Guillain–Barré syndrome spectrum associated with COVID-19: an up-to-date systematic review of 73 cases

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Abstract
Since coronavirus disease-2019 (COVID-19) outbreak in January 2020, several pieces of evidence suggested an association between the spectrum of Guillain–Barré syndrome (GBS) and severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). Most findings were reported in the form of case reports or case series, whereas a comprehensive overview is still lacking. We conducted a systematic review and searched for all published cases until July 20th 2020. We included 73 patients reported in 52 publications. A broad age range was affected (mean 55, min 11–max 94 years) with male predominance (68.5%). Most patients showed respiratory and/or systemic symptoms, and developed GBS manifestations after COVID-19. However, asymptomatic cases for COVID-19 were also described. The distributions of clinical variants and electrophysiological subtypes resemble those of classic GBS, with a higher prevalence of the classic sensorimotor form and the acute inflammatory demyelinating polyneuropathy, although rare variants like Miller Fisher syndrome were also reported. Cerebrospinal fluid (CSF) albuminocytological dissociation was present in around 71% cases, and CSF SARS-CoV-2 RNA was absent in all tested cases. More than 70% of patients showed a good prognosis, mostly after treatment with intravenous immunoglobulin. Patients with less favorable outcome were associated with a significantly older age in accordance with previous findings regarding both classic GBS and COVID-19. COVID-19-associated GBS seems to share most features of classic post-infectious GBS and possibly the same immune-mediated pathogenetic mechanisms. Nevertheless, more extensive epidemiological studies are needed to clarify these issues.

Keywords COVID-19 · SARS-CoV-2 · Coronavirus · Guillain–Barré syndrome · Miller Fisher syndrome · Neurology · Autoimmune · Polyradiculopathy · Neuroimmunology

Introduction
Coronavirus disease 2019 (COVID-19) pandemic has rapidly spread around the world from Jan-2020, with more than 14,000,000 cases confirmed so far [1]. Although primary affecting the respiratory system, central and peripheral neurological manifestations associated with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection have been increasingly reported [2–4]. In detail, several pieces of evidence suggested an association between SARS-CoV-2 infection and the development of Guillain–Barré Syndrome (GBS) [5–56].

GBS represents the most common cause of acute flaccid paralysis [57]. The classic form is an immune-mediated acute-onset demyelinating polyradiculoneuropathy (acute inflammatory demyelinating polyneuropathy—AIDP) typically presenting with ascending weakness, loss of deep tendon reflexes, and sensory deficits. Diagnosis of GBS relies on the results of clinical, electrophysiological, and cerebrospinal fluid (CSF) examinations (classically albuminocytological dissociation) [57–59]. The clinical spectrum of GBS encompasses a classic sensorimotor form, Miller Fisher syndrome (MFS), bilateral facial palsy with paraesthesia, pure...
motor, pure sensory, paraparetic, pharyngeal–cervical–brachial variants, polyneuritis cranialis (GBS–MFS overlap), and Bickerstaff brainstem encephalitis [57–60]. As regard electrophysiological features, three main subtypes are recognized: AIDP, acute motor axonal neuropathy (AMAN), and acute motor sensory axonal neuropathy (AMSAN) [57, 58, 61]. Peripheral nerve damage is thought to be provoked by an aberrant immune response to infections, in some cases driven by the production of autoreactive antibodies (anti-ganglioside antibodies) [57–59]. Potential triggering pathogens include both viruses [e.g., cytomegalovirus (CMV), Epstein–Barr virus (EBV), influenza virus, hepatitis E virus, and Zika virus] and bacteria (e.g., Campylobacter Jejuni, Mycoplasma Pneumoniae) [57, 58, 62]. However, a relationship with other events has been also described (e.g., vaccinations, surgery, administration of checkpoint inhibitors, and malignancy) [57, 58]. Given that a potential causal association with beta-coronaviruses [Middle East Respiratory Syndrome (MERS-CoV)] has already been speculated, the relationship between COVID-19 and GBS deserves undoubtedly further attention [63, 64].

With this background, our systematic review aimed to provide a comprehensive and updated overview of all case reports and series of COVID-19-related GBS to identify predominant clinical, laboratory, and neurophysiological patterns and to discuss the possible underlying pathophysiology.

**Methods**

We performed a systematic review according to the SALSA (Search, Appraisal, Synthesis, and Analysis) analytic framework [65]. We screened in PubMed and Google Scholar databases for all case descriptions of GBS associated with COVID-19 that were published from January 1st 2020 up to July 20th 2020. Keywords (including all commonly used abbreviations of these terms) used in the search strategy were as follows: “acute autoimmune neuropathy” OR “acute inflammatory demyelinating polyneuropathy” OR “acute inflammatory demyelinating polyradiculoneuropathy,” OR “acute inflammatory polyneuropathy” OR “Demyelinating Polyradiculoneuropathy” OR “Guillain–Barre Syndrome” OR “Guillain–Barre” OR “Miller–Fisher” OR “Bickerstaff encephalitis” OR “AIDP” OR “AMAN” OR “AMSAN” OR polyneuritis cranialis] AND [“COVID-19” OR “Wuhan coronavirus” OR “novel coronavirus” OR “novel coronavirus 2019” OR “SARS” OR “SARS-CoV-2”]. Suitable references were also identified in the authors’ archives of scientific literature on GBS. We restricted our search to studies published in English, Spanish, or Italian. Publications that were not peer-reviewed were excluded from this study. PRISMA criteria were applied. For each case, we extracted data concerning demographic and clinical variables, results of diagnostic investigations, and outcome. If the GBS clinical variant [57] or the electrophysiological subtype [61] was not explicitly reported in the paper, we reconstructed it, when possible, from reported details. We also classified the diagnostic certainty of all cases according to the Brighton Criteria [66]. Searches were performed by SAR, AA, and MF. The selection of relevant articles was shared with all authors.

For statistical analysis, we used IBM SPSS Statistics version 21 (IBM, Armonk, NY, USA). Based on the distribution of values, continuous data were expressed as mean ± standard deviation or as median and interquartile range (IQR). Depending on the number of groups and data distribution, we applied the t test, the Mann–Whitney U test or the Kruskal–Wallis test (followed by Dunn–Bonferroni post hoc test). All reported p values were adjusted for multiple comparisons. We adopted the Chi-square test for categorical variables. Differences were considered statistically significant at p < 0.05.

For the present study, no authorization to an Ethics Committee was asked, because the original reports, nor this work, provided any personal information of the patients.

**Results**

Our literature search identified 101 papers, including 37 case reports, 12 case series, 3 reviews with case reports, 42 reviews, 4 letters, 1 original article, 1 point of view, and 1 brief report. Four and one patients were excluded from the analysis because of a missing laboratory-proven SARS-CoV-2 infection or an ambiguous GBS diagnosis [disease course resembling chronic inflammatory demyelinating neuropathy (CIDP)], respectively. A total of 52 studies were included in the final analysis (total patients = 73) [5–56]. All data concerning the analyzed patients are reported in Table 1. For one case [20], most clinical and diagnostic details were not reported; therefore, many of our analyses were limited to 72 patients.

**Epidemiological distribution and demographic characteristics of the patients**

To date, GBS cases (n = 73) were reported from all continents except Australia. In details, patients were originally from Italy (n = 20), Iran (n = 10), Spain (n = 9), USA (n = 8), United Kingdom (n = 5), France (n = 4), Switzerland (n = 4), Germany (n = 3), Austria (n = 1), Brazil (n = 1), Canada (n = 1), China (n = 1), India (n = 1), Morocco (n = 1), Saudi Arabia (n = 1), Sudan (n = 1), The Netherlands (n = 1), and Turkey (n = 1) (Table 1, Fig. 1). The mean age at onset was 55 ± 17 years (min 11–max 94), including four pediatric cases [21, 27, 35, 41]. A significative prevalence of men
Compared to women was noticed (50 vs. 23 cases: 68.5% vs. 31.5%) with no significant difference in age at onset between men and women (mean: 55 ± 18 vs. 56 ± 16 years, \( p = 0.643 \)). Comorbidities were variably reported with no prevalence of a particular disease.

**Clinical picture, diagnosis, and therapy of COVID-19**

All reported GBS cases (\( n = 72 \)) except two were symptomatic for COVID-19 with various severity. Most common manifestations of COVID-19 included fever (73.6%, 53/72), cough (72.2%, 52/72), dyspnea and/or pneumonia (63.8%, 46/72), hypo-/ageusia (22.2%, 16/72), hypo-/anosmia (20.8%, 15/72), and diarrhea (18.1%, 13/72). One of the two asymptomatic subjects never developed fever, respiratory symptoms, or pneumonia [10], whereas the other patient showed an asymptomatic pneumonia at chest computed tomography (CT) [12]. In all but six patients with available data [22, 24, 36, 44, 45, 52], SARS-CoV-2 RT-PCR with naso- or oropharyngeal swab or fecal exam was positive at first or following tests. Nevertheless, these six patients tested positive at SARS-CoV-2 serology. In four patients, the laboratory exam for the diagnostic confirmation was not specified [20, 40]. Typical “ground glass” aspects at chest-CT or similar findings at CT, Magnetic Resonance Imaging (MRI) or X-ray compatible with COVID-19 interstitial pneumonia were reported in 40 cases. The detailed therapies for COVID-19 are described in Table 1.

**Clinical features of GBS spectrum**

In all (\( n = 72 \)) but four patients [10, 37, 40, 56], GBS manifestations developed after those of COVID-19 [median (IQR): 14 (7–20), min 2–max 33 days]. Differently, COVID-19 symptoms began concurrent in one case [37], 1 day [40] and 8 days [55] after GBS onset in two other cases and never developed in another one [10] (Table 1). Common clinical manifestations at onset included sensory symptoms (72.2%, 52/72) alone or in combination with paraparesis or tetraparesis (65.2%, 47/72, respectively). Cranial nerve involvement (e.g., facial, oculomotor nerves) was less frequently described at onset (16.7%, 12/72). Moreover, all cases but one [26] showed lower limbs or generalized areflexia, whereas in 37.5% (27/72) of the cases, gait ataxia was reported at onset or during the disease course. Even if ascending weakness evolving into flaccid tetraparesis (76.4%, 55/72) and spreading/persistence of sensory symptoms (84.7%, 61/72) represented the most common clinical evolutions, 50.0% (36/72) and 23.6% (17/72) patients showed cranial nerve deficits and dysphagia, respectively, during disease course (Table 1). Moreover, 36.1% (26/72) of the patients developed respiratory symptoms, and some of them evolved to respiratory failure (Table 1). Autonomic disturbances were rarely reported (16.7%, 12/72). In cases with MFS/MFS-GBS overlap, areflexia, oculomotor disturbances, and ataxia were present in 100% (9/9), 66.7% (6/9) and 66.7% (6/9), respectively [8, 19, 23, 30, 32, 33, 43, 44]. The median of time to nadir was calculated in 40 patients with available data and resulted 4 days (IQR 3–9) (Table 1).

**Results of electrophysiological, CSF, biochemical, and neuroimaging investigations**

Detailed electroneurography results were reported in 84.9% (62/73) of the cases. Specifically, 77.4% (48/62) cases showed a pattern compatible with a demyelinating polyradiculoneuropathy. In contrast, axonal damage was prominent in 14.5% (9/62). In a minority of the patients (8.1%), a mixed pattern was reported (5/62). Regarding CSF analysis (full results were available in 59 out of 73 cases), the classical albuminocytological dissociation (cell count <5/µl with elevated CSF proteins) was detected in 71.2% of the cases (42/59) with a median CSF protein of 100.0 mg/dl (min: 49, max: 317 mg/dl). Mild pleocytosis (i.e., cell count ≥ 5/µl), with a maximum cell count of 13/µl, was evident in 5/59 cases (8.5%). Furthermore, CSF SARS-CoV-2 RNA was undetectable in all tested patients (\( n = 31 \)) (Table 1).

Detailed blood haematological and biochemical examinations showed variably leucocytosis (\( n = 4 \)), leucopenia (\( n = 17 \)), thrombocytosis (\( n = 3 \)), thrombocytopenia (\( n = 5 \)), and increased levels of C-reactive protein (CRP) (\( n = 22 \)), erythrocyte sedimentation rate (\( n = 4 \)), v-Dimer (\( n = 5 \)), fibrinogen (\( n = 3 \)), ferritin (\( n = 3 \)), LDH (\( n = 7 \)), IL-6 (\( n = 4 \), IL-1 (\( n = 3 \), IL-8 (\( n = 3 \), and TNF-α (\( n = 3 \)) (Table 1).

Furthermore, anti-GD1b and anti-GM1 antibodies were positive in one patient with MFS [23] and in one with classic sensorimotor GBS [13], respectively, whereas 33 cases tested negative (one in equivocal range) for anti-ganglioside antibodies.

Cranial and spinal MRI scans were performed in a minority of the patients (23/73, 31.5%). Five patients (three cases with AIDP [9, 12, 25], one case with MFS [30], and one case with bilateral facial palsy with paresthesia [52]) showed cranial nerve contrast enhancement in the context of corresponding cranial nerve palsies. Moreover, brainstem leptomeningeal enhancement was described in two cases with AIDP, both with clinical cranial nerve involvement [18, 46]. On the other hand, spinal nerve roots and leptomeningeal enhancement were reported in eight [9, 27, 31, 36, 37, 42, 52] and two cases [17, 46], respectively (Table 1).

