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Case Report

Ulnar Nerve Palsy as COVID-19 Sequelae in 3 Patients

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The pathophysiology and treatment of COVID-19 have been at the forefront of medical research this past year. While great strides have been made in our knowledge of the disease, there is still much that is unknown. More than one-third of patients with COVID-19 present with symptoms involving the nervous system. The reason for this is unclear, although several theories have been postulated. In this case study, we present 3 patients with severe ulnar nerve dysfunction following treatment for COVID-19 in the intensive care unit. We discuss reasons why this may have occurred, the etiology of which is likely multifactorial. We are reporting these cases to inform and alert physicians to the possibility of ulnar nerve involvement in the presentation of patients with COVID-19.

COVID-19, caused by SARS-CoV-2, causes symptoms of fever, shortness of breath, headache, anosmia, ageusia, cough, myalgia, and diarrhea in those affected. The spread of cases increased exponentially over the past months, and COVID-19 was declared as a pandemic by the World Health Organization in March of 2020. COVID-19 causes neurological symptoms in over one-third of patients.[1] These can be subdivided into 2 types: central nervous system manifestations (dizziness, headache, and ataxia) and peripheral nervous system manifestations (anosmia and ageusia). The extension of COVID-19's effects to the field of hand surgery remains to be seen. Thus far, there have been reports of thrombotic complications leading to radial artery occlusion and digital ischemia.[2,3] We describe 3 patients who presented to our clinic with ulnar nerve palsy following COVID-19 treatment in the intensive care unit (ICU). We postulate reasons for this occurrence and the implications of each. Written informed consent was obtained from each patient for the publication of this case report.

Case Report

Patient A

A 65-year-old female retired respiratory therapist with a history of obstructive sleep apnea, hypertension, and obesity presented with a 1-week history of shortness of breath, fever, and cough. SARS-CoV-2 polymerase chain reaction test was positive. She was initially hypoxic to 92% on room air. She was started on supplemental oxygen and hydroxychloroquine. She was intubated 2 days later because of worsening hypoxia. She was placed in a prone position on the ventilator for a 24-hour period 3 days later. She was ultimately intubated in the ICU for 41 days. During this time, norepinephrine bitartrate was intermittently necessary to maintain her blood pressure. Two weeks after intubation, the patient was diagnosed with acute tubular necrosis and treated with furosemide diuresis. As sedation was weaned, she demonstrated symptoms of metabolic encephalopathy for approximately 5 days. The patient's first complaint of right hand discomfort was reported 5 weeks after the onset of COVID-19 symptoms. Pulmonology initiated a trial of gabapentin. She was hospitalized for 60 days total, at which point she was discharged to a long-term acute care facility, and the patient was weaned from the ventilator 10 days later.

Upon evaluation by a hand surgeon, the patient reported 7/10 burning pain and numbness in the ring and small fingers. The patient's right hand felt clumsy and weak. She had a positive ulnar nerve Tinel sign at the elbow, positive ulnar nerve compression test, and positive Tinel sign at Guyon's canal. The patient's median

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nerve examination was normal. There was associated clawing of the middle, ring, and small fingers. She was unable to make a fist, fully extend her fingers, or cross her fingers. The 2-point discrimination in the median nerve distribution was 7 mm and that in the ulnar nerve distribution was >15 mm. Electrodiagnostic studies revealed severe right ulnar neuropathy localized to the elbow, with evidence of axon loss and mild bilateral carpal tunnel syndrome. The patient underwent ulnar nerve decompression at Guyon's canal and the cubital tunnel with submuscular transposition. Given the patient's advanced disease and positive Tinel sign at Guyon's canal, submuscular transposition and Guyon canal release were performed to address the ulnar nerve as definitively as possible in 1 procedure. Intraoperatively, the flexor carpi ulnaris appeared atrophied and pale compared with surrounding musculature. She was sent to therapy after surgery. The patient reported 80% improvement in strength and numbness 1 year after surgery, with a slight claw deformity.

