



# Clinical features and prognosis of patients with Guillain-Barré and acute transverse myelitis overlap syndrome

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## ABSTRACT

**Objectives:** Patients who present with Guillain-Barré syndrome (GBS) and acute transverse myelitis (ATM), either simultaneously or consecutively, are defined as having GBS/ATM overlap syndrome. As this syndrome has been underinvestigated, we performed a literature review to evaluate case reports of GBS/ATM overlap syndrome to facilitate its early diagnosis.

**Patients and methods:** We searched four scientific literature databases (PUBMED, EMBASE, ELSEVIER and WEB OF SCIENCE) for cases that presented as GBS/ATM overlap syndrome. Eighteen articles that described 23 cases were included, and the clinical and prognostic data were analyzed.

**Results:** Initially, only five (29.4%) patients were diagnosed with GBS/ATM overlap syndrome. Patients with GBS/ATM overlap syndrome presented as four clinical features. First, some of the patients displayed abnormal pyramidal signs, including 29.4% of patients who had positive pyramidal signs or a negative plantar reflex and 17.6% of patients who had signs of areflexia or hyporeflexia combined with positive pyramidal signs. Second, patients suffered pain and respiratory failure at a high rate (43.5% with pain at the onset of the disease, 43.5% with ventilator support, and 47.8% shown with respiratory failure). Third, patients had a partial clinical recovery of immunomodulators, 56.5% of patients had a favorable outcome, 46.2% of patients who received intravenous immunoglobulin (IVIG) combined steroids responded well to the treatment. Fourth, acute axonal polyneuropathy seemed to be associated with poor outcomes (odds ratio = 3.00, 95% CI = 1.35–6.68,  $P = 0.01$ ). Abnormalities in spinal cord magnetic resonance imaging (MRI) were detected in all patients, and the most frequently involved segments were the cervical cord (69.6%) and the thoracic cord (69.6%). In addition to spinal cord lesions, in three patients lesions in the medulla and cerebral hemisphere were also observed. The most common prescriptions included a high dose of methylprednisolone at 1 g/day for 3–5 days that was followed by a 6-week course of oral prednisone and IVIG at 0.4 g/kg/day for 5 days.

**Conclusion:** While it is difficult to make an early diagnosis of GBS/ATM overlap syndrome, electrophysiology is helpful in the diagnosis of GBS and spinal cord MRIs are key to identifying ATM. Brain MRIs are also recommended to detect subclinical lesions. The combined use of IVIG and steroids was the most frequent treatment. However, less than half of the patients responded positively to treatment. Acute axonal neuropathy may be a risk factor for a poor prognosis.

## 1. Introduction

Guillain-Barré syndrome (GBS) and acute transverse myelitis (ATM) can be even more complicated and are simultaneously or consecutively developed in patients, which have been identified as GBS /ATM overlap syndrome. GBS and ATM are both autoimmune diseases with many differences in histological and pathological evidences. GBS, characterized by symmetrical weakness of the limbs, hyporeflexia or areflexia, is a common cause of acute flaccid paralysis. GBS may be triggered by an abnormal T-cell activation, which leads to the production of antibodies

that are directed against myelin proteins of peripheral nerves [1]. ATM is a demyelinating disease of the central nervous system (CNS) that is characterized by bilateral limb paralysis, sensory disturbances below the lesion level, and sphincter disturbances. It can be idiopathic, parainfectious, or disease-associated. ATM is caused by either direct infection of the spinal cord or by an autoimmune reaction [2–4]. Number of reports for patients with demyelination in both the CNS and the peripheral nervous system (PNS) is very small. Moreover, GBS/ATM overlap syndrome is often undiagnosed [5]. Therefore, we performed a literature review to evaluate the clinical presentation, diagnosis,

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therapy, and prognosis for patients with GBS/ATM overlap syndrome to facilitate its early diagnosis.

## 2. Patients and methods

We performed searches in scientific literature databases including PUBMED ([ncbi.nlm.nih.gov/pubmed](http://ncbi.nlm.nih.gov/pubmed)), EMBASE ([elsevier.com/solutions/embase-biomedical-research](http://elsevier.com/solutions/embase-biomedical-research)), ELSEVIER ([sciencedirect.com](http://sciencedirect.com)) and WEB OF SCIENCE ([isiknowledge.com](http://isiknowledge.com)). Literature was limited within January 1990 to November 2018 using the following search terms or MeSH: acute inflammatory demyelinating polyneuropathy (AIDP), acute motor sensory axonal neuropathy (AMSAN), acute motor axonal neuropathy (AMAN), Guillain-Barré syndrome (GBS), Miller Fisher syndrome (MFS), acute myelitis (AM), transverse myelitis (TM), acute transverse myelitis (ATM), acute postinfectious polyradiculitis and myelitis, acute postinfectious myeloradiculonevritis. We collected information on sex, age, preceding infections, clinical presentation, electrophysiology, neuroimaging, therapy, and patient outcomes for GBS/ATM overlap syndrome. Additionally, we only considered articles in which the diagnosis of GBS/ATM overlap syndrome was based on the patients' clinical presentation/imaging data and electrophysiology.

