



ORIGINAL ARTICLE

Clinical response to therapeutic plasma exchange in patients with immune-mediated inflammatory diseases of the central nervous system



Andrés Rodríguez Galeano^{a,b,*}, Erika Ruge Joya^{a,b}, Diana Bravo Guerra^{a,b}, Juan Roa Giraldo^{a,c}

^a Unidad de Cuidado Intensivo Pediátrico, Fundación Hospital Pediátrico La Misericordia, Bogotá, Colombia

^b Medicina Crítica y Cuidado Intensivo Pediátrico, Universidad el Bosque, Bogotá, Colombia

^c Unidad de Cuidado Neurocrítico Pediátrico, Fundación Hospital Pediátrico La Misericordia, Bogotá, Colombia

Received 14 June 2025; accepted 17 November 2025

Available online 16 February 2026

KEYWORDS

Autoimmune encephalitis;
Acute disseminated encephalomyelitis;
Guillain-Barré syndrome;
Therapeutic plasma exchange;
Apheresis

Abstract

Introduction: Inflammatory immune-mediated diseases of the central nervous system, such as autoimmune encephalitis, acute disseminated encephalomyelitis or Guillain-Barré syndrome, pose diagnostic and therapeutic challenges in the pediatric population. Therapeutic plasma exchange has emerged as a useful option in these cases. This study evaluated the clinical response to therapeutic plasma exchange in children with these conditions.

Methods: We conducted a retrospective cohort study at Fundación Hospital Pediátrico La Misericordia in Bogotá (2018–2022), including 50 patients with a confirmed diagnosis of antibody-mediated inflammatory disease of the central nervous system who were managed with therapeutic plasma exchange. We collected data on clinical, therapeutic and outcome variables and performed descriptive, survival, and Cox regression analyses.

Results: The mean age was 10 years, with a uniform sex distribution. The most frequent conditions were autoimmune encephalitis (36%) and acute disseminated encephalomyelitis (14%). At discharge, 56% of patients had persistent neurologic symptoms and 46% had recovered their prior functional status. The mortality was 6%. The use of antiepileptic drugs was significantly associated with a lower risk of relapse (hazard ratio, 0.081; $P = .024$) and steroid use with increased survival, particularly in patients with autoimmune encephalitis, acute disseminated encephalomyelitis and myasthenia gravis ($P < .05$).

DOI of original article: <https://doi.org/10.1016/j.anpedi.2025.504087>

* Corresponding author.

E-mail address: consultoriopediakids@gmail.com (A. Rodríguez Galeano).

Conclusion: Therapeutic plasma exchange is a viable and safe treatment strategy for children with immune-mediated inflammatory diseases of the central nervous system. The concomitant use of antiepileptic drugs and steroids showed benefits in reducing relapse and mortality.

© 2025 Asociación Española de Pediatría. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

PALABRAS CLAVE

Encefalitis autoinmune;
Encefalomiелitis aguda diseminada;
Síndrome de Guillain-Barré;
Recambio terapéutico de plasma;
Aféresis

Respuesta clínica a la terapia de recambio plasmático en pacientes con enfermedades inflamatorias del sistema nervioso central inmunomediadas

Resumen

Introducción: Las enfermedades inflamatorias inmunomediadas del sistema nervioso central en la población pediátrica, como la encefalitis autoinmune, encefalomiелitis aguda diseminada y síndrome de Guillain-Barré, presentan desafíos diagnósticos y terapéuticos. La terapia de recambio plasmático ha surgido como una opción útil en estos casos. Este estudio evaluó la respuesta clínica a la terapia de recambio plasmático en niños con estas patologías.

Metodología: Estudio de cohorte retrospectiva realizado en la Fundación Hospital Pediátrico La Misericordia, Bogotá (2018–2022), que incluyó a 50 pacientes con diagnóstico confirmado de enfermedad inflamatoria del sistema nervioso central mediada por anticuerpos y tratados con terapia de recambio plasmático. Se recolectaron variables clínicas, terapéuticas y desenlaces, y se aplicaron análisis descriptivos, de supervivencia y modelos de regresión de Cox.

Resultados: La edad media fue de 10 años, con distribución equitativa por sexo. Las patologías más frecuentes fueron encefalitis autoinmune (36%) y encefalomiелitis aguda diseminada (14%). El 56% de los pacientes persistió con síntomas neurológicos al egreso; 46% recuperó su funcionalidad previa. La mortalidad fue del 6%. El uso de anticonvulsivantes se asoció significativamente con menor riesgo de recaída (HR 0,081; $P = ,024$), y el uso de esteroides con una mayor supervivencia, especialmente en encefalitis autoinmune, encefalomiелitis aguda diseminada y miastenia gravis ($P < ,05$).

Conclusión: La terapia de recambio plasmático es una estrategia terapéutica viable y segura en niños con enfermedades inflamatorias del sistema nervioso central inmunomediadas. El uso concomitante de anticonvulsivantes y esteroides mostró beneficios en la reducción de recaídas y mortalidad.