Patient B

A 61-year-old male retired postal service worker with a history of hypertension, idiopathic cardiomyopathy, and gout presented with a 2-week history of shortness of breath, fevers, chills, and cough. SARS-CoV-2 polymerase chain reaction test was positive. He was diagnosed with pneumonia and started on nasal cannula oxygen, as well as hydroxychloroquine, ceftriaxone, and doxycycline. He was intubated the following day. While intubated, the patient was treated for acute kidney injury and transaminitis. Norepinephrine bitartrate was intermittently necessary to maintain his blood pressure. He remained intubated for 2 weeks. At the time of extubation, the patient experienced encephalopathic symptoms for a 2-week period. Head computed tomography scan was normal. Three days after discharge from the hospital, he presented with bilateral hand pain and was referred to hand surgery.

At the initial evaluation, he complained of weakness, stiffness, sharp pain, and numbness in the ring and small fingers bilaterally. He had a positive ulnar nerve Tinel sign at the elbow and a positive ulnar nerve compression test. There was associated clawing of the middle, ring, and small fingers. He was unable to make a fist, fully extend his fingers, or cross his fingers. He had atrophy of the first dorsal interossei. The patient's median nerve examination consisted of a positive Tinel sign at the carpal tunnel and a positive Phalen test. The 2-point discrimination in the median nerve distribution was 5 mm and that in the ulnar nerve distribution was 15 mm. Electrodiagnostic studies revealed severe ulnar neuropathy at the elbow, with right worse than left, and moderate right carpal tunnel syndrome. The patient underwent right cubital tunnel release with submuscular transposition and right carpal tunnel release. Submuscular transposition was performed to address the ulnar nerve as definitively as possible in 1 procedure, given the patient's advanced disease. The ulnar nerve was noted to be adherent to the floor of the cubital tunnel, possibly a consequence of ischemic fibrosis. He was sent to therapy after surgery. The patient reported a 75% improvement in strength and complete resolution of numbness 1 year after surgery.

Patient C

A 55-year-old male judge with a history of hypertension and obesity presented with 6 days of fever, shortness of breath, vomiting, myalgia, and anosmia. He was hypoxic to 83% and was started on nasal cannula oxygen, remdesivir, and dexamethasone. SARS-CoV-2 polymerase chain reaction test was positive. He was intubated on day 3 because of worsening hypoxia. He was placed prone on 4 separate occasions for 16-hour periods over the next 2 weeks. He had several episodes of hematochezia on day 12 because of an actively bleeding branch of the inferior mesenteric artery with the suspected etiology of diverticulosis, which was ultimately embolized with coils. He received transfusions with packed red blood cells. Norepinephrine bitartrate was intermittently necessary to maintain his blood pressure. He was extubated on hospital day 28 and transitioned to a high-flow nasal cannula. After extubation, he was diagnosed with encephalopathy; he was unresponsive to commands and was nonverbal for a 5-day period. He was discharged to an inpatient rehabilitation center on day 35. At this facility, bilateral common peroneal neuropathy with foot drop and bilateral hand numbness and weakness were first documented. Sacral decubitus ulcers were noted and treated by wound care. He was discharged on day 61.

Upon evaluation by a hand surgeon, he had complaints of numbness in the right ring and small fingers. He had a positive ulnar nerve Tinel sign at the elbow, positive ulnar nerve compression test, and positive Tinel sign at Guyon's canal. The patient's median nerve examination was normal. There was associated clawing of the middle, ring, and small fingers. He was unable to make a fist, fully extend his fingers, or cross his fingers. The 2-point discrimination in the median nerve distribution was <5 mm and that in the ulnar nerve distribution was >15 mm. Electrodiagnostic studies revealed severe right-sided ulnar neuropathy with moderate carpal tunnel. He underwent ulnar nerve decompression at Guyon's canal and at the cubital tunnel with submuscular transposition. He had complete resolution of ulnar nerve symptoms 6 months after surgery.