The following exclusion criteria were used: (1) Patients in the acute phase of chronic inflammatory demyelinating polyneuropathy; (2) Patients with polyneuropathy that was caused by a direct infection, such as leprosy or a herpes zoster infection; (3) Patients with polyneuropathy that was caused by a connective tissue disease, a metabolic or endocrine disorder, a nutritional disorder, chemical or drug factors; (4) Patients with a subacute combined degeneration of the spinal cord, syringomyelia, or compressive myelopathy; (5) Patients with a genetic peripheral neuropathy or myelopathy. We identified 18 studies (case reports and original articles), which described 23 cases that fit these criteria.

Peak clinical severity was ranked by the degree of maximal upper limb weakness using an ordinal scale (0, normal; 1, weak, but able to lift arms off the bed; 2, a flicker of movement; 3, no movement) [6]. The functional grading of the disease was defined according to the Hughes scale (0, healthy; 1, minor signs, able to run; 2, able to walk > 5 m without assistance, but unable to run; 3, able to walk > 5 m with assistance; 4, bed-bound or chair-bound; 5, requiring assisted ventilation for at least part of the day; and 6, dead). A favorable outcome was defined as functional independence and the ability to ambulate independently (a score of 0–2 on the Hughes scale), while a poor outcome was defined as a score of 3–6 [6].

The demographic data, clinical presentations, and the electrophysiologic and radiographic results of the patients with a favorable outcome were compared to those of patients with a poor outcome. These factors included sex, age, peak clinical degree, respiratory failure, pain, electrophysiological results, and the length of the spinal cord lesions. The association between each of these variables and outcome status was examined using binary univariate logistic regression analysis. Statistical analyses were performed using the SPSS statistical software package, version 20.0. Statistical significance was defined as a P value lower than 0.05. All statistical tests were two-tailed.

## 3. Results

### 3.1. Demographics and preceding infections

The demographics and preceding infections data for the 23 patients who are reported on in the 18 articles included in this study are presented in Table 1. The mean age of the patients was 21.3 years (range, 8 months to 77 years) and the male-to-female ratio was 10:13. In 21 cases (91.3%), GBS/ATM overlap syndrome was investigated after an infection or vaccination.

### 3.2. Clinical presentations

The patients with GBS/ATM overlap syndrome that were included in this study had a range of clinical presentations (Table 2). Cranial nerve palsy includes diplopia, horizontal nystagmus, restricted eye movement, facial paralysis, dysarthria, and mild dysphagia. Patients with GBS/ATM overlap syndrome had three clinical features. First, some of the patients displayed abnormal pyramidal signs, including 29.4% of the patients who had positive pyramidal signs or a negative plantar reflex and 17.6% of the patients who had signs of areflexia or hyporeflexia combined with positive pyramidal signs. Second, 43.5% of patients experienced pain at the onset of the disease. Third, 47.8% of the patients suffered respiratory failure, and of those, 43.5% required ventilator support, while 17–30 % of patients with GBS alone required ventilator support [25]. We noticed that sensory level (69.6%) and sphincter disturbance (95.7%) are most frequent presentations and useful in an early detection for concurrent ATM.

### 3.3. Laboratory and electrophysiological results

A cerebrospinal fluid (CSF) examination was reported for 19 patients in this study. Ten (52.6%) patients showed an albuminocytologic dissociation. Anti-ganglioside antibodies were detected in 3 patients, and of these, only 1 (33.3%) patient tested strongly positive for anti-GM1 antibodies. Leukocytes in the CSF were normal for 15 patients and elevated in 4 patients, with a maximum value of  $58 \times 10^9/l$ . Protein in the CSF was normal for 12 patients and elevated in 7 patients, with a maximum value of 763 g/dl. Sugar in the CSF was normal for all 19 patients. Oligoclonal band testing was performed for 6 patients and all results were negative. Initial cerebrospinal fluid pressure was also reported for 3 patients, all of which were normal.

Electrophysiology revealed acute demyelinating polyneuropathy and acute axonal polyneuropathy in 11 (47.8%) and 12 (52.2%) patients, respectively. The latter includes 4 patients with AMAN and 8 patients with AMSAN.