© 2025 Asociación Española de Pediatría. Publicado por Elsevier España, S.L.U. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Inflammatory immune-mediated diseases of the central nervous system (CNS) comprise a heterogeneous group of neurologic disorders where the immune system plays a central role in the pathophysiology of the disease.¹ In the pediatric population, these diseases include Guillain-Barré syndrome, myasthenia gravis, Anti-N-methyl-D-aspartate (NMDA) receptor encephalitis, and acquired demyelinating neuropathies, among others.^{2,3} Although these conditions are relatively rare in children, the development of more sensitive and specific diagnostic tools has enabled earlier and more accurate identification.^{2,4} The treatment of these diseases has advanced considerably, with the introduction of several immunomodulatory strategies.^{3,5} Among these, therapeutic plasma exchange (TPE) has emerged as an effective option, especially in cases refractory to conventional treatment with steroids or other immunosuppressive therapies.^{2,3} Several international clinical guidelines support the use of TPE with varying strengths of recommendation, and its implementation in clinical practice has grown significant-

tly in recent years.^{2,3,5,6} In this context, we conducted a study with the following objectives: (a) to describe the demographic and clinical characteristics of patients with immune-mediated inflammatory diseases of the CNS treated with TPE; (b) to describe TPE protocols in terms of the type and number of sessions, replacement modality, associated complications, and tolerance; (c) to determine the incidence of relapse and mortality in this population; and (d) to assess the potential association of adjuvant therapies (including steroids, antiepileptic drugs, immunomodulators, biologics, and psychotropic drugs) with relapse and mortality.

Material and methods

We conducted a retrospective, observational and analytical cohort study. The research protocol was approved by the Research Ethics Committee of the Fundación Hospital Pediátrico La Misericordia (HOMI), a tertiary care hospital located in Bogotá, Colombia. The local ethics committee approved the request for a waiver of consent.

Per the inclusion criteria, the sample included patients of any sex aged less than 18 years managed at HOMI between 2018 and 2022, with a diagnosis of antibody-mediated inflammatory disease of the CNS confirmed by a pediatric neurologist and treated with TPE. The exclusion criteria were incomplete documentation in health records precluding adequate data retrieval and indication of TPE unrelated to neurologic disease. A structured form was designed to collect the data, including: age, sex, year of care, duration of the disease, clinical manifestations, specific neurologic diagnosis, American Society for Apheresis (ASFA) therapeutic apheresis category, associated comorbidities, characteristics of the TPE (date of initiation, duration in days, exchange volume, solution used, development of complications), length of stay in hospital and in the pediatric intensive care unit, pharmacological treatment at discharge, requirement for support devices, presence of neurologic or neuropsychiatric sequelae, relapses, number of follow-up visits, and mortality.

Patients with inflammatory immune-mediated diseases of the CNS who received TPE were identified through a search of the electronic health records system of the hospital for the International Classification of Diseases-Tenth Revision (ICD-10) codes G35, G36, G36.0, G36.8, G36.9, G37.3, G37.8, G37.9, G04, G70.0, and G70.9. To identify therapeutic procedures, we used the Colombian standardized health care procedure classification system (CUPS) codes 911203 (plasmapheresis) and 911302 (therapeutic plasma exchange). Following approval by the Ethics Committee, fellows in pediatric intensive care reviewed the electronic health records and completed the data collection forms. The data were consolidated and entered into Microsoft Excel. The sample size was calculated with Epidat, version 4.2, using the following parameters: average volume of 11 000 pediatric patients per year managed at HOMI during the study period, expected prevalence of 2.7%,⁷ 95% level of confidence and 5% precision, which yielded a minimum sample size of 41 patients. The sample was obtained by convenience sampling, including all participants considered eligible based on the established criteria.

The statistical analysis was performed with SPSS, version 27. We expressed quantitative variables with measures of central tendency and dispersion, and qualitative variables with absolute and relative frequencies. The association between categorical variables was analyzed using contingency tables and the χ^2 test. To analyze the effect of treatments on relapse and mortality after TPE, we used the Kaplan-Meier method, comparing curves with the log-rank test. We fitted Cox regression models to estimate hazard ratios (HRs) with the corresponding 95% CIs, considering *P* values of less than .05 statistically significant. We interpreted HRs with a CI that included 1 as indicative of no association, above one as indicative of risk and below one as indicative of a protective effect.

To reduce selection bias, we included consecutively all individuals under 18 years of age who received TPE for antibody-mediated inflammatory diseases of the CNS between 2018 and 2022, identified by ICD-10 and CUPS codes, with a diagnosis confirmed by a pediatric neurologist. To control information bias, data collection was performed by trained staff using a structured form, and collected data underwent double random review. Confounding bias

Table 1 Sociodemographic characteristics of the pediatric sample with immune-mediated neurologic diseases managed with therapeutic plasma exchange.

Sociodemographic variable	Result (N = 50)
Age in years, mean (SD)	10 (4.92)
Age in years, median	12
Age range in years	1–16
<i>Sex distribution</i>	
Female	50% (25)
Male	50% (25)

was minimized through adjustments in the survival and Cox regression analyses. No patients were lost to follow-up, so data imputation was not required.

Results

A total of 50 pediatric patients with immune-mediated diseases met the eligibility criteria; no health records were excluded.

