected to participate in the study. The average age was 42.6 ± 13.5 years, with males being more prevalent (65%). The patients were brought in within two weeks after the onset of symptoms, and most of them (71.7%) had a variant known as acute inflammatory demyelinating polyradiculoneuropathy (AIDP) in **Table 1**.

Table 1: Baseline Characteristics of Study Participants

Variable	Value (n=60)
Mean age (years)	42.6 ± 13.5
Gender (Male/Female)	39 (65%) / 21 (35%)
Mean duration before admission (days)	8.4 ± 3.2
GBS Variant (AIDP/AMAN/AMSAN)	43/10/7
ICU admission required	28 (46.7%)
Mechanical ventilation	14 (23.3%)

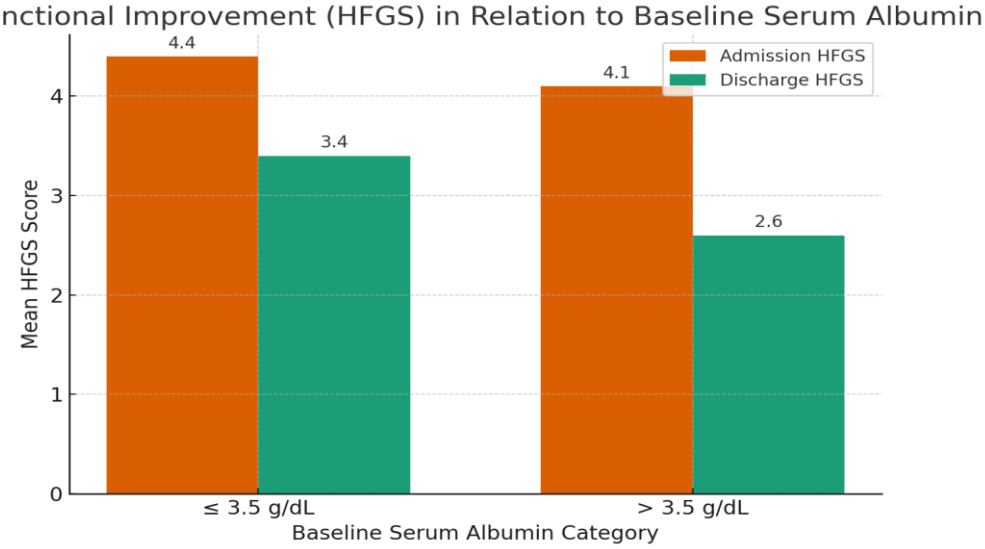
The average baseline serum albumin level was 3.48 ± 0.42 g/dL. After completing the plasmapheresis sessions, there was a significant drop in albumin levels (mean post-treatment albumin 3.11 ± 0.37 g/dL, $p < 0.001$). This lowering was steady among all subtypes of GBS. Changes in serum albumin before and after treatment were summarized in **Table 2**.

Table 2: Serum Albumin Levels Before and After Plasmapheresis

Time Point	Mean Albumin (g/dL) ± SD	*p*-value
Pre-treatment	3.48 ± 0.42	
Post-treatment	3.11 ± 0.37	<0.001

The Hughes Functional Grading Scale (HFGS) of clinical severity improved significantly after plasmapheresis. The HFGS score improved on average with a drop of 4.23 ± 0.61 at the time of admission to 2.98 ± 0.77 at discharge ($p<0.001$). Patients with a higher baseline albumin level (>3.5 g/dL) experienced significantly better functional recovery at follow-up tests compared to those with lower levels, as illustrated in **Figure 1**.

Figure 1: Functional Improvement (HFGS) in Relation to Baseline Serum Albumin



Patients in care assigned to an ICU bed had a significantly lower baseline albumin level (3.32 ± 0.39 g/dL) when stratified-adjusted to patients undergoing general ward care (3.61 ± 0.44 g/dL, $p = 0.02$). This relationship remained the same upon controlling for age, gender, and the type of disease, as shown in **Table 3**.

Table 3: Comparison of Albumin Levels by ICU Admission Status

Group	Mean Albumin (g/dL) ± SD	*p*-value
ICU patients	3.32 ± 0.39	0.02
Non-ICU patients	3.61 ± 0.44	

Fourteen patients (23.3%) required mechanical ventilation. There was significantly lower baseline albumin in the ventilated patients (3.18± 0.36 g/dL) compared to non-ventilated patients (3.57 ± 0.43 g/ dL, p=0.004). There were 3 of these patients (5 percent) who had mortality with the baseline albumin being less than or equal to 3.0 g/dL. The association of albumin class with a significant outcome is summarized in **Table 4**.

