IJBPAS, March, 2026, 15(3): 1336-1349

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

A REVIEW ON: GUILLAIN-BARRE SYNDROME

TADAKHE VS[1*] AND BHANGALE CJ[2]

1: Department of Quality Assurance, PRES college of Pharmacy (For women), Chincholi, Nashik, Maharashtra, India

2: Ph.D., Department of Pharmaceutical Chemistry, PRES college of Pharmacy (For women), Chincholi, Nashik, Maharashtra, India

***Corresponding Author: Ms. Vaishnavi S. Tadakhe: E Mail: tadakhevaishnavi711@gmail.com**

Received 24th Dec. 2024; Revised 20th Jan. 2025; Accepted 20th March 2025; Available online 1st March 2026

https://doi.org/10.31032/IJBPAS/2026/15.3.9993

ABSTRACT

Background and purpose: Since Guillain-Barre Syndrome, and Strohl first described Guillain-Barre syndrome (GBS) in 1916, the syndrome has received significant attention in the literature. In order to identify prospective directions for further research, the author examines the history of studies on its pathophysiology and therapy.

Results: The present International Guillain-Barre Syndrome research, involving 2000 patients, is the result of previous investigations that have shown the clinical spectrum of GBS since the early 1900s. The most common kind, (AIDP), was discovered in the 1950s and 1960s to be inflammatory in character. In the 1990s, two types of axons were identified: acute motor-sensory neurotoxic neurotoxicity and severe motor axonal neuropathy. In the 1990s and early 2000s, antibodies against the bacteria Campylobacter jejuni glycans were found to react with glycolipids upon axonal membranes, resulting in these forms. Although the precise cause of Acute Inflammation Demyelinating Polyneuropathy is uncertain, the immune system's responses to the compact synaptic proteins P2 and P0, which cause experimental immune neuritis, suggest the importance of T cells. Corticosteroids were not found to be beneficial in randomized controlled studies conducted throughout the 1970s and 1980s.

Experiments in the 1980s and 1990s demonstrated the advantages of intravenous immunoglobulin and plasma exchange, respectively.

Conclusions: Future research should look for indications to identify smaller groups with different therapeutic responses, conduct population-based epidemiological research to delineate the disease's true history of nature, analyze pathologists in the initial stages corpses, and validate immune system responses of T cells in AIDP. To incorporate responsible antibodies and improve therapy studies to include anti-T-cell treatments.

Keyword: Guillain-Barre Syndrome, Immunology, pathogenesis, pathology, Neurophysiology, treatment

INTRODUCTION

One of the most severe neurological conditions is Guillain-Barre syndrome, which can leave a person totally immobilized and dependent on a ventilator in a matter of days. Guillain-Barre, and Strohl identified a distinct clinical condition characterized by a quick commencement of extremity weakness, lack of tendon reflexes, elevated cerebrospinal fluid (CSF) fluid protein exhibiting a standard cellular count. The syndrome is heterogeneous according to later clinical, neurophysiological, and pathological investigations. The pathophysiology of demyelinating and axonal subtypes has been examined in more sophisticated pathological and immunological investigations. Collaborations at national and international levels have accelerated efforts to define and forecast disease course and identify triggering infections. Management criteria have been established by an international consensus group. Effective medicines have been identified through multicentre trials, and pharmaceutical corporations are showing an interest. This review suggests directions for further research based on the history of GBS research **[1]**.

(AIDP) is the most frequent subtype in Western countries, and it is predominantly defined by demyelinating pathology with various degrees of secondary axonal damage. Acute motor axonal neuropathy (AMAN) **[2]**.

CLINICAL FEATURES

Numerous studies performed in different nations have determined that the prevalence of GBS is roughly 1 in 100,000. It is marginally more prevalent in men, and its incidence increases with seniority **[3, 4]**. In 1916, Guillain-Barre, and Strohl distinguished GBS from other causes of acute ascending paralysis, emphasizing the absence of tendon reflexes and the high cerebrospinal fluid protein content and normal cell count **[5]**.

Leg sensory sensations usually signal the beginning of the disease, which is followed by a sharp increase in weakening that begins distal and moves proximally. A common complaint is lumbar discomfort, which could be a sign of inflammation in the nerve

roots and possibly a breach in the CSF barrier that allows proteins to enter the CSF. GBS-related weakness typically has a "pyramidal distribution," with notable impairment in knee and hip flexion as well as ankle dorsiflexion. Arm weakness is often most pronounced after shoulder abduction and elbow extension. While sensory symptoms are common, they are usually minor and often limited to reduced vibration and proprioception. The presence of diminished or absent reflexes, along with a lack of significant large fiber sensory loss yet full paralysis, often leads to misdiagnosis as hysteria. Respiratory complications can occur abruptly and unexpectedly; however, there is typically a gradual decline in vital capacity, necessitating intubation and ventilation when it reaches around 1 Liter **[6]**.

