

Pulmonary Embolism as a Complication Following Anterior Cervical Discectomy and Fusion in a Patient with a History of COVID-19: A Case Report and Literature Review

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Abstract

This is a case report of an otherwise healthy 45 year old male patient with a history of COVID-19, who later underwent an Anterior Cervical Spine Decompression and Fusion of level three to four for progressing neurological symptoms. The patient was readmitted eleven days postoperatively for shortness of breath and found to have a Pulmonary Embolism. The patient was at low risk for postoperative VTE, with no known current significant risk factors. He had a history of COVID-19, along with lab values and imaging that have been shown in other case series to help support the link between covid-19 and hypercoagulable state. We hope to support this hypothesis, and bring light to future larger-scale studies, in order to better understand this disease and effectively create a preoperative assessment to identify such patients at risk, along with post-operative protocols for these patients having procedures in the future. To our knowledge, this is the first reported case of confirmed postoperative DVT/PE in an otherwise low-risk patient, who had a history of COVID-19 with full recovery. The rarity of this complication, along with options for how to risk-stratify these patients should be formally addressed, especially in those who require urgent spine surgery. These options are discussed, reviewed, and remarks as to where further attention and research is needed is addressed.

Keywords: Anterior Cervical Discectomy and Fusion; COVID-19; Pulmonary Embolism.

Introduction

Anterior cervical discectomy and fusion (ACDF) is a common procedure for patients who have severe neck pain with or without radicular symptoms. Originally described by Smith and Robinson, "cervical disc syndrome" is a condition that stems from cervical disc degeneration (CDD) and is defined by a constellation of symptoms that includes chronic pain in the neck/shoulders, paresthesias in the upper extremities, limited neck range of motion, and radiographic evidence of CDD [1]. When indicated, ACDF can be performed at the presumed painful disc levels. The procedure consists of disc material being removed, an interbody spacer with autologous or cadaver bone grafting material placed, along with an anterior cervical plate. Clinical outcomes following ACDF are good, as patients have reported up to 50% mean improvement in their pain, along with up to 82% of patients reporting satisfactory outcomes as demonstrated by Riew et al [2-3]. Postoperative complications, following ACDF include dysphagia (5.3%), esophageal perforation (0.2%), recurrent laryngeal nerve palsy (1.3%), infection (1.2%), adjacent segment disease (8.1%), pseudarthrosis (2.0%), graft or hardware failure (2.1%), cerebrospinal fluid leak (0.5%), hematoma (1.0%), vertebral artery injury (0.4%), and new or worsening neurological deficit (0.5%) [4].

Postoperative venous thromboembolism (VTE), which includes deep vein thrombosis (DVT) and pulmonary embolism (PE), has been well

demonstrated in hip and knee arthroplasty and other orthopedic procedures, however, less is known about the incidence in spine surgery [5]. In a recent study, the estimated incidence of postoperative DVT and PE was low, at 1.02% and 0.94% respectively [5]. Significant risk factors include chronic venous insufficiency, obesity, atrial fibrillation, and ischemic heart disease [5]. When compared to other cervical spine surgeries (such as posterior spinal fusion), ACDF has even lower incidences of DVT and PE [6]. Regardless, this complication can increase mortality rates and hospitalization, and there should be a preoperative assessment to identify patients at risk [6].

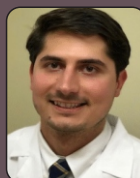
The coronavirus disease of 2019, which is a result of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was officially declared a pandemic by the World Health Organization in March 2020 [11]. As of October 23, 2020, this pandemic has resulted in 8,387,047 cases and 222,447 deaths [12]. COVID-19 is associated with a number of systemic complications, including but not limited to pneumonia, acute respiratory distress syndrome, myocardial injury and myocarditis, acute myocardial infarction, dysrhythmias, and VTE [8]. Recent studies have also demonstrated changes in coagulation function between patients with SARS-CoV-2 versus healthy patients, and D-Dimer levels have been shown to help in diagnosing and monitoring severe cases of hypercoagulability [9-10]. We present a case of a 45-year-old male with cervical disc syndrome, who after undergoing a one level

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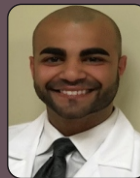
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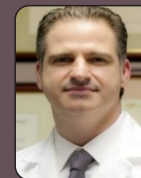
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ACDF procedure developed a pulmonary embolism within thirty days postoperatively. This patient had fully recovered from a recent history of COVID-19 and was otherwise healthy without significant VTE risk factors. We hope to bring light to this new disease, and how it can potentially affect cervical spine surgery.