### 3.4. Radiographic results

Abnormalities in the spinal cord magnetic resonance imaging (MRI) (focal or multifocal lesions) were detected for all 23 patients (Table 3). All lesions showed hyperintense signals on T2-weighted imaging. The cervical and thoracic regions of the spinal cord were the most-involved areas. The majority of the enhancement was a nodular or mild enhancement. Several patients underwent a follow-up that included a spinal cord MRI, which showed that the shortest time for lesion disappearance was 13 days after onset and the longest was 9 months; 1 patient progressed to the medulla several weeks later with severe atrophy of C1-T1 segment. Lesions could not always be detected during the first MRI scan, with 2 patients that had a normal first MRI scan and a second scan that discovered lesions. In addition to spinal cord lesions, medulla and cerebral hemisphere lesions were found in 3 patients.

### 3.5. Diagnosis and treatment

Not all patients can be diagnosed with GBS/ATM overlap syndrome during the early stages of the disease, with only 5 (29.4%) of the patients being initially diagnosed with GBS/ATM overlap syndrome while the others were diagnosed with GBS or ATM alone. Electrophysiology is helpful for the diagnosis of GBS while spinal cord MRIs are essential to the identification of ATM. Immunotherapies were prescribed to all patients, and the most common treatment was a combination of immunoglobulin and steroids (56.5%). A high dose of methylprednisolone at 1 g/day for 3–5 days followed by a 6-week course of oral prednisone and intravenous immunoglobulin (IVIG) at 0.4 g/kg/day for 5 days were the most common treatment prescriptions. However, only 6 of the 13 patients who received IVIG combined steroids had favorable

**Table 1**  
Demographic and preceding infections of the patients with GBS/ATM overlap syndrome.

References	No. of cases	Age	Sex	Preceding infections
Bajaj NP et al.(2001) [7]	1	28	F	mumps virus infection
Chua HC et al.(2001) [8]	1	34	F	varicella infection
Howell KB et al.(2007) [9]	1	14	M	viral illness
Schulze Beerhorst K (2007) [10]	1	28	M	pulmonary infection
Saidha S et al. (2008) [11]	1	19	M	diarrhea
Adamovic T (2009) [12]	1	8-month-old	M	cold and a vaccination
Lin JJ et al.(2011) [13]	5	8	M	flu-like illness
		9	M	flu-like illness
		13	M	flu-like illness
		13	F	flu-like illness
		15	F	flu-like illness
Sato N et al.(2011) [14]	1	77	F	H1N1 influenza
Canpolat M (2013) [15]	1	7	F	legionella pneumophila infection
Topcu Y (2013) [16]	1	14	F	mycoplasma pneumoniae
Holland NR (2013) [17]	1	17	F	diarrhea
Carman KB et al.(2013) [18]	1	12	M	bartonella henselae infection
Gächter C et al.(2015) [19]	1	48	M	none
Hyung Chung(2015) [20]	2	10	F	viral illness with fever
		10	F	viral illness with fever
Anshuman Srivastava(2016) [21]	1	35	F	none
Orkun Tolunay(2016) [22]	1	4	F	cough and fever
L. M. Oliveira(2017) [23]	1	65	M	influenza vaccination, mycoplasma infection, diarrhea
Ramia Zakhour(2018) [24]	1	10	F	henselae infection

F : female, M : male.

**Table 2**  
Clinical presentation of the patients with GBS/ATM overlap syndrome.

Clinical presentation	N /total
Limb weakness	23/23
paraplegia	4/23
quadriplegia	19/23
Flaccid paralysis at onset	15/15
Tendon reflex	
areflexia or hyporeflexia	16/17
normal	1/17
Pyramidal sign positive or plantar reflex negative	5/17
Areflexia with pyramidal sign positive	3/17
Sensory disturbance	19/23
distal sensory disturbance	6/23
sensory level	16/23
Sensory ataxia	1/23
Urinary dysfunction	18/23
Bowel dysfunction	3/23
Respiratory failure	11/23
ventilator support	10/23
Conscious disturbance	2/23
somnia	1/23
confusion and collapse	1/23
Cranial nerve palsy	7/23
Pain at onset	10/23
neck pain	3/23
back pain	5/23
leg pain	2/23
chest pain	1/23
pain between her shoulder blades	1/23
Vomiting	1/23
Labile blood pressure	2/23
Peak clinical severity	
0-1	11/23
2-3	12/23

0, normal; 1, weak, but able to lift arms off the bed; 2, a flicker of movement; 3, no movement.

outcome. All 3 patients who received treatment with IVIG and steroids combined with plasma exchange or cyclophosphamide were the patients with only partial clinical recovery in this study (Table 4).