A limited number of patients exhibit atypical symptoms, like papilledema **[7]**, which is believed to be a consequence of cerebral oedema and low sodium levels (Hyponatremia) **[8]**. Three-quarters of patients experience mild autonomic disruption, whereas a small percentage experience severe bradyarrhythmia, which is a contributing factor in rare fatalities. In most population studies, mortality ranges from 5 to 10% **[9]**. It is a monophasic condition, with weakness peaking in four weeks, followed by a plateau phase and recovery. Within 12 months, 60% of patients can walk without assistance, whereas the remaining patients still experience lingering symptoms to varying degrees **[10]**.

A history of a prior illness, usually respiratory or gastrointestinal, which may have been developed so little as to be completely asymptomatic, is reported by three-quarters of patients. The neuropathy often starts 7–10 days following any triggering infection. Many more antecedent events are described, including vaccination and surgery. Recent epidemiological studies have shown that the risk of an immunization causing GBS is quite low **[11]**. The risk of contracting GBS from influenza is estimated to be significantly higher than the risk of contracting GBS with the existing influenza vaccine. Based on serological research, the most prevalent antecedent infections are Cytomegalovirus, Epstein-Bar virus, and Campylobacter jejuni. Patients could occasionally keep on doing the produce Candida jejuni in their feces for as long as three months after the onset of GBS **[12]**. It is quite uncommon to have a persistent CMV or EBV infection. Numerous reports link varicella, influenza, and mycoplasma pneumonia to GBS **[13]**.

PATHOLOGY

Since few individuals in GBS die, autopsy studies are limited. Early research revealed a limited inflammatory infiltration and peripheral nerve oedema. The significance

of perivascular lymphocytes was underlined in classic investigations by Asbury and colleagues, which were similar to the results in the experimental allergic neuritis animal model **[14]**. The way that GBS was believed to be created was greatly influenced by their theory that the degeneration involving those lymphocytes had an immunological basis. Electron microscopy studies on nerve samples have revealed demyelination associated with macrophages. It appears that macrophages phagocytosed myelin pieces after entering into the Schwann cell wall **[14, 15]**. This time, monocytes were found located between myelin and axons, namely around the Ranvier node. Axonal damage and limited infiltration of inflammatory agents are found in AMAN pathological studies **[16]**. According to pathological research, the macrophage is the cause of nerve injury, however antibodies may also target the myelin or axon. Similar degenerative alterations occur in AMSAN, although both motor and ventral nerve roots are affected **[17]**.

IMMUNOLOGY

GBS must have an immunological etiology, as evidenced by the identification of a correlation between the condition and several triggering infections. The neurological alterations, which included macrophage targeting and nerve degeneration in at least AIP, which might be used to maintain an antibody-mediated disease, supported theory. The efficiency of blood exchange in shortening the healing period further supported the serum factor regulating the sillness. Melnick **[18]** was one of the first to make available data suggesting that complement-fixing antibodies might exist during the initial stages of GBS starting in the 1960s. Sensitive C1 esterase activity assays demonstrated complement absorption and its role in the disease, notwithstanding the difficulty of reproducing these findings **[19]**. Demyelinating neuropathy in rabbits vaccinated with galactocerebroside suggests that autoantibodies against myelin antigens may be the cause of neuropathy **[20]**. The underlying mechanism of human disease is comparable to the laboratory model of allergic neuritis brought on by administering peripheral nerve adjuvants to sensitive species. EAN can be triggered for each individual myelin protein molecules, such as P0 and P2, and disease can be transmitted when lines of T cells react with P2 **[21, 22]**. As a result, many studies were conducted to check for antibody towards P2, P0, along with additional antigens of proteins in GBS, nevertheless the majority of these studies were unsuccessful **[23]**. The 1980s saw the discovery of lipid-recognizing antibodies, which are now more often identified in particular subgroups of GBS **[24]**. Nearly all Miller Fisher Sickness patients (95%) have antibodies against the ganglioside GQ1b

[25, 26]. This syndrome is thought to be closely related to GBS, and these antibodies play a role in its pathogenesis. It was also found that the antibodies from GBS with ophthalmoplegia and Bickerstaff's encephalitis were comparable **[27, 28]**. Using mouse hemidiaphragm preparations, antiGq1b monoclonals stained with antibodies the junction of neuromuscular tissue where they retained complement and linked similarly to patient serum for in vitro assays **[29]**.

It was discovered that antiganglioside antibodies are linked to AMAN **[30]**. These models have also been applied to rabbit illness models in animals **[31]**. Additionally, ganglioside-immunized patients **[32]**. added to the body of evidence indicating a pathology for GBS involving complement-fixing antibodies against human gangliosides, were known to develop neuropathology under specific conditions.

Although substantial evidence linking antiganglioside antibodies to MFS and AMAN has been reported, the most prevalent kind of GBS in Western nations (AIDP) has rarely been linked to ganglioside antibodies using standard methods **[33]**. Antibodies against complexes of numerous gangliosides enhance the occurrence of antiganglioside antibodies, despite the fact that there currently exists few published research on this topic **[34, 35]**. We look forward to these. Usually produced with the help of T cells, immunoglobulin against gangliosides are classified as either the IgG1 or IgG3 subtype. Since T cells penetrate the pathogenic lesion that surrounds the GBS nerve, they probably aid in the production of antibodies. According to a number of studies, individuals with GBS had elevated periphery blood concentrations of activated T lymphocytes **[36]**, altered regulatory T cells **[37]**, and elevated T-cederived cytokine levels **[38]**. YT cells that can recognize nonprotein antigenic substances like these substances have been isolated from gastrointestinal bleeding nerves, but they may additionally originate from vasculitis patients **[39]**. fortunately, there isn't enough conclusive evidence, it's conceivable that these types of T cells might have been that participated. CD1, and these has been elevated in the nervous systems of GBS individuals, limits YT cells **[40]**. Yet, there is no clear CD1 polymorphism linked to GBS **[41]**. The first studies looking at T cell expression of protein antigens, such as the P2 Protein, which is and these were linked to EAN, were unsuccessful.

Cytomegalovirus, in addition **[48]** Therefore, it would seem plausible to hypothesize that contamination both one of these agents results in the development of anti-Ophthalmoplegia, which degrades myelin by reacting with these substances and other glycolipids. The breakdown and conduction failure may come from

stimulation of complement or autoantibodies that target macrophages via the fc receptor. To cause disease, these specific antibodies would need to pass across the blood-nerve barrier. Active T cells may reduce the blood–nerve barrier, allowing anti-neural immunoglobulin to cause nerve damage, according to EAN studies **[49, 50]**. Naturally, a nonspecific event that allows antigen-specific antibodies to enter and cause disease could be a breach of the blood-nerve barrier. Matrix metalloproteinases have been proposed as the mediators of barrier degradation **[51]**. Certain elements of the generating infection may boost immunological sensitivity to a given drug. Certain C. jejuni serotypes appear to be more susceptible to the development of these autoreactive antibodies, possibly due to their inclusion of more neurogenic epitopes **[52, 53]**.

It is estimated that the probability of GBS after C. jejuni intestinal inflammation occurs at approximately 1 in 1000. Genetic and immunologic factors must be working together in order to affect this risk. There is generally a dearth of research on the connection connecting HLA and GBS **[54, 55]**. Very few familial instances of GBS have been reported **[56, 57]**.

While anti-ganglioside antibodies are among the most commonly reported antibodies in GBS, here are other observations regarding antibodies that may be detrimental in a small number of individuals. Antibody molecules against a protein known as "neurofascin" that is present in the neural tube of Ranvier have been the subject of recent studies; in one study, 4% of AIDP patients had positive blood tests **[58]**.

NEUROPHYSIOLOGY

The diagnosis and classification of the GBS subtype can be improved by applying neurophysiology. Tiny action potentials, protracted distal motor latency, delayed F waves, and conduction block are frequently seen in early diagnosis of the condition **[59]**. Sometimes a peripheral nerve issue requires a repeat study since the previous one is abnormal. Axonal variations of the medical condition are characterized by reduced motor and/or perceptual activity potentials with degeneration potentials following the completion of the acute form of the illness. Only 3% of studies carried out within three weeks of commencement indicated axonal damage, although 69% of neurophysiological tests performed within the framework of the European IvIg and Corticosteroid research were consistent with AIDP. The 23% of trials that were equivocal at the beginning of the process could have led to axonal dominance **[60]**.

TREATMENT

Patients benefit from the spontaneous improvement of GBS, whereas researchers seeking efficient treatments suffer as a

result. A prognostic score system developed by the Rotterdam group that enables reasonably accurate future outcome prediction for individual patients has been improved and recalculated using the IGOS database **[61]**. Older age, prior diarrhea, and the degree of weakness are significant bad prognostic factors. Future studies should investigate whether the predictive algorithm's accuracy can be improved by including more items, particularly disease subtypes and antibodies against brain antigens.