Table 4: Association of Baseline Albumin with Clinical Outcomes

Baseline Albumin Group	Ventilation Required	ICU Stay >10 Days	Mortality
≤3.0 g/dL (n=12)	8 (66.7%)	9 (75.0%)	3 (25%)
>3.0 g/dL (n=48)	6 (12.5%)	11 (22.9%)	0 (0%)
p-value	0.001	0.003	0.02

These findings, in general, indicate that serum albumin is not merely dependent on plasmapheresis but is closely related to the severity of the disease, ICU admission, the need for ventilation, and patient outcome in the short term. The high baseline proportion of serum albumin was associated with a fast recovery, along with reduced stay at the ICU, but low levels provided poor prognoses. This confirms the truth about the fact that albumin in serum can be regarded as an independent prognostic indicator of patients with GBS receiving plasmapheresis.

Discussion

This paper critically analyzes the potential use of serum albumin in predicting the outcome in those patients with Guillain-Barr (GBS) who have been subjected to plasmapheresis. The outcomes indicated that low basal serum albumin was correlated with worse disease condition, their need of intensive care, their increased chance of being ventilated, and no good short-term prognosis. It enhances the new emerging idea that biochemical markers may be employed as prognostic markers in GBS. GBS is also portrayed as a severe complication which causes acute neuromuscular system paralysis. It has an unpredictable clinical presentation that could be as simple as weakness to a respiratory crisis. Predicting patients whose outcomes are at risk of being poor beforehand is extremely necessary to offer timely intervention and allocate resources wisely. Pheresis and intravenous immunoglobulin (IVIG) are two rigorously proven therapies for treating GBS, which have similar success rates in reducing the progression of the disease and shortening the time to disability (1). Treatment selection has depended on institutional availability of resources, patient-specific factors, and contraindications to treatment. Plasmapheresis has long been used as the treatment of choice in most centers for severe or rapidly progressive disease.

Various clinical and laboratory parameters determine whether GBS is resolved. In the previous research, it was revealed that even with adequate treatment, long-term disability and mortality are not rare, which proves the significance of prognostic indicators (2). Pre-albuminemia serum in our study also proved to be an effective correlating factor, easy to measure, and with a simple clinical outcome. This is consistent with studies indicating that plasma biomarkers are relevant in identifying the immune reactions underlying the pathogenesis of GBS (3). The relationship between plasmapheresis and fluctuations of serum albumin can be explained. Not only is albumin lost in the process, but it is also subjected to redox changes that may result in a loss of antioxidant and transport functions (4). Such biochemical shifts may aggravate processes of oxidative stress and inflammation in GBS, leading to their influence on the process of recovery.

Additionally, our results are supported by evidence of the correlation between liver metabolism and the clinical outcome of severe GBS. Dynamic hepatic dysfunction may reduce circulating albumin levels due to both acute-phase inflammatory processes and a nutritional deficiency, which has been shown to potentially worsen prognosis (5). Since most GBS patients have impaired mobility and higher metabolic requirements when they are sick, it is crucial to ensure proper nutritional and hepatic functioning. Tools, including age, baseline disability, and respiratory involvement at the bedside, have been suggested to indicate early prognostic clinical scoring systems that predict the need for mechanical ventilation or long-term support (6).

Nonetheless, there is a tendency for such tools not to include readily available laboratory variables, such as albumin. Adding albumin to these models may enhance their predictive capability, especially in areas where complex testing is not available due to resource limitations. The ICU care of GBS patients entails the early identification of patients at risk of deteriorating. Serum albumin in this context can be used as a bedside indicator to triage patients to a higher level of observation and care (7). Our findings indicated that low baseline albumin indicated a greater likelihood of proceeding to ICU admission and ventilation, as is consistent with the notion of hypoalbuminemia being a marker of disease severity. Other metabolic aberrations have also been linked to the severity of GBS. To take an example, poor short-term prognosis has been associated with hyperglycemia at admission (8). Such findings, in conjunction with our results, indicate that metabolic and nutritional biomarkers can be useful in assessing prognosis that cannot only be addressed using mere neurological evaluations.