Sociodemographic and clinical characteristics

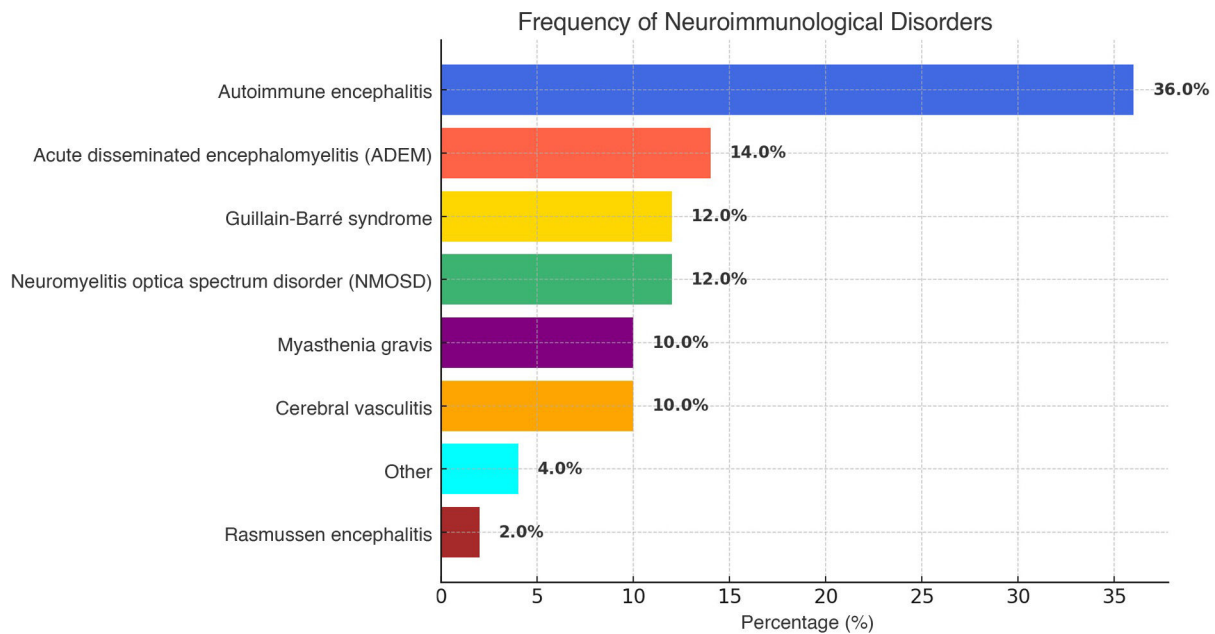
The mean age (SD) was 10 (4.92) years, with a median of 12 years. Ages ranged between 1 and 16 years. The sex distribution was uniform, with 50% of female patients (Table 1). The analysis of sex distribution by type of inflammatory immune-mediated disease of the CNS revealed that autoimmune encephalitis was more frequent in male patients (55.6%). The male sex also predominated in Guillain-Barré syndrome (66.7%) and especially in acute disseminated encephalomyelitis (ADEM) (85.7%). On the other hand, neuromyelitis optica, myasthenia gravis, cerebral vasculitis, and Rasmussen encephalitis were more common in female patients, with proportions of 83.3%, 60.0%, 80.0%, and 100%, respectively (Table 2).

Patients with autoimmune encephalitis had a mean age of 10 years (SD, 4), while those diagnosed with Guillain-Barré syndrome had a mean age of 11 years (SD, 4). In neuromyelitis optica, the mean age was 13 years (SD, 5), and in myasthenia gravis, 9 years (SD, 6). Patients with ADEM were the youngest at the time of diagnosis, with a mean age of five years (SD, 5). In the case of cerebral vasculitis, the mean age was 12 years (SD, 3). The only documented case of Rasmussen encephalitis occurred at age 13. The mean (SD) duration of the disease was 27.18 (80.23) days, with a median of 5.5 days. The minimum duration of the disease was 1 day and the maximum was 540 days. As regards the neurologic manifestations, motor deficits were recorded in 46.0% of cases, altered level of consciousness in 34.0%, neuropsychiatric manifestations in 24.0%, sensory deficits in 20.0%, and circadian cycle disturbances in 6.0%.

In the sample under study, autoimmune encephalitis was diagnosed in 36.0% of patients, ADEM in 14.0%, Guillain-Barré syndrome in 12.0%, neuromyelitis optica in 12.0%, myasthenia gravis in 10.0%, and cerebral vasculitis in 10.0%. Rasmussen encephalitis and other diseases were less common, diagnosed in 2.0% and 4.0% of patients, respectively (Fig. 1).

Table 2 Distribution by sex of the different neuroimmunological diseases in the pediatric sample managed with plasma exchange therapy.

Disease	Female (n = 25)	Male (n = 25)
Autoimmune encephalitis	44.4% (8)	55.6% (10)
Guillain-Barré syndrome	33.3% (2)	66.7% (4)
Neuromyelitis optica	83.3% (5)	16.7% (1)
Myasthenia gravis	60.0% (3)	40.0% (2)
Acute disseminated encephalomyelitis (ADEM)	14.3% (1)	85.7% (6)
Cerebral vasculitis	80.0% (4)	20.0% (1)
Rasmussen encephalitis	100.0% (1)	0.0% (0)
Other	50.0% (1)	50.0% (1)

**Figure 1** Immune-mediated diseases of the central nervous system managed with therapeutic plasma exchange in the pediatric population.

According to the ASFA classification, 60.0% (30) of patients were in category 1, 36.0% in category 2, and 4.0% in category 3. Most patients (70.0%, n = 35) had no comorbidities. Among the observed comorbidities, febrile seizures were documented in 4.0% of the patients, cognitive impairment in 4.0%, refractory epilepsy in 4.0%, and, at a lower frequency, hypothyroidism, primary immunodeficiency, migraine, cerebral palsy, brucellosis, and bone marrow transplantation, each documented in 2.0% of the patients.