For many years, corticosteroids have been used with conflicting claims regarding their efficacy. Their apparent efficacy was only acknowledged to be illusory after they were examined in sizable national and later worldwide double randomized controlled trials **[62]**. However, plasma exchange functions effectively. According to a North American study with 245 participants in the 1980s, it reduced the amount of time ventilated patients spent walking without assistance by a month or more (from a standard deviation of 85 days to the median of 53 days) and the quantity of time they spending time on the ventilator by half (which lasted from a median values of 48 days to 24 days) when compared to supportive treatment **[63]**. A Cochrane analysis backed up this finding, and large-scale French trials confirmed it **[64]**. Despite not having been confirmed in a placebo-controlled experiment, plasma exchange has become widely accepted as a treatment of first resort for GBS since it is immoral to do sham exchange on very sick patients **[65]**.

Small capacity plasma transfers are being investigated as a possible alternative to traditional plasma exchange in resource-constrained regions of the world **[66]**. Since plasma exchange is currently regarded as the standard of care, it was vital to compare new treatments with it. In a Dutch trial, injections of immunoglobulin (IVIg) were demonstrated to have results that were at least as efficacious as plasma exchange; this conclusion was echoed in other studies and confirmed by a Cochrane review **[67, 68]**. Thus, IVIg is also accepted as a first-line treatment. The additional IVIg course proved to be more effective and was associated with more severe adverse effects **[69]**.

No discernible impact has been found for any of the other treatments that have been explored thus far **[70]**. Due to its rarity, variability, and varied course, GBS makes randomized controlled studies challenging. Therefore, large sample sizes are required to detect substantial effects. Furthermore, it is ethically required to provide one of the conventional medicines to both treatment groups while searching for a potential novel treatment’s additive effect. Multinational multicentre research is necessary because conventional randomised controlled trials

require large numbers. The pharmaceutical sector has shown interest in the topic in spite of these challenges. Trials of complement inhibitors, the IgG-cleaving enzyme imidase, which was isolated from Streptococcus pyogenes, and the newborn Fc receptor blocker efgartigimod alfa, which lowers IgG levels, are either planned or currently underway **[71, 72]**. The IgG and complement-dependent fundamental pathophysiology of GBS is the basis for these treatments. If the results of response from T cells during the initial GBS are confirmed, intervention with one of the many anti-T-cell drugs currently available should be investigated. Because statistical examination must take into consideration a large number of important baseline characteristics, conducting randomised clinical trials including contemporary controls in GBS is difficult **[73]**. and new techniques for evaluating innovative therapies are required. Drugs, dosages, and concentrate on participant groups could be chosen using screening trials analysed using Bayesian statistical methods and predetermined efficacy boundaries based on historical the form of databases, like IGOS, even though we will still rely on traditional placebo-controlled research for registering new treatments. Axonal and degenerative subtypes should ideally be differentiated at randomization; however, this is challenging because the electrophysiology subtype may alter throughout time and necessitate repeated investigations for verification. Currently, the electrophysiology subtype is not thought to have an impact on therapy selection. But rather than being supported by evidence, this conclusion is based on its absence.

Future research should randomly select different subgroups and look for differences in the reactions of those groups. To determine the best method for classifying subtypes, more investigation is needed. Trials that compare the efficacy of each subtype must have sizable enough sample numbers. It is hoped that autoantibodies or additional biomarkers particular for AIDP may be discovered and prove useful in selecting the appropriate treatment, given the encouraging results of methotrexate in patients with moderate GBS and panneurofascin inhibitors **[74]**.

However, this conclusion is predicated on the lack of evidence rather than its presence. Future studies should determine various subgroups at randomisation and search for variations in their responses. More research is required to identify the most effective subtype classification technique Trials that compare the efficacy of each subtype must have sizable enough sample numbers. It is hoped that antibodies or additional biomarkers specific for AIDP may be discovered and prove useful in selecting the appropriate treatment, given the

encouraging results of rituximab in patients with moderate GBS and panneurofascin antibodies **[75]**. Last but not least, the person laying in bed is frail, exhausted, frequently in pain, and quite afraid. Throughout the course of the illness, professional nursing, medical, and holistic care should be the primary focus of immunotherapy use and medication trials.

ACKNOWLEDGEMENT

The principal of the PRES College of Pharmaceutical (For Women), Chincholi, Nashik, is commended by the writers for providing the necessary facilities for carrying out this review.

REFERENCES

[1] Hughes, Richard A C. "Guillain-Barré syndrome: History, pathogenesis, treatment, and future directions." European journal of neurology vol. 31(11) ,2024 ,6346.