Inflammatory markers have become the focus in distinguishing between GBS and other neuropathies similar to it, as well as in disease prognosis. An example includes the high platelet-to-lymphocyte ratios and proinflammatory cytokines, which are viewed as diagnostic and prognostic aids (9). Serum albumin, which has an anti-inflammatory effect, can indirectly measure the level of systemic inflammation in GBS. Machine learning methods have also shown promise in incorporating a wide range of clinical and laboratory data, such as albumin, to enhance prognostic accuracy (10). Our research did not utilize such computational models, and existing correlations between albumin and clinical outcomes leave room to consider albumin as a possible variable in predictive algorithms that could be later incorporated into GBS. In extreme circumstances, there is usually a need to be admitted to the intensive care unit to be closely monitored and treated for complications like autonomic dysfunction, respiratory failure, and infection (11). The results obtained reveal that albumin levels are lower in ICU patients in most cases, indicating that albumin may act as an overall physiological reserve marker.

Plasmapheresis alone is a feasible therapy for neurological conditions, such as GBS, in decades of clinical trials (12). It should be noted that, due to the procedure's mechanism of action, there is a risk of unintentionally increasing albumin levels, which may impact the outcomes. This supports the need to observe and, in case of necessity, correct hypoalbuminemia throughout therapy. The latest meta-analyses have indicated that hematological indices, such as the neutrophil-to-lymphocyte ratio, are associated with a poor prognosis in GBS (13). Our findings apply the same concept to serum albumin, lending support to the notion that serum albumin is a constituent of a panel of prognostic laboratory indicators. Respiratory failure constitutes one of the deadliest complications of GBS, and the studies designed to predict the necessity of mechanical ventilation due to respiratory failure have already appeared (14). Indicators such as the mEGOS score have already been validated as prognostic, but have yet to include albumin (15). The addition of albumin to these tools may enhance the discriminative power, especially early on in the disease course, of high-risk patients.

The effect of plasmapheresis session quantity on clinical outcomes has been observed in other severe diseases, with the outcome indicating that treatment intensity may interfere with initial patient conditions, such as albumin status (16). In pancreatitis caused by hypertriglyceridemia, the length of stay in plasmapheresis, in particular, is associated with a better prognosis (17), suggesting a potential role for therapy and biomarker coupling in general policy. COVID-19 has also demonstrated the complexity of GBS since SARS-CoV-2 infection has been linked with subsequent post-infectious GBS cases (18). Additional inflammatory and metabolic changes, with possible effects on albumin concentrations and outcome, can characterize such cases. The importance of integrating biochemical, clinical, and electrophysiological results to achieve optimal GBS management outcomes has been highlighted in recent literature reviews (19). A combination of several factors aligns well with our research, with serum albumin being a cost-effective, accessible, and prognostically significant parameter for prognostic evaluation.

Conclusion

This research demonstrates that serum albumin is a valuable standalone prognostic indicator in patients with Guillain-Barré syndrome who undergo plasmapheresis. Higher baselines of albumin

were significantly correlated with the severity of the disease, along with higher levels of ICU admission, need to resort to mechanical ventilation, and negative short-term outcomes. Although plasmapheresis helped enhance the neurological status, it was found to lead to a measurable reduction of albumin levels, a fact that necessitates its regular examination during treatment. The results indicate that serum albumin also reflects nutritional and hepatic status, as well as the presence of inflammation and oxidative state, in influencing recovery. Albumin has excellent accessibility, low cost of measurement, and easy measurement, all of which make it usable in the available prognostic models to improve risk stratification, especially in resource-limited settings. Proper nutrition and supportive therapy earlier in the course of GBS patients may help in improving overall prognosis and functional recovery after plasmapheresis, as early recognition of hypoalbuminemia. These findings should be further proved using multicenter studies.

