COVID-19 and Acute Cervical Spinal Cord Injury—Case Report of 2 Patients

Do We Need to Rethink Our Standard Treatment Strategy?

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Study Design: This was a case series.

Objective: The authors sought to examine the high-risk population of COVID-positive patients with acute cervical spinal cord injury (SCI) in a large level 1 trauma and tertiary referral center.

Summary of Background Data: There are limited studies regarding the surgical management of patients with acute SCI in the setting of the recent coronavirus pandemic.

Methods: The authors describe the cases of 2 patients who died from COVID-related complications after acute cervical SCI.

Results: Patients with SCI are at increased risk of pulmonary complications. COVID-19 infection represents a double hit in this patient population, increasing potential morbidity and mortality in the perioperative time frame. Careful consideration must be made regarding the timing of potential surgical intervention in the treatment of acute SCI.

Conclusions: Nationwide database of COVID-positive patients with acute spinal cord injury should be collected and analyzed to better understand how to manage acute SCI in the COVID-19 era. The authors recommend preoperative discussion in patients with acute cervical SCI with COVID-19, specifically emphasizing the increased risk of respiratory complications and mortality.

Key Words: COVID-19, spine, spinal cord injury, SCI

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Coronavirus disease 2019 (COVID-19) dramatically altered the standard of care across all specialties and settings; in particular, urgent and emergent surgery have become topics of debate.[1] Institutions have developed algorithms to prevent nosocomial infection of providers, preserve scarce personal protective equipment, and categorize and prioritize different types of surgery.[2–4] When surgery cannot be postponed to mitigate the risk associated with COVID-19, guidelines suggest that urgent and emergent surgical procedures be performed with multidisciplinary perioperative management, appropriate personal protective equipment, and regional anesthesia when appropriate.[5] Universal testing for surgical admissions has been implemented in many institutions, and a large proportion of COVID-positive patients present without symptoms.[6]

Acute spinal cord injury (SCI) often necessitates urgent or emergent operative intervention to mitigate devastating neurological consequences.[7] The most common cause of death in patients with COVID-19 is acute respiratory distress syndrome (ARDS) secondary to severe pneumonia with pulmonary infiltration and severe hypoxemia.[8] Acute cervical SCI can cause weakness or paralysis of the respiratory and trunk muscles so that a concurrent COVID-19 infection may exacerbate an already weakened pulmonary system and reduced vital capacity. Despite this, little has been reported regarding COVID-positive patients with acute cervical spinal cord injuries.[9]

While guidelines exist regarding the implementation of urgent or emergent surgery and even the triaging of spine surgery in the COVID-19 era, few, if any, studies address how a positive COVID-19 test impacts surgical timing and decision making for patients with acute cervical SCI.[2] The traditional dogma of surgical decompression for cervical SCI within 24 hours may need to be re-examined in the setting of a new pandemic.[7] We present 2 patients with acute cervical SCI who presented without COVID-19 but tested COVID-positive and died shortly after urgent spinal decompression surgery from COVID-related respiratory complications.

MATERIALS AND METHODS

Two patients were included in the case reports. We reviewed their chart for relevant information, which we include in the narrative section. This report was written following the CARE checklist for reporting information in a case report.[10] The cases described contain no more than minimal identifiable health information. The institutional review board reviewed the study and considered it exempt.

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CASE PRESENTATION/RESULTS

Case #1

A 57-year-old man presented to the emergency department after diving 50 feet off a cliff into a deep lake. He did not contact the bottom or impact with any solid surface but did reportedly impact the water feet first with feet and legs flexing forward, causing him to strike his head on the surface of the water. His primary survey was intact, but on the secondary survey, the patient had an absent rectal tone and no motor function or sensation to the bilateral lower extremities. He had bilateral upper extremity paresthesias and absent bilateral hand intrinsic and finger flexor motor function. Per hospital protocol at the time, the patient was screened for signs or symptoms of COVID. He screened negative and thus was not immediately tested for COVID-19. Chest x-ray and chest computed tomography (CT) revealed no abnormalities indicative of COVID infection or acute intrathoracic trauma.

CT reformat scans of the cervical, thoracic, and lumbar spine were negative for any acute fractures or abnormalities, but magnetic resonance imaging revealed a large cervical disk herniation at the C5/C6 level with caudal extension causing central stenosis with edema within the compressed cord at the same level. Per hospital protocol at the time, a COVID test was sent for preoperative and admission clearance, which resulted positive, so the patient was admitted to a designated COVID intensive care unit (ICU). He was placed in a rigid cervical orthosis with spine precautions, and mean arterial pressure was maintained at >85 mm Hg.

