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Electrophysiological Evaluation of Carpal Tunnel Syndrome in Patients with post-COVID Neuropathy

ALAM SM[1*], JANNAT M[2], HASAN M[3],SIDDIK SH[4]

Abstract:

Background: *The COVID-19 pandemic is caused by severe acute respiratory syndrome caused by coronavirus 2 (SARS-COV-2). Although the predominant clinical presentation is respiratory disease, neurological manifestations are increasingly recognised. The study aimed to evaluate the frequency of carpal tunnel syndrome among COVID-19 neuropathy patients and establish a causal link between carpal tunnel syndrome and COVID-19 infection. Electrophysiological evaluation of carpal tunnel syndrome can be used as a diagnostic as well as a prognostic marker so that patients can undergo an early therapeutic trial.* ***Objective:*** *The objective of this study was to see the frequency and electrophysiological pattern of post-COVID* ***carpal tunnel syndrome.*** ***Methods:*** *This cross-sectional observational study was undertaken in the Department of Neurology, BSMMU, Dhaka, Bangladesh. Non-randomized convenient purposive sampling was done to selected COVID neuropathy patients. A total of 44 patients were selected purposively. Study subjects were taken from confirmed cases of COVID-19 infection with symptoms of neuropathy admitted at the COVID unit and visited at COVID follow-up Clinic of BSMMU, Dhaka, after meeting inclusion and exclusion criteria from October 2020 to March 2022. Detailed history, physical examination findings, previous medical records, and investigation findings were recorded in the data 'sheet. An electrophysiological evaluation of neuropathy was done for each patient.* ***Results:*** *Out of 44 patients, most of the pathological forms of neuropathy were demyelinating (44.4%), followed by axonal (40.7%), and the rest were mixed (14.8%). We found polyneuropathy 14 (51.9%), carpal tunnel syndrome 7(25.9%), and 3(11.1%) mononeuropathy. Among 7 Carpal Tunnel Syndrome patients, we found four patients had unilateral (two right and two left), and three had bilateral involvement.* ***Conclusion:*** *Electrophysiologically we found various types of neuropathies among our patients. Carpal tunnel syndromes and related neuropathies appear to be possible sequelae of COVID-19 infection. So electrophysiological examination could be done for patients with symptomatic carpal tunnel syndrome after Covid 19 infection.*

Keywards: *CTS,carpal tunnel syndrome; COVID-19; electrophysiology; neuropathy.*

Introduction:

The Novel Coronavirus (COVID-19) outbreak originated from the Wuhan city, China in December 2019.[1] Since then the virus had spread to various countries across the globe including Bangladesh due to its ominously high rate of transmission. WHO had declared the illness as pandemic on March 11, 2020.[2] The identified virus is named as

1. Dr. SK. Mahbub Alam, MD, Associate Professor, Department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka- 1000
2. Dr. Maftahul Jannat, MD, Medical Officer, Department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka-1000
3. Dr. Mehedi Hasan, MD, Medical Officer, Department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka-1000
4. Dr.Sahariar Hossain Siddik,MBBS, Resident Neurology,Department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka- 1000

SARS-CoV-2 and the illness caused by the virus is named corona virus disease 2019 (COVID-19).

The primary manifestation of COVID-19 infection is pneumonia. Although the most common and important presentation is with respiratory disease, reports of neurological features are increasing involving both central nervous system and peripheral nervous system.

Among peripheral nervous system manifestations hypogeusia, hyposmia, neuralgia, Guillain Barre Syndrome along with other neuropathies, and skeletal muscle injury were found in different literature .[3]

The involvement of the nervous system can be due to a direct action of these viruses on the nervous tissue and/or to an indirect action through the activation of immune-mediated mechanisms[4,5]. Reactive arthritis after COVID-19 has been reported by different authors during the ongoing pandemic;[6-8] all the synovial fluid cultures and polymerase chain reactions proved negative, suggesting that it can be the result of a type III hypersensitivity reaction or of an autoimmune response involving cross-reactivity between SARS-CoV-2 antigens and synoviocytes, quite similar to what happens in seronegative rheumatoid arthritis, the well-known autoimmune disorder primarily affecting the synovial membrane.[9] Since carpal, cubital or tarsal tunnel syndrome is sometimes an accompanying event of rheumatoid arthritis[10-12], it is likely that a reactive arthritis after COVID-19 with irritation and thickening of the synovial sheaths may lead to a compression of the median, ulnar or tibial nerve inside the respective tunnels.