Case Presentation

A 45-year-old male, with a past medical history of ACDF at levels four to five, and GERD presented to the emergency department (ED) for three weeks of shortness of breath. The patient was diagnosed with COVID-19 by an outpatient clinic a month prior and presented for further evaluation for his continued shortness of breath. The patient also reported on having intermittent bilateral hand paresthesias, however, was not experiencing those symptoms at the current ED visit. Patients' vital signs, along with labs, complete blood count (CBC), basic metabolic panel (BMP), troponins, D-dimer, were all within normal limits (WNL). Plain chest radiograph taken at that time was unremarkable, and computerized tomography (CT) of the chest with contrast demonstrated clear lungs bilaterally with no pulmonary embolism. On physical exam the patient had normal breath sounds in all four quadrants, and was overall neurovascularly intact in all extremities. This information was relayed to the patient and he was given instructions for supportive care and to follow up with his primary care physician.

One month later, the patient presented to the ED with a chief complaint of neck pain, intermittent bilateral forearm and hand paresthesias, and limited neck range of motion. His shortness of breath had improved since the prior ED visit. Paresthesias were present mainly in his forearms, 4 and 5th digits, bilaterally, however he reported this was intermittent and had been present for years. A review of symptoms was negative for any fever, chills, COVID-19 related symptoms, gait disturbances, bowel or bladder changes. Neurologic physical examination was overall intact, without upper motor neuron signs and mild 4+ out of 5 abduction weakness to his right little finger and negative grip test bilaterally.

Plain radiographs of the cervical spine were obtained which demonstrated flattening of cervical lordosis, disc space narrowing at C3 to C4, and intact hardware at C4 to C5.

An MRI of the Cervical spine demonstrated moderate degenerative loss of disc height at C3 to C4, a moderately large broad-based disc extrusion with flattening of the ventral spinal cord and residual AP spinal column dimension of 4.3mm (Figure 1 and 2).

Spinal cord signal at this level was preserved, and there was right-sided foraminal stenosis from uncinata hypertrophy. There were also severe

degenerative changes at C6-7 with myelomalacia, however spinal stenosis at this level was mild and less pronounced and determined to be more of a chronic finding.

It was determined from both clinical and imaging findings that the patient was having axial neck pain, lhermitte signs, with cervical disc syndrome at C3 to C4, and would benefit from surgery. His acute onset of neck pain within one day, with radiation into the right shoulder and trapezium followed the C4 nerve root distribution. The surgical treatment plan was anterior cervical discectomy and fusion at C3 to C4. There was a thorough conversation with the patient and he agreed to continue with surgical decompression of the cervical cord from a large herniated disc at level C3 to C4.

Operation

On June 3, 2020, a C3 to C4 ACDF was performed using a left-sided anterior approach. The herniated disc material was successfully removed, and an interbody fusion cage was placed, followed by screw instrumentation (Figure 3 and 4). The procedure was performed under fluoroscopy supervision and with neuromonitoring. There were no noted complications, estimated blood loss was 20 milliliters (mL) and a Jackson pratt drain was placed during the closure. The patient was transferred to the post-anesthesia care unit and subsequently to the orthopedic floor in stable condition. He received physical therapy twice daily, sequential compression devices for VTE prophylaxis and the rest of the hospital course was unremarkable. The Jackson Pratt drain was removed on postoperative day two and the patient was safely discharged from the hospital to home on June 5th, 2020 with a Philadelphia collar to wear as needed for comfort. Vitals and labs at discharge were all within normal limits.