Therapeutic plasma exchange

All patients underwent TPE using the Aquarius system with a membrane plasma separation filter; the procedure was performed daily and took an estimated 120 min. The mean (SD) time from admission for immune-mediated inflammatory disease of the CNS to the start of TPE was 7.74 (7.27) days, with a median of five days. The range was 1–30 days. On

the other hand, the mean (SD) duration of plasma exchange was 6.7 (1.77) days, with a median of seven days and a range of two to 14 days. When it came to the replacement solution, 56.0% (n = 28) received albumin and 44.0% fresh frozen plasma followed by albumin. Twenty-six percent experienced complications related to the procedure. The most frequent complications were pain at the site of catheter insertion (16.0%), hypotension (6.0%), transfusion reactions (4.0%) and infection (4.0%). Bleeding diathesis was the least frequent complication (2.0% of cases).

Length of stay, concurrent treatments, relapse and mortality

The mean (SD) length of stay in the pediatric intensive care unit was 15.34 (13.07) days, with a median of 10 days. The range was 3–58 days. The mean (SD) overall length of stay in the hospital was 46.08 (27.24) days, with a median of 42 days and a range of 14–115 days.

Table 3 Received treatment by immune-mediated neurologic disease.

	Autoimmune encephalitis	Guillain-Barré syndrome	Neuromyelitis optica	Myasthenia gravis	Acute disseminated encephalomyelitis (ADEM)	Vasculitis cerebral	Rasmussen encephalitis	Other
Steroids	14 (77.8%)	0 (0.0%)	5 (83.3%)	4 (80.0%)	5 (71.4%)	5 (100.0%)	0 (0.0%)	0 (0.0%)
Antiepileptic drugs	9 (50.0%)	2 (33.3%)	1 (16.7%)	0 (0.0%)	3 (42.9%)	1 (20.0%)	1 (100.0%)	1 (50.0%)
Immunomodulators	4 (22.2%)	0 (0.0%)	2 (33.3%)	4 (80.0%)	0 (0.0%)	2 (40.0%)	1 (100.0%)	0 (0.0%)
Biologic	6 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)
Psychotropic drugs	2 (11.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Sixty-six percent of patients received steroids, 36.0% antiepileptic drugs, 26.0% immunomodulators, 14.0% biologics, and 6.0% psychotropic drugs. Steroids were the most frequent treatment for several neurologic diseases and were used in 100% of cases of cerebral vasculitis, followed in frequency by neuromyelitis optica (83.3%), myasthenia gravis (80.0%), autoimmune encephalitis (77.8%), and ADEM (71.4%), with no reports of its use in Guillain-Barré syndrome, Rasmussen encephalitis, or other conditions. Antiepileptic drugs were predominantly used in Rasmussen encephalitis (100.0%), followed by autoimmune encephalitis (50.0%), and ADEM (42.9%), with less frequent use in Guillain-Barré syndrome (33.3%), cerebral vasculitis (20.0%), and neuromyelitis optica (16.7%), and were not used in myasthenia gravis. Immunomodulators were frequently used in myasthenia gravis (80.0%), cerebral vasculitis (40.0%), neuromyelitis optica (33.3%), and in all cases of Rasmussen encephalitis (100.0%), but were not used in ADEM, Guillain-Barré syndrome, or other diseases. Biologics were used in autoimmune encephalitis (33.3%) and other diseases (50.0%), while psychotropic drugs were the least frequently used, documented only in patients with ADEM (14.3%) and autoimmune encephalitis (11.1%) (Table 3).

In the course of treatment, 19 patients (38.0%) required two or more immunomodulators. At discharge, seven patients (14.0%) required respiratory or feeding support devices, including a tracheostomy in four (8.0%) and an enteral feeding tube in another four (8.0%). Neurologic or neuropsychiatric symptoms persisted in 28 patients (56.0%) and sleep disturbances in three (6.0%). Only 23 (46.0%) recovered their previous level of functioning. Relapses were reported in seven cases (14.0%) and three patients died (6.0%). Medical follow-up was irregular: 25 patients (50.0%) did not attend follow-up visits, while the rest made between 1 and 16 visits.

Survival analysis

We fitted a multivariate Cox regression model that included the use of antiepileptic drugs, steroids, immunomodulators, biologics, and psychotropic drugs as variables. In addition, the analysis was stratified by type of immune-mediated neurologic disease.

Relapse

The survival analysis indicated that only the use of antiepileptic drugs was consistently associated with a reduction in recurrence that was clinically significant, with a HR of 0.081 (95% CI, 0.009–0.723; $P = .024$), which corresponds to an approximate 92% reduction in the risk of relapse compared to patients who did not receive them (Fig. 2). The analysis did not show statistically significant differences between the other drug groups: steroids, immunomodulators, biologics, and psychotropic drugs (Table 4).

Mortality

Furthermore, the survival analysis revealed that the use of steroids, particularly prednisolone, was associated with a significant reduction in mortality. Of the nine patients who did not receive steroids, three died (33.3%), compared to none of the 18 patients who did receive them.