[2] Griffin J., Li C., Ho T. *et al*., "Guillain-Barre syndrome ´ in northern China. The spectrum of neuropathological changes in clinically defined cases," Brain, vol. 118, no. 3, 1995, 577–595.

[3] McGrogan A., Madle G. C., Seaman H. E., and De Vries C. S., "The epidemiology of Guillain-Barre syndrome worldwide: a ´systematic literature review," Neuroepidemiology, vol. 32, no. 2, 2009, 150–163.

[4] Sejvar J. J., Baughman A. L., Wise M., and Morgan O. W., "Population incidence of Guillain-Barre syndrome: a systematic ´ review and meta-analysis," Neuroepidemiology, vol. 36, no. 2, 2011, 123–133.

[5] Guillain G, Barré JA, Strohl A. Surun syndrome de radiculonévrite avec hyperalbuminose du liquide céphalo-rachidien sans réaction cellulaire. Remarques sur les caractéres cliniques et graphiques des réflexes tendineux. Bull Soc Méd Hôp Paris. vol.40,19161,462-1470.

[6] Lawn N. D., Fletcher D. D., Henderson R. D., Wolter T. D., and Wijdicks E. F., "Anticipating mechanical ventilation in Guillain-Barre syndrome," ´ Archives of Neurology, vol. 58, no. 6, 2001, 893–898,.

[7] Reid A. C. and Draper I. T., "Pathogenesis of papilloedema and raised intracranial pressure in Guillain-Barre syndrome," ´ British Medical Journal, vol. 281, no. 6252, 1980, 1393–1394,.

[8] Colls B. M., "Guillain-Barre syndrome and hyponatraemia," ´ Internal Medicine Journal, vol. 34, no. 4, 2004, 218.

[9] Souayah N., Nasar A., Suri M. F. K., and Qureshi A. I., "National trends in hospital outcomes among patients with Guillain-e´ syndrome requiring mechanical ventilation," Journal of Clinical Neuromuscular Disease, vol. 10, no. 1, 2008 ,24–28,.

[10] Winer J. B., Hughes R. A. C., and Osmond C., "A prospective study of acute idiopathic neuropathy. I. Clinical features and their prognostic value," Journal of Neurology Neurosurgery & Psychiatry, vol. 51, no. 5, 1988, 605–612.

[11] Bardage C., Persson I., Ortqvist A., Bergman U., Ludvigsson J. F., and Granath

F., "Neurological and autoimmune disorders after vaccination against pandemic influenza A (H1N1) with a monovalent adjuvanted vaccine: population based cohort study in Stockholm, Sweden," BMJ, vol. 343, 2011,5956,.

[12] Goddard E. A., Lastovica A. J., and Argent A. C., "Campylobacter 0:41 isolation in Guillain-Barre syndrome," ´ Archives of Disease in Childhood, vol. 76, no. 6, 1997, 526–528,.

[13] Cresswell F., Eadie J., Longley N., and Macallan D., "Severe Guillain-Barre syndrome following primary infection with ´ varicella zoster virus in an adult," International Journal of Infectious Diseases, vol. 14, no. 2, 2010 ,161–e163.

[14] Asbury A. K., Arnason B. G., and Adams R. D., "The inflammatory lesion in idiopathic polyneuritis. Its role in pathogenesis," Medicine, vol. 48, no. 3, 1969 , 173–215.

[15] Prineas J. W., "Acute idiopathic polyneuritis. An electron microscope study," Laboratory Investigation, vol. 26, no. 2, 1972 ,133–147.

[16] Griffin J. W., Li C. Y., Macko C. *et al*., "Early nodal changes in the acute motor axonal neuropathy pattern of the Guillain-Barre´ syndrome," Journal of Neurocytology, vol. 25, no. 1, 1996, 33–51.

[17] Griffin J. W., Li C. Y., Ho T. W. *et al*., "Pathology of the motorsensory axonal guillain-barre syndrome," ´ Annals of Neurology, vol. 39, no. 1, 1996, 17–28.

[18] Melnick S. C., "Thirty-eight cases of the Guillain-Barre syn- ´ drome: an immunological study," British Medical Journal, vol. 1, no. 5327, 1963, 368–373.

[19] Koski C. L., Humphrey R., and Shin M. L., "Anti-peripheral myelin antibody in patients with demyelinating neuropathy: quantitative and kinetic determination of serum antibody by complement component 1 fixation," Proceedings of the National Academy of Sciences of the United States of America, vol. 82, no. 3, 1985, 905–909.