Discussion

All patients were intubated and sedated in the ICU, and all presented with encephalopathic symptoms on extubation. Two of the 3 patients were positioned prone on ventilator support, the first patient for one 24-hour block and the second patient for several 16-hour blocks. The reason for ulnar nerve palsy in these patients is unclear and likely multifactorial. Factors that could have played a role include, but are not limited to patient positioning, the thrombogenic nature of COVID-19, a direct effect of COVID-19 on the peripheral nervous system, and an immune-mediated injury.

Patient positioning while intubated, either supine or prone, may contribute to ulnar nerve palsy. In the landmark PROne positioning in SEVere Acute respiratory distress syndrome (PROSEVA) study, prone positioning resulted in decreased 28-day and 90-day mortality rates in patients with severe acute respiratory distress syndrome.[4] Proning promotes better matching of pulmonary perfusion to ventilation and recruitment of dependent areas of the lung. There is increased pressure on the ulnar nerve at the cubital tunnel with elbow flexion beyond 90°, forearm pronation, and shoulder abduction beyond 90° while patients are prone.[5] It is critical to avoid these positions in patients that are intubated and sedated for prolonged periods of time. The increased pressure and stretch on the nerve can cause local ischemia and lead to sustained axonal damage if prolonged. Peripheral nerve studies in animal models demonstrate that reperfusion injury after prolonged ischemia results in endoneurial edema, conduction block, blood-nerve barrier disruption, and demyelination.[6] With the standard prone position, the head is positioned in neutral on foam padding; the shoulders are abducted <90°, the elbows are flexed <90°, and the forearm is positioned in neutral at or below the level of the mattress. Soft foam padding is placed under the elbows and at the inner aspect of the upper arm.

The authors could not find a study in the literature documenting a patient with isolated ulnar nerve palsy after an ICU stay, potentially because of the rarity of this occurrence. A prospective study

revealed that 0.2% (2/986) of patients develop new-onset ulnar neuropathy when admitted to internal medicine services. In comparison, the incidence of postoperative ulnar nerve palsy in patients proned during spine surgery is 0.5%.[7] Based on the findings of this study, it is vitally important that ICU physicians and nurses be well-educated on the importance of arm positioning when proning patients with COVID-19.

COVID-19 is a systemic disease that primarily injures the vascular endothelium. COVID-19 activates the coagulation cascade, causing widespread micro- and macrothrombosis. Over time, unchecked viral disease incites inflammation and edema, promoting generalized thrombogenesis with systemic organ dysfunction. Venous and arterial thrombotic events occur in approximately 31% of patients with COVID-19 in the ICU.[8] It is possible that this could have resulted in decreased perfusion to the ulnar nerve, increasing the risk of ulnar nerve dysfunction. There have been reports in the literature of arterial and venous thrombotic events resulting in neuropathic symptoms such as hypothenar hammer syndrome causing ulnar artery thrombosis and subsequent ulnar nerve dysfunction at Guyon's canal.

Numerous case reports have been published this year describing patients with peripheral nervous system dysfunction associated with COVID-19. In mild/moderate cases of COVID-19, 86% have olfactory dysfunction, and 88% have gustatory dysfunction. There have been reports of cranial nerve I, III, IV, VI, VII, and XII palsies in patients with COVID-19.[9] There is also an association with Guillain-Barré syndrome, an acute inflammatory demyelinating peripheral polyneuropathy.[10] SARS-CoV-2 enters cells via angiotensin-converting enzyme 2 receptors, which are present in the lungs, arteries, heart, kidney, intestines, and nervous system. It remains unclear whether COVID-19's effect on the peripheral nervous system is because of direct viral neurotropism, immune-mediated injury from proinflammatory cytokines, or the thrombotic nature of the disease.

This case report suggests an association between ulnar nerve palsy and COVID-19. More cases are required to support causality. We are reporting this case to inform and alert physicians to the possibility of ulnar nerve involvement in the presentation of patients with COVID-19.

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