**Distribution of clinical and electrophysiological variants and diagnosis of GBS**

From the clinical point of view, most examined patients presented with a classic sensorimotor variant (70.0%,
51/73), whereas Miller Fisher syndrome, GBS/MFS overlap variants (including polynuertitis cranialis), bilateral facial palsy with paresthesia, pure motor, and paraparetic were described in seven, two, five, four, and one patients, respectively. In three cases, no clinical variant could be established using the reported details (Table 1). In the examined population, 81.8% subjects fulfilled electrophysiological criteria for AIDP (45/55), 12.7% (7/55) for AMSAN, and 5.4% (3/55) for AMAN subtypes. Finally, a specific electrophysiological subtype was not attributable in 18 patients due to the lack of detailed information. The diagnosis of GBS was established based on clinical, CSF, and electrophysiological findings in 44/73 (60.3%) patients, clinical, and electrophysiological data in 18/73 (24.7%) cases, clinical, and CSF data in 8/73 (11.0%), and only clinical findings in 3/73 (4.1%) patients. Indeed, the highest level of diagnostic certainty (level one) was confirmed in 44/73 cases (60.3%). Level two and three were obtained in 24/73 cases (32.9%) and 5/73 (6.8%), respectively (Table 1).

Management of GBS and patient outcomes

All cases with available therapy data (n = 70) except ten [13, 15, 23, 25, 26, 33, 35–37, 41] were treated with intravenous immunoglobulin (IVIG) (Table 1). Conversely, plasma exchange and steroid therapy were performed in ten (four of them received also IVIG) and two cases, respectively. In two patients, no therapy was given. Mechanical or non-invasive ventilation was implemented in 21.4% (15/70) and 7.1% (5/70) patients due to worsening of GBS or COVID-19, respectively. At further observation (n = 68), 72.1% (49/68) patients demonstrated clinical improvement with partial or complete remission, 10.3% (7/68) cases showed no improvement, 11.8% (8/68) still required critical care treatment, and 5.8% (4/68) died (Table 1).

Interestingly, patients with no improvement or poor outcome (n = 19) showed a slightly higher (but not significant) frequency of clinical history and/or a radiological picture of COVID-19 pneumonia (14/19, 73.7%) compared to those with a favorable prognosis (29/48, 60.4%, p = 0.541). Moreover, the former group of patients was significantly older (mean 62.7 ± 17.8 years, p = 0.011), but with comparable distribution of sex (p = 0.622) and electrophysiological subtypes (p = 0.144) and similar latency between COVID-19 and GBS (p = 0.588) and nadir (p = 0.825), compared to the latter (mean age 51.8 ± 16.6 years). The same findings were confirmed even after excluding cases with no improvement from the analysis (to prevent a possible bias related to the short follow-up time).

Discussion

COVID-19 pandemic prompts all efforts for the early recognition and treatment of its manifestations. In analogy to other viruses, belonging or not to the coronavirus family [63, 67], neurologic complications in COVID-19 are emerging as one of the most significant clinical chapters of this pandemic. In this regard, peripheral and central nervous system damage in COVID-19 has been postulated to be the consequence of two different mechanisms: 1) hematogenous (infection of endothelial cells or leukocytes) or trans-neuronal (via olfactory tract or other cranial nerves) dissemination to central nervous system in relation with viral neurotropism, and 2) abnormal immune-mediated response causing secondary neurological involvement [62, 68, 69]. The first mechanism is supposed to be responsible for the most common neurological symptoms developed by patients with COVID-19 (e.g., hypogeusia, hyposmia, headache, vertigo, and dizziness). In contrast, the second can lead to severe complications during or after the course of the illness, either dysimmune (e.g., myelitis, encephalitis, GBS) or induced by cytokine overproduction (hypercoagulable state and cerebrovascular events) [68, 69].

In the present systematic review, we reviewed clinical features, results of diagnostic investigations, and outcome in 73 cases of COVID-19-associated GBS spectrum [5–56].

In the present study, mean age at onset in patients with GBS largely overlapped that of classic COVID-19 subjects [70, 71]. However, pediatric cases with GBS have been increasingly reported in the literature [21, 27, 35, 41], suggesting that, with the spreading of the pandemic, a broader age range might be affected. Moreover, we found a higher prevalence of GBS in males compared to females, as previously reported for Zika virus–GBS [72]. This finding may also reflect the gender epidemiology of SARS-CoV-2. In this regard, males typically show a worse COVID-19 outcome compared to the females [70, 71], possibly due to a generally shorter life expectancy or to higher circulating Angiotensin-Converting-Enzyme 2 (ACE2) levels, the cellular receptor for SARS-CoV-2, in the former compared to the latter [71]. Moreover, given that GBS is a rare disease [57] the epidemiological distribution of the reported cases seems to reflect current worldwide outbreaks, with Europe being the “hottest” spot in March–May 2020 and USA together with Asia in the following period [73, 74]. On another issue, despite a few GBS cases seemed to have a para-infectious profile [10, 37, 38, 40, 55, 56] as described for Zika virus [75], all other reported patients developed neurological symptoms with a typical latency after COVID-19 (median time 14 days). This feature, together with the frequently reported negative nasopharyngeal swab at GBS onset [22, 24, 36, 44, 45, 52] and clinical improvement after IVIG therapy, seems to support
| Article          | Country | Age | Sex | GBS clinical picture                                                                 | Days between COVID-19 symptoms and GBS onset | Onset | Disease course                          | Autonomic disturbances | Respiratory symptoms/failure | Time to Nadir<sup>b</sup> | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                  | Level of diagnostic certainty<sup>b</sup> | GBS variant        |
|------------------|---------|-----|-----|---------------------------------------------------------------------------------------|---------------------------------------------|-------|----------------------------------------|------------------------|-----------------------------|------------------------|---------------------------|-------------------|-----------------------------|--------------------------------|---------------------|
| Agosti et al. [5] | Italy   | 68  | M   | Bilateral facial palsy, progressive symmetric ascending flaccid tetraparesis, achilles tendon areflexia | 5 days after LL weakness                     | LL weakness | NA                                      | No                     | NA                          | NA                     | Dry cough associated with fever, dysgeusia, and hypoaesthesia | Dys-lipidemia, benign prostatic hypertrophy, hypertension, abdominal aortic aneurysm | Clinical + CSF + electrophysiology | 1                       | Pure motor       |
| Alberti et al. [6] | Italy   | 71  | M   | Ascendant weakness, flaccid tetraparesis, hypoesthesia and paraesthesia in the 4 limbs, generalized areflexia, dyspnea | 4 days after LL paraesthesia (no resolution of pneumonia) | LL paraesthesia | None                                    | Yes (concurrent pneumonia) | 4 days after symptoms onset (24 h after the admission) | None                   | Fever (low grade), dyspnea, pneumonia | Hypertension, treated abdominal aortic aneurysm, treated lung cancer | Clinical + CSF + electrophysiology | 1                       | Classic sensorimotor |
| Arnaud et al. [7] | France  | 64  | M   | Generalized areflexia, severe flaccid proximal paraparesis, decreased proprioceptive length-dependent sensitivity and LL pinprick and light touch hypoesthesia | 23 days after Fast progressive LL weakness | Fast progressive LL weakness | None | No                                      | 4 days after symptoms onset | None                       | None                   | Fever, cough, diarrhea, dyspnea, severe interstitial pneumonia | DM type 2 | Clinical + CSF + electrophysiology | 1 | Classic sensorimotor |
| Assini et al. [8] | Italy   | 55  | M   | Masseter weakness, tongue protrusion (bilateral hypoglossal nerve paralysis), UL and LL hyporeflexia without muscle weakness, soft palate elevation defect | 20 days after Bilateral eyelid ptosis, dysphagia, dysphonia | Bilateral eyelid ptosis, dysphagia, dysphonia | None | Yes (concurrent pneumonia) | NA                     | NA                         | Fever, anosmia, agnosia, cough, pneumonia | NA | Clinical + electrophysiology | 2 | Classic sensorimotor overlap with Miller-Fisher |
Table 1 (continued)

| Article                  | Country | Age | Sex | Days between COVID-19 symptoms and GBS onset | Onset                                      | Disease course                                      | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir\(^a\) | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis | Level of diagnostic certainty\(^b\) | GBS variant |
|--------------------------|---------|-----|-----|---------------------------------------------|--------------------------------------------|--------------------------------------------------|------------------------|----------------------------|----------------------|-------------------------|------------------------|----------------|--------------------------------|-------------|
| Assini et al. [8]        | Italy   | 60  | M   | 20 days after                               | Distal tetraparesis with right foot drop, autonomic disturbances | UL and LL distal weakness, right foot drop, generalized areflexia | Gastoplegia, paralytic ileus, loss of blood pressure control | Yes (concurrent pneumonia) | NA                   | Fever, severe interstitial pneumonia | NA                     | Clinical + electrophysiology | 2                       | Pure motor                  |
| Bigaut et al. [9]        | France  | 43  | M   | 21 days after                               | UL and LL paraesthesia, distal LL weakness | Extension to midhigh and tips of the finger with ataxia, right peripheral facial nerve palsy, generalized areflexia | None                   | No                        | 2 days after symptoms onset | Cough, astenia, myalgia in legs, followed by acute anosmia and ageusia with diarrhea, mild interstitial pneumonia | NA                     | Clinical + CSF + electrophysiology | 1                       | Classic sensori-motor          |
| Bigaut et al. [9]        | France  | 70  | F   | 10 days after                               | Acute proximal tetraparesis, distal forelimb and personal paraesthesia | Respiratory weakness, loss of ambulation | None                   | Yes                       | 3 days after symptoms onset | Anosmia, ageusia, diarrhoea, astenia, myalgia, moderate interstitial pneumonia | Obesity              | Clinical + CSF + electrophysiology | 1                       | Classic sensori-motor          |
| Bracaglia et al. [10]    | Italy   | 66  | F   | Unknown (due to asymptomatic infection)     | Acute proximal and distal tetraparesis, lumbar pain and distal tingling sensation | Loss of ambulation, difficulty in speaking and swallowing, generalized areflexia | None                   | No                        | NA                   | Asymptomatic            | None                   | Clinical + electrophysiology | 2                       | Classic sensori-motor                  |
| Camdessanche et al. [11] | France  | 64  | M   | 11 days after                               | UL and LL paraesthesia                         | Ascendent weakness, flaccid tetraparesis, generalized areflexia, dysphagia | None                   | Yes                       | 3 days after symptoms onset | Fever (high grade), cough, pneumonia | None                   | Clinical + CSF + electrophysiology | 1                       | Classic sensori-motor                  |
| Chan et al. [12]         | Canada  | 58  | M   | 20 days after home isolation for suspected contact | Bilateral facial weakness, dysarthria, feet paraesthesia, LL areflexia | NA                                           | None                   | No                        | NA                   | Asymptomatic, interstitial pneumonia | None                   | Clinical + CSF + electrophysiology | 1                       | Bilateral facial palsy with paraesthesia |

\(^a\) Nadir: lowest score achieved during the course of disease.

\(^b\) Level of diagnostic certainty: Level 1: definite, Level 2: possible, Level 3: probable.
Table 1 (continued)