References

1. Khan MH, Islam MK, Rahman S, Rahman AF, Sarker SK, Mohsin M, Salim M, Tanvir SM, Habibullah M, Hossain MM. Effectiveness of plasmapheresis and IVIG in the treatment of Guillain-Barre syndrome: a cross-sectional observational study. Bangladesh Critical Care Journal. 2023 Oct 4;11(2):95-102.
2. Meregildo-Rodriguez ED, Bardales-Zuta VH. Mortality and disability reported after immunoglobulins or plasmapheresis treatment of Guillain-Barré syndrome. Le infezioni in medicina. 2021 Dec 10;29(4):589.
3. Wu CL, Chao CH, Lin SW, Chien YY, Huang WY, Weng WC, Su FC, Wei YC. Case report: Plasma biomarkers reflect immune mechanisms of Guillain–Barré Syndrome. Frontiers in Neurology. 2021 Sep 3;12:720794.
4. Boss K, Stettner M, Szepanowski F, Mausberg AK, Paar M, Pul R, Kleinschnitz C, Oettl K, Kribben A. Severe and long-lasting alteration of albumin redox state by plasmapheresis. Scientific Reports. 2022 Jul 16;12(1):12165.
5. Xie J, Yu H, Lv W, Li K, Li H, Ji Y, Cai Y, Cheng Y, Luo L, Wu C, Xu Y. Association of dynamic hepatic metabolism with clinical outcomes in patients with severe Guillain-Barré syndrome: A prospective cohort study from multi-centers in China. Journal of the Peripheral Nervous System. 2024 Dec;29(4):415-27.
6. Di X, Wang J, Li L, Liu L. Establishment of a single-center-based early prognostic scoring system for Guillain-Barré syndrome. BMC neurology. 2023 Mar 4;23(1):97.
7. Rao GU. Critical Care in Guillain–Barré Syndrome. Journal of Neuroanaesthesiology and Critical Care. 2024 Jun;11(02):077-85.
8. Bhatele P, Pai AR. Correlation between elevated blood and cerebrospinal fluid glucose levels and the severity and short-term prognosis of Guillain–Barré syndrome. Acta Neurologica Belgica. 2025 Jun 5:1-8.
9. Song S, Bai Y, Mu H, Xiao J, Li W, Zhao Y, Yan C, Zheng J, Wang C, Wang Q. An auxiliary diagnostic strategy for distinguishing Guillain–Barré syndrome and chronic inflammatory demyelinating polyneuropathy: combining platelet-to-lymphocyte ratio and cerebrospinal fluid interleukin-8 levels. BMC neurology. 2025 Jul 30;25(1):314.
10. Guo J, Zhang R, Dong R, Yang F, Wang Y, Miao W. Interpretable Machine Learning Model for Predicting the Prognosis of Guillain-Barré Syndrome Patients. Journal of Inflammation Research. 2024 Dec 31:5901-13.
11. Diale MI. Management, morbidity and mortality of Guillain Barré syndrome patients admitted to ICU at Universitas Academic Hospital (Doctoral dissertation, University of the Free State).
12. Aras MR, PANPALLI ATES M, Albayrak M, AFACAN OZTURK HB, Yildiz A, Yilmaz F, Saglam B, Comoglu SS. Therapeutic Plasma Exchange in Neurological Disorders: A 9-year Experience. UHOD: International Journal of Hematology & Oncology/Uluslararasi Hematoloji Onkoloji Dergisi. 2022 Oct 1;32(4).
13. Cabanillas-Lazo M, Quispe-Vicuna C, Cruzalegui-Bazan C, Pascual-Guevara M, Mori-Quispe N, Alva-Diaz C. The neutrophil-to-lymphocyte ratio as a prognostic biomarker in Guillain-Barre

syndrome: a systematic review with meta-analysis. Frontiers in neurology. 2023 Jun 2;14:1153690.
14. Yao J, Zhou R, Liu Y, Liu Y, Cao Q, Lu Z. Predicting of mechanical ventilation and outcomes by using models and biomarker in Guillain-Barré syndrome. Neurology and Therapy. 2023 Dec;12(6):2121-32.
15. Xue G, Zhang Y, Wang R, Yang Y, Wang H, Li J, He X, Zhang Q, Yang X. Construction and evaluation of a prognostic prediction model based on the mEGOS score for patients with Guillain-Barré syndrome. Frontiers in Neurology. 2023 Nov 30;14:1303243.
16. Porosnicu TM, Sandesc D, Jipa D, Gindac C, Oancea C, Bratosin F, Fericean RM, Kodimala SC, Pilut CN, Nussbaum LA, Sirbu IO. Assessing the outcomes of patients with severe SARS-CoV-2 infection after therapeutic plasma exchange by number of TPE sessions. Journal of Clinical Medicine. 2023 Feb 22;12(5):1743.
17. Nguyen HT. Evaluate the efficacy of plasmapheresis therapy in patient with hypertriglyceridemia-induced pancreatitis in108 Military Central Hospital from January 2016 to January 2023 (Master's thesis).
18. Chakraborty U, Hati A, Chandra A. Covid-19 associated Guillain-Barré syndrome: A series of a relatively uncommon neurological complication. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2021 Nov 1;15(6):102326.
19. Zahir F, Zainab G, Karim MA. Guillain-barré syndrome: Recent approaches in pathophysio-logy, diagnosis and management. Int. J. Biol. Biotech. 2024;21(3):299-306.