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Pulmonary Embolism after Acute Spinal Cord Injury and COVID-19: A Case Report

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Abstract:

The coronavirus virus disease 2019 (COVID-19) is best known for its pulmonary sequelae. Understanding of the disease process is rapidly growing and the medical community already appreciates a hypercoagulable state associated with COVID-19. Acute spinal cord injury (SCI) has an inherent increased risk for venous thromboembolism (VTE). In this case report the patient presented with bilateral lower extremity weakness and sensory loss secondary to thoracic disc herniation. Incidentally, at the same time as the initial presentation, the patient was also found to have COVID-19 without significant respiratory symptoms. During hospitalization, the patient developed extensive bilateral lower extremity deep vein thrombosis (DVT) despite chemoprophylaxis. Therapeutic anticoagulation was initiated, yet several days later he developed pleuritic chest pain. Computed tomography (CT) angiography revealed bilateral pulmonary emboli. This case highlights the need for clinicians to have elevated vigilance in regards to screening and treatment for VTE in high-risk patients, such as SCI with a concurrent diagnosis of COVID-19.

Key Words:

- Spinal Cord Injury
- COVID-19
- Pulmonary Embolism
- Coronavirus
- Case Report

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Introduction:

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was discovered in Wuhan, China in December of 2019 and its associated disease is known as the coronavirus disease 2019 (COVID-19). Initially it was believed that older patients were most at risk for hospitalization, morbidity and mortality from COVID-19[1]. These reports suggested the main hallmark of COVID-19 was severe respiratory symptoms, in particular acute respiratory distress syndrome[1,2].

Newer reports reveal that COVID-19 is more of a systemic disease than previously appreciated, including an increased risk for venous thromboembolism (VTE) and stroke likely secondary to an associated hypercoagulable state[3–5]. Younger populations (less than 50 years old) with COVID-19 exhibit an increased risk of stroke secondary to this coagulopathy[6]. Other neurological conditions, such as spinal cord injury (SCI), also confer an increased risk for VTE[7,8]. Propagation of a deep vein thrombosis (DVT) can lead to a pulmonary embolism (PE)[9].

Currently, only two other case reports of SCI with COVID-19 have been published[10,11]. Presented in this report is an individual with an acute SCI and COVID-19 that developed bilateral DVT despite chemoprophylaxis. Even with initiation of therapeutic anticoagulation and subsequently achieving therapeutic levels, he still developed bilateral PE. This case underscores the increased VTE risk COVID-19 coagulopathy confers in acute SCI.

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Case:

A 48 year old male, with a history of chronic low back pain, presented to an outside hospital emergency department with an exacerbation of back pain. He denied any falls, trauma or recent back injuries. At initial presentation he had no motor or sensory changes and no bowel or bladder involvement. He was discharged to his home on the same day of presentation with a six-day course of oral steroids and nonsteroidal anti-inflammatories. One week later, the patient returned to the outside hospital with new complaints of urinary retention, constipation, lower extremity weakness and sensory impairment. A magnetic resonance imaging (MRI) scan revealed multilevel degenerative disk disease with a T11-12 compressive mass of unclear etiology, for which he was given 10 mg of intravenous (IV) dexamethasone. Acute kidney injury (AKI) was noted with a creatinine of 11.5 mg / dl (normal 0.5 - 1.2 mg / dl). A foley catheter was placed and IV fluids were administered. He was found to have polymerase chain reaction (PCR) positivity for SARS-CoV-2. At this time, he denied having any known clinical symptoms consistent with COVID-19 including fever, cough, chest pain, shortness of breath, abdominal pain, nausea, vomiting or diarrhea. The patient was transferred to a tertiary facility for higher level of neurosurgical care for his spinal cord compression.

Upon arrival at the tertiary center, the patient was afebrile with stable blood pressure, but mildly tachycardic (103 beats per minute) and his oxygen saturation was 96% on room air. The patient appeared comfortable with normal respiratory effort, with equal bilateral breath sounds without rales, wheezes or rhonchi. The patient had no lower extremity motor or sensory function. Initial d-dimer level was 83,881 ng / ml (normal 0 - 500 ng / ml) and c-reactive protein (CRP) level was 13.95 mg / dl (normal 0.0 - 0.7 mg / dl; see Figure 1A for laboratory value trends).