| Article | Country | Age | Sex | GBS clinical picture | Days between COVID-19 symptoms and GBS onset | Onset | Disease course | Autonomic disturbances | Respiratory symptoms/failure | Time to Nadir/* | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis | Level of diagnostic certainty^b | GBS variant |
|---------|---------|-----|-----|----------------------|---------------------------------------------|-------|---------------|------------------------|------------------------|----------------|------------------------|-----------------------|--------------|-----------------------------|-------------|
| Chan et al. [13] | USA | 68 | M | Gait disturbance, hands and feet paraesthesia | 18 days after | LL proximal weakness, absent vibratory and proprioceptive sense at the toes, UL hyporeflexia, LL areflexia, unsteady gait with inability to toe or heel walk, bilateral facial weakness, dysphagia, dysarthria, neck flexion weakness | None | No | 8 days after the onset of symptoms | Fever and upper respiratory symptoms | NA | Clinical + CSF | 2 | Classic sensorimotor |
| Chan et al. [13] | USA | 84 | M | Hands and feet paraesthesia, progressive gait disturbance | 16 days after | Bilateral facial weakness, progressive arm weakness, neuromuscular respiratory failure | Yes (not specified autonomic dysfunction) | Yes | 25 days after the onset of symptoms | Fever | NA | Clinical + CSF | 2 | Classic sensorimotor |
| Coen et al. [14] | Switzerland | 70 | M | Paraparesis, distal allodynia | 6 days after | Generalized areflexia | Difficulties in voiding and constipation | No | NA | Dry cough, myalgia, fatigue | None | Clinical + CSF + electrophysiology | 1 | Classic sensorimotor |
| Ebrahimzadeh et al. [15] | Iran | 46 | M | Pain and numbness in distal LL and UL extremities, ascending weakness in legs | 18 days after | Mild peripheral right facial nerve palsy, generalized areflexia | None | No | 7 days after symptoms onset | Low-grade fever, sore throat, dry cough and mild dyspnea, bilateral interstitial pneumonia (concurrent with neurological symptoms) | None | Clinical + CSF + electrophysiology | 1 | Classic sensorimotor |
| Article            | Country     | Age | Sex | GBS clinical picture                                                                 | Days between COVID-19 symptoms and GBS onset | Onset                      | Disease course                                      | Autonomic disturbances | Respiratory symptoms/failure | Time to Nadirb | COVID-19 clinical picture  | Previous comorbidities | GBS diagnosis                                      | Level of diagnostic certaintyb | GBS variant              |
|--------------------|-------------|-----|-----|---------------------------------------------------------------------------------------|---------------------------------------------|---------------------------|----------------------------------------------------|------------------------|-----------------------------|-----------------|--------------------------------|---------------------|-------------------------------------------------|--------------------------|-------------------------|
| Ebrahimzadeh et al. [15] | Iran        | 65  | M   | Progressive ascending LL and UL extremities weakness and paraesthesia                   | 10 days after                               | Proximal and distal UL and LL weakness, UL hyporeflexia and LL areflexia | None                  | No                        | No               | History of COVID-19 (symptoms not specified), fine crackles in both lungs (concurrent with neurological symptoms) | Hypertension   | Clinical + electrophysiology                      | 2                      | Classic sensorimotor                        |
| El Otmani et al. [16]  | Morocco     | 70  | F   | Weakness and paraesthesia in the 4 limbs                                              | 3 days after                                | None                      | Tetraparesis, hypotonia, generalised areflexia, bilateral positive Lasègue sign | None                   | No                          | NA              | Dry cough, pneumonia              | Rheumatoid arthritis | Clinical + CSF + electrophysiology              | 1                      | Classic sensorimotor                        |
| Esteban Molina et al. [17] | Spain       | 55  | F   | Paraparesis and weakness in the 4 limbs                                               | 14 days after                               | Lumbar pain, dysphagia, tetraplegia, general areflexia, bilateral areflexia, bilateral facial palsy, lingual and perioral areflexia | None                  | Yes                       | 3 days after symptoms onset (48 h after the admission) | Fever, dry cough and dyspnoea, pneumonia | Dyslipidemia              | Clinical + CSF + electrophysiology              | 1                      | Classic sensorimotor                        |
| Farzi et al. [18]       | Iran        | 41  | M   | Paraesthesia of the feet                                                               | 10 days after                               | None                      | Tetraparesis, areflexia at the LL and hyporeflexia at the UL, stocking-and-glove hypesthesia and reduced sense of vibration and position | None                   | No                          | 7 days after symptoms onset                | Cough, dyspnea and fever  | DM type II                              | Clinical + electrophysiology                   | 2                      | Classic sensorimotor                        |
| Fernández-Domínguez et al. [19] | Spain       | 74  | F   | Gait ataxia and generalized areflexia                                                 | 15 days after                               | NA                        | NA                                                 | NA                     | No                          | NA              | Respiratory symptoms (not further detailed) | Hypertension and follicular lymphoma | Clinical + CSF                       | 2                      | Miller Fisher variant                        |
| Finsterer et al. [20]    | India       | 20  | M   | NA                                                                                    | 5 days after                                | NA                        | NA                                                 | NA                     | NA                          | NA              | NA                                           | Clinical + electrophysiology                   | 2                      | NA                                              |                         |                         |
| Article                        | Country | Age | Sex | GBS clinical picture                                                                 | Days between COVID-19 symptoms and GBS onset | Onset                                                                 | Disease course                                                                 | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir<sup>b</sup> | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                      | Level of diagnostic certainty<sup>b</sup> | GBS variant                      |
|-------------------------------|---------|-----|-----|--------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------|----------------------------------|------------------------|-----------------------------|--------------------------|--------------------------------|------------------------------------------------|--------------------------|
| Frank et al. [21]             | Brazil  | 15  | M   | Paraparesis, pain in the LL                                                          | > 5 days after                              | Paraparesis, pain in the LL                                        | Rapidly progressive ascending tetraparesis, areflexia                   | NA                    | No                               | NA                     | Fever, intense sweating        | NA                       | Clinical + electro-physiology | 2                          | Classic sensori-motor      |
| Gigli et al. [22]             | Italy   | 53  | M   | Parasthesia, gait ataxia                                                             | NA                                          | NA                                                                  | NA                                                                         | NA                    | NA                               | NA                     | Fever, diarrhea              | NA                       | Clinical + CSF + electrophysiology | 1                          | NA                      |
| Gutiérrez-Ortiz et al. [23]   | Spain   | 50  | M   | Vertical diplopia, perioral paraesthesia, gait ataxia                                  | 3 days after                               | Vertical diplopia, perioral paraesthesia, gait ataxia              | Right internuclear ophthalmoplegia and right fascicular oculomotor palsy, ataxia, generalized areflexia | None                  | No                               | NA                     | Fever, cough, malaise, headache, low back pain, anosmia, ageusia | None                       | Clinical + CSF             | 2                          | Miller Fisher variant       |
| Gutiérrez-Ortiz et al. [23]   | Spain   | 39  | M   | Vertical diplopia (bilateral abducens palsy)                                         | 3 days after                               | Vertical diplopia (bilateral abducens palsy)                        | Generalized areflexia                                                  | None                  | No                               | NA                     | Diarrhea, low-grade fever    | None                      | Clinical + CSF             | 2                          | Polynyuritis cranialis (GBS-Miller Fisher Interface) |
| Helbok et al. [24]            | Austria | 68  | M   | Hypoesthesia and paraesthesia in the LL, proximal weakness, areflexia, stand ataxia  | 14 days after                              | Hypoesthesia and paraesthesia in the LL, proximal weakness, areflexia, stand ataxia | Ascending weakness, flaccid tetraparesis, generalized areflexia         | NA                    | Yes                              | 2 days after symptoms onset (24 h after the admission) | Fever, dry cough, myalgia, anemia and ageusia. | None                       | Clinical + CSF + electrophysiology | 1                          | Classic sensori-motor      |
| Hutchins et al. [25]          | USA     | 21  | M   | Right-sided facial numbness and weakness                                               | 16 days after                               | Right-sided facial numbness and weakness                            | Bilateral facial palsy, severe dysarthria, bilateral L.L. weakness, bilateral UL. paraesthesia, areflexia | NA                    | No                               | 3 days after symptoms onset | Fever, cough, dyspnoea, diaphoresis, nausea, headache | Hypertension, pre-diabetes, and class I obesity | Clinical + CSF + electrophysiology | 1                          | Bilateral facial palsy with paraesthesia |
| Juliao Caamaño et al. [26]    | Spain   | 61  | M   | Facial diplegia                                                                       | 10 days after                               | Facial diplegia                                                      | No progression                                                          | None                  | No                               | 1 day after symptoms onset | Fever and cough              | None                      | Clinical + electrophysiology | 3                          | Bilateral facial nerve palsy |

<sup>b</sup> Level of diagnostic certainty: 1: Conclusive; 2: Probable; 3: Possible; 4: Uncertain

GBS: Guillain-Barre Syndrome
COVID-19: Coronavirus Disease 2019
CSF: Cerebrospinal Fluid
Clinical: Clinical examination
Electrophysiology: Electrophysiological study
Bronchial asthma: Asthma affecting the bronchi
Miller Fisher variant: Miller Fisher syndrome with variations
Polynyuritis cranialis: Polynyuritis cranialis
Classic sensori-motor: Classic sensori-motor pattern
| Article                  | Country                    | Age | Sex | Days between COVID-19 symptoms and GBS onset | GBS clinical picture                                                                 | Onset                                                                 | Disease course                                                                 | Autonomic disturbances | Respiratory symptoms/failure | Time to Nadir^a | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                        | Level of diagnostic certainty^b | GBS variant          |
|------------------------|----------------------------|-----|-----|---------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------|--------------------------------|----------------|-----------------------------|-------------------------|----------------------------------|-------------------------------|----------------------|
| Khalifa et al. [27]     | Kingdom of Saudi Arabia    | 11  | M   | 20 days after                               | Gait ataxia, areflexia and paraesthesia in the LL                                      | NA                                                                    | No                                                                 | NA                     | Acute upper respiratory tract infection, low-grade fever, dry cough. | NA                       | Clinical + CSF + electrophysiology | 1                        | Classic sensorimotor            |
| Kilinc et al. [28]      | The Netherlands            | 50  | M   | 24 days after                               | Facial diplegia, symmetrical proximal weakness, paraesthesia of distal extremities, gait ataxia, areflexia | NA                                                                    | No                                                                 | 11 days after symptoms onset | Dry cough                       | None                      | Clinical + electrophysiology     | 2                        | Classic sensorimotor            |
| Lampe et al. [29]       | Germany                    | 65  | M   | 2 days after                                | Acute right UL and LL weakness causing recurrent falls                                  | Right UL paresis, slight paraesthesia more pronounced on the right side, generalized hyporeflexia | None                                                                 | 3 days after symptoms onset | Fever and dry cough               | None                      | Clinical + CSF + electrophysiology | 1                        | Pure motor                     |
| Lantos et al. [30]      | USA                        | 36  | M   | 4 days after                                | Ophthalmoparesis and hypeoesthesia below knee                                            | Progressive ophthalmoparesis (including initial left III cranial nerve and eventual bilateral VI cranial nerve palsies), ataxia, and hyporeflexia | None                                                                 | NA                     | Fever, chills, and myalgia       | None                      | Clinical                        | 3                        | Miller Fisher variant           |
| Lascano et al. [31]     | Switzerland                | 52  | F   | 15 days after (no resolution of pneumonic)  | Back pain, diarrhea, rapidly progressive tetraparesis, distal paraesthesia               | Constipation, abdominal pain                                            | Yes                                                                                 | 4 days after symptoms onset | Dry cough, dysgeusia, cacosmia | None                      | Clinical + CSF + electrophysiology | 1                        | Classic sensorimotor            |
Table 1 (continued)