**Table 3**  
Radiographic results of the patients with GBS/ATM overlap syndrome.

Radiographic Projects	N /total N
Spinal lesion location	
cervical cord	16/23
thoracic cord	16/23
lumbar cord	2/23
sacral cord	1/23
cone	1/23
whole spinal cord	1/23
Spinal lesion length	
1-4 segments	7/18
5-8 segments	4/18
9-12 segments	4/18
≥ 13 segments	3/18
Spinal lesion with enhancement	11/13
Spinal lesion with edema	9/15
Brain MRI	
normal	10/13
abnormal	3/13
lesion in medulla	2/13
lesion in cerebral hemisphere	1/13

### 3.6. Outcome

In this study, we used the following standard: the favorable outcome with a 0–2 Hughes Scale score, and a poor outcome as a score of 3–6 [6]. Our study identified thirteen patients with favorable outcomes and ten patients with poor outcomes.

Eighteen articles reported detailed information, including spinal cord MRIs, electrophysiology, peak clinical degree, respiratory failure, and pain for eighteen patients. Electrophysiology showed that 100% of the patients in the poor outcome group suffered acute axonal polyneuropathy while 40% in the favorable outcome group suffered acute axonal polyneuropathy, which suggests that acute axonal polyneuropathy is associated with a poor outcome (odds ratio = 3.00, 95% CI = 1.35–6.68,  $P = 0.01$ ). Respiratory failure occurred in 30% of the patients with a good outcome and in 75% of the patients with a poor prognosis, but the difference between the two groups was not statistically significant (odds ratio = 0.14, 95% CI = 0.02–1.16,  $P = 0.07$ ) (Table 5).

**Table 4**  
Diagnosis and treatment of the patients with GBS/ATM overlap syndrome.

	N/total N	Favorable outcome N/total N
Initial diagnosis		
GBS	6/17	–
ATM	6/17	–
GBS/ATM overlap syndrome	5/17	–
Treatment		
IVIG	5/23	5/23
Steroids	1/23	1/23
IVIG + steroids	13/23	6/23
IVIG + steroids + plasmapheresis	1/23	0/23
IVIG + steroids + plasmapheresis + cyclophosphamide	2/23	0/23
Steroids + cyclophosphamide	1/23	1/23

**4. Discussion**

Cases of GBS/ATM overlap syndrome seem to be very rare and are variable. There are difficulties for the diagnosis of GBS/ATM overlap syndrome at an early stage, when symptoms of CNS/PNS are involved simultaneously or consecutively. We have noticed that only a few patients can be diagnosed with GBS/ATM overlap syndrome in the first time. In this review, we attempt to summarize clinical symptoms, imaging, electrophysiology, cerebrospinal fluid examinations, treatments, and prognoses among patients with GBS/ATM overlap syndrome.

We concluded that GBS/ATM overlap syndrome should be suspected in patients (1) with signs of areflexia or hyporeflexia and with positive pyramidal signs, (2) who suffered pain at the onset of the disease, excluded for other potential causes including abscesses, tumors, bleeding, infections, and trauma. Moreover, about half of the patients need ventilator support, suggesting that close monitoring of patients' respiratory conditions should be carried out to guard against respiratory failure.

Symptom observation showed that sensory level and sphincter disturbance indicate concurrent ATM, as well as an abnormal spinal cord magnetic resonance imaging (MRI) detected in almost all patients with GBS/ATM overlap syndrome. Mao et al. [26] reported that abnormalities were shown for spinal cord MRIs of seventeen among nineteen patients with GBS/ATM overlap syndrome. We also showed that the spinal cord MRIs could be useful in the identification of ATM. In this study, two patients were initially shown with normal spinal cord MRIs and lesions were laterally identified. We think that an MRI detection for spinal cord are evident and useful when the patient has symptoms of myelopathy even when the initial MRI is normal. Follow-up MRIs of the spinal cord can show that lesions disappeared or shrank as clinical symptoms subsided, or progressed when worsened, and to re-evaluate

functional consequences due to ATM symptoms. In addition to spinal cord lesions, a few patients presented as lesions in their brain as revealed by MRIs, which indicates that it is advisable to check brain MRIs to detect subclinical lesions in patients with GBS/ATM syndrome.