The log-rank test showed a statistically significant difference in survival between groups ($P = .010$) (Fig. 3). The Cox regression analysis yielded an HR of 0.005 (95% CI, 0.000–284.12) with a P value of .343, indicative of a lack of association. However, the disease-specific analysis revealed that steroid use was significantly associated with lower mortality in patients with autoimmune encephalitis, ADEM, and myasthenia gravis ($P < .05$). We did not find a significant association between mortality and antiepileptic drugs, immunomodulators, biologics or psychotropic drugs (Table 4).

Discussion

All patients underwent TPE, whose efficacy has been documented in the literature for various neuroimmunological diseases, especially autoimmune encephalitis, myasthenia gravis, and Guillain-Barré syndrome.⁸ The distribution by sex and age in our cohort does not necessarily reflect the epidemiological characteristics of these diseases,^{9–13} as the sample only included patients who required TPE. Thus, we observed a slight predominance of male patients in autoimmune encephalitis and ADEM, and of female patients in neuromyelitis optica, with the average of diagnosis ranging from five to 13 years, differences that can probably be attributed to the selection bias inherent in our design. On

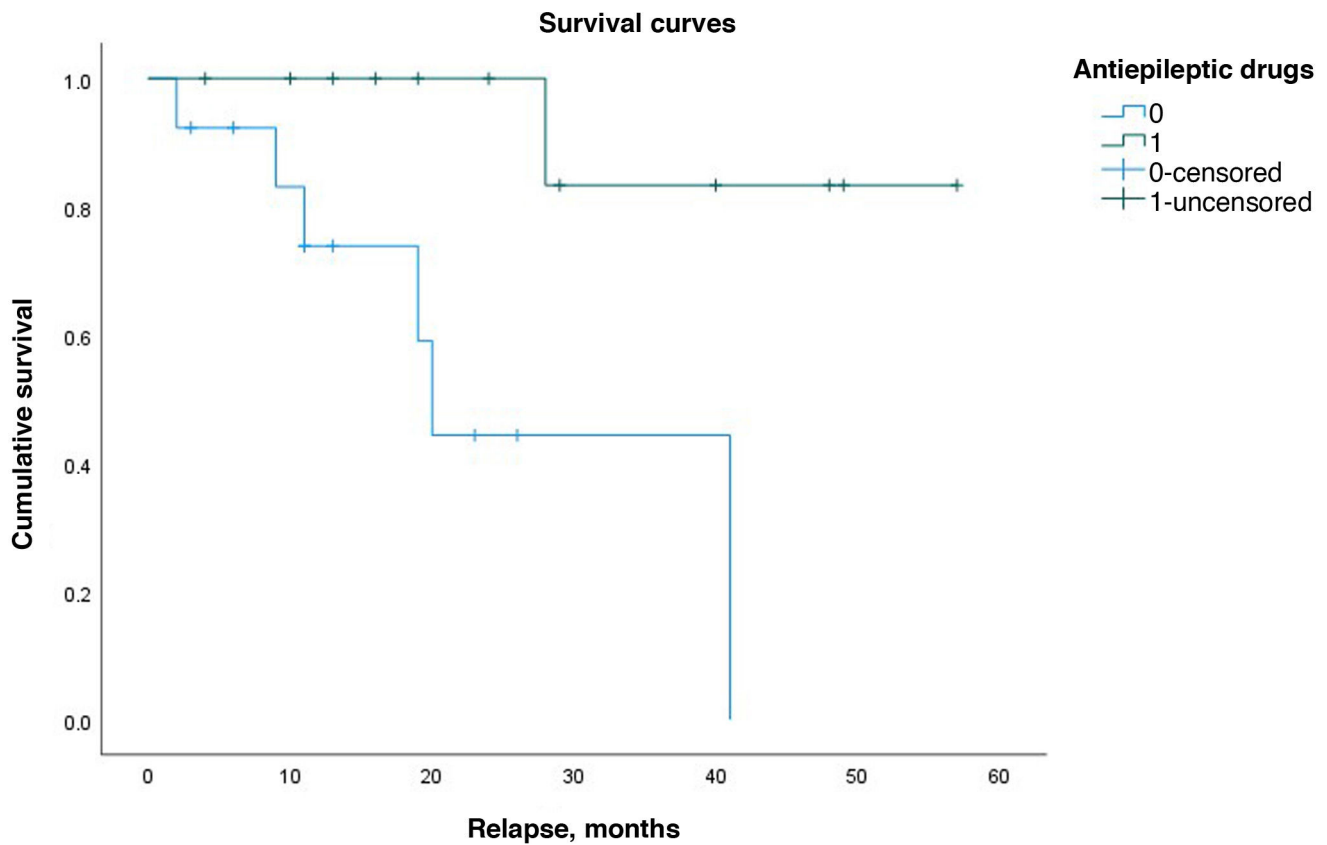


Figure 2 Risk of relapse of patients with Immune-mediated diseases of the central nervous system managed with therapeutic plasma exchange and antiepileptic drugs.

Table 4 Association between treatments and risk of relapse or mortality in immune-mediated neurologic diseases: survival analysis.