| Article          | Country     | Age | Sex | COVID-19 clinical picture | GBS clinical picture                                                                 | Onset                                      | Disease course | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir<sup>b</sup> | Previous comorbidities | GBS diagnosis        | Level of diagnostic certainty<sup>b</sup> | GBS variant       |
|------------------|-------------|-----|-----|----------------------------|--------------------------------------------------------------------------------------|-------------------------------------------|----------------|------------------------|-------------------------------|--------------------------|------------------------|---------------------|---------------------------------------------|-------------------|
| Lascano et al.   | Switzerland | 63  | F   | 7 days after (no resolu-     | Limb weakness, pain on the left calf                                               | Moderate tetraparesis, LL and left UL    | None           | No                     | 5 days after symptoms onset | Dry cough, shivering, breathing difficulties, chest pain, odynophagia | DM type 2               | Clinical + electrophysiology           | 2                | Classic sensorimotor                        |
| [31]             |             |     |     | tion of pneumonia)          |                                                                                      | allodynia, severe hypopallesthesia, areflexia (except for bicipital tendon reflexes) | None           | Yes                    | 4 days after symptoms onset | None                     | (concurrent pneumonia) | None                | Clinical + CSF + electrophysiology       | 1                | Classic sensorimotor                        |
| Lascano et al.   | Switzerland | 61  | F   | 22 days after                | LL weakness, dizziness, dysphagia                                                   | Moderate tetraparesis, bilateral facial   | None           | Yes                    | 4 days after symptoms onset | None                     | NA                     | None                | NA                           | Classic sensorimotor                        |
| [31]             |             |     |     | after                         |                                                                                      | palsy, lower limb allodynia, severe hypo- | None           | Yes                    | 4 days after symptoms onset | None                     | Fever, cough, ageusia, bilateral pneumonia | NA               | Clinical + CSF                             | 2                | Miller Fisher variant                       |
| Manganotti et al.| Italy       | 50  | F   | 16 days after                | Diplopia and facial paraesthesia                                                     | Ataxia, diplopia in vertical and lateral  | None           | Yes (concurrent pneu- | NA                           | None                     | Fever, cough, ageusia, bilateral pneumonia | NA               | Clinical + CSF + electrophysiology       | 2                | Classic sensorimotor                        |
| [32]             |             |     |     | after                         |                                                                                      | gaze, left upper arm dystymia, generalized areflexia, mild lower facial defects, and  | None           | Yes                    | NA                           | None                     | Fever, dyspnea, hyposmia and ageusia | Clinical + CSF + electrophysiology | 1                | Classic sensorimotor                        |
| Manganotti et al.| Italy       | 72  | M   | 18 days after                | Tetraparesis UL > LL, LL paraesthesia, generalized areflexia, facial weakness on the | NA                                         | NA             | No                     | NA                           | NA                       | Clinical + CSF + electrophysiology | 1                | Classic sensorimotor                        |
| Article                          | Country | Age | Sex | GBS clinical picture                                                                 | Days between COVID-19 symptoms and GBS onset | Onset           | Disease course | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir | COVID-19 clinical picture                  | Previous comorbidities | GBS diagnosis                            | Level of diagnostic certainty | GBS variant            |
|---------------------------------|---------|-----|-----|--------------------------------------------------------------------------------------|---------------------------------------------|-----------------|-----------------|-----------------------|-----------------------------|----------------|--------------------------------------------|----------------------------|--------------------------|------------------------------------------|------------------------|------------------------|
| Manganotti et al. [33]          | Italy   | 72  | M   | Tetraparesis, LL > UL, paraesthesia, global areflexia, diplopia, facial hypoaesthesia,facial weakness | 30 days after                               | Tetraparesis   | NA              | NA                    | No                          | NA             | Fever, cough, dyspnea, hyposmia and ageusia | NA                         | Clinical + electrophysiology              | 1                         | Classic sensori-motor                        |
| Manganotti et al. [33]          | Italy   | 49  | F   | Ophthalmoplegia, limb ataxia, generalized areflexia, diplopia, facial hypoaesthesia, facial weakness | 14 days after                               | Ophthalmoplegia | NA              | NA                    | No                          | NA             | Fever, cough, dyspnea, hyposmia and ageusia | NA                         | Clinical + CSF + electrophysiology        | 1                         | Miller Fisher variant                        |
| Manganotti et al. [33]          | Italy   | 94  | M   | LL weakness, generalized hyporeflexia                                                  | 33 days after                               | LL weakness    | NA              | NA                    | No                          | NA             | Fever, cough, gastrointestinal symptoms   | NA                         | Clinical + electrophysiology              | 2                         | Classic sensori-motor                        |
| Manganotti et al. [33]          | Italy   | 76  | M   | Quadruparesis, UL > LL, generalized areflexia, facial weakness, transient diplopia     | 22 days after                               | Quadruparesis   | NA              | NA                    | No                          | NA             | Fever, cough, dysuria, hyposmia, ageusia | NA                         | Clinical + CSF + electrophysiology        | 1                         | Pure motor                                 |
| Marta-Enguita et al. [34]       | Spain   | 76  | F   | Back pain and progressive tetraparesis with distal-onset paraesthesia                  | 8 days after                                | Back pain and progressive tetraparesis with distal-onset paraesthesia | NA              | Progressive with dysphagia and cranial nerves involvement, generalized areflexia | NA                      | Cough and fever without dyspnea              | 3                          | NA                                     |
| Mozhdehipanah et al. [35]       | Iran    | 38  | M   | Progressive LL paraesthesia, facial diplopia, lobar areflexia                           | 16 days after                               | Progressive LL paraesthesia, facial diplopia, lobar areflexia | Mild LL weakness, bulbar symptoms developed | Blood pressure instability, tachycardia | No            | Upper respiratory infection (no further details) | NA                         | Clinical + CSF + electrophysiology       | 1                         | Bilateral facial palsy with paraesthesia     |
| Mozhdehipanah et al. [35]       | Iran    | 14  | F   | Ascending quadriparesis, UL hyporeflexia, LL areflexia, distal hypoaesthesia, ataxia | NA                                          | Ascending quadriparesis, UL hyporeflexia, LL areflexia, distal hypoaesthesia, ataxia | NA              | NA                    | No                          | NA             | Upper respiratory infection (no further details) | NA                         | Clinical + CSF                           | 2                         | Classic sensori-motor                        |
| Article                          | Country  | Age | Sex | GBS clinical picture                                                                 | Days between COVID-19 symptoms and GBS onset | Onset | Disease course                                      | Autonomic disturbances | Respiratory symptoms/failure | Time to Nadir\(^b\) | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                                      | Level of diagnostic certainty\(^b\) | GBS variant  |
|--------------------------------|----------|-----|-----|--------------------------------------------------------------------------------------|---------------------------------------------|-------|---------------------------------------------------|------------------------|----------------------------|------------------------|--------------------------|------------------------|-------------------------------------------------|-----------------------------|-------------|
| Mozhidehipanah et al. [35]     | Iran     | 44  | F   | Weakness of LL                                                                       | 26 days after                               | Weakness of LL | Tetraparesis, generalized areflexia, symmetrical hypoesthesia | NA                     | Yes                       | NA                     | Dry cough, fever, myalgia, progressive dyspnea  | COPD                   | Clinical + CSF + electrophysiology               | 1              | Classic sensori-motor                           |
| Mozhidehipanah et al. [35]     | Iran     | 66  | F   | Progressive UL and LL weakness, generalized areflexia, symmetrical hypoesthesia      | 30 days after                               | Progressive UL | NA                                               | No                     | No                        | NA                     | Fever, dry cough, severe myalgia                | DM, hypertension, and rheumatoid arthritis        | Clinical + CSF + electrophysiology               | 1              | Classic sensori-motor                           |
| Naddaf et al. [36]             | USA      | 58  | F   | Progressive paraparesis, imbalance, severe lower thoracic pain without radiation     | 17 days after                               | Progressive paraparesis | Mild neck flexion weakness, mild/moderate distal UL and proximal and distal LL weakness, UL hyporeflexia, LL areflexia, moderately severe length-dependent sensory loss in the feet, ataxic gait | None                   | No                        | NA                     | Fever, dysgeusia without anosmia, bilateral interstitial pneumonia | None                   | Clinical + CSF + electrophysiology               | 1              | Classic sensori-motor                           |
| Oguz-Akarsu et al. [37]        | Turkey   | 53  | F   | Concurrent pneumonia                                                                 | Concurrent pneumonia                        | Dysarthria, progressive LL weakness and numbness | Ataxia, generalized areflexia | None                   | No                        | NA                     | Mild fever (37.5 °C), pneumonia                 | None                   | Clinical + electrophysiology                    | 2              | Classic sensori-motor                           |
| Ottaviani et al. [38]          | Italy    | 66  | F   | Flaccid paraparesis, no sensory symptoms                                             | 7 days after (concurrent pneumonia)         | Flaccid paraparesis | Progressively developed proximal weakness in all limbs, dysesthesia, and unilateral facial palsy, generalized areflexia | NA                     | Yes                       | 13 days after symptoms onset                   | Fever and cough, pneumonia                      | NA                     | Clinical + CSF + electrophysiology               | 1              | Classic sensori-motor                           |
Table 1 (continued)

| Article            | Country | Age | Sex | GBS clinical picture                                      | Days between COVID-19 symptoms and GBS onset | Onset                              | Disease course                     | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir<sup>a</sup> | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis | Level of diagnostic certainty<sup>b</sup> | GBS variant |
|--------------------|---------|-----|-----|-----------------------------------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------|------------------------|----------------------------|----------------------------|--------------------------|-------------------------|----------------|--------------------------------|--------------|
| Padroni et al.     | Italy   | 70  | F   | UL and LL paraesthesia, gait difficulties, asthenia       | 23 days after                              | Ascendant weakness, tetraparesis       | None                              | Yes                    | 6 days after symptoms onset | Fever (38.5 °C), dry cough, pneumonia | Clinical + CSF + Electrophysiology | None                     | 1                          | Classic sensorimotor |              |
| Paterson et al.    | UK      | 42  | M   | Distal limb numbness and weakness, dysphagia             | 13 day after                               | Tetraparesis, generalized areflexia, sensory loss | NA                                | Yes                    | 16 days after symptoms onset | Cough, fever, dyspnea, diarrhea, anosmia | None                     | Clinical + CSF + electrophysiology | 1                          | Classic sensorimotor   |              |
| Paterson et al.    | UK      | 60  | M   | Distal limb numbness and weakness                         | 1 day before                               | Tetraparesis, generalized areflexia, sensory loss | NA                                | Yes                    | 5 days after symptoms onset | Headache, aguesia, anosmia | Clinical + CSF + electrophysiology | NA                       | 1                          | Classic sensorimotor |              |
| Paterson et al.    | UK      | 38  | M   | Distal limb numbness, weakness, clumsiness               | 21 day after                               | Mild distal weakness, sensory ataxia   | None                              | No                     | NA                         | Cough, diarrhea            | Clinical + CSF + electrophysiology | NA                       | 1                          | Classic sensorimotor |              |
| Paybast et al.     | Iran    | 38  | M   | Acute progressive ascending paraesthesia of distal LL    | 21 days after                              | Quadruparesthesia, bilateral facial droop with drooling of saliva and slurred speech, generalized areflexia, swallowing inability, bilateral absent gag reflex | No                                | 3 days after symptoms onset | Symptoms of upper respiratory tract infection | Hypertension              | Clinical + CSF + electrophysiology | 1                          | Classic sensorimotor |              |
| Article          | Country | Age | Sex | GBS clinical picture                                                                 | Previous comorbidities | GBS diagnosis                                | Level of diagnostic certainty | GBS variant   |
|------------------|---------|-----|-----|--------------------------------------------------------------------------------------|------------------------|---------------------------------------------|-----------------------------|--------------|
| Paybast et al.   | Iran    | 14  | F   | Progressive ascending quadruparesis, mild LL weakness                                | None                   | Clinical + CSF                             | 2                           | Classic sensorimotor |
| Pfefferkorn et al. | Germany | 51  | M   | UL and LL weakness, acral paraesthesia                                               | None                   | NA                                          | 1                           | Classic sensorimotor |
| Rana et al.      | USA     | 54  | M   | LL paresthesias of LL                                                                | Resting tachycardia and urinary retention | Rhinorrhea, odynophagia, fever, chills, and night sweats | 2                           | Miller Fisher variant |
| Article                  | Country | Age | Sex | GBS clinical picture                                                                 | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                  | Level of diagnostic certainty | GBS variant  |
|-------------------------|---------|-----|-----|--------------------------------------------------------------------------------------|--------------------------|------------------------|---------------------------------|-------------------------------|--------------|
| Reyes-Bueno et al. [44] | Spain   | 50  | F   | Root-type pain in all four limbs, dorsal and lumbar back pain                        | Diarrhea, dry mouth,    | None                   | NA                              | 1                             | Miller Fisher variant          |
|                         |         |     |     |                                                                                     | diarrhea and unstable   |                        | Clinical + CSF + electrophysiology |                               |              |
|                         |         |     |     |                                                                                     | blood pressure          |                        |                                 |                               |              |
| Riva et al. [45]        | Italy   | 60+ | M   | Progressive limb weakness and distal paresthesia at four limbs                      | Fever, headache, myalgia, anemia and ageusia | NA                     | Clinical + electrophysiology   | 2                             | Classic sensorimotor            |
|                         |         |     |     |                                                                                     |                          |                        |                                 |                               |              |
| Sancho-Saldaña et al. [46] | Spain | 56  | F   | Unsteadiness and paresthesia in both hands                                           | Fever, dry cough and dyspnea, pneumonia | NA                     | Clinical + CSF + electrophysiology | 1                             | Classic sensorimotor            |
|                         |         |     |     |                                                                                     |                          |                        |                                 |                               |              |
| Scheidl et al. [47]     | Germany | 54  | F   | Proximal weakness of LL, numbness of 4 limbs                                        | Temporary ageusia,      | None                   | Clinical + CSF + electrophysiology | 1                             | Paraparetic variant             |
|                         |         |     |     |                                                                                     |                          |                        |                                 |                               |              |
| Sedaghaz et al. [48]    | Iran    | 65  | M   | LL distal weakness                                                                  | Fever, cough and sometimes dyspnea, pneumonia | DM type 2                | Clinical + electrophysiology   | 2                             | Classic sensorimotor            |
| Article            | Country            | Age | Sex | GBS clinical picture                                      | Days between COVID-19 symptoms and GBS onset | Onset                              | Disease course                                      | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir \(^b\) | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis                  | Level of diagnostic certainty \(^b\) | GBS variant     |
|-------------------|--------------------|-----|-----|--------------------------------------------------------|---------------------------------------------|-------------------------------------|-----------------------------------------------|------------------------|-------------------------------|-------------------|-----------------------------|---------------------|-----------------------------|-----------------------------|---------------------|
| Sidig et al. [49] | Sudan              | 65  | M   | Numbness and weakness in both UL and LL                | 5 days after                               | Ascending weakness, bilateral facial paraesthesia and palsy, clumsiness of UL, tetraparesis, slight palatal muscle weakness, areflexia | Urinary incontinence                  | Yes                    | NA                            |                   | Low-grade fever, sore throat, dry cough, headache and generalized fatigability | DM and Hypertension | Clinical + electrophysiology | 2                     | Classic sensorimotor |
| Su et al. [50]    | USA                | 72  | M   | Proximal UL and LL weakness                            | 6 days after                               | Progression with worsening of the paresis, areflexia, hypoesthesia | Hypotension alternating with hypertension and tachycardia | Yes                    | 8 days after symptoms onset |                   | Mild diarrhea, anorexia and chills without fever or respiratory symptoms | Coronary artery disease, hypertension and alcohol abuse | Clinical + CSF + electrophysiology | 1                     | Classic sensorimotor |
| Tiet et al. [51]  | United Kingdom     | 49  | M   | Distal LL paraesthesia                                 | 21 days after                              | LL and UL weakness, facial diplegia, distal reduced sensation to pinprick and vibration sense, LL dysesthesia, generalized areflexia | None                        | No                     | 4 days after symptoms onset |                   | Shortness of breath, headache and cough | Sinusitis          | Clinical + CSF + electrophysiology | 1                     | Classic sensorimotor |
| Toscano et al. [52]| Italy              | 77  | F   | UL and LL paraesthesia                                 | 7 days after                               | Flaccid tetraplegia, areflexia, facial weakness, dysphagia, tongue weakness | None                        | Yes                    | NA                            |                   | Fever, cough, ageusia, pneumonia | Previous ischemic stroke, diverticulosis, arterial hypertension, atrial fibrillation | Clinical + CSF + electrophysiology | 1                     | Classic sensorimotor |
| Toscano et al. [52]| Italy              | 23  | M   | Facial palsy                                           | 10 days after                              | LL paraesthesia, generalized areflexia, sensory ataxia | None                        | No                     | 2 days after symptoms onset |                   | Fever, pharyngitis         | NA                  | Clinical + CSF + electrophysiology | 1                     | Bilateral facial palsy with paraesthesia |