[20] Saida T., Saida K., Silberberg D. H., and Brown M. J., "Experimental allergic neuritis induced by galactocerebroside," Annals of Neurology, vol. 9, 1981, 87–101.

[21] Hartung H.-P., Schafer B., Fierz W., Heininger K., and Toyka K. V., "Ciclosporin A prevents P2 T cell line-mediated experimental autoimmune neuritis (AT-EAN) in rat," Neuroscience Letters, vol. 83, no. 1-2, 1987, 195–200.

[22] Zhu J., Pelidou S.H., Deretzi G. *et al*., "P0 glycoprotein peptides 56–71 and 180–199 dose-dependently induce acute and chronic experimental autoimmune neuritis in Lewis rats associated with epitope spreading," Journal of Neuroimmunology, vol. 114, no. 1, 2001, 90–106.

[23] Hughes R. A. C., Gray I. A., and Gregson N. A., "Immune responses to myelin antigens in Guillain-Barre syndrome," ´ Journal of Neuroimmunology, vol. 6, no. 5, 1984,303–312.

[24] Quarles R. H., Ilyas A. A., and Willison H. J., "Antibodies to glycolipids in demyelinating diseases of the human peripheral nervous system," Chemistry and

Physics of Lipids, vol. 42, no. 1– 3, 1986, 235–248.

[25] Chiba A., Kusunoki S., Shimizu T., and Kanazawa I., "Serum IgG antibody to ganglioside GQ1b is a possible marker of Miller Fisher syndrome," Annals of Neurology, vol. 31, no. 6, 1992, 677– 679.

[26] Willison H. J., Veitch J., Paterson G., and Kennedy P. G. E., "Miller Fisher syndrome is associated with serum antibodies to GQ1b ganglioside," Journal of Neurology Neurosurgery & Psychiatry, vol. 56, no. 2, 1993, 204–206.

[27] Odaka M., Yuki N., and Hirata K., "Anti-GQ1b IgG antibody syndrome: clinical and immunological range," Journal of Neurology Neurosurgery & Psychiatry, vol. 70, no. 1, 2001, 50–55.

[28] Odaka M., Yuki N., Yamada M. *et al*., "Bickerstaff 's brainstem encephalitis: clinical features of 62 cases and a subgroup associated with Guillain-Barre syndrome," ′ Brain, vol. 126, no. 10, 2003, 2279–2290.

[29] O'Hanlon G. M., Plomp J. J., Chakrabarti M. *et al*., "AntiGQ1b ganglioside antibodies mediate complement-dependent destruction of the motor nerve terminal," Brain, vol. 124, no. 5, 2001, 893–906.

[30] Ho T. W., Willison H. J., Nachamkin I. *et al*., "Anti-GD1a antibody is associated with axonal but not demyelinating forms of Guillain-Barre syndrome," ′ Annals of Neurology, vol. 45, 1999, 168–173.

[31] Yuki N., Yamada M., Koga M. *et al*., "Animal model of axonal Guillain-Barre syndrome induced by sensitization with GM1 ′ ganglioside," Annals of Neurology, vol. 49, no. 6, 2001, 712–720.

[32] Govoni V., Granieri E., Tola M. R. *et al*., "Exogenous gangliosides and Guillain-Barre syndrome. An observational study in ′ the Local Health District of Ferrara, Italy," Brain, vol. 120, no. 7, 1997,1123–1130.

[33] Willison H. J. and Goodyear C. S., "Glycolipid antigens and autoantibodies in autoimmune neuropathies," Trends in Immunology, vol. 34, no. 9, 2013, 453–459.

[34] Kaida K. and Kusunoki S., "Antibodies to gangliosides and ganglioside complexes in Guillain-Barre syndrome and Fisher ′ syndrome: mini-review," Journal of Neuroimmunology, vol. 223, no. 1-2, 2010, 5–12.

[35] Kusunoki S., Kaida K.I., and Ueda M., "Antibodies against gangliosides and ganglioside complexes in Guillain-Barre syn- ′ drome: new aspects of research," Biochimica et Biophysica Acta, vol. 1780, no. 3, 2008, 441–444.

[36] Hu W., Janke A., Ortler S. *et al*., "Expression of CD28- related costimulatory molecule and its ligand in inflammatory neuropathies," Neurology, vol. 68, no. 4, 2007, 277–282.

[37] Chi L.J., Wang H.B., Zhang Y., and Wang W.Z., "Abnormality of circulating CD4+CD25+ regulatory T cell in patients with Guillain-Barre syndrome," ′ Journal of Neuroimmunology, vol. 192, no. 1-2, 2007,206–214.