Treatment	Event	HR	95% CI	P	Frequency (event/group)
Steroids	Relapse	1.64	0.19–13.8	.643	No: 1/7; Yes: 6/18
Antiepileptic drugs	Relapse	0.08	0.00–0.72	.024	No: 6/13; Yes: 1/12
Immunomodulators	Relapse	1.86	0.39–8.69	.428	No: 3/16; Yes: 4/9
Biologics	Relapse	0.03	0.00–99.9	.407	No: 7/21; Yes: 0/4
Psychotropic drugs	Relapse	2.44	0.45–12.9	.295	No: 5/23; Yes: 2/2
Steroids	Death	0.005	0.000–284.1	.343	No: 3/9; Yes: 0/18
Antiepileptic drugs	Death	0.018	0.000–204.9	.399	No: 3/15; Yes: 0/12
Immunomodulators	Death	0.961	0.087–10.60	.974	No: 2/18; Yes: 1/9
Biologics	Death	0.039	0.000–3402	.641	No: 3/23; Yes: 0/4
Psychotropic drugs	Death	0.044	0.000–6716	.745	No: 3/25; Yes: 0/2

Abbreviation: HR, hazard ratio.

the other hand, complications related to TPE occurred in 26% of patients, a proportion that is within the range of values reported in the literature, from 16% to 55%.^{14,15} Hypotension was documented in 6% of cases, while other studies have reported values ranging from 0.8% to 14%.^{14,16} Transfusion reactions occurred in 4% of the sample, a frequency contained within the range reported by Eyre et al. (2%–6%).¹⁴ Infections were also detected in 4% of patients, slightly above the 2.1% reported in the previous literature.^{14–16} Finally, bleeding diathesis was documented in 2% of patients,

a percentage similar to the one reported by Paglialonga et al.¹⁶

The timing of TPE is a key consideration. The ASFA 2023 guidelines recommend its use as a rescue treatment after failure of steroids/ intravenous immunoglobulin (IVIg) therapy in autoimmune encephalitis and ADEM, although they contemplate its early use in severe attacks while second-line therapies take effect.¹⁷ In our cohort, the time to TPE (median, five days; mean, 7.74 days) was within the expected range in many centers, but the observed dispersion

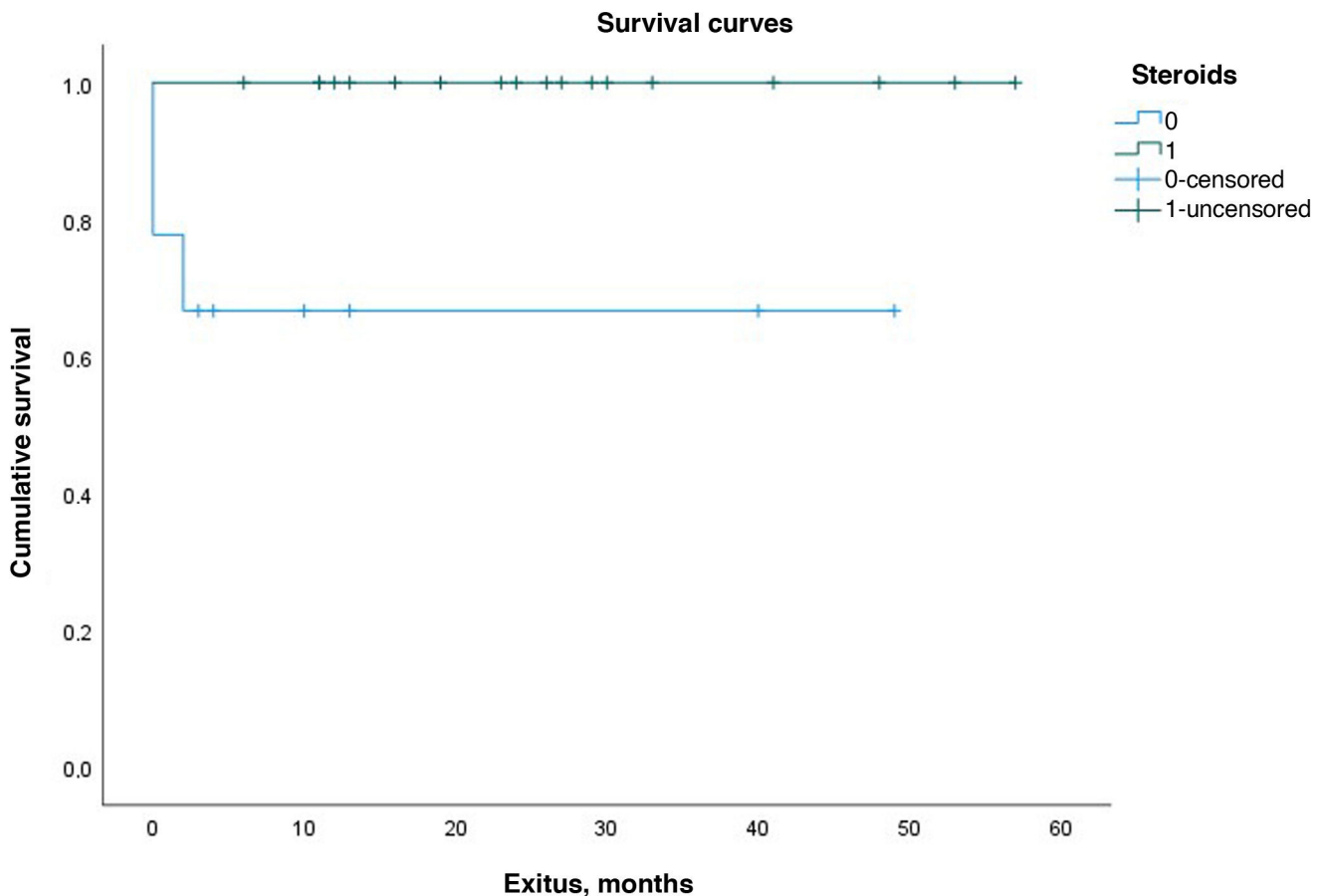


Figure 3 Risk of mortality in patients with Immune-mediated diseases of the central nervous system treated with therapeutic plasma exchange and steroids.