Here, we hypothesize that a peripheral microangiopathy involving nerve supply, a viral demyelination, or an immune-mediated irritating antigenic stimulus on synovial sheaths after SARS-CoV-2 infection may all induce a carpal, cubital or tarsal tunnel. syndrome of variable entity in genetically predisposed subjects associated with myxoid nerve degeneration.[12]

As the disease burden become increasing the present study was intended to see whether there is any positive electrophysiological findings and type of electrophysiological findings among symptomatic post COVID neuropathic patients including carpal tunnel syndrome. It will also help to develop strategies for early detection and provision of therapy for carpal tunnel syndrome and other neuropathies.

Methods:

This cross sectional observational study was conducted in COVID unit and COVID follow up clinic of BSMMU, Dhaka, Bangladesh, from October 2020 to March 2022 after obtaining ethical clearance IRB board of BSMMU. All confirmed cases of COVID 19 infection with symptoms of neuropathy admitted at COVID unit and visited at COVID follow up Clinic of BSMMU were taken as study population after taking informed written consent. Total 44 patients were selected purposively.

At first all COVID -19 patients who were admitted at COVID Unit or returned to the COVID follow up clinic of BSMMU were interrogated for any neuropathic symptoms. Those who had neuropathy clinically from the onset and those who developed neuropathy after recovery were selected for the study. Detailed clinical history and physical examination were done and patient were sent for Nerve conduction study. Nerve conduction study were done by Nihon Kohden machine in Neurology department of BSMMU. Normal referrence values for nerve conduction study was taken from text book of Electromyography and neuromuscular disorders by David C. Preston and Barbara E. Shapiro.[13] Necessary medical records were evaluated. The medical records demographic, neurological & other clinical and laboratory investigations and findings of nerve conduction study of the patients were recorded in the preformed data sheet.

At the end of data collection, all the data were rechecked, coded and entered in standard statistical software using SPSS. Qualitative data were expressed as frequency and percentage. The P value <0.05 will be considered statistically significant.

Results:

It was observed that mean age of the patients was 48.5±17.9 years with a range of 11 – 90 years. In this study majority of the patients were male and

male: female ratio was 1.8:1 Majority of the patients were service holder (47.7 %), among females majority were housewife 40.9% (Table -1).

Table-I

Sociodemographic characteristics of the study patients (n=44)

Variables	Number of patients	Percentage (%)
Age group (years)		
<40	15	34.1
41-60	17	38.6
>60	12	27.3
Mean±SD Range (min-max) (11 – 90) years	48.5±17.9	
Sex		
Male	28	63.6
Female	16	36.4
Male: female ratio	1.8:1	
Occupation		
Service holder	21	47.7
Business	3	6.8
Housewife	18	40.9
Others	2	4.5

It was found that common presentations were headache (45.5%),loss of taste (45.5%), loss of smell (43.2%) followed by peripheral neuropathy (40.9%). some patients had muscle wasting (18.2%) and dizziness (11.4%) as shown in diagram 1.

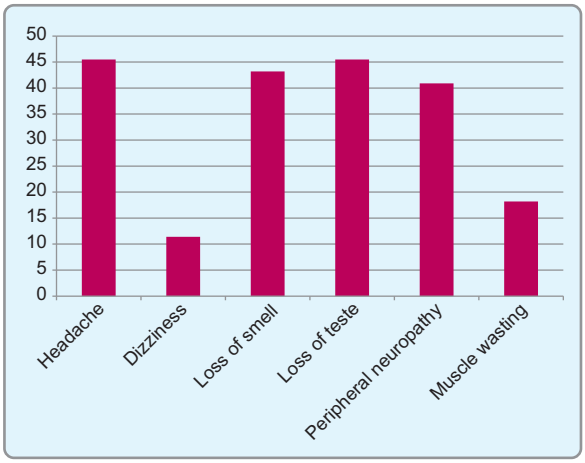

Fig.-1: *Distribution of the study patients by clinical presentation (n=44)*

In this study most of the neuropathies were mild 26 (59.1%), followed by moderate 12 (27.3%). Rest of the neuropathies 6 (13.6%) were severe.