\(^b\) Level of diagnostic certainty: Clinical + electrodiagnostic tests (e.g., electrophysiology, CSF analysis).
Table 1 (continued)

| Article | Country | Age | Sex | GBS clinical picture | Days between COVID-19 symptoms and GBS onset | Onset | Disease course | Autonomic disturbances | Respiratory symptoms/ failure | Time to Nadir⁻ | COVID-19 clinical picture | Previous comorbidities | GBS diagnosis | Level of diagnostic certainty⁶ | GBS variant |
|---------|---------|-----|-----|----------------------|---------------------------------------------|-------|---------------|----------------------|---------------------------|----------------|---------------------------|------------------------|--------------|-------------------------------|-------------|
| Toscano et al. [52] | Italy | 55 | M | 10 days after Neck pain, Parasthesias in the 4 limbs, LL weakness | None | Flaccid tetraparesis, arreflexia, facial weakness | Yes | NA | Fever, cough, pneumonia | NA | Clinical + CSF + electrophysiology | 1 | Classic sensori-motor |
| Toscano et al. [52] | Italy | 76 | M | 5 days after Lumbar pain, LL weakness | None | Flaccid tetraparesis, generalized arreflexia, ataxia | No | 4 days after symptoms onset | Cough and hyposmia | NA | Clinical + CSF+ Electrophysiology | 1 | Classic sensori-motor |
| Toscano et al. [52] | Italy | 61 | M | 7 days after LL weakness and paresthesia | None | Ascending weakness, tetraparesis, facial weakness, arreflexia, dysphagia | Yes | NA | Cough, ageusia and anosmia, pneumonia | NA | Clinical + CSF + electrophysiology | 1 | Classic sensori-motor |
| Velayos Galán et al. [53] | Spain | 43 | M | 10 days after Distal weakness and numbness of the 4 limbs, gait ataxia | NA | Progression of the weakness with bilateral facial paresis and dysphagia, generalized arreflexia | No | 2 days after admission | Cough, pneumonia | NA | Clinical + electrophysiology | 2 | Classic sensori-motor |
| Virani et al. [54] | USA | 54 | M | 8 days after LL weakness, numbness | Ascending weakness, tetraparesis, areflexia | Urinary retention | Yes | Shortly after presentation in the outpatient clinic (after 2 days of symptoms onset) | Fever (102 F), dry cough, pneumonia | NA | Clostridium difficile colitis | Clinical | 3 | Classic sensori-motor |
| Webb et al. [55] | United Kingdom | 57 | 6 days after Ataxia, progressive limb weakness and foot dyesthesias | Tetraparesis, generalized arreflexia, hypoesthesia in the 4 limbs, hypopallesthesia in LL, dysphagia | None | NA | Mild cough and headache, myalgia and malaise, slight fever, diarrhea, pneumonia | Untreated hypertension and psoriasis | NA | Clinical + CSF + electrophysiology | 1 | Classic sensori-motor |
| Zhao et al. [56] | China | 61 | F | 8 days before LL weakness | Ascending weakness, tetraparesis, arreflexia, LL distal hypoesthesia | None | No | Fever (38.2 °C), dry cough, pneumonia | NA | Clinical + CSF + electrophysiology | 1 | Classic sensori-motor |
| Article                  | COVID-19 diagnosis          | Blood findings                                                                 | Auto-antibodies and screening for most common GBS causes | CSF findings                                      | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome                           |
|-------------------------|-----------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------|-------------------------|-----------------------------|-----------------------------------|
| Agosti et al. [5]       | RT-PCR + chest CT           | Thrombocytopenia (101 × 10^9/L, reference value: 125–300 × 10^9/L), lymphocytopenia (0.48 × 10^9/L, reference value: 1.1–3.2 × 10^9/L) | Negative ANA, anti-DNA, c-ANCA, p-ANCA, negative screening for Campylobacter jejuni, Mycoplasma pneumoniae, Salmonella enterica, CMV, HSV 1 and 2, VZV, influenza virus A and B, HIV, normal B12 and serum protein electrophoresis | Increased total protein (98 mg/dL), cell count: 2/10^6/L | Demyelinating AIDP | NA | IVIG 400 mg/kg/day (5 days) | Antiviral drugs (not specifically mentioned) | Improvement, discharged home after 30 days |
| Alberti et al. [6]      | RT-PCR + chest CT           | NA                                                                             | NA                                                      | Increased total protein (54 mg/dL), 9 cells/µl, negative SARS-CoV-2 PCR | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) + mechanical invasive ventilation | Lopinavir/ritonavir, hydroxychloroquine | 24 h after admission, death because of respiratory failure |
| Arnaud et al. [7]       | RT-PCR + chest CT           | NA                                                                             | Negative anti-ganglioside and antineural antibodies, negative Campylobacter Jejuni, HIV, syphilis, CMV, EBV serology | Increased total protein (1.65 g/L), no pleocytosis, negative oligoclonal bands, negative SARS-CoV-2 PCR, negative EVB and CMV RT-PCR | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) | Hydroxychloroquin, cefotaxime, azithromycine | Progressive improvement |
| Assini et al. [8]       | RT-PCR                      | Lymphocytopenia, increased LDH and inflammation markers, low serum albumin (2.9 mg/dL) | NA                                                      | Normal total protein level, increased IgG/albumin ratio (233), negative SARS-CoV-2 PCR, presence of oligoclonal bands (both in serum and CSF) | Demyelinating with sural sparing AIDP | Brain: no pathological findings | IVIG 400 mg/kg (5 days) | Hydroxychloroquine, arbidol, ritonavir and lopinavir + mechanical invasive ventilation | 5 days after IVIG, improvement of swallowing, speech, tongue motility, eyelid ptosis and strength |
| Assini et al. [8]       | RT-PCR + chest CT           | Lymphocytopenia, increased LDH and GGT, leucocytosis, low serum albumin (2.6 mg/dL) | Negative anti-ganglioside antibodies                    | Normal total protein level, increased IgG/albumin ratio (170), negative SARS-CoV-2 PCR, presence of oligoclonal bands (both in serum and CSF) | Motor sensory axonal, muscular neurogenic changes AMSAN | NA | IVIG 400 mg/kg (5 days) | Hydroxychloroquine, antiretroviral therapy, tocilizumab + tracheostomy and assisted ventilation | 5 days after IVIG, improvement of vegetative symptoms, persistence of hyporeflexia and right foot drop |
| Article                              | COVID-19 diagnosis | Blood findings (continued) | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|-------------------------------------|-------------------|---------------------------|----------------------------------------------------------|--------------|-------------------------------------------------|------------------------|------------------------|----------|
| Bigaut et al. [9]                   | RT-PCR + chest CT | Normal blood count, negative CRP | Negative anti-ganglioside antibodies, negative HIV, Lyme and syphilis serology | Increased total protein (0.95 g/L), cell count: 1 × 10^7/L, negative SARS-CoV-2 PCR | Demyelinating AIDP | Spinal: Radiculitis andplexitis on both brachial and lumbar plexus; multiple cranial neuritis (in III, VI, VII, and VIII nerves) | IVIG 400 mg/kg (5 days) + non-invasive ventilation | NA | Progressive improvement |
| Bigaut et al. [9]                   | RT-PCR + chest CT | Increased CRP              | Negative anti-ganglioside antibodies                      | Increased total protein (1.6 g/L), cell count: 6 × 10^7/L, negative SARS-CoV-2 PCR | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) | NA | Slow progressive improvement |
| Bracaglia et al. [10]               | RT-PCR (normal chest CT) | Elevated CPK (461 U/L, normal < 145), CRP 5.65 mg/dL (normal < 0.5), lymphocytopenia (0.68 × 10^9/L, normal 1-1.07), mild increase of LDH (284 U/L, normal < 248), GOT and GPT (549 and 547 U/L, normal < 35), elevation of IL-6 (11 pg/mL, normal < 5.9) | Negative anti-ganglioside antibodies; negative microbiologic testing on CSF and serum for HSV1-2, EBV, VZV, CMV, HIV, Mycoplasma Pneumoniae and Borrelia. | Increased total protein (245 mg/dL) and increased cell count: 13 cells/μL, polymorphonucleate 61.5% | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) | Hydroxychloroquine, ritonavir, darunavir | Improvement of UL and LL weakness, development of facial diplegia |
| Camdessanche et al. [11]           | RT-PCR + chest CT | NA                        | Negative anti-gangliosides antibodies; negative screening for *Campylobacter jejuni*, *Mycoplasma pneumoniae*, Salmonella enterica, CMV, EBV, HSV1-2, VZV, Influenza virus A & B, HIV, and hepatitis E | Increased total protein (1.66 g/L), normal cell count | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) + mechanical invasive ventilation | Oxygen therapy, paracetamol, low molecular weight heparin, lopinavir/ritonavir 400/100 mg twice a day for 10 days | NA |
| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|--------------------|----------------|---------------------------------------------------------|--------------|------------------------------------------------|------------------------|-----------------------|---------|
| Chan et al. [12] | RT-PCR + chest CT | Persistent thrombocytosis (maximum PC 688 ×10^9/L), elevated d-dimer (1.47 mg/L) | NA | Increased total protein (1.00 g/L), cell count: 4 ×10^9/L (normal), negative SARS-CoV-2 PCR | Demyelinating AIDP | Brain: bilateral intracranial facial nerve enhancement | IVIG 400 mg/kg (5 days) | Empiric azithromycin and ceftriaxone | Slight improvement of facial weakness, unchanged paraesthesia |
| Chan et al. [13] | RT-PCR | NA | Negative anti-gangliosides antibodies | Increased total protein (226 mg/dL), leucocytes: 3 cells/mm³, glucose: 56 mg/dL, negative SARS-CoV-2 PCR | NA | Lumbosacral spine: no pathological findings | 5 sessions of plasmapheresis | NA | Resolution of dysphagia, ambulation with minimal assistance 28 days after symptoms onset |
| Chan et al. [13] | RT-PCR | NA | Elevated GM2 IgG/IgM antibodies | Increased total protein (67 mg/dL), leucocytes: 1 cells/mm³, glucose 58 mg/dL, negative SARS-CoV-2 PCR | NA | NA | Mechanical invasive ventilation + 5 sessions of plasmapheresis (without benefit on ventilation) + IVIG | NA | Persistence of quadriparesis with intermittent autonomic dysfunction, slowly weaned from the ventilator |
| Coen et al. [14] | RT-PCR + serology | Normal (not specified) | Negative anti-gangliosides antibodies; negative meningoencephalitis panel | Albuminocytological dissociation, no intrathecal IgG synthesis, negative SARS-CoV-2 PCR | Demyelinating with sural sparing AIDP | Brain: NA | Spinal: no pathological findings | IVIG 400 mg/kg (5 days) | NA | Rapid improvement. From day 11 from hospitalisation Rehabilitation |
| Ebrahimzadeh et al. [15] | RT-PCR + chest CT | Normal CRP (5 mg/L), normal serum protein immunoelectrophoresis | Negative anti-GQ1b antibodies, negative screening for Campylobacter jejuni, HIV, EBV, CMV, influenza virus (type A and B), HCV, non-reactive VDRL | Increased total protein (78 mg/dL), normal cell count (erythrocyte = 0/mm³, leucocyte = 4/mm³), normal glucose (70 mg/dL) | Demyelinating AIDP | Brain: no pathological findings Spinal: no pathological findings | None | Hydroxychloroquine for 5 days | Improvement of muscle strength to near normal after 16 days |
| Article            | COVID-19 diagnosis | Blood findings                                                                 | Auto-antibodies and screening for most common GBS causes | CSF findings                                                                 | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome                      |
|--------------------|--------------------|--------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------|--------------------------|------------------------------|
| Ebrahimzadeh et al. [15] | RT-PCR + chest CT | Slightly elevated CRP (34 mg/L), normal serum protein immunoelectrophoresis | Negative anti-GQ1b antibodies, negative screening for *Campylobacter jejuni*, HIV, EBV, CMV, influenza virus (type A and B), HCV, non-reactive VDRL | NA                                                                           | Demyelinating AIDP                                                       | NA                     | IVIG                     | NA Improvement of muscle strength in all extremities after 14 days |
| El Otmani et al. [16]   | RT-PCR + chest CT | Lymphocytopenia (520/ml)                                                      | NA                                                       | Increased total protein (1 g/L), normal cell count, negative PCR assay for SARS-CoV-2 | Motor sensory axonal AMSAN                                               | NA                     | IVIG 400 mg/kg/day (5 days) | Hydroxylchloroquine 600 mg/day; azithromycin 500 mg at the first day, then 250 mg per day At week 1 from admission no significant neurological improvement |
| Esteban Molina et al. [17] | RT-PCR + chest X-ray | Leucocyte 7400/mm³, lymphocyte 2400/mm³, Hb 14 g/dL, PC 408,000/mm³, D-Dimer 556 ng/ml, Ferritin 544 ng/ml, CRP 2.04 mg/dL, Fibrinogen 6.8 g/dl | Negative bacteriological and viral tests                  | Increased total protein (86 mg/dL), cell count: 3x10⁶/L                       | Demyelinating AIDP                                                       | Brain: leptomeningeal enhancement in midbrain and cervical spine | IVIG 400 mg/kg/day (5 days) | Hydroxylchloroquine, azithromycin, ceftriaxion Motor improvement but persistence of paraesthesia |
| Farzi et al. [18]       | RT-PCR + chest CT | Lymphopenia (WBC 5.9 x 10⁹/L, neutrophils 85%, lymphocytes 15%), elevated levels of CRP, ESR 69 mm/h | NA                                                       | NA                                                                           | Demyelinating AIDP                                                       | NA                     | IVIG (2 g/kg over 5 days) | Improvement after 3 days, favorable outcome |
| Fernández-Dominguez et al. [19] | RT-PCR       | NA                                                                               | Negative anti-GD1b antibodies, negative other anti-ganglioside antibodies | Increased total protein (110 mg/dL), albuminocytologic dissociation            | Demyelinating NA                                                        | Brain: no pathological findings | IVIG 20 g/d (5 days) | Hydroxylchloroquine, lopinavir/ritonavir NA |
| Finsterer et al. [20]    | NA                | NA                                                                               | NA                                                       | Axonal AMAN                                                                  | NA                                                                        | NA                     | IVIG                     | NA Recovery                   |
Table 1 (continued)