suggests delays in some cases. This is relevant, as the evidence suggests that early initiation is associated with better outcomes in diseases such as neuromyelitis optica spectrum disorder and Guillain-Barré syndrome.^{17,18}

From an operational standpoint, TPE requires high-flow venous access and controlled environments (intensive care unit [ICU], nephrology, or hematology), which limits its availability and highlights the need for early referral pathways and clearly defined initiation criteria. In our study, five to six sessions were performed over 10–14 days, with 1.0–1.5 plasma volumes replaced per session. Regarding replacement fluids, the standard option in neurologic indications is 5% albumin; however, we used fresh frozen plasma in 44% of cases, mainly when there was risk or evidence of coagulopathy and/or a fibrinogen level below 100 mg/dL, or in the case of invasive procedures, in adherence to hemostatic safety recommendations.¹⁹ Moreover, to minimize interactions, TPE was scheduled before the administration of IVIG or other biologics when combination therapy was planned to avoid their elimination during the procedure.

When it came to treatment after discharge, steroids were the most commonly prescribed drugs (66%), followed by antiepileptic drugs (36%) and immunomodulators (26%). One relevant finding in this regard was the lower relapse rate in patients who continued to take antiepileptic drugs, which suggests a potential protective effect beyond symp-

tom control. This result contrasts partially with previous reports in the literature. For instance, Du et al. (2023) point out that in anti-NMDA receptor encephalitis, most patients can discontinue antiepileptic drugs within the first year without significant risk of relapse, although the authors recommended individualizing the decision based on the persistence of epileptic activity, the presence of cortical lesions, and the availability of immunotherapy.²⁰ Our findings suggest that extending treatment could offer additional benefits in certain pediatric populations, a hypothesis that warrants exploration in prospective studies. When it came to steroids, we found that their prescription was associated with lower mortality, which was in line with the literature supporting the use of high-dose intravenous methylprednisolone as first-line treatment in autoimmune encephalitis and ADEM, followed by oral steroid tapers, and with their central role in juvenile myasthenia gravis.²¹ For ADEM, the standard of care includes intravenous methylprednisolone followed by an oral steroid taper over several weeks. In the case of juvenile myasthenia gravis, although the specific evidence is limited, it is known that immunosuppressive therapies, including steroids, are essential in its management to improve muscle strength and alleviate symptoms.²²

Among the strengths of our study, we highlight the detailed collection of clinical and therapeutic data in a population with uncommon conditions, which provides use-

ful evidence in a field in which it is still scarce. However, we must also acknowledge its limitations: the small sample size, with few patients per disease, limits the generalizability of the findings; the absence of a control group precluded comparison with outcomes in the absence of TPE; and the retrospective design may have introduced selection and information biases. The lack of structured follow-up also limited the accurate evaluation of relapses, and some minor complications, such as hypotension at the start of the session, may have gone undetected. Consequently, the results should be interpreted with caution and do not allow us to draw definitive conclusions. We consider it necessary to promote larger-scale, multicenter, prospective studies that also explore the association of TPE with concomitant therapies—such as steroids and antiepileptic drugs—to allow establishment of standardized protocols and optimize safety and efficacy in the pediatric population.

Conclusion

Therapeutic plasma exchange proved to be a safe and well-tolerated treatment option in pediatric patients with immune-mediated inflammatory diseases of the CNS, supporting the recovery process. The use of antiepileptic drugs was associated with a lower overall risk of relapse, and the use of steroids with increased survival in the autoimmune encephalitis, ADEM, and myasthenia gravis subgroups. Larger prospective studies are needed to confirm these results.

Funding

This research did not receive any external funding.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Acknowledgments

We thank Dr Juan David Vega Padilla for providing methodological and statistical support.