All patients included in this study were treated with immunotherapies. IVIG is the first choice for treating GBS while plasma exchange is a second-line treatment [27]. Steroid therapy and plasma exchange are effective for ATM [28,29]. If the initial steroid therapy and plasma exchange do not work for severe cases of ATM, other treatments such as IVIG or cyclophosphamide can be considered [30]. Evidence suggests that steroids are an effective treatment for ATM. IVIG is an effective treatment for GBS, which indicates that a combination of steroids and IVIG may be an effective treatment for GBS/ATM overlap syndrome. However, less than half of the patients that received IVIG combined steroids responded positively in this study. It is not clear why there is only a partial clinical recovery of immunomodulators. Although CNS demyelinating diseases and PNS demyelinating diseases tend to have a good prognosis, a combination of the two diseases may lead to a poor prognosis in some patients [31]. Martens-Le et al. reported that the prognosis for children with demyelinating diseases involving both CNS and PNS may be worse than the prognosis for GBS or ATM alone [27]. Such cases could indicate an immune response against epitopes that are common to components of both the central and the peripheral nervous system and are thus distinct from either ATM or GBS in isolation [9]. Currently, the first-line treatment for GBS/ATM overlap syndrome is unclear. A study of adult patients with demyelinating diseases that involve both the CNS and the PNS after an infection suggests that IVIG should be used as a first-line treatment because it is more efficient than steroids [32]. However, steroids alone are not a viable choice for the treatment of patients with GBS/ATM overlap syndrome [22].

This study found that ATM with axonal type polyneuropathy could

**Table 5**  
Analysis of outcomes and influential factors for the patients with GBS/ATM overlap syndrome.

	Favorable Outcome (n = 10)	Poor Outcome (n = 8)	Odds Ratio	95% CI	P Value
Male	4	3	1.11	0.16-7.51	0.91
Age (yr) < 18	5	5	0.60	0.90-3.99	0.60
Mean ± S.D.	23.87 ± 21.21	24.25 ± 22.39	1.00	0.96-1.05	0.97
Peak clinical degree					
0-1	6	2	4.50	0.59-34.61	0.15
2-3	4	6			
Mean ± S.D.	1.40 ± 1.08	2.13 ± 0.84	2.26	0.77-6.69	0.14
Respiratory failure	3	6	0.14	0.02-1.16	0.07
Pain	5	5	0.60	0.09-3.99	0.60
Electrophysiology					
Acute demyelinating polyneuropathy	6	0	3.00	1.35-6.68	0.01
acute axonal polyneuropathy	4	8			
Length of spinal cord lesions					
≤ 4 segments	5	2	3.00	0.40-22.71	0.29
> 5 segments	5	6			
Mean ± S.D.	6.90 ± 6.69	8.50 ± 3.89	1.06	0.89-1.26	0.54

lead to a worse prognosis. Previous studies have shown similar results. Ortiz-Corredor F et al. reported that a poor prognosis in GBS is usually associated with electrophysiological subtypes (axonal type) [33]. Winer JB et al. found that when compared to demyelinating polyneuropathy, many patients with AMSAN have a poorer prognosis and cannot typically walk independently within six months of onset [34]. R.A. Hughes et al. reported that acute motor axonal peripheral neuropathy is typically associated with a rapid progression to nadir [1]. Although GBS is generally considered to be an acute inflammatory demyelinating peripheral neuropathy, in some cases, the axonal portion may be the primary target of the immune-mediated nerve injury [35]. The neuropathology of acute motor axonal peripheral neuropathy suggests that macrophages invade the nodes of Ranvier and axonal degeneration is found in severe cases. Prognostic estimates of GBS/ATM overlap syndrome have been performed based on clinical, electrophysiological, and magnetic resonance imaging findings, and a long term follow-up of patients is needed. Studies with larger sample sizes are also needed to validate our findings in the future.

In this review, the diagnosis of ATM was based on the patients' clinical presentation/imaging data and cerebrospinal fluid test. Multiple sclerosis and neuromyelitis optica are important differential diagnosis. Unfortunately, only oligoclonal band testing was performed for 6 patients, other multiple sclerosis-related tests and aquaporin antibodies were not detected. Studies with larger sample sizes are also needed to validate our findings in the future.

## 5. Conclusions

The early diagnosis of GBS/ATM overlap syndrome is difficult and spinal MRI and electromyography/nerve conduction studies should be performed to assess this entity. The combined use of IVIG and steroids is the most frequently used treatment. However, less than half of the patients responded positively to this treatment. Additionally, acute axonal neuropathy may be a risk factor for a poor prognosis. Further studies are necessary to clarify its incidence, potential etiologies, risk factors, optimal management, and prognosis.

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## Author's contributions

Guo F participated in concept development, data collection and analysis and prepared manuscript, revised manuscript and tables; Zhang YB oversaw concept development, data analysis, manuscript revision and financial support.

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