On hospital day 2, per hospital protocol at the time, the patient was intubated in the COVID trauma ICU without complication before transport to the operating room. The patient underwent anterior cervical discectomy and fusion at levels C5/C6 and C6/C7. He remained intubated postoperatively and was transferred back to the ICU. On the morning of hospital day 3, he was alert and oriented off propofol sedation. However, he was noted to have right lower lobe atelectasis, and ventilator settings had to be increased. That evening, he became febrile, received empiric broad-spectrum antibiotics, and bronchoalveolar lavage was obtained. He remained intubated on hospital day 4 with zero change in the motor examination with continued absent perianal sensation and voluntary anal contraction. His SCI was determined to be C5 AIS A. He developed hypotension and fevers to 106-degree Fahrenheit; the therapeutic hypothermia team was consulted, antibiotics were broadened to include antifungals, and a repeat bronchoalveolar lavage sent. On hospital day 5, he became progressively more hypoxic and was transferred to a separate, designated medical COVID ICU for ARDS. There he was placed in a prone position intermittently, started on remdesivir, treated with broad-spectrum intravenous antibiotics, and found to have a nonocclusive deep venous thrombosis in his right common femoral vein. The patient declined precipitously during the admission and developed polymicrobial pneumonia with septic shock, acute kidney injury requiring continuous renal replacement therapy, transaminitis, pulmonary emboli, refractory hypotension, and acidosis with multisystem organ failure. On hospital day 19, the patient developed asystole secondary to severe acidemia; advanced cardiac life support was initiated and return of spontaneous circulation achieved. The family was contacted as the patient became pulseless again. Resuscitative efforts were ceased at the family's request and the patient expired.

Case #2

A 64-year-old man presented to the emergency department after a motor vehicle collision. He had multiple traumatic injuries, including scalp and forehead lacerations, right hemopneumothorax treated with a chest tube, splenic laceration, rib fractures 3–7, and retroperitoneal hematoma. The orthopedic spine service was consulted for a type III odontoid fracture, a C7 vertebral body fracture with bilateral pedicle extension, and acute bilateral upper extremity greater than lower extremity weakness and bilateral upper extremity pain presumed secondary to central cord syndrome. Magnetic resonance imaging of the cervical spine showed C3/C4 and C4/C5 disk osteophyte complexes, causing severe central canal stenosis. The odontoid fracture was managed nonoperatively in a rigid cervical orthosis as the surgical intervention was planned for the C7 vertebral body fracture.

As in case 1, per hospital protocol, the patient screened negative on the questionnaire, was asymptomatic for cough, fever, or shortness of breath, and tested negative on admission for COVID-19. However, the patient was intubated on hospital day 2 after he developed respiratory distress. He underwent posterior spinal instrumentation and fusion from C2–T2 with laminectomies C3–C7 that same day. On hospital day 4, a second chest tube was placed, and the patient remained intubated and sedated with continued respiratory issues. On hospital day 7, the patient became febrile and a repeat COVID test was positive; the patient was transferred to the designated medical COVID ICU. He developed polymicrobial pneumonia and COVID-associated pneumonia. Despite medical management with broad-spectrum antibiotics and pressor and ventilator support, his renal function worsened and his ventilator settings continued to increase. He was palliatively extubated on hospital day 15 after ongoing family goals of care discussions.

DISCUSSION

A flurry of recent studies address urgent and emergent surgery during the COVID-19 pandemic, but to our knowledge, studies examining how COVID-19 impacts patients with acute cervical SCI are thus far limited to case reports.[9] We present 2 cases to share our institution's recent experience. Patient 1 presented asymptomatically but tested positive for COVID-19 and developed significant respiratory distress after emergent decompressive surgery. Patient 2 also presented without COVID symptoms but experienced pulmonary decline shortly after admission prompting intubation and urgent surgical decompression. He later tested positive. It is possible his initial test was a false negative or that he contracted the nosocomial illness shortly after admission as the average incubation time for COVID-19 is thought to be 5 days.[11] In both cases, the patients expired likely because of COVID-related complications, thus raising the question of how to best manage these patients with acute SCI.

While few studies have examined the role of COVID in acute spine trauma, the early reported outcomes of orthopedic trauma surgery in COVID-positive patients have been dismal thus far and portend poorly for patients with spine trauma. An early study from New York showed that inpatient mortality is significantly increased (56% vs. 4%) for COVID-positive patients with acute hip fractures.[12] A national multicentre study in the United Kingdom showed that COVID-19 was independently associated with an increased 30-day mortality rate in patients with hip fractures.[13] While hip fractures have been studied more because of their markedly increased

incidence compared with acute spine trauma, there remains concern that these poor outcomes will translate to spine trauma given the similarity in these patient populations with regard to decreased respiratory function and reserve.