Among all patients 17(38.6%) patients had normal electrophysiological findings and rest 27(61.4%) were abnormal.

Diagram-2: Pie chart showing distribution of the study patients according to pathophysiology of neuropathy (n=27)

In this study most of the pathological form of neuropathy were demyelinating (44.4%) followed by axonal (40.7%) and rest were mixed (14.8%) as shown in Pie chart.

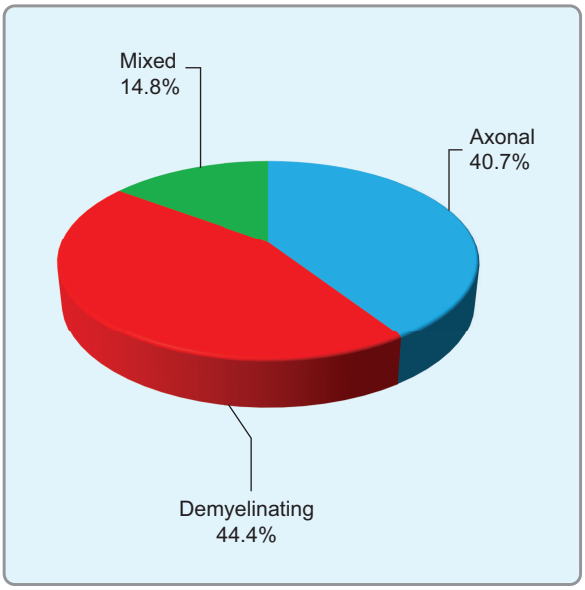

Fig.-2: *Distribution of study population according to pathophysiology of neuropathy*

In this study we found most of the patients 14 (51.9%) had polyneuropathy follwed by entrapment neuropathy 7(25.9%), mononeuropathy 3(11.1%) and multiple mononeuropathy 3 (11.1%).

In our study 4 (14.8 %) patients had pure motor neuropathy, 6 (22.2%) had pure sensory neuropathy and rest 17 (63%) had mixed sensory-motor neuropathy.

Table-II

Distribution of patients according to motor nerve distal latencies.

Distal latency (upper limbs)	Number of patients	Percentage (%)	Distal latency (lower limbs)	Number of patients	Percentage (%)
Median, left			Peroneal, left		
Normal (≤4.4)	24	54.5	Normal (≤6.5)	24	54.5
Prolonged (>4.4)	6	13.6	Prolonged (>6.5)	3	6.8
Absent	14	31.8	Absent	17	38.6
Median, right			Peroneal, right		
Normal (≤4.4)	27	61.4	Normal (d”6.5)	21	47.7
Prolonged (>4.4)	6	13.6	Prolonged (>6.5)	1	2.3
Absent	11	25.0	Absent	22	50.0
Ulnar, left			Tibial ,left		
Normal (≤3.3)	27	61.4	Normal (≤6.7)	2	4.5
Prolonged (>3.3)	3	6.8	Prolonged (>6.7)	25	56.8
Absent	14	31.8	Absent	17	38.6
Ulnar, right			Tibial ,right		
Normal (≤3.3)	3	6.8	Normal (≤6.7)	1	2.3
Prolonged (>3.3)	30	68.2	Prolonged (>6.7)	20	45.5
Absent	11	25.0	Absent	23	52.3

Table-III

Distribution of patients according to motor nerve conduction velocities.

Conduction velocity (upper limbs)	Number of patients	Percentage (%)	Conduction velocity (lower limbs)	Number of patients	Percentage (%)
Median, Left			Peroneal, left		
Normal (≥49.0)	28	63.6	Normal(≥44)	15	34.1
Decreased (<49.0)	2	4.5	Decresed(<44)	12	27.3
Absent	14	31.8	Absent	17	38.6
Median,right			Peroneal, right		
Normal (≥49.0)	27	61.4	Normal(≥44)	14	31.8
Decreased (<49.0)	6	13.6	Decresed(<44)	8	18.2
Absent	11	25.0	Absent	22	50.0
Ulnar, left			Tibial ,left		
Normal (≥49.0)	29	65.9	Normal(≥41)	17	38.6
Decreased (<49.0)	1	2.3	Decresed(<41)	10	22.7
Absent	14	31.8	Absent	17	38.6
Ulnar, right			Tibial ,right		
Normal (≥49.0)	30	68.2	Normal(≥41)	13	29.5
Decreased (<49.0)	3	6.8	Decresed(<41)	8	18.2
Absent	11	25.0	Absent	23	52.3

Table-IV

Distribution of patients according to motor nerve amplitude (CMAP)

CMAPs (upper limbs)	Number of patients	Percentage (%)	CMAPs (lower limbs)	Number of patients	Percentage (%)
Median, left			Peroneal, left		
Normal (≥4.0)	27	61.4	Normal ≥2	25	56.8
Decreased (<4.0)	3	6.8	Decreased <2	2	4.5
Absent	14	31.8	Absent	17	38.6
Median, right			Peroneal, right		
Normal (≥4.0)	1	2.3	Normal ≥2	2	4.5
Decreased (<4.0)	32	72.7	Decreased <2	20	45.5
Absent	11	25.0	Absent	22	50.0
Ulnar, left			Tibial ,left		
Normal (≥6.0)	25	56.8	Normal ≥4	27	61.4
Decreased (<6.0)	5	11.4	Decreased <4	0	0.0
Absent	14	31.8	Absent	17	38.6
Ulnar, right			Tibial ,right		
Normal (≥6.0)	29	65.9	Normal ≥4	21	47.7
Decreased (<6.0)	4	9.1	Decreased <4	0	0.0
Absent	11	25.0	Absent	23	52.3

Table-V

Distribution of the study patients by F-wave study of upper limbs

F-wave study (left)	Number of patients	Percentage (%)	F-wave study (right)	Number of patients	Percentage (%)
Normal ≤31	26	59.1	Normal ≤31	24	54.5
Prologed>31	1	2.3	Prologed>31	8	18.2
Absent	17	38.6	Absent	12	27.3

Table-VI

Distribution of patients according to sensory nerve distal latencies

Distal latency	Number of patients	Percentage (%)	Distal latency	Number of patients	Percentage (%)
Median, left			Median, right		
Normal ≤3.5	30	68.2	Normal ≤3.5	28	63.6
Prologed>3.5	3	6.8	Prologed>3.5	6	13.6
Absent	11	25.0	Absent	10	22.7
Ulnar, left			Ulnar, right		
Normal ≤3.1	31	70.5	Normal ≤3.1	34	77.3
Prolonged>3.1	2	4.5	Prolonged>3.1	0	0.0
Absent	11	25.0	Absent	10	22.7
Sural (left)			Sural (right)		
Normal ≤4.4	30	68.2	Normal ≤4.4	22	50.0
Prolonged>4.4	0	0.0	Prolonged>4.4	1	2.3
Absent	14	31.8	Absent	21	47.7

Table-VII

Distribution of patients according to sensory nerve conduction velocity

Conduction velocity	Number of patients	Percentage (%)	Conduction velocity	Number of patients	Percentage (%)
Median, left			Median, right		
Normale”50	22	50.0	Normal ≥50	18	40.9
Reduced<50	11	25.0	Reduced<50	16	36.4
Absent	11	25.0	Absent	10	22.7
Ulnar, left			Ulnar, right		
Normale”50	19	43.2	Normal ≥50	27	61.4
Reduced<50	14	31.8	Reduced<50	7	15.9
Absent	11	25.0	Absent	10	22.7
Sural (left)			Sural (right)		
Normale”40	27	61.4	Normal ≥40	22	50.0
Reduced<40	3	6.8	Reduced<40	1	2.3
Absent	14	31.8	Absent	21	47.7

Table-VIII

Distribution of patients according to sensory nerve amplitude (SNAP)

SNAP	Number of patients	Percentage (%)	SNAP	Number of patients	Percentage (%)
Median, left			Median, right		
Normal ≥20	26	59.1	Normal ≥20	23	52.3
Reduced<20	7	15.9	Reduced<20	11	25.0
Absent	11	25.0	Absent	10	22.7
Ulnar, left			Ulnar, right		
Normal ≥17	27	61.4	Normal ≥17	28	63.6
Reduced<17	6	13.6	Reduced<17	6	13.6
Absent	11	25.0	Absent	10	22.7
Sural (left)			Sural (right)		
Normal ≥6	28	63.6	Normal ≥6	22	50.0
Reduced<6	2	4.5	Reduced<6	1	2.3
Absent	14	31.8	Absent	21	47.7

Table-IX

Distribution of the study patients according to clinical and electrophysiological diagnosis

According to clinical diagnosis		
GBS		
AMAN	1	3.7
AIDP	1	3.7
Carpal tunnel syndrome		
Right	2	7.4
Left	2	7.4
Both	3	11.1
Critical illness neuropathy	2	7.4
Sensory neuropathy	6	22.2
Polyneuropathy (sensory, motor)	11	40.7

Discussion:

This was a cross sectional descriptive study carried out on patient who admitted in COVID unit and came in COVID follow up clinic of BSMMU, Dhaka, Bangladesh. In this study majority of the respondents 17 (38.6%) were belonging to age group 41-60 years. The mean age of the patients was 48.5±17.9 years with a range of 11 – 90 years. In this study majority of the patients were male and male: female ratio was 1.8:1. In another study done by Oaklander. A. L et al reported that participant's mean ages were averaged 43.3 ± 3.3 years, and among them 68.8% were female.[14] Our study has almost similar mean age but we found higher percentage of male patients 63.6%(28). In another study done by Ftiha et al documented that 36.4% of patients of their study group had peripheral neuropathy after COVID-19 infection.[15] In our study we also have almost similar findings of peripheral neuropathy (40.9%). In this study we found most of the neuropathies were mild (59.1%), followed by moderate (27.3%) and rest of the neuropathies (13.6%) were severe according to Neuropathy Disability Score (NDS).[16] In a previous study done by Yan et all reported that 56.3% of post-COVID-19 patients had neuromuscular affection.[17] In our electrophysiological study we found 12(44.4%) patients had demyelinating neuropathy, 11(40.7%) had axonal neuropathy and mixed neuropathy in 4(14.80%) of cases.

Carpal Tunnel Syndrome was found in 7 patients, among them 4 patients had unilateral and 3 patients had bilateral involvement. In one previous study Lica Roncati et al found that there is a causal link of Carpal Tunnel Syndrome (CTS) with COVID - 19 infection.[12]

Conclusion:

Though COVID-19 primarily affects the respiratory and cardiovascular systems, neurological involvement is not very uncommon. Some patients suffered from neurological complications without severe illness. Electrophysiologically we found various types of neuropathies among our patients. Carpal tunnel syndromes and related neuropathies appear to be possible sequelae of COVID-19 infection. So electrophysiological examination could be done for patients with symptomatic carpal tunnel syndrome after Covid 19 infection.

Ethical issues : All patients gave informed written consent and study was approved by Institutional Review Board of Bangabandhu Sheikh Mujib Medical University.

Disclosure: The authors reports no disclosures.

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References:

1. Zhu N., Dingyu Z., Wenling W., Xingwang L., Bo Y., Jingdong S., Xiang Z., Baoying H., Weifeng S., Roujian L., Peihua N, FaxianZ., Xuejun M., Dayan W., Wenbo X., Guizhen W., George FG., Wenjie T. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020; 382(8):727–33. https://doi.org/10.1056/NEJMoa2001017.
2. WHO Director-General's opening remarks at the media briefing on COVID-19 – 11 March 2020. 11 March 2020. Available at https://www.who.int/dg/ speeches/detail/who-director-general-s-opening-remarks-at-the-mediabriefing-on-covid-19—11-march-2020 (accessed 22nd April 2020).
3. Ahmed I, Rathore FA. Neurological Manifestations and complications of COVID-19: A literature review. Journal of clinical Neuroscience. 2020: 77(2020) :8-12
4. Al-Obaidi MMJ, Bahadoran A, Wang SM, Manikam R, Raju CS, Sekaran SD. Disruption of the blood brain barrier is vital property of neurotropic viral infection of the central nervous system. ActaVirol. 2018; 62(1): 16–27.
5. Wu Y, Xu X, Chen Z, Duan J, Hashimoto K, Yang L, et al. Nervous system involvement after infection with COVID-19 and other

coronaviruses. Brain Behav Immun. 2020 Mar 30; S0889-1591(20)30357-3.

6. . Saricaoglu E.M., Hasanoglu I., Guner R. The first reactive arthritis case associated with COVID-19. *J Med Virol.* 2021;93(1):192–193. [PMC free article] [PubMed] [Google Scholar]
7. Hønge B.L., Hermansen M.F., Storgaard M. Reactive arthritis after COVID-19. *BMJ Case Rep.* 2021;14(3) [PMC free article] [PubMed] [Google Scholar]
8. Gasparotto M., Framba V., Piovella C., Doria A., et al. Post-COVID-19 arthritis: a case report and literature review. *Clin Rheumatol.* 2021 doi: 10.1007/s10067-020-05550-1. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
9. Herbison G.J., Teng C., Martin J.H., Ditunno J.F., Jr. Carpal tunnel syndrome in rheumatoid arthritis. *Am J Phys Med.* 1973;52(2):68–74. [PubMed] [Google Scholar]
10. Balagtas-Balmaseda O.M., Grabois M., Balmaseda P.F., Lidsky M.D. Cubital tunnel syndrome in rheumatoid arthritis. *Arch Phys Med Rehabil.* 1983;64(4):163–166. [PubMed] [Google Scholar]
11. Grabois M., Puentes J., Lidsky M. Tarsal tunnel syndrome in rheumatoid arthritis. *Arch Phys Med Rehabil.* 1981;62(8):401–403. [PubMed] [Google Scholar]
12. Roncati L, Gianotti G, Gravina D, Attolini G, Zanelli G, Della Rosa N, Adani R. Carpal, cubital or tarsal tunnel syndrome after SARS-CoV-2 infection: A causal link?. Medical Hypotheses. 2021 Aug 1;153:110638.
13. David C. Preston, Barbara E. Shapiro. Electromyography and neuromuscular disorders. 4th edition, Elsevier,2020.
14. Anne Louise Oaklander, Alexander J. Mills, Mary Kelley, Lisa S. Toran, Bryan Smith, Marinos C. Dalakas, Avindra Nath Neurol Neuroimmunol Neuroinflamm May 2022, 9 (3) e1146; DOI: 10.1212/NXI.0000000000001146
15. Ftiha F, Shalom M, Jradeh H. Neurological symptoms due to coronavirus disease 2019. *Neurol Int*. 2020; **12**(1): 8639
16. Lamia Afifi[1], Ahmed M Abdelalim *MD* [2], Amal S Ashour[2], Aussan Al-Athwari. Severity of neuropathy was done according to Neuropathy Disability Score (NDS) Correlation between clinical neuropathy scores and nerve conduction studies in patients with diabetic peripheral neuropathy.
17. Yan C.H., Faraji F., Prajapati D.P., Boone C.E., DeConde A.S. Association of chemosensory dysfunction and Covid-19 in patients presenting with influenza-like symptoms. *Int Forum Allergy Rhinol.* 2020 doi: 10.1002/alr.22579. [PMC free article] [PubMed] [CrossRef] [Google Scholar]tients from a single center using an internet based cross sectional survey [28].