References

- Cervantes CE, Bloch EM, Sperati CJ. Therapeutic plasma exchange: core curriculum 2023. *Am J Kidney Dis.* 2023;81:475–92, <http://dx.doi.org/10.1053/j.ajkd.2022.10.017>.
- Linker RA, Chan A, Sommer M, Koziolok M, Müller GA, Paulus W, et al. Plasma exchange therapy for steroid-refractory superimposed relapses in secondary progressive multiple sclerosis. *J Neurol.* 2007;254:1288–9, <http://dx.doi.org/10.1007/s00415-006-0497-0>.
- Chou IJ, Whitehouse WP, Wang HS, Tanasescu R, Constantinescu CS. Diagnostic modalities in multiple sclerosis: perspectives in children. *Biomed J.* 2014;37:50–9, <http://dx.doi.org/10.4103/2319-4170.129269>.
- Schwartz J, Padmanabhan A, Aquni N, Balogun RA, Connelly SL, Delaney M, et al. Guidelines on the use of therapeutic apheresis in clinical practice—evidence-based approach from the Writing Committee of the American Society for Apheresis: the seventh special issue. *J Clin Apher.* 2016;31:149–62, <http://dx.doi.org/10.1002/jca.21470>.
- Korinthenberg R. Acute polyradiculoneuritis: Guillain-Barré syndrome. *Handb Clin Neurol.* 2013;112:1157–62, <http://dx.doi.org/10.1016/B978-0-444-52910-7.00036-2>.
- Korinthenberg R, Trollmann R, Felderhoff-Müser U, Bernert G, Hackenberg A, Hufnagel M, et al. Diagnosis and treatment of Guillain-Barré syndrome in childhood and adolescence: An evidence- and consensus-based guideline. *Eur J Paediatr Neurol.* 2020;25:5–16, <http://dx.doi.org/10.1016/j.ejpn.2020.01.003>.
- Albarracín JD, Segura OM. Esclerosis múltiple en pacientes pediátricos: fisiopatología, diagnóstico y manejo. *MedUNAB.* 2011;14:167–79, <http://dx.doi.org/10.29375/01237047.1524>.
- Ipe TS, Meyer EK, Sanford KW, Joshi SK, Wong ECC, Raval JS. Use of therapeutic plasma exchange for pediatric neurological diseases. *J Clin Apher.* 2021;36:161–76, <http://dx.doi.org/10.1002/jca.21850>.
- De Bruijn MAAM, Bruijstens AL, Bastiaansen AEM, van Sonderen A, Schreurs MWJ, Sillevius Smitt PAE, et al. Pediatric autoimmune encephalitis: recognition and diagnosis. *Neurol Neuroimmunol Neuroinflamm.* 2020;7:e682, <http://dx.doi.org/10.1212/NXI.0000000000000682>. Published 2020 Feb 11.
- Sen S, Kumar A, Roy B. Clinical outcome of Guillain-Barré syndrome in 108 children. *Indian Pediatr.* 2021;58:833–5, <http://dx.doi.org/10.1007/s13312-021-2302-7>.
- Fraga MM, de Oliveira EML, Len CA, Campos MF, Terreri MT. Devic's disease in an adolescent girl with juvenile dermatomyositis. *Rev Bras Reumatol Engl Ed.* 2017;57:475–8, <http://dx.doi.org/10.1016/j.rbre.2014.12.004>.
- Gokce G, Ceylan OM, Mutlu FM, Altinsoy HI, Koylu T. Relapsing Devic's disease in a child. *J Pediatr Neurosci.* 2013;8:146–9, <http://dx.doi.org/10.4103/1817-1745.117852>.
- Wang CX. Assessment and Management of Acute Disseminated Encephalomyelitis (ADEM) in the pediatric patient. *Paediatr Drugs.* 2021;23:213–21, <http://dx.doi.org/10.1007/s40272-021-00441-7>.
- Eyre M, Hacoheh Y, Barton C, Hemingway C, Lim M. Therapeutic plasma exchange in paediatric neurology: a critical review and proposed treatment algorithm. *Dev Med Child Neurol.* 2018;60:765–79, <http://dx.doi.org/10.1111/dmcn.13925>.
- Michon B, Moghrabi A, Winikoff R, Barrette S, Bernstein ML, Champagne J, et al. Complications of apheresis in children. *Transfusion.* 2007;47:1837–42, <http://dx.doi.org/10.1111/j.1537-2995.2007.01405.x>.
- Paglialonga F, Schmitt CP, Shroff R, Vondrak K, Aufricht C, Watson AR, et al. Indications, technique, and outcome of therapeutic apheresis in European pediatric nephrology units. *Pediatr Nephrol.* 2015;30:103–11, <http://dx.doi.org/10.1007/s00467-014-2907-3>.
- Connelly SL, Alquist CR, Aquni NA, Hofmann JC, Klingel R, Onwuemene OA, et al. Guidelines on the use of therapeutic apheresis in clinical practice - evidence-based approach from the writing committee of the American Society for Apheresis: The Ninth Special Issue. *J Clin Apher.* 2023;38:77–278, <http://dx.doi.org/10.1002/jca.22043>.
- Padmanabhan A, Connelly SL, Aquni N, Balogun RA, Klingel R, Meyer E, et al. Guidelines on the use of therapeutic apheresis in clinical practice - evidence-based approach from the writing committee of the American Society for Apheresis: The Eighth Special Issue. *J Clin Apher.* 2019;34:171–354, <http://dx.doi.org/10.1002/jca.21705>.
- Strasser E. Principles of therapeutic apheresis in neurological disease. *Transfus Med Hemother.* 2023;50:88–97, <http://dx.doi.org/10.1159/000529463>.

20. Du J, Guo Y, Zhu Q. Use of anti-seizure medications in different types of autoimmune encephalitis: a narrative review. *Front Neurol.* 2023;14:1111384, <http://dx.doi.org/10.3389/fneur.2023.1111384>.
21. Nosadini M, Thomas T, Eyre M, Anlar B, Armangue T, Benseler SM, et al. International consensus recommendations for the treatment of pediatric NMDAR antibody encephalitis. *Neurol Neuroimmunol Neuroinflamm.* 2021;8:e1052, <http://dx.doi.org/10.1212/NXI.0000000000001052>.
22. Gadian J, Kirk E, Holliday K, Lim M, Absoud M. Systematic review of immunoglobulin use in paediatric neurological and neurodevelopmental disorders. *Dev Med Child Neurol.* 2017;59:136–44, <http://dx.doi.org/10.1111/dmcn.13349>.