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COVID-19 status was confirmed via SARS-CoV-2 PCR. Chest radiography on admission revealed bibasilar opacities consistent with atelectasis (Figure 1B). Intermittent pneumatic compression devices were used for mechanical VTE prophylaxis as chemoprophylaxis was held given pending neurosurgery.

The patient underwent a T10-L1 decompressive laminectomy with removal of a large extruded T11-12 herniated disc performed by neurosurgery on hospital day two, without other intraoperative pathology noted, and was started on VTE chemoprophylaxis with heparin 5000 units administered subcutaneously three times a day after clearance by neurosurgery on hospital day three. Physiatry was consulted on hospital day six and neurological examination showed the patient had T11 American Spinal Injury Association Impairment Scale (AIS) A paraplegia. AKI from urinary retention secondary to neurogenic bladder had resolved with creatinine returning to normal range. Neurogenic bladder management options were discussed including continuous indwelling foley versus training with intermittent straight catheterization program. Increased DVT risk in SCI was also discussed with the primary team. Indwelling foley catheter was continued for neurogenic bladder management. The patient was without any significant clinical signs or symptoms of DVT and was continued on VTE chemoprophylaxis.

On hospital day ten the patient developed a fever (102.4 F temperature maximum) with tachycardia (120 beat per minute maximum) but was not in any acute respiratory distress (96-100% oxygen saturations on room air with 18-20 respirations per minute). Urinary tract infection (UTI) from Escherichia coli was diagnosed and treatment with antibiotics was initiated. Bilateral lower extremity venous duplex ultrasound was performed and extensive DVT of the left leg

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involving the femoral, popliteal, gastrocnemius, soleal, posterior tibial and peroneal veins were found; DVT of the right peroneal and soleal veins were also noted (Figure 1C). Within two hours of DVT diagnosis and with clearance from neurosurgery, his anticoagulation was changed from chemoprophylaxis dosing to therapeutic dosing using a heparin algorithm infusion (1650 units/hour) with a partial thromboplastin time (PTT) target range of 50-70 seconds. No bolus on initiation of algorithm and no heparin boluses throughout treatment were given. One day later his PTT increased from 30 to 48 seconds. His D-dimer was still abnormally high but was downtrending; however, it had doubled from two days prior (Figure 1A).

On hospital day fourteen the patient developed new right lower pleuritic chest pain. He was maintaining oxygen saturation percentages between 96-98% on room air without complaints of dyspnea. A computed tomography angiogram (CTA) found pulmonary emboli involving the left lower lobe and right middle lobe pulmonary arteries as well as segmental involvement in the right lower lobe (Figure 1D). His heparin algorithm infusion was changed to 1650 units/hr with a PTT goal of 60-100 seconds. Anticoagulation was transitioned to oral 15 mg rivaroxaban at a dose of 15 mg two times per day on hospital discharge.

The patient was discharged home on hospital day sixteen with home care services and outpatient follow up. A major social challenge of this case was that the patient was an undocumented and uninsured individual. The physiatry team worked in conjunction with social work and case management, along with hospital administration to address the patient's rehabilitation needs while the patient was in the acute care hospital. The patient completed a bowel and bladder program. The patient received daily physical and occupational therapy to

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assess and train in transfers and functional needs. Wheelchair assessment was completed and the patient received a wheelchair. Family training occurred. Bladder management was transitioned to intermittent straight catheterization with urology follow-up. Social work and discharge planning teams setup for home therapy and the patient was recommended for outpatient spinal cord injury follow-up. Additionally, the patient was connected with a primary care physician upon discharge. This study conforms to all CARE guidelines and reports the required information accordingly (see Supplemental Checklist, Supplemental Digital Content 1, http://links.lww.com/PHM/B115).

Discussion:

This is the first published case report in the United States of acute SCI with COVID-19. The patient presented with bladder and bowel dysfunction, as well as lower extremity motor and sensory loss from acute SCI secondary to a large compressive lower thoracic disk herniation. After neurosurgical laminectomy and discectomy, the patient's neurological function did not significantly improve, continuing with T11 AIS A paraplegia. Concurrently, the patient was PCR positive for SARS-CoV-2 virus, both at an outside hospital and at a tertiary hospital, without clinically apparent COVID-19 symptoms.

It is now understood that a substantial number of patients can be asymptomatic carriers of SARS-CoV-2[12], with estimates of asymptomatic cases ranging from 40% to about 80%[13,14]. Despite lacking symptoms requiring inpatient medical care, mild cases still have active infections, are transmissible, and are not entirely immune to systemic effects[15]. One of the effects of systemic SARS-CoV-2 infection is an associated hypercoagulability with increased risk of

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VTE[5,16,17]. In fact, younger populations with COVID-19, presumably with more reserve against its pulmonary insult, might not present until catastrophic consequences of VTE, such as stroke[6]. PE has been reported in patients with only mild COVID-19 symptoms[18].

In the case of this patient, during the workup for fever, extensive bilateral lower extremity DVT were found. These DVT developed despite standard VTE chemoprophylaxis with 5000 units of heparin administered subcutaneously three times a day[19]. Prophylactic doses should be considered in all patients to manage COVID-19 coagulopathy[20]. Thrombophilia is typically described in the context of Virchow's triad: blood stasis, endothelial damage and hypercoagulability[21]. Acute SCI fulfills all three components of Virchow's triad[22]. VTE risk is highest in the first few weeks following acute SCI[23] and 9.7% of first-year SCI deaths are related to VTE[21]. This patient had two additional hypercoagulable risk factors, first a recent surgery[24] and second the aforementioned hypercoagulability secondary to COVID-19[4]. Further evidence of his prothrombotic state was a d-dimer level at presentation of 83,881 ng / mL (over 150 times the upper limit of normal). Immensely elevated d-dimers are also consistent with reports of COVID-19 patients[25]. Interestingly, just before the diagnosis of the DVT and UTI there was an increase in both d-dimer and CRP (Figure 1A).

There have been several methods utilized in VTE prophylaxis in SCI including vena cava filters and chemoprophylaxis[21]. In this patient's case, standard dosing of heparin for chemoprophylaxis failed to prevent DVT formation. The patient was switched to a therapeutic level of anticoagulation using a heparin algorithm infusion after diagnosis of DVT. Yet, several

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days later, despite being on heparin infusion anticoagulation treatment, he subsequently developed new clinical symptoms and was diagnosed with bilateral pulmonary emboli.

Given the growing appreciation of COVID-19 coagulopathies, at least prophylactic anticoagulation has been suggested for all hospitalized COVID-19 patients without contraindications[26]. One study found 69% of ICU-admitted COVID-19 patients had a noted VTE when screening with venous duplex ultrasound and also found that COVID-19 patients on prophylactic anticoagulation doses were more likely to have VTE than those on therapeutic doses[27]. Even in COVID-19 patients without an established VTE, it has been suggested to use higher-than-prophylactic doses of anticoagulation[27,28] and that systematic VTE screenings should be performed[27] with extended VTE-prophylaxis after discharge[29]. Data is sparse regarding therapeutic effectiveness of direct oral anticoagulants in COVID-19 for VTE prevention[30]. Risk stratification systems for COVID-19 coagulopathy have been proposed[20]; however, the medical community needs high-quality controlled studies testing ideas related to VTE-prophylaxis and management in COVID-19[26,30].

Conclusion:

Acute SCI already has a substantial VTE risk. Fortunately, there were no major pulmonary sequelae and the patient was successfully discharged home; however, this case suggests that COVID-19 coagulopathy likely compounds this VTE-risk further. Concurrent COVID-19 diagnosis in already high-risk VTE populations should necessitate increased VTE vigilance and might require more aggressive management or interventions.

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Conflicts of interest:

The authors report no disclosures relevant to the manuscript.

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Figures:

Figure 1: (A) Patient laboratory values during hospitalization. Periods of heparin anticoagulation are depicted in green (5000 units three times per day) and blue (drip 1650 units per hour). PTT goal during therapeutic anticoagulation is denoted in purple. (B) Chest radiography at admission. (C) Lower extremity schematic depicting location of DVT in blue. (D) CT scan demonstrating pulmonary emboli marked with blue arrows. Top: axial view, middle: coronal view, bottom: lateral view. Normal laboratory values: CRP: 0.0 - 0.7 mg / dl; D-dimer: 0 - 500 ng / ml; PT: 10.3 - 13.5 seconds; PTT: 25 - 35 seconds. Abbreviations: CRP, c-reactive protein; INR, international normalized ratio; PT, prothrombin time; PTT, partial thromboplastin time; TID, three times per day.

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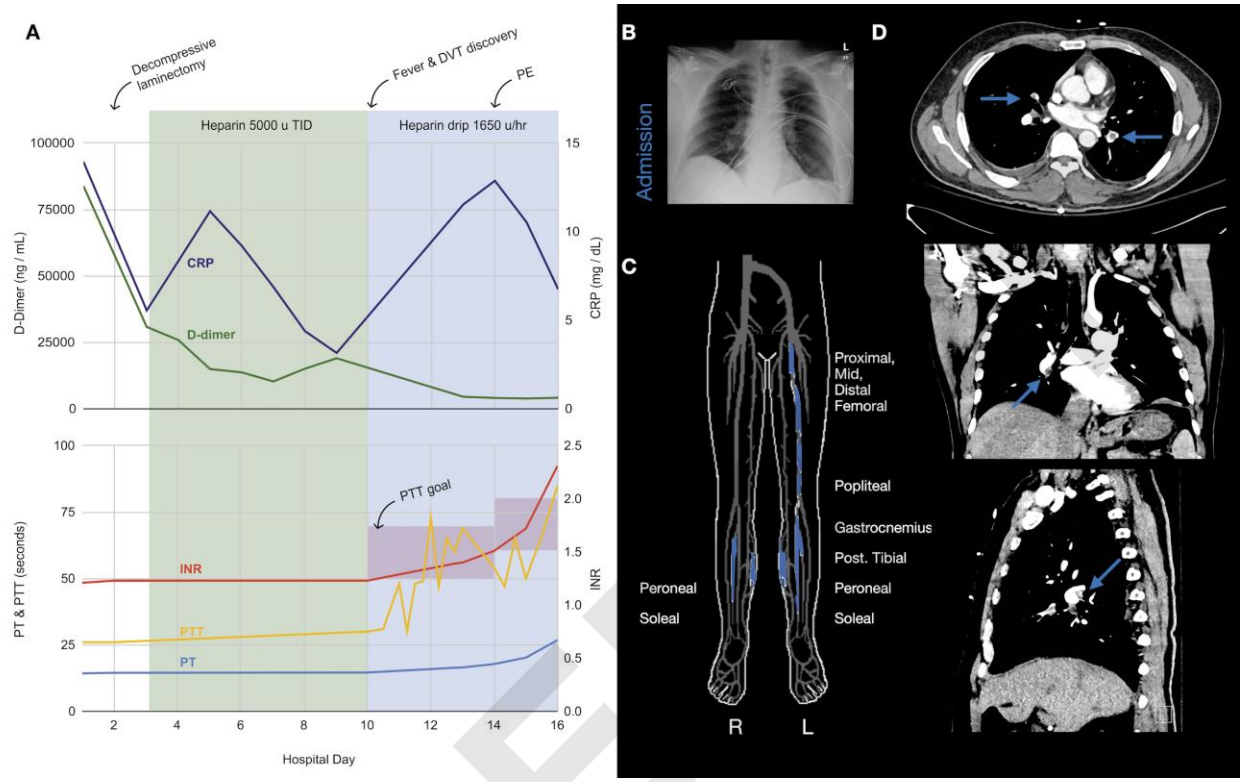
Figure 1



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