| Article               | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|-----------------------|--------------------|----------------|----------------------------------------------------------|--------------|---------------------------------------------------------------------|------------------------|-------------------------|---------|
| Frank et al. [21]     | RT-PCR, + serology (IgG and IgM) | WBC and CRP normal | Negative hepatitis B and C, HIV and VDRL tests | Two CSF analysis 2 weeks apart, both showing normal cell count and CSF biochemistry, negative SARS-CoV-2 PCR, negative PCR for HSV1, HSV2, CMV, EBV, VZV, Zika virus; Dengue virus and Chikungunya virus | Axonal AMAN | Brain: no pathological findings | IVIG 400 mg/kg/day (5 days) | Methylprednisolone, azithromycin, albendazole | Some improvement, weakness persisted |
| Gigli et al. [22]     | Chest CT + serology (negative RT-PCR) | NA | Negative anti-ganglioside antibodies, negative PCR for influenza A and B viruses (nasal swab) | Increased total protein (192.8 mg/L), leucocytes: 2.6 cells/µL, positive Ig for SARS-CoV-2, negative SARS-CoV-2 PCR | Demyelinating AIDP | NA | NA | NA | NA |
| Gutiérrez-Ortiz et al. [23] | RT-PCR | Lymphocytes 1000 cells/µL, CRP 2.8 mg/dL | Positive anti-GD1b antibodies, other anti-ganglioside antibodies negative | Increased total protein (80 mg/dL), no leucocytes, glucose 62 mg/dL, negative SARS-CoV-2 PCR | NA | NA | IVIG 400 mg/kg (5 days) | NA | After 2 weeks from admission complete resolution except anosmia, ageusia |
| Gutiérrez-Ortiz et al. [23] | RT-PCR | Leucopenia (3100 cells/µL) | NA | Increased total protein (62 mg/dL), WBC: 2 µL (all monocytes), glucose: 50 mg/dL, negative SARS-CoV-2 PCR | NA | NA | None | Paracetamol | 2 weeks later complete neurological recovery with no ageusia, complete eye movements, and normal deep tendon reflexes |
| Article                      | COVID-19 diagnosis                     | Blood findings                                                                 | Auto-antibodies and screening for most common GBS causes | CSF findings                                                                                       | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy                          | Outcome                                                                 |
|-----------------------------|----------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------|-----------------------------------------------|------------------------------------------------------------------------|
| Helbok et al. [24]          | Chest CT + serology (repeated negative RT-PCR) | WBC 8.1 G/L (normal: 4.0–10.0 G/L), CRP 2.3 mg/dL (normal: 0.0–0.5 mg/dL), fibrinogen level 6.50 mg/dL (normal: 210–400 mg/dL), LDH 276 U/L (normal: 100–250 U/L), erythrocyte sedimentation rate 55 mm/h | Negative PCR for CMV, EBV, influenza virus A/B, Respiratory Syncytiatal Virus and IgM antibodies for *Chlamydia pneumoniae* and *Mycoplasma pneumoniae* | Increased total protein (64 mg/dL), cell count: 2 cells/mm³, serum/CSF glucose ratio of 0.83, negative SARS-CoV-2 PCR, positive anti-SARS-CoV-2 antibodies (not determined if intrathecal synthesis or passive transfer from blood) | Demyelinating with sural sparing AIDP | Spinal: no pathological findings | IVIG 30 g + plasma exchange (4 cycles) + mechanical invasive ventilation | None | Improvement of muscle forces with recovery of mobility without significant help after 8 weeks |
| Hutchins et al. [25]       | RT-PCR + chest CT                      | Lymphopenia (absolute lymphocyte count of 0.7 K/mm³) | Serum HSV IgG and IgM, Respiratory viral panel PCR negative Negative GM1, GD1b, and GQ1b IgG and IgM, aquaporin-4 receptor (IgG), HIV 1/2, HSV 1/2 (IgG and IgM), CMV (IgG, Mycoplasma pneumoniae (IgG and IgM), Barrella burgdorferi (IgG and IgM), Bartonella species (IgG and IgM), and syphilis (Venereal Disease Research Laboratory test) | Increased total protein (49 mg/dL), normal glucose levels (65 mg/dL), no leukocytes | Mixed demyelinating and axonal EMG subtype unknown | Brain: enhancement of the facial and abducens nerves bilaterally, as well as the right oculomotor nerve | Plasma exchange (5 cycles) | NA | Discharged to inpatient rehabilitation |
| Article                                      | COVID-19 diagnosis | Blood findings                                      | Auto-antibodies and screening for common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------------------------------------------|--------------------|-----------------------------------------------------|-----------------------------------------------------|--------------|-----------------------------------------------------------------------|------------------------|------------------------|---------|
| Juliao Caamaño et al. [26]                  | RT-PCR NA          | NA                                                  | NA                                                  | NA           | Normal total protein (44 mg/dL), no pleocytosis                        | Brain: no pathological findings | Oral prednisolone     | IVG 1 g/kg (2 days)     | Discharge to home after 2 weeks |
| Khalifa et al. [27]                          | RT-PCR + chest X-ray + chest CT | WBC 5.5 × 10³, PC 396 × 10³, CRP 61.9 mg/dL, ferritin 57.3 mg/L (normal 10-50), and D-dimer 0.5 mg/L (normal 0-0.5) | Negative screening for: influenza A and B viruses; influenza A virus subtypes H1, H3, and H5 including H5N1 of the Asian lineage; parainfluenza virus types 1, 2, 3, and 4; respiratory syncytial virus types A and B; adenovirus; metapneumovirus; rhinovirus; coronavirus; C. pneumoniae; E. coli O157 and CAV 229E, HKU1, and NELA and O1-3. | Cell count: 5 mm³, increased total protein (316.7 mg/dL) | Demyelinating AIDP | Brain: no pathological findings | IVIG 2 g/kg (6 days) | None |
| Kilinc et al. [28]                           | Fecal PCR + serology | NA                                                  | NA                                                  | NA           | Negative anti-GQ1b antibodies, serologic tests on: Borrelia burgdorferi, syphilis, Campylobacter jejuni, CMV, and Mycoplasma pneumoniae | Brain: no pathological findings | Predominantly demyelinating AIDP | IVG 2 g/kg (6 days) | Persistence of mild symptoms at the discharge (after 14 days) |
Table 1 (continued)

| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|--------------------|----------------|--------------------------------------------------------|--------------|---------------------------------------------------------------|----------------------|----------------------|---------|
| Lampe et al. [29] | RT-PCR (negative chest X-ray) | Slightly increased CRP (1.92 mg/dL) | Negative anti-ganglioside antibodies; negative influenza and respiratory syncytial virus | Increased total protein (56 mg/dL), normal cell count (2 cells/μL) | Demyelinating AIDP | NA | IVIG 400 mg/kg (5 days) | None |
| Lantos et al. [30] | RT-PCR | NA | GM1 antibodies in the equivocal range | NA | Brain: enlargement, prominent enhancement with gadolinium, and T2 hyperintense signal of the left cranial nerve III | IVIG | Hydroxychloroquine | Improvement, discharge after 4 days |
| Lascano et al. [31] | RT-PCR + chest X-ray + positive IgM (IgG positivity 2 weeks later) | WBC 8900 cells/mm³; lymphocytes 1200 cells/mm³; PC 45,500 cells/mm³ | Negative anti-ganglioside antibodies | Increased total protein (60 mg/dL), leucocytes: 3 cells/μL, negative SARS-CoV-2 PCR | Demyelinating AIDP | Spinal: no nerve root gadolinium enhancement | IVIG 400 mg/kg (5 days) + mechanical invasive ventilation | Azithromycin |
| Lascano et al. [31] | RT-PCR + chest X-ray | WBC 3300 cells/mm³; lymphocytes 800 cells/mm³; PC 119,000 cells/mm³ | Normal total protein (40 mg/dL), cell count: 2 cells/μL | Mixed demyelinating (conduction blocks) and axonal with sural sparing pattern Predominantly AIDP | | NA | IVIG 400 mg/kg (5 days) | Amoniçillín, clarithromycin |
| Lascano et al. [31] | RT-PCR + chest X-ray | WBC 4000 cells/mm³; lymphocytes 600 cells/mm³; PC 322,000 cells/mm³ | Increased total protein (140 mg/dL), cell count: 4 cells/μL, negative SARS-CoV-2 PCR | Demyelinating with sural sparing pattern AIDP | Brain: no pathological findings Spinal cord: lumbosacral nerve root enhancement | IVIG 400 mg/kg (5 days) | Amoniçillín | Improvement of tetraparesis and ability to walk with assistance. Persistence of LL areflexia and distal paraesthesia |
| Article                      | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome                                |
|-----------------------------|--------------------|----------------|--------------------------------------------------------|-------------|---------------------------------------------------------------------|-------------------------|-------------------------------|------------------------------------------|
| Manganotti et al. [32]      | RT-PCR + chest CT  | NA             | Negative anti-ganglioside antibodies negative serum anti-HIV, anti-HBV, anti-HCV antibodies | Increased total protein (74.9 mg/dL), negative CSF PCR for bacteria, fungi, Mycobacterium tuberculosis, Herpes viruses, Enteroviruses, Japanese B virus and Dengue viruses | NA                                                                  | Brain: no pathological findings | IVIG 400 mg/kg (5 days) | Lopinavir/ritonavir, hydroxychloroquine, antibiotic therapy, oxygen support (35%) | Resolution of all symptoms except for minor hyporeflexia at the LL |
| Manganotti et al. [33]      | RT-PCR             | IL-1: 0.2 pg/ml (< 0.001 pg/ml), IL-6: 113.0 pg/ml (0.8–6.4 pg/ml), IL-8: 20.0 pg/ml (6.7–16.2 pg/ml), TNF-α: 16.0 pg/ml (7.8–12.2 pg/ml) | Negative anti-ganglioside antibodies negative HIV, HBV, HCV negative serological tests for autoimmune disorders | Increased total protein (52 mg/dL), leucocytes: 1 cell/mm³, negative SARS-CoV-2 PCR | Demyelinating AIDP | NA | IVIG 400 mg/kg/day (5 days) | Hydroxychloroquine, oseltamivir, darunavir, methylprednisolone + mechanical invasive ventilation | Improvement of motor symptoms |
| Manganotti et al. [33]      | RT-PCR             | IL-1: 0.5 pg/ml (< 0.001 pg/ml), IL-6: 9.8 pg/ml (0.8–6.4 pg/ml), IL-8: 55.0 pg/ml (6.7–16.2 pg/ml), TNF-α: 16.0 pg/ml (7.8–12.2 pg/ml) | Negative anti-ganglioside antibodies negative HIV, HBV, HCV negative serological tests for autoimmune disorders | Normal total protein (40 mg/dL), leucocytes: 1 cell/mm³, negative SARS-CoV-2 PCR | Mixed demyelinating and axonal EMG subtype unknown | Brain: no pathological findings | IVIG 400 mg/kg/day (5 days) | Hydroxychloroquine, lopinavir/ritonavir, methylprednisolone + mechanical invasive ventilation | Improvement of motor symptoms |
| Manganotti et al. [33]      | RT-PCR             | NA             | Negative anti-ganglioside antibodies negative HIV, HBV, HCV negative serological tests for autoimmune disorders | Increased total protein (72 mg/dL), leucocytes: 5 cell/mm³, negative SARS-CoV-2 PCR | Mainly demyelinating Predominantly AIDP | Brain: no pathological findings | IVIG 400 mg/kg/day (5 days) | Hydroxychloroquine, lopinavir/ritonavir, methylprednisolone | Improvement |
| Manganotti et al. [33]      | RT-PCR             | NA             | NA | Mixed demyelinating and axonal EMG subtype unknown | Brain: no pathological findings | IVIG 400 mg/kg/day (5 days) | Methylprednisolone 60 mg for 5 days | Methylprednisolone | Stationary |
| Article                      | COVID-19 diagnosis | Blood findings                                                                 | Auto-antibodies and screening for most common GBS causes | CSF findings                                      | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome                  |
|-----------------------------|--------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------|------------------------|--------------------------|--------------------------|
| Manganotti et al. [33]      | RT-PCR             | IL-1: 0.2 pg/ml (<0.001 pg/ml), IL-6: 32.7 pg/ml (0.8–6.4 pg/ml), IL-8: 17.9 pg/ml (6.7–16.2 pg/ml), TNF-α: 11.1 pg/ml (7.8–12.2 pg/ml), IL-2R: 1203.0 pg/ml (440.0–1435.0 pg/ml), IL-10: 4.6 (1.8–3.8 pg/ml) | Negative anti-ganglioside antibodies, negative HIV, HBV, HCV negative serological tests for autoimmune disorders | Increased total protein (53 mg/dL), leucocytes: 2 cell/mm³, negative SARS-CoV-2 PCR | Mixed demyelinating and axonal EMG subtype unknown | NA                     | IVIG 400 mg/kg/day (5 days) | Hydroxychloroquine, lopinavir/ritonavir, methylprednisolone, meropenem, linezolid, clarithromycin, fluconazole, doxycycline + mechanical invasive ventilation | Improvement |
| Marta-Enguita et al. [34]   | RT-PCR + chest CT  | Thrombocytopenia, n-Dimer elevation                                           | NA                                                     | NA                                               | NA                                                                 | NA                     | NA                       | NA                       | Death after 10 days          |
| Mozhidehipanah et al. [35]  | RT-PCR (negative chest CT) | Normal WBC, CRP and ESR                                                    | NA                                                     | Increased total protein (139 mg/dL), normal cell count, negative CSF HSV serology and gram stain and culture | Demyelinating AIDP                                                   | NA                     | Plasma exchange (5 cycles) | NA                       | Significant improvement of muscle weakness after 3 weeks, persistence of mild bifacial paresis |
| Mozhidehipanah et al. [35]  | RT-PCR             | Normal WBC, CRP and ESR                                                    | NA                                                     | Albuminocytological dissociation                  | NA                                                                 | NA                     | IVIG 400 mg/kg/day (5 days) | NA                       | Complete recovery, except for the persistence of hyporeflexia |
| Mozhidehipanah et al. [35]  | RT-PCR + chest CT  | Leucocytosis lymphopenia, elevated ESR and CRP                             | NA                                                     | Increased total protein (89 mg/dL), normal cell count and glucose (not further specified) | Axonal AMSAN                                                        | NA                     | IVIG 400 mg/kg/day (3 days) | Hydroxychloroquine, lopinavir/ritonavir | Death after 3 days from starting treatment with IVIG |
| Mozhidehipanah et al. [35]  | RT-PCR + chest CT  | Leucocytosis, lymphopenia, elevated ESR and CRP                             | NA                                                     | Increased total protein (273 mg/dL), total cells count: 2/mm³, negative CSF SARS-CoV-2 RT-PCR, negative meningitisencephalitis panel, negative oligoclonal bands and IgG index | Demyelinating AIDP                                                   | NA                     | IVIG 400 mg/kg/day (5 days) | Hydroxychloroquine, lopinavir/ritonavir | No significant clinical improvement |
| Naddaf et al. [36]          | Positive SARS-CoV-2 IgG (index value: 8.2, normal <0.8) and IgA+ chest CT (negative RT-PCR) | Normal complete blood count, elevated n-dimer (690 ng/mL), ferritin (575 mcg/L), ESR (26 mmHg), alanine aminotransferase (73 U/L) | Negative anti-ganglioside antibodies negative HIV, syphilis, West Nile virus, Lyme disease testing, EBV and CMV serology consistent with remote infection, negative paraneoplastic evaluation | Increased total protein (273 mg/dL), total cells count: 2/mm³, negative CSF SARS-CoV-2 RT-PCR, negative meningitisencephalitis panel, negative oligoclonal bands and IgG index | Demyelinating AIDP | NA | Plasma exchange (5 sessions) | Hydroxychloroquine, zinc, methylprednisolone 40 mg bid for 5 days | Improvement of motor and gait examination. Persistence of slight ataxia without requiring gait aid |
**Table 1 (continued)**

| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|-------------------|----------------|----------------------------------------------------------|--------------|-------------------------------------------------|------------------------|-----------------------|---------|
| Oguz-Akarsu et al. [37] | RT-PCR + chest MRT + chest CT | Mild neutropenia (1.49 cells/µL) and a high monocyte percentage (19.77) | HIV test negative | Normal total protein (32.6 mg/dL) with no leucocytes | Demyelinating with sural sparing pattern AIDP | Cervical and lumbar and spine: asymmetrical thickening and hyperintensity of post-ganglionic roots supplying the brachial and lumbar plexuses in STIR sequences | Plasma exchange (five sessions, one every other day) | Hydroxychloroquine, azithromycin | Marked neurological improvement after 2 weeks and she was able to walk without assistance |
| Ottaviani et al. [38] | RT-PCR + chest CT | Lymphopenia, increased d-dimer, CRP and CK | Negative anti-ganglioside antibodies | Increased total protein (108 mg/dL), cell count: 0 cells/µL | Mainly demyelinating | Predominantly AIDP | NA | IVIG 400 mg/kg (5 days) | Lopinavir/ritonavir, hydroxychloroquine | Progressive worsening with multi-organ failure |
| Padroni et al. [39] | RT-PCR + chest CT | WBC 10.41 × 10⁹/L (neutrophils 8.15 × 10⁹/L), normal d-dimer | Negative screening for *Mycoplasma pneumoniae*, CMV, *Legionella pneumophila*, *Streptococcus pneumoniae*, HSV, VZV, EBV, HIV-1, *Borrelia burgdorferi*, auto-antibodies not performed | Increased total protein (48 mg/dL), cell count: 1 × 10⁶/L | Motor sensory axonal AMSAN | NA | IVIG 400 mg/kg (5 days) + mechanical invasive ventilation | NA | At day 6 from admission: ICU with mechanical invasive ventilation |
| Paterson et al. [40] | Definite diagnosis (not specified) (normal chest CT) | Increased neutrophils and CRP | NA | Increased total protein (0.5 g/L), leucocytes: 3 cells/µL (0–5), | Demyelinating AIDP | NA | IVIG + mechanical invasive ventilation | None | 17 days of hospitalisation, at discharge able to walk 5 m (across an open space) but incapable of manual work/running |
| Paterson et al. [40] | Definite diagnosis (not specified) (normal chest CT) | Increased CRP and fibrinogen | NA | Increased total protein (0.6 g/L), leucocytes: 2 cells/µL (0–5), Glucose 3.4 (mmol/L; 2.2-4.2) | Demyelinating AIDP | Brain: no pathological findings | IVIG | Mechanical invasive ventilation | 46 days (ongoing) of hospitalisation, still critical and requiring ventilation |
| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|-------------------|----------------|------------------------------------------------------|-------------|-----------------------------------------------------------------|------------------------|-----------------------|---------|
| Paybast et al. [41] | RT-PCR | NA | NA | Increased total protein (139 mg/dL), normal glucose and cell count, normal CSF viral serology, negative gram stain and culture | Mixed demyelinating and axonal EMG subtype unknown | NA | 5 sessions of therapeutic plasma exchange, intravenous bolus of labetalol to control sympathetic nervous system over-reactivity | Hydroxychloroquine sulphate 200 mg two times per day for a week | Persistence of generalized hyporeflexia, decreased light touch sensation in distal limbs, mild bilateral facial paresis, sympathetic over-reactivity successfully controlled with labetalol, |
| Paybast et al. [41] | RT-PCR | NA | NA | Albuminocytological dissociation | NA | NA | IVIG 20 g (5 days) | Hydroxychloroquine sulphate 200 mg two times per day for a week | Persistence of generalized hyporeflexia and decreased light touch sensation in distal limbs |
| Pfefferkorn et al. [42] | RT-PCR + chest CT | NA | Negative anti-gangliosides antibodies | At admission: Normal total protein, cell count: WPL, negative SARS-CoV-2 PCR At day 13th: increased total protein (10.231 mg/L), normal cell count | Demyelinating AIDP | Spinal: massive symmetrical contrast enhancement of the spinal nerve roots at all levels of the spine including the cauda equina. Anterior and posterior nerve roots were equally affected | IVIG 30 g (5 days) + mechanical invasive ventilation + plasma exchange | NA | At day 31 from admission: motor improvement with regression of facial and hypoglossal paresis but still needed mechanical ventilation |
| Rana et al. [43] | RT-PCR | NA | NA | Demyelinating with sural sparing AIDP | Thoracic and lumbar spine: no evidence of myopathy or radiculopathy | IVIG 400 mg/kg (5 days) | Hydroxychloroquine and azithromycin | On day 4 respiratory improvement, on day 7 rehabilitation |
| Article                        | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings                                      | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome                                                                 |
|-------------------------------|--------------------|----------------|----------------------------------------------------------|--------------------------------------------------|-------------------------------------------------|---------------------------|--------------------------|----------------------------------------------------------------------|
| Reyes-Bueno et al. [44]       | Serology (negative RT-PCR) | NA             | Negative anti-ganglioside antibodies                     | Increased total protein (70 mg/dl), cell count: 5 cells/µl, albuminocytological dissociation | Demyelinating with alteration of the Blink-Reflex. Further EMG: polyradiculoneuropathy with proximal and brainstem involvement | AIDP | IVIG 400 mg/kg (5 days) + Gabapentin | NA After the 18th day progressive improvement of facial and limb paresis, diplopia and pain. Consequent neurological rehabilitation |
| Riva et al. [45]              | Chest CT + serology (negative RT-PCR) | No pathological findings | Negative anti-ganglioside antibodies | Normal total protein and cells; negative PCR for SARS-CoV2, EBV, CMV, VZV, HSV 1–2, HIV | Demyelinating with sural sparing | AIDP | IVIG 400 mg/kg (5 days) | None Slowly improvement after the 10th day |
| Sancho-Saldaña et al. [46]    | RT-PCR + chest X-Ray | NA             | Negative anti-ganglioside antibodies                     | Increased total protein (0.86 g/L), cell count: 3 leucocytes | Demyelinating AIDP | Whole spine: brainstem and cervical meningeal enhancement | IVIG 400 mg/kg (5 days) | Hydrixochloroquine, azithromycin Recovering by day 7 after the onset of weakness. |
| Scheidl et al. [47]           | RT-PCR             | No pathological findings | Negative Campylobacter Jejuni and Borrelia serology, negative ANA, anti-DNA, c-ANCA, p-ANCA | Increased total protein (140 g/L), albuminocytological dissociation | Demyelinating AIDP | Brain: NA Cervical spine: no pathological findings | IVIG 400 mg/kg (5 days) | None Complete recovery |
| Sedaghat et al. [48]          | RT-PCR + chest CT  | Increased WBC 14.6 × 10^3 (neutrophils 82.7%, lymphocytes 10.4%) and CRP | NA | Motor sensory Axonal AMSAN | Brain: no pathological findings | Spinal: two cervical intervertebral disc herniations | IVIG 400 mg/kg (5 days) | Hydrixochloroquine, lopinavir/ritonavir, azithromycin Not reported |
| Sidig et al. [49]             | RT-PCR + chest CT  | NA             | None | None | Brain: no pathological findings | NA | NA | Death after 7 days; because of progressive respiratory failure |
| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiologic subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|-------------------|----------------|-----------------------------------------------------|-------------|--------------------------------------------------------------------------------|-----------------------|------------------------|---------|
| Su et al. [50] | RT-PCR + chest X-ray | WBC 12,000 cells/µl | Negative anti-ganglioside GM1, GD1b and GQ1b antibodies, acetylcholine receptor binding, voltage-gated calcium channel, antimembrane and ANCA | Increased total protein (313 mg/dL), WBC: 1 cell | Demyelinating AIDP | NA | IVIG 2 gm/kg (for 4 days) | None |
| Tiet et al. [51] | RT-PCR | Elevated lactate on venous blood gas (3.3 mmo/L), mildly elevated CRP (20 mg/L). Normal WBC, sodium, potassium and renal function. | NA | Increased total protein (> 1.25 g/L), cell count 1 x 10^6/L | Demyelinating AIDP | NA | IVIG 400 mg/kg/day (5 days) | None |
| Toscano et al. [52] | RT-PCR + Chest CT + serology | Lymphocytopenia, increased CRP, LDH, ketonuria | Negative anti-ganglioside antibodies | Day 2: normal total protein, no cells, negative SARS-CoV-2 PCR Day 10: increased total protein (101 mg/dL), cell count: 4/mm^3, negative SARS-CoV-2 PCR | Axonal with sural sparing AMSAN | Brain: no pathological findings Spinal: Enhancement of caudal nerve roots | IVIG 400 mg/kg (2 cycles) + temporary mechanical non-invasive ventilation | Paracetamol |
| Toscano et al. [52] | RT-PCR (negative chest CT) | Lymphocytopenia; increased ferritin, CRP, LDH | NA | Increased total protein (123 mg/dL), no cells, negative SARS-CoV-2 PCR | Motor sensory axonal with sural sparing AMSAN | Brain: enhancement of facial nerve bilaterally Spinal: no pathological findings | IVIG 400 mg/kg | Amoxicillin |
| Toscano et al. [52] | RT-PCR + chest CT | Lymphocytopenia; increased CRP, LDH, ketonuria | Negative anti-ganglioside antibodies | Increased total protein (193 mg/dL), no cells, negative SARS-CoV-2 PCR | Motor axonal AMAN | Brain: no pathological findings Spinal: enhancement of caudal nerve roots | IVIG 400 mg/kg (2 cycles) + mechanical invasive ventilation | Azithromycin |

| |
| ICU admission due to respiratory failure and tetraplegia. At week 4 still critical |

On day 28 persistence of severe weakness |

Resolution of facial diplegia, improved upper and lower limbs weakness; able to mobilize unassisted 11 weeks after neurorehabilitation |

At week 4 persistence of severe UL weakness, dysphagia, and LL paraplegia |

At week 4 improvement of ataxia and mild improvement of facial weakness |

At week 4 still critical |
Table 1 (continued)

| Article | COVID-19 diagnosis | Blood findings | Auto-antibodies and screening for most common GBS causes | CSF findings | Electrophysiology: Neuropathy type and GBS electrophysiological subtype | MRI (brain and spinal) | Management and therapy | Outcome |
|---------|--------------------|----------------|----------------------------------------------------------|--------------|------------------------------------------------------------------------|------------------------|------------------------|---------|
| Toscano et al. [52] | RT-PCR + serology (negative chest CT) | Lymphocytopenia; increased CRP, ketonuria | NA | Normal protein, no cells, negative SARS-CoV-2 PCR | Demyelinating AIDP | Brain: no pathological findings | IVIG 400 mg/kg | None | At week 4 mild improvement in UL but unable to stand |
| Toscano et al. [52] | Chest CT + serology (negative RT-PCR in nasopharyngeal swab and BAL) | Lymphocytopenia; increased CRP, LDH | Negative anti-ganglioside antibodies; negative screening for Campylobacter jejuni, EBV, CMV, HSV, VZV, influenza, HIV | Normal total protein (40 mg/dL), white cell count 3/mm³; negative SARS-CoV-2 PCR | Demyelinating AIDP | Brain: NA | Spinal: no pathological findings | IVIG 400 mg/kg + plasma exchange + mechanical invasive ventilation + enteral nutrition | None | At week 4 flaccid tetraplegia, dysphagia, ventilation dependent |
| Velayos Galán et al. [53] | RT-PCR + chest X-ray | NA | NA | NA | Demyelinating AIDP | IVIG 400 mg/kg (5 days) | Hydroxychloroquine, lopinavir/ritonavir, amoxicillin, corticosteroids + low-flow oxygen therapy | NA |
| Virani et al. [54] | rt-pcr + chest mrt | WBC 8.6 × 10⁹/L; Hb 15.4 g/dl; PC 211 × 10⁹/L; procalcitonin: 0.15 ng/ml | Negative ANA, ANCA, anti-ganglioside antibodies, syphilis serology HIV, hepatitis B and hepatitis C | Increased total protein Demyelinating AIDP (0.51 g/L), normal glucose and cell count, negative SARS-CoV-2 PCR, negative viral PCR | NA | Brain: NA | Spinal: no pathological findings | IVIG 400 mg/kg (5 days) + mechanical invasive ventilation (4 days) | Hydroxychloroquine 400 mg bid for first 2 doses, then 200 mg bid for 8 doses | At day 4 of IVIG: liberation from mechanical ventilation, resolution of UL symptoms, persistence of LL weakness. Sent to a rehabilitation facility |
| Webb et al. [55] | RT-PCR + chest X-ray + chest CT | Lymphopenia (0.9 × 10⁹/L), thrombocytosis (490 × 10⁹/L) raised CRP (25 mg/L) | Negative ANA, ANCA, anti-ganglioside antibodies, syphilis serology HIV, hepatitis B and hepatitis C | Increased total protein Demyelinating AIDP (0.51 g/L), normal glucose and cell count, negative SARS-CoV-2 PCR, negative viral PCR | NA | NA | Brain: NA | Spinal: no pathological findings | IVIG 400 mg/kg/day (5 days) + Mechanical invasive ventilation | Co-amoxiclav | After 1 week in ICU: no oxygen requirement and ventilation |
| Zhao et al. [56] | RT-PCR + chest CT | WBC 0.52 × 10⁹/L; PC 113 × 10⁹/L | NA | Increased total protein Demyelinating AIDP (124 mg/dL), cell count 5 × 10⁹/L | NA | IVIG (dosing not reported) | Arbidol, lopinavir/ritonavir | At day 30 resolution of neurological and respiratory symptoms |

AIDP, acute inflammatory demyelinating polyneuropathy; AMAN, acute motor axonal neuropathy; AMSAN, acute motor sensory axonal neuropathy; ANA, antinuclear antibodies; ANCA, anti-neutrophil cytoplasmic antibodies; BAL, bronchoalveolar lavage; CK, creatine kinase; CMV, cytomegalovirus; COPD, chronic obstructive pulmonary disease; COVID-19, coronavirus disease 2019; CRP, C-reactive protein; CSF, cerebrospinal fluid; CT, computed tomography; DM, diabetes mellitus; EBV, Epstein–Barr virus; ESR, erythrocyte sedimentation rate; F, female; GBS, Guillain–Barré syndrome; GGT, gamma-glutamyl transferase; GOT, glutamic oxaloacetic transaminase; GPT, glutamate pyruvate transaminase; Hb, haemoglobin; HIV, human immunodeficiency virus; HSV, herpex simplex virus; ICU, intensive-care unit; IL, interleukin; IVIG, intravenous immunoglobulin; IL, interleukin; LDH, lactate dehydrogenase; LL, lower limbs; M, male; MRI, magnetic resonance imaging; NA, not available; PC, platelet count; PCR, Polymerase Chain Reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus-2; TNF, tumor necrosis factor; UL, upper limbs; VDRL, Veneral Disease Research Laboratory; VZV, varicella-zoster virus; WBC, white blood cells; X-ray: radiography

aTime to Nadir refers to days elapsed between the onset of neurological symptoms and the development of the worst clinical picture when no progression was reported nadir was considered comitant with GBS symptoms onset

bAccording to Brighton diagnostic criteria [66]
the notion of a prominent post-infectious immune-mediated mechanism. However, in this context, the massive release of cytokines in COVID-19 may also contribute to the amplification of the dysimmune process underlying GBS [76, 77]. In this regard, the increase of blood inflammatory markers (e.g., CRP, IL-6, TNF-α, IL-1, etc.) in GBS tested cases may reinforce the hypothesis of a systemic inflammatory storm in COVID-19 [76, 77]. However, given the limited data, we could not perform an accurate analysis of the distribution and, eventually, prognostic value of inflammatory markers in COVID-19-associated GBS. Moreover, we cannot exclude that in cases with GBS developing before or together with COVID-19 symptoms, the disease might have progressed sub-clinically in the early phase to manifest afterwards with its typical systemic clinical picture. Indeed, two cases [10, 12], who tested positive for SARS-CoV-2, never developed COVID-19 respiratory or systemic symptoms and one of them showed an asymptomatic pneumonia at chest-CT [12]. However, only more extensive epidemiological and translational studies, with the aim to compare the characteristics of GBS associated or not with COVID-19, could clarify these issues.

In our population, most common clinical manifestations and distribution of clinical variants resemble those of classic GBS confirming the predominance of the sensorimotor syndrome compared to MFS and other rare variants [57–59, 66]. Similarly, the results of CSF analysis reflected typical neurochemical findings in non-COVID-19 GBS. In the latter, elevated CSF proteins and pleocytosis were described in about 50–80% [57, 78] and 11–15% cases, respectively [58, 79, 80], largely overlapping with the percentages in our cohort. In this regard, the mostly normal cell count, together with the absence of SARS-CoV-2 RNA in all tested CSF samples [6–9, 12–14, 16, 21–24, 31, 33, 36, 42, 44, 45, 52, 55], makes the possibility of a direct invasion from SARS-CoV-2 into the nerve roots with intrathecal viral replication less probable. However, a possible bias might rely on the lack of systematic data concerning the latency between symptom onset and CSF sampling in COVID-19 GBS cases. On another issue, in a further case of MFS associated with COVID-19, who came to our attention, we observed the absence of intrathecal synthesis of SARS-CoV-2 antibodies together with a massive increase of CSF phosphorylated neurofilament heavy chain (pNfH) and serum neurofilament light chain (NFL) proteins, supporting the role of neurochemical markers as easily implementable tools for the detection of nervous system affection in COVID-19-related diseases [81, 82].

At variance with CSF findings, we found a discrepancy concerning MRI findings between classic GBS and COVID-19-related GBS. Specifically, while most cases of the former group showed typically spinal root enhancement at MRI [83], in the latter group, in analogy with Zika-associated GBS, the same finding was less frequently reported [84]. However, caution should be warranted in the interpretation of these results, given that MRI findings might have been underestimated, due to lack of a sufficient number of exams in the context of pandemic-imposed restrictions in the routine clinical setting.

Regarding the distribution of GBS electrophysiological variants, our analysis showed that COVID-19-associated GBS manifests prevalently with AIDP and, to a lesser extent, with AMSAN and AMAN, in line with classic GBS in Western countries [66, 85]. Conversely, the observation of positive anti-GD1b antibodies in one COVID-19-related MFS patient and negative anti-ganglioside antibodies in other five cases appear in discordance with the high prevalence (≈ 90%) of anti-GQ1b antibodies among non-COVID-19 MFS cases [86], and may suggest different immune-mediated mechanisms. However, these results could not be generalized until a wider population would be tested.

In analogy to classic GBS, approximately one-fifth of COVID-19-associated GBS subjects required mechanical ventilation during hospitalisation [87]. In this regard, cases with no improvement or unfavorable outcome showed, in comparison to those with a good prognosis, an older age, confirming similar findings both in classic GBS [58, 88] and in COVID-19 [89], and a slightly higher frequency (without reaching a statistical significance) of past or concurrent COVID-19 pneumonia. However, given the short follow-up time in most cases, we could not reach a definite conclusion on the impact of past or concurrent COVID-19 restrictive syndrome due to pneumonia on the prognosis of GBS patients. Future prospective studies are needed to clarify this issue. Moreover, given that also preceding diarrhea (mostly caused by Campylobacter Jejuni infection) is a strong negative prognostic factor in classic GBS [57, 88], further prospective studies are needed to compare the severity of GBS related to COVID-19 to that associated with C. jejuni. Finally, in the context of respiratory failure and ventilation associated with COVID-19, the differential diagnosis should always take into consideration critical illness neuropathy and myopathy, which tend to develop later during the critical course [90]. Despite these findings, approximately one-third of COVID-19-related GBS patients showed no clinical and/or radiological evidence of pneumonia, providing evidence that GBS may also develop in the context of a paucisymptomatic or even asymptomatic COVID-19. However, given that among the GBS population only two asymptomatic COVID-19 patients were reported to date, we may speculate that, in most cases, a certain degree of lung injury (even minimal) or at least hematic dissemination (e.g., fever underlying significant viral load) is necessary to trigger the immuno-mediated process through lymphocytic recognition of self-antigens or molecular mimicry.
Major strengths of our review are the inclusion of a high number of patients, together with an in-depth analysis of the clinical and diagnostic features of COVID-19-associated GBS. We are aware that selection bias might have occurred, given that most reported cases to date have been described mostly in Europe (47 out of 73) and during COVID-19 highest spreading. Therefore, future extensive epidemiological studies are necessary to ascertain the nature of the association between COVID-19 and GBS (causal or coincidental). Moreover, we cannot exclude the possibility that at least some of the cases represent instances of CIDP, given the frequent absence of a follow-up longer than 2 months. On another issue, the low but possible evidence of an epidemiological link between vaccines and GBS development [57, 58] should aware the clinicians of the possible occurrence of GBS after COVID-19 vaccination in the long-term future.

In conclusion, based on the systematic review of 73 cases, we showed that the clinical picture of COVID-19-associated GBS seems to resemble that of classic GBS or Zika-associated GBS. Moreover, the chronological evolution, the response to IVIG, and the absence of SARS-CoV-2 RNA in CSF may suggest a prominent post-infectious immune-mediated mechanism rather than a para-infectious one. Although most cases were symptomatic for COVID-19, the preliminary report of a few patients without respiratory or systemic symptoms raises a significant healthcare issue, namely the importance of SARS-CoV-2 testing in all patients with suspected GBS during the pandemic, with the aim to provide an eventual rapid case isolation. Nevertheless, only further analyses on more comprehensive cohorts could help in clarifying better all these issues.

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**Compliance with ethical standards**

**Conflicts of interest** The authors declare that they have no conflict of interest related to the content of this article.

**Ethical standard** For the present study, no authorization to an Ethics Committee was asked, because the original reports, nor this work, provided any personal information of the patients.
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