Postoperative Course

On post operative day 11 the patient presented to the ED with a chief complaint of right-sided chest pain, shortness of breath with deep respirations, along with pain and swelling to bilateral lower extremities for one day. On review of systems, there were no fever, chills, cough, abdominal pain, or trauma. On physical exam per emergency room physician, there was decreased lung base sounds bilaterally on auscultation. Labs revealed CBC and BMP and serum troponin I to be WNL, COVID-19 PCR test was negative, however quantitative D-Dimer Assay was increased (280 ng/mL DDU). Plain x-ray radiograph of the chest was normal and it was decided to order a CT angiogram of

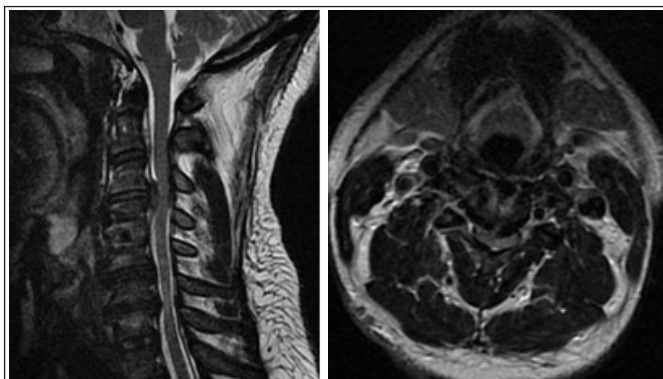


Figure 1: Sagittal T2-weighted MRI. **Figure 2:** Axial T2-weighted MRI.



Figure 4: Lateral Plain Radiograph Cervical Spine depicting ACDF at levels C3 to C4. Demonstration of prior ACDF at C4 to C5.

Figure 3: Anterior-Posterior Plain Radiograph depicting ACDF at levels C3 to C4. Demonstration of prior ACDF at C4 to C5.

the chest with contrast to rule out pulmonary embolism given elevated D-Dimer, recent surgery, COVID-19 history, and patients' symptoms. The CT angiography was positive for right lower lobe pulmonary embolism (Figure 5).



Figure 5: Computed Tomography Angiogram of the chest, showing small pulmonary emboli of the right lower lobe.

The patient was admitted to the hospital under the medical service and initiated on full heparin infusion protocol with an aPTT goal of 58-99 seconds. Given the known risks for initiating anticoagulation following spine surgery, orthopedic surgery was consulted, for recommendations and monitoring. The patient was placed on neurological checks every four hours for twenty-four hours and given a soft cervical collar to wear as needed for comfort. The following day bilateral lower extremity ultrasound-guided dopplers were performed, which demonstrated a right-sided thrombus in the soleus vein.

He was transitioned to Xarelto 15mg to be taken twice daily for two weeks, then 20 mg daily for two weeks at follow up appointment. The patient was safely discharged to home in stable conditions. The patient at most recent follow-up is doing well, with complete resolution of his cervical disc syndrome, and has completed his anticoagulation course without complications.

Discussion

In this report, we present an otherwise healthy individual, with no known VTE risk factors, who underwent an urgent ACDF procedure for cervical disc syndrome, and developed a pulmonary embolism eleven days postoperatively. Recent literature has shown that ACDF when compared to other spine procedures has a lower incidence of postoperative VTE [6]. What makes this case unique is this patient's history of COVID-19. Although he was fully recovered, with negative PCR tests before the procedure, there has been recent literature showing a relationship between this disease and hypercoagulability [10]. In orthopedics, especially in the arthroplasty specialty, there is ample literature to support the use of postoperative chemical anticoagulation along with promoting early ambulation to help reduce the incidence of postoperative VTE complications [14]. However less is known about the use of chemical anticoagulation therapy following spine surgery.

One concerning postoperative complication in cervical, thoracic and lumbar spine surgery is acute postoperative epidural hematomas, which require emergent hematoma evacuation in the operating room to prevent neurologic compromise. There has been some evidence to support that full anticoagulation therapy, in the acute pre or post-operative setting can increase the risk of this complication [15]. There is high variability among published institutions regarding their post-operative spine VTE prophylaxis practices, however most seem to follow a protocol that does not include chemical anticoagulation.

However, in a recent study at a high volume tertiