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Spectrum of Acute Neuropathy Associated With Covid-19: A Clinical and Electrophysiological Study of 13 Patients From a Single Center

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ABSTRACT

Objectives: To analyze clinical and nerve conduction patterns in patients with acute neuropathy, preceded by or concomitantly having Covid-19 disease (Acute neuropathy associated with Covid-19 or ANAC 19).

Methods: A retrospective analysis of clinical details, laboratory evaluation and electrophysiological parameters in patients with ANAC 19 was performed. These data were compared with non-Covid Guillain-Barre syndrome (GBS) described in literature and also with patients with acute neuropathy without Covid-19 who had presented to the center during the study period.

Results: Records of 13 patients with ANAC 19 were reviewed. Most patients clinically had paraparesis, and electrophysiologically showed demyelinating neuropathy. Peroneal and sural nerves were the most frequently abnormal motor and sensory nerves, respectively. A proportion of patients showed a peroneal velocity-sparing pattern. Higher incidence of paraparesis and encephalopathy differentiated ANAC 19 from non-Covid GBS.

Conclusions: ANAC 19 had a comparable electrophysiological profile to non-Covid GBS; however, it had a distinct clinical presentation.

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Introduction

Acute neuropathy in Covid-19 disease is well recognized. Acute inflammatory demyelinating polyneuropathy (AIDP), acute motor sensory axonal neuropathy (AMSAN) and other varieties of Covid-19-associated Guillain-Barre syndrome (GBS) have been summarized in systematic reviews (Abu-Rumeileh et al., 2021; Sriwastava et al., 2021). Although previous authors have described electrophysiological characteristics of Covid-19-related neuropathy, they are limited to specific neuropathy types such as AIDP (Uncini et al., 2021) or critical illness neuropathy (Frithiof et al., 2021).

This retrospective case series aimed to analyze clinical and nerve conduction patterns in patients with a broad spectrum of acute neuropathy, preceded by or concomitantly having Covid-19 disease (ANAC 19). It then applied the GBS diagnostic criteria at a patient level and single nerve level to provide comprehensive electrophysiological insight into ANAC 19.

Materials and Methods

A retrospective analysis was performed of nerve conduction studies (NCS) in patients with confirmed or probable Covid-19 disease, presenting with acute quadriparesis, paraparesis, or sensory symptoms. Case files, electronic records and laboratory evaluation details of all the included patients were accessed and analyzed in detail. Confirmed Covid-19 disease was defined as a person with positive RT PCR, other nucleic acid test for Covid-19, or Covid-19 antigen test. Probable Covid-19 was defined according to the guideline definition of the European Center for Disease Prevention and Control (McArthur et al., 2020). The NCS were performed in the hospital's electrophysiology laboratory between August 2020 and April 2021. Each NCS was performed as the last study of the day, following which the laboratory was fumigated. Records of bilateral median (motor including F waves, and sensory), ulnar (motor including F waves, and sensory), peroneal (motor including F waves) and sural (sensory) NCS were reviewed. Sensory NCS was antidromic in sural, and antidromic/orthodromic in median and ulnar nerves. One patient could not undergo left ulnar NCS due to technical reasons. Normative data (except for antidromic upper limb sensory amplitudes) was derived from Gupta

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Table 1
Basic clinical details.

	ANAC-19*	NCN#
Parameter	N (%)	N (%)
Total cases	13 (100)	8 (100)
Confirmed Covid-19	12 (92.31)	0 (0)
Probable Covid-19	1 (7.69)	0 (0)
Males	9 (69.23)	5 (62.50)
Females	4 (30.77)	3 (37.50)
Mean age (years)	65.54±8.6	46.63±22.1
Diabetes	11 (84.62%)	2 (25%)
Paraparesis	8 (61.54)	2 (25)
Quadriparesis	4 (30.77)	6 (75)
Pure sensory symptoms	1 (7.69)	0 (0)
Dysautonomia	1 (7.69)	1 (12.5)
Encephalopathy	4 (30.77)	2 ⁵ (25)

* Acute neuropathy associated with Covid-19

Non-Covid neuropathy

⁵ Acute intermittent porphyria and CO₂ narcosis were diagnosed

et al. (Gupta et al., 1994) and Taly et al. (Taly et al., 1991). Normative sensory amplitudes for antidromic median (13 microvolts) and antidromic ulnar (9 microvolts) were derived from Chen et al. (Chen et al., 2016). Hadden criteria (Hadden et al., 1998) were applied to classify the NCS as demyelinating, axonal, or others. Umapathi criteria (Umapathi et al., 2019) were applied to classify as definite, probable, or possible GBS. Clinical presentation, imaging, and cerebrospinal fluid (CSF) analysis were also evaluated when available.

Results

Demographic details

Clinical presentation and laboratory evaluation details of 13 patients were analyzed. Twelve patients were confirmed Covid-19 with RT PCR/rapid antigen test, while one patient was probable Covid-19. Four patients were female and nine were male. Mean age of the cohort was 65.54±8.6 years (Table 1).

Clinical features of Covid-19

Fever (n=9), dyspnea (n=7), and cough (n=5) were the most common presenting manifestations of Covid-19 in the cohort. Risk factor assessment for severe Covid-19 disease revealed diabetes in 11 patients, hypertension in eight, CAD in two, chronic kidney disease in one, and obesity in two patients. Severity of Covid-19 was assessed as per standard clinical criteria (Zhang et al., 2020). Five patients had critical Covid-19, seven had severe Covid-19, and one patient had moderate Covid-19 disease. One patient each had a comorbid diagnosis of pancreatitis, pulmonary arterial hypertension, pulmonary thromboembolism, and secondary hemophagocytic lymphohistiocytosis.

Onset of neuropathic symptoms

Following the onset of non-neurological Covid-19 features, neuropathic symptoms started in the first week of illness in three patients, in the second week in one patient, in the third week in four patients, in the fourth week in three patients, and in the second month in one. One patient had onset beyond two months of Covid-19; this patient experienced progressive worsening of pulmonary symptoms coincident with the onset of neurological symptoms, probably suggesting reinfection.

Diabetes status

Eleven patients were diabetic at presentation. Duration of diabetes was available in the records of two patients: one had been diabetic for five years and the other for 1.5 months prior to the onset of neuropathy. Diabetes duration of another six patients was reviewed through telephonic enquiry. Of these, one patient denied diabetes prior to onset of Covid-19. Four patients were diabetic for ≥20 years, and one patient for 1.5 years. The duration of diabetes for three patients could not be accessed.

Six patients had HbA1c performed: three had HbA1c of ≤7%, the remaining three patients had HbA1c values of 7.8%, 9.7%, and 12.0%. Of the five diabetic patients without HbA1c, one patient had an FBS of 274 mg/dl, another had a GRBS of 275 mg/dl with ketoacidosis, while the remaining three had GRBS of 161 mg/dl, 290 mg/dl, and 297 mg/dl at presentation.

Neurological signs

Eight patients had paraparesis, while four had quadriparesis. One patient had only positive sensory symptoms. One patient with quadriparesis had acute dysautonomia with severe BP fluctuations. Four patients had cranial nerve involvement in the form of bifacial palsy (n=2) and dysarthria (n=2). Two patients had global areflexia, six had global hyporeflexia, and one had distal hyporeflexia. Although the majority of the patients had a combination of limb weakness in more than one limb with areflexia/hyporeflexia, only one patient satisfied the features required for diagnosis of GBS as per the strict traditional NINCDS criteria (progressive limb weakness in more than one limb with global areflexia) (Asbury and Cornblath, 1990). Basic clinical details of the cohort are summarized and compared with a non-Covid group in Table 1. Four patients had associated encephalopathy. Persistent limb weakness in the intensive care unit (ICU) post-intubation was the presenting feature in three patients.

CSF and MRI findings

Five patients had CSF tested, of which two had albuminocytological dissociation and three had normal CSF parameters. Magnetic resonance imaging (MRI) of the brain and spinal cord were both performed in four patients and MRI brain alone in three other patients. All the brain and spinal cord MRIs were noncontributory. Computed tomography (CT) chest severity scores were available in seven patients. The average CT severity score in the seven patients was 17.14±4.4.

Nerve conduction studies

Thirteen NCS were evaluated: 77 motor nerves (26 median, 25 ulnar, and 26 peroneal) were reviewed, and 77 sensory nerves (26 median, 25 ulnar, and 26 sural) were analyzed. Tibial NCS was performed in all patients but was not included in analysis. Median and ulnar sensory NCS were antidromic in seven patients and orthodromic in the rest. NCS was conducted in the first week of neurological symptoms in two patients, second week in four patients, third week in two patients, fourth week in four patients, and fifth week in one patient.

On applying Hadden criteria (Hadden et al., 1998), 11 patients had demyelinating neuropathy, while two patients had axonopathy. Both the patients with axonopathy fulfilled electro-diagnostic criteria for AMSAN (Uncini et al., 2012). Four patients had definite GBS with a sural-sparing pattern according to Umapathi criteria (Umapathi et al., 2019), while nine patients had probable GBS. All four patients with definite GBS had demyelinating neuropathy.

Distal latency, conduction velocity and F latency of each motor nerve tested was evaluated for conformity with Hadden criteria (Hadden et al., 1998) for demyelination (Table 3). Two patients satisfied the Hadden criteria (Hadden et al., 1998) for partial conduction block. One patient with definite GBS had conduction block in the forearm segment of the median nerve. Another patient with probable GBS demonstrated conduction block in the forearm segment of the ulnar nerve.

Conduction velocities in the upper limb vs lower limb motor nerves were compared. Conduction velocity above Hadden criteria (Hadden et al., 1998) threshold in at least one peroneal nerve, with conduction velocity below Hadden criteria (Hadden et al., 1998) threshold in at least one median/ulnar nerve was defined as a peroneal velocity-sparing pattern. In patients with bilateral elicitable peroneal compound muscle action potential (CMAP) and probable GBS (n=6), a peroneal velocity-sparing pattern was seen in three patients: all three were classified as demyelinating neuropathy. Three of the four patients with definite GBS showed a peroneal velocity-sparing pattern.

Sensory NCS parameters were classified as absent SNAPs, normal SNAPs, or reduced amplitude (but not absent) SNAPs. Details of the sensory NCS are summarized in Table 4.

Probable GBS

The majority of the patients (n=9) were categorized as probable GBS on applying Umapathi criteria (Umapathi et al., 2019). Both of the patients with axonopathy on NCS belonged to this category. Two patients with probable GBS had CSF analysis performed and both showed albumino-cytological dissociation consistent with inflammatory radiculoneuropathy. Seven patients with probable GBS did not having CSF analysis. However, among these seven, structural pathology of the brain and spine was ruled out with an MRI in two patients. In another two patients, MRI brain alone was performed, which was again non-contributory. Three patients with probable GBS had neither MRI nor CSF analysis. However, all three had limb weakness with hyporeflexia clinically consistent with radiculoneuropathy.

Other laboratory evaluation

Other laboratory evaluation details of the patients were reviewed. Serum globulin (n=13), a marker for paraproteinemia (Rison and Beydoun, 2016), was normal in all patients except one, who had transient serum globulin elevation. Hypercalcemia is another indication to screen for M protein (Cook and MacDonald, 2007). Corrected serum calcium (n=11) was normal in all tested patients. Urine Bence-Jones protein was performed in one patient and was negative. Urine porphobilinogen in three patients was also negative. Vitamin B12 levels (n=10) were high in eight (probably due to Vitamin B12 supplementation prior to testing) and normal in two patients. TSH levels (n=13) were normal in 12 and low in one patient. CPK (n=10) was mildly elevated (293 U/L, 206 U/L) in two patients and normal in the rest. ANA/ANA profile (n=5) was performed in five, of whom one had borderline dsDNA and the rest were negative. Four patients had RA done; all were negative. Viral markers (n=12) including HIV, HbsAg, and HCV testing revealed newly detected HIV in one patient and previously diagnosed HCV in another patient. RPR (n=4) was negative in all the tested patients.

ANAC 19 vs non-Covid neuropathy

The NCS data, case files, and electronic records were reviewed for patients with acute neuropathy without Covid-19 infection at the center during the same period (i.e., between August 2020

Table 2
Basic electrophysiological classification.

	ANAC-19*	NCN#
Definite GBS	4 (30.77)	3 (37.50)
Probable GBS	9 (69.23)	5 (62.50)
Demyelinating	11 (84.62)	4 (50)
Axonal	2 (15.38)	3 (37.50)
Equivocal	0 (0)	1 (12.5)

GBS, Guillain-Barre syndrome

* Acute neuropathy associated with Covid-19

Non-Covid neuropathy

Table 3
Detailed motor nerve conduction study findings.

	ANAC-19*	NCN#
Motor nerves analyzed		
Total	77/77 (100%)	48/48 (100%)
Median	26/77 (33.77%)	16/48 (33.33%)
Ulnar	25/77 (32.46%)	16/48 (33.33%)
Peroneal	26/77 (33.77%)	16/48 (33.33%)
Prolonged distal latency beyond Hadden criteria		
Total	21/77 (27.27%)	7/48 (14.58%)
Median	9/26 (34.62%)	3/16 (18.75%)
Ulnar	5/25 (20%)	2/16 (12.5%)
Peroneal	7/26 (26.92%)	2/16 (12.5%)
Reduced conduction velocity below Hadden criteria		
Total	28/77 (36.36%)	10/48 (20.83%)
Median	12/26 (46.15%)	4/16 (25%)
Ulnar	9/25 (36%)	2/16 (12.5%)
Peroneal	7/26 (26.92%)	4/16 (25%)
Prolonged F latency beyond Hadden criteria		
Total	14/77 (18.18%)	7/48 (14.58%)
Median	5/26 (19.23%)	2/16 (12.5%)
Ulnar	4/25 (16%)	3/16 (18.75%)
Peroneal	5/26 (19.23%)	2/16 (12.5%)
Absent F waves		
Total	26/77 (33.77%)	11/48 (22.92%)
Median	3/26 (11.54%)	0/16 (0)
Ulnar	3/25 (12%)	1/16 (6.25%)
Peroneal	20/26 (76.92%)	10/16 (62.5%)
Unexcitable CMAP		
Total	5/77 (6.49%)	1/48 (2.08%)
Median	0/26 (0)	0/16 (0)
Ulnar	0/25 (0)	0/16 (0)
Peroneal	5/26 (19.23%)	1/16 (6.25%)
Probable GBS with bilateral elicitable peroneal CMAPs (P-GBS with BEPC)	6	5
Peroneal velocity sparing in P-GBS with BEPC	3/6	0/5
Definite GBS with bilateral elicitable peroneal CMAPs (D-GBS with BEPC)	4	2
Peroneal velocity sparing in D-GBS with BEPC	3/4	0/3

GBS, Guillain-Barre syndrome; CMAP, compound muscle action potential

* Acute neuropathy associated with Covid-19

Non-Covid neuropathy

and April 2021). Eight patients with non-Covid acute neuropathy were identified. Clinical and electrophysiological parameters of these eight patients were compared with 13 patients with ANAC 19. Mean age, prevalence of diabetes, and presentation with paraparesis and encephalopathy were higher in ANAC 19. Also, a demyelinating pattern was more frequent in ANAC 19 compared with the non-Covid group. Overall, NCS abnormalities were more frequent in ANAC 19 (Tables 2, 3 and 4).

Table 4
Sensory nerve conduction study findings.

	ANAC-19*	NCN#
Sensory nerves analyzed		
Total	77/77 (100%)	48/48 (100%)
Median	26/77 (33.77%)	16/48 (33.33%)
Ulnar	25/77 (32.46%)	16/48 (33.33%)
Sural	26/77 (33.77%)	16/48 (33.33%)
Absent SNAPs		
Total	26/77 (33.77%)	1/48 (2.08%)
Median	4/26 (15.38%)	0/16 (0)
Ulnar	6/25 (24%)	0/16 (0)
Sural	16/26 (61.54%)	1/16 (6.25%)
Elicitable but reduced SNAP amplitude	26/77 (33.77%)	14/48 (29.17%)
Total	12/26 (46.15%)	6/16 (37.5%)
Median	10/25 (40%)	5/16 (31.25%)
Ulnar	4/26 (15.38%)	3/16 (18.75%)
Sural		

* Acute neuropathy associated with Covid-19

Non-Covid neuropathy

Encephaloneuropathy

Among patients with encephalopathy (n=4), two patients had definite GBS and the remaining two had probable GBS. Three patients had quadriplegia and one had paraparesis. MRI brain was performed in all four patients and was non-contributory. Two patients had CSF analysis, of which one had albumino-cytological dissociation.

Course of neuropathy in hospital

Two patients were seen in the outpatient department. Their clinical course after initial assessment was therefore unclear. A modified Rankin scale (Broderick et al., 2017) in eight inpatients and MRC sum score (Turan et al., 2020) in three inpatients is described in Supplementary Table 3. Of the 11 inpatients in the cohort, six were static, three improved, and two worsened during the hospital stay.

Treatment

As part of treatment of Covid-19 disease, 12 patients each were treated with steroids and remdesivir, five patients received convalescent plasma, while two received methylene blue. The patient with a diagnosis of hemophagocytic lymphohistiocytosis received etoposide in addition to steroids and intravenous immunoglobulin (IV Ig). For the treatment of neuropathy, six of the 13 patients received IV Ig; two patients had better limb power at discharge, one patient died, there was no improvement in limb power in two patients, and one patient remains in ICU at the time of writing this report. The detailed clinical and electrophysiological features, progression of illness in admitted patients, and laboratory evaluation data and details are provided in Supplementary Tables 1 to 5.

Discussion

ANAC 19 has previously been reported through isolated case reports, small case series, and systematic reviews (Abu-Rumeileh et al., 2021; Sriwastava et al., 2021). AIDP, AMSAN, acute motor axonal neuropathy, Miller-Fisher syndrome, and other subtypes of GBS have been reported, with AIDP being the predominant electrophysiological manifestation (Abu-Rumeileh et al., 2021; Ghosh et al., 2020; Sriwastava et al., 2021). It is believed that this is the largest single-center case series of ANAC 19 reported to date.

Clinical features

The mean age of the Covid cohort (65.54±8.6 years) was much higher than the non-Covid cohort (46.63±22.1 years). The Covid cohort was from the first Covid wave in India when the elderly were more affected than the young (Jain et al., 2021). The age difference in the two groups may be a reflection of this fact. About 84% of the Covid patients in the cohort were diabetic compared with 25% in the non-Covid group, again probably reflecting the age difference in the two groups.

With respect to neuropathy onset, most of the patients in this cohort developed neurological symptoms within one month of onset of Covid-19, which is consistent with other studies (Sriwastava et al., 2021). Three patients had onset in the first week, suggesting a para-infectious process, while the rest had onset beyond one week, probably suggesting a post-infectious pathology.

Clinically, more than half the patients in the current cohort had paraparesis. The paraparetic variant is an uncommon form of GBS and constitutes about 5–10% of all GBS cases (Leonhard et al., 2019). However, paraparesis appears to be more common in ANAC 19. Previous authors have reported 17–37% of Covid-19-associated GBS patients as having paraparesis, depending on the electrophysiological subtype (Sriwastava et al., 2021). Paraparesis was the most common presentation seen in 61.54% of the current patients. This predilection for lower limb involvement in ANAC 19 warrants further evaluation.

Encephaloneuropathy was seen in >30% of patients in the current cohort. Associated encephalopathy may point towards a potential common factor causing central nervous system and peripheral nervous system involvement in Covid-19. However, all four patients with encephalopathy in this cohort had confounding factors [uncontrolled diabetes and uremia in four, history of hypoxia (SpO₂ <94%) in two, and hypernatremia (sodium 165 meq/L) in one], which may have contributed to the encephalopathy. Given that most sick patients with Covid-19 have such comorbidities, it may be difficult to establish beyond doubt that encephalopathy in Covid-19 is per se a viral/post-viral pathology and therefore must be interpreted with caution.

Electrophysiological features

Brighton criteria (Sejvar et al., 2011) have been historically used to ascertain the diagnostic certainty of GBS since 2011. However, Brighton criteria require CSF analysis for classification as level 1 of highest certainty. Previous authors have noted the difficulties in performing CSF analysis in the current pandemic scenario (Uncini et al., 2021). In this context, Umaphathi electrophysiological criteria were used (Umaphathi et al., 2019) to ascertain the probability of GBS. Around 30% had definite GBS and the remaining had probable GBS.

The majority of the patients in this cohort had demyelinating neuropathy. This is similar to non-Covid GBS, in which AIDP is the most common electrophysiological subtype (Dimachkie et al., 2013). The proportion of patients with demyelinating neuropathy (84.62%) in the current series is higher than previously reported Covid-19-associated GBS (Abu-Rumeileh et al., 2021; Sriwastava et al., 2021).

F-wave abnormalities were most the sensitive NCS parameters similar to non-Covid polyneuropathies (Sathya et al., 2017). Absent F waves were more frequently seen than prolonged F latencies. Absent F waves as a significant feature of Covid-19-associated AIDP has previously been noted (Uncini et al., 2021) and the current cohort showed similar results. The peroneal nerve was most frequently abnormal motor nerve, while sural SNAP amplitudes were the most frequently abnormal sensory parameters. A sural sparing

pattern typical of GBS was seen in 30.77% patients; all patients with sural sparing had demyelinating neuropathy.

Electrophysiological abnormalities were frequent in the upper limbs, even in the absence of clinical upper limb involvement. All the patients had at least one abnormal NCS parameter in at least one upper limb nerve. This indicates that all nine patients who clinically had only lower limb involvement had subclinical NCS abnormalities in the upper limbs as well.

Peroneal velocity sparing

Peroneal velocity sparing was defined for the first time and identified in six patients, all of whom had a demyelinating pattern. Peroneal velocity sparing indicates that the largest diameter fibers are relatively spared in the lower limb nerves compared with the upper limb. Sural sparing may actually be confounded by a tendency of upper limb nerves for entrapment neuropathy at the wrist (Umapathi et al., 2020). However, peroneal velocity sparing is free from such confounding factors as the forearm segments of upper limb nerves are less prone to entrapment. Therefore, peroneal velocity sparing may be a better marker for demyelinating neuropathy and definitely warrants further evaluation in a larger cohort of patients.

Possible role of coexisting confounders

The presence of diabetes in most of the Covid patients in this study may have confounded some of the electrophysiological findings. Subclinical NCS abnormalities are relatively common in diabetic patients (Akbar et al., 2000). Therefore, the possibility that the NCS abnormalities noted in the current patients were in fact caused by pre-existing diabetic neuropathy cannot be ruled out. However, the pattern of acute neurological symptoms in this cohort is unlikely to have been caused by diabetes. Also, axonopathy is more common than demyelinating pattern in diabetes (Bansal et al., 2006), which is contrary to the findings in the current cohort that showed a predominant demyelinating neuropathy.

Among the five patients who had critical Covid-19, four developed neuropathic symptoms during critical illness, while one developed symptoms after recovery from critical illness. Among these patients, one had axonal neuropathy, which is considered typical of critical illness neuropathy (Shepherd et al., 2017); the rest had demyelinating features on NCS. However, the absence of electromyography in the setting of critical illness remains a lacuna in the electro diagnosis of these patients.

Therefore, multiple factors may be at play in the genesis of ANAC 19. Possible pathogenetic mechanisms include direct viral infection of the nerves/roots, antibody-mediated post-viral peripheral nervous system inflammation akin to GBS, or cytokine-mediated nervous system dysfunction similar to critical illness neuropathy. It is also possible that coexisting diabetes may worsen or contribute to the overall neural damage.

It is believed that this is the largest single-center series of patients with ANAC 19. A detailed analysis of pattern and frequency of involvement of 77 motor and 77 sensory nerves was conducted at a single center with uniform criteria. This was a major strength of the study. While previous studies (Table 5) have focused on specific neuropathic illnesses such as AIDP (Uncini et al., 2021) or critical illness neuropathy (Frithof et al., 2021) associated with Covid-19, the current study is unique in that it includes a possible broad spectrum of ANAC 19. Also, Hadden criteria were applied at an individual nerve level for the studied nerves, which was lacking in the studies by Uncini et al. (Uncini et al., 2021) and Frithof et al. (Frithof et al., 2021). The retrospective nature of the study, small sample size, lack of CSF and imaging studies in many patients, and the large number of patients with diabetes remain limitations.

Table 5
Comparison of studies on Covid-19-related neuropathy.

	Uncini et al., 2021	Frithof et al., 2021	Current study
Covid cases	24	14	13
Controls	48	10	8
Neuropathy type	AIDP	CIN	ANAC 19
Mean age of cases (years)	NA	60.5±11	65.54±8.6
Diabetic cases	3	NA	11
Demyelinating cases	24/24	NA	11/13
Axonal cases	0/24	7/14	2/13

NA, Not available; AIDP, acute inflammatory demyelinating polyneuropathy; CIN, Critical illness neuropathy; ANAC 19, acute neuropathy associated with Covid-19

Conclusion

ANAC 19 should be a consideration in every patient with acute motor or sensory symptoms with definite or probable Covid-19 disease. It predominantly presents as a demyelinating neuropathy and less commonly as axonopathy, sharing many features of non-Covid GBS on electrophysiological studies. The higher proportion of patients with paraparesis and encephalopathy differentiate it from non-Covid acute neuropathy.

Author contributions

Dr S.D.Y was involved in the conception of the study, acquisition, analysis and interpretation of data, and drafting the manuscript. Dr V.K.C.K was involved in acquisition, analysis and interpretation of data, and drafting the manuscript.

Declaration of conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical approval

Given the retrospective nature of the study and the fact that it did not provide any personal information of the patients, no authorization to an Ethics Committee was asked.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.ijid.2021.07.066](https://doi.org/10.1016/j.ijid.2021.07.066).

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