[38] Nyati K. K., Prasad K. N., Verma A., and Paliwal V. K., "Correlation of matrix metalloproteinases-2 and -9 with proinflammatory cytokines in Guillain-Barre syndrome," ´ Journal of Neuroscience Research, vol. 88, no. 16, 2010, 3540–3546.

[39] Ben-Smith A., Gaston J. S. H., Barber P. C., and Winer J. B., "Isolation and characterisation of T lymphocytes from sural nerve biopsies in patients with Guillain-Barre syndrome and ´ chronic inflammatory demyelinating polyneuropathy," Journal of Neurology Neurosurgery & Psychiatry, vol. 61, no. 4, 1996, 362– 368.

[40] Khalili-Shiraz A., N. Gregson N., and Hughes R., "CD 1 expression in human peripheral nerve of GBS patients," Biochemical Society Transactions, vol. 25, no. 2, 1997, 172.

[41] Kuijf M. L., Geleijns K., Ennaji N., van Rijs W., van Doorn P. A., and Jacobs B. C., "Susceptibility to Guillain-Barre syndrome ´ is not associated with CD1A and CD1E gene polymorphisms," Journal of Neuroimmunology, vol. 205, no. 1-2, 2008, 110–112.

[42] Chiba A., Kusunoki S., Obata H., Machinami R., and I. Kanazawa I., "Ganglioside composition of the human cranial nerves, with special reference to pathophysiology of Miller Fisher syndrome," Brain Research, vol. 745, no. 1-2, 1997, 32–36.

[43] Gong Y., Tagawa Y., Lunn M. P. T. *et al*., "Localization of major gangliosides in the PNS: implications for immune neuropathies," Brain, vol. 125, no. 11, 2002, 2491–2506.

[44] Ang C. W., Endtz H. P., Jacobs B. C. *et al*., "Campylobacter jejuni lipopolysaccharides from Guillain-Barre syndrome ´ patients induce IgG anti-GM1 antibodies in rabbits," Journal of Neuroimmunology, vol. 104, no. 2, 2000,133–138.

[45] Sheikh K. A., Nachamkin I., Ho T. W. *et al*., "Campylobacter jejuni lipopolysaccharides in Guillain-Barre syndrome: molec- ´ ular mimicry and host susceptibility," Neurology, vol. 51, no. 2, 1998, 371–378.

[46] Yuki N., "Molecular mimicry between gangliosides and lipopolysaccharides of Campylobacter jejuni isolated from patients with Guillain-Barre syndrome and Miller Fisher ´ syndrome," Journal of Infectious Diseases, vol. 176, no. 6, 1997, 150–153.

[47] Mori M., Kuwabara S., Miyake M. *et al*., "Haemophilus influenzae has a GM1 ganglioside-like structure and elicits GuillainBarre syndrome," ´ Neurology, vol. 52, no. 6, 1999, 1282–1284.

[48] Khalili-Shirazi A., Gregson N., Gray I., Rees J., Winer J., and Hughes R., "Antiganglioside antibodies in Guillain-Barre´ syndrome after a recent cytomegalovirus infection," Journal of Neurology Neurosurgery & Psychiatry, vol. 66, no. 3, 1999, 376–379.

[49] Spies J. M., Pollard J. D., Bonner J. G., Westland K. W., and McLeod J. G., "Synergy between antibody and P2-

reactive T cells in experimental allergic neuritis," Journal of Neuroimmunology, vol. 57, no. 1-2, 1995,77–84.

[50] Westland K. W., Pollard J. D., Sander S., Bonner J. G., Linington C., and McLeod J. G., "Activated non-neural specific T cells open the blood-brain barrier to circulating antibodies," Brain, vol. 122, no. 7, 1999, 1283–1291.

[51] Creange A., Sharshar T., Planchenault T. *et al*., "Matrix ′ metalloproteinase-9 is increased and correlates with severity in Guillain-Barre syndrome," ′ Neurology, vol. 53, no. 8, 1999,1683– 1691.

[52] Koga M., Gilbert M., Li J. *et al*., "Antecedent infections in Fisher syndrome: a common pathogenesis of molecular mimicry," Neurology, vol. 64, no. 9, 2005,1605–1611.

[53] Yuki N., Taki T., Takahashi M. *et al*., "Penner's serotype 4 of Campylobacter jejuni has a lipopolysaccharide that bears a GM1 ganglioside epitope as well as one that bears a GD1a epitope," Infection and Immunity, vol. 62, no. 5, 1994, 2101–2103.

[54] Winer J. B., Briggs D., Welsh K., and Hughes R. A. C., "HLA antigens in the Guillain-Barre syndrome," ′ Journal of Neuroimmunology, vol. 18, no. 1, 1988,13–16.

[55] Rees J. H., Vaugham R. W., Kondeatis E., and Hughes R. A. C., "HLA-class II alleles in Guillain-Barre syndrome and ′ miller fisher syndrome and their association with preceding Campylobacter jejuni infection," Journal of Neuroimmunology, vol. 62, no. 1, 1995,53–57.

[56] MacGregor G. A., "Familial Guillain-Barre syndrome," ′ The Lancet, vol. 2, no. 7425, 1965,1296.

[57] Saunders M. and Rake M., "Familial Guillain-Barre syndrome," ′ The Lancet, vol. 286, no. 7422, 1965, 1106–1107.

[58] Ng J. K., Malotka J., Kawakami N. *et al*., "Neurofascin as a target for autoantibodies in peripheral neuropathies," Neurology, vol. 79, 2012, 2241–2248.

[59] Cornblath D. R., "Electrophysiology in Guillain-Barre syn- ′ drome," Annals of Neurology, vol. 27, 1990, 17–20.

[60] Hadden R. D. M., Cornblath D. R., Hughes R. A. C. *et al*., "Electrophysiological classification of Guillain-Barre syn- ′ drome: clinical associations and outcome," Annals of Neurology, vol. 44, no. 5, 1998,780–788.

[61] Doets AY, Lingsma HF, Walgaard C, *et al*.,"Predicting outcome in Guillain-Barré syndrome: international validation of the modified Erasmus GBS outcome score" Neurology, vol.98, 2022,518-e532.

[62] Hughes RA, Brassington R, GunnAA, van Doorn PA. "Corticosteroids for Guillain-Barré syndrome" Cochrane Database Syst Rev., vol.10, 2016,1446.

[63] The Guillain-Barré Syndrome Study Group. "Plasmapheresis and acute Guillain-Barré syndrome. Neurology"1985;35:1096-1104.

[64] Chevret S, Hughes RA, Annane D. "Plasma exchange for GuillainBarré syndrome." Cochrane Database Syst Rev. vol.2, 2017,CD001798.

[65] van Doorn PA, Van den Bergh PYK, Hadden RDM, *et al*. "European academy of neurology/peripheral nerve society guideline on diagnosis and treatment of Guillain-Barré syndrome" J Peripher Nerv Syst. Vol.28(4), 2023,535-563

[66] Chevret S, Hughes RA, Annane D., "Plasma exchange for GuillainBarré syndrome." Cochrane Database Syst Rev., vol. 2, 2017, CD00

[67] Islam B, Islam Z, Rahman S, *et al*. "Small volume plasma exchange for Guillain-Barré syndrome in resource-limited settings: a phase II safety and feasibility study." BMJ Open. 8,2018, e022862.

[68] van der Meche FG, Schmitz PI., "A randomized trial comparing intravenous immune globulin and plasma exchange in GuillainBarré syndrome." Dutch Guillain-Barré Study Group. N Engl J Med. Vol. 326, 1992,1123-1129.

[69] Hughes RA, Swan AV, van Doorn PA., "Intravenous immunoglobulin for Guillain-Barré syndrome." Cochrane Database Syst Rev., vol. 9, 2014, CD002063.

[70] Walgaard C, Jacobs BC, Lingsma HF, *et al*. "Second intravenous immunoglobulin dose in patients with Guillain-Barré syndrome with poor prognosis (SID-GBS): a double-blind, randomised, placebocontrolled trial." Lancet Neurol., 2021, 275-283.

[71] Doets AY, Hughes RA, Brassington R, Hadden RD, Pritchard J., "Pharmacological treatment other than corticosteroids, intravenous immunoglobulin and plasma exchange for Guillain-Barré syndrome." Cochrane Database Syst Rev. 2020, CD008630.

[72] Rostaing L, Noble J, Malvezzi P, Jouve T. "Imlifidase therapy: exploring its clinical uses." Expert Opin Pharmacother. vol. 24, 2023, 259-265.

[73] Zhang H, Ma J, Feng Y, *et al*. "Efgartigimod in the treatmentofGuillainBarré syndrome. J Neurol. 2024."

[74] van Leeuwen N, Walgaard C, van Doorn PA, Jacobs BC, Steyerberg EW, Lingsma HF., "Efficient design and analysis of randomized controlled trials in rare neurological diseases: an example in GuillainBarré syndrome." Vol.14,2019, e0211404.

[75] Fehmi J, Davies AJ, Walters J, *et al*. "IgG1 pan-neurofascin antibodies identify a severe yet treatable neuropathy with a high mortality." J Neurol Neurosurg Psychiatry., vol. 92, 2021,1089-1095.