It is well known that respiratory dysfunction, including decreased vital capacity and weakened muscles of expiration, is a major cause of morbidity and mortality in SCI and leads to an increased susceptibility to pulmonary infection, ARDS, and death.[14,15] COVID-19 disease primarily affects the pulmonary system, so its additional presence in patients with SCI represents a significant challenge for respiratory management. Recent studies have begun to examine COVID-positive patients with chronic SCI and even recommended creating a database of patients with SCI affected by COVID-19.[16,17] The diagnosis of COVID-19 may be delayed in patients with SCI because they often do not present with the typical symptoms of fever (because of thermoregulatory dysfunction), cough, and shortness of breath but rather with hypoxia, tachypnea, and worsened ability to clear secretions.[18] Both of our patients with acute SCI and COVID-19 also presented without traditional symptoms but quickly developed respiratory distress. However, this may better be explained by the findings of a retrospective study of orthopedic patients that showed that of the 12.1% of patients who tested positive for COVID-19, 58.3% were asymptomatic at presentation.[6] Patients with acute SCI and COVID-19 infection require increased scrutiny and extra attention with regards to respiratory management.

While researchers have described COVID-19 in patients with SCI, few studies address COVID-positive patients with *acute* SCI. A case report from Thailand describes a young man with a traumatic C5 AIS (American Spinal Injury Association Impairment Scale) A injury who underwent urgent anterior cervical discectomy and fusion and extubated uneventfully postoperatively but was found to be COVID-positive on postoperative day 4 after becoming febrile.[9] The patient developed COVID-19 pneumonia treated without mechanical ventilation and died on postop-day 10 from sudden cardiac arrest.[9] This patient's course was similar to our own and highlighted the need for further research to determine optimal treatment algorithms in the setting of a new pervasive illness that increases morbidity in patients with acute SCI. Efforts should be aimed at creating a large, national database of COVID-positive patients with acute SCI requiring possible surgical intervention to formulate evidence-based guidelines for treatment.

Early experiences in China have led to the formation of some expert consensus-derived guidelines for spine trauma in the setting of COVID-19.[19] In addition to many recommendations regarding the protection of personnel from contamination, the authors specifically recommend minimizing time under anesthesia, using the posterior approach in case tracheotomy is needed after exacerbation of COVID infection, and for immediate tracheotomy for patients with SCI at or above C4. In our experience, there was no difference in outcome between anterior and posterior approaches. Patient 1, who underwent an anterior cervical discectomy and fusion, was able to be placed prone for extended periods of time without complication at the surgical site. The authors additionally state that severe COVID-19 infection should be considered an absolute contraindication to surgery for unstable spine fractures with or without SCI (although immobilization with bracing should be continued as able) and that they recommend against high-dose methylprednisolone in the setting of acute SCI and COVID-19.[19] Our institution does not routinely use steroids in the setting of acute SCI and thus these were not used in our 2 patients. Although neither of our patients was critically ill because of COVID-19 at the time of presentation, we did not question the idea that urgent surgical intervention was indicated. As with the experience of these authors,[19] we also strongly recommend a detailed, informed discussion with patients and family that coexisting COVID-19 infection may significantly exacerbate the respiratory dysfunction already associated with SCI and that potentially worse outcomes are anticipated.

The case of patient 1, in particular, raises the question of whether or not the current standard of care (urgent or emergent surgical decompression for acute cervical SCI) should be re-examined in the COVID-19 era. Patient 1 presented without COVID-19 symptoms after acute traumatic cervical SCI but declined precipitously following surgery and never was able to be extubated. For COVID-infected patients, other surgical specialties have attempted to pursue less invasive options, mirroring the treatment options generally reserved for the critically ill, for common surgical emergencies like percutaneous treatment and intravenous antibiotic therapy for acute appendicitis and cholecystitis.[20] It has been shown and established that patients with cervical SCI have respiratory dysfunction with reduced vital capacity, weak cough, and excess oxygen cost for breathing with decreased chest and lung compliance.[14] Should we think of COVID-infected patients with concomitant SCI, and thus, a "double hit" to the respiratory system, as we think about operating on the critically ill? It is impossible to say whether or not surgery contributed to the decline of patient 1, but the informed consent process and thoughts regarding surgical timing should address the potentially life-threatening adverse effects of surgery weighed against the limited possibility of neurological recovery with surgical decompression.[7] Further studies are needed to assess the role of early versus late surgical decompression for patients with acute SCI and COVID-19 infection.

CONCLUSION

The COVID-19 pandemic has had a resounding impact on worldwide health care and poses unique dilemmas in the world of SCI. Patients who emergently present with SCI may potentially be asymptomatic or presymptomatic COVID patients. The implications of traumatic SCI in the setting of the novel coronavirus are likely profound. In patients with additional risk factors for poor COVID prognosis, intubation and the stress from surgery have the potential to increase the susceptibility to COVID-19's effects on the body, including pneumonia, ARDS, cardiovascular

compromise, and hypercoagulability. The traditional dogma of urgent surgical decompression for acute SCI may need to be re-examined in the COVID-19 era. Larger case series and rigorous studies need to be reported and conducted to improve our understanding of how COVID-19 affects the surgical management of patients with COVID-positive acute cervical SCI. A frank discussion with patients and family members regarding the potential increased respiratory complications and mortality from COVID-19 in patients with cervical acute SCI is essential when discussing surgical intervention and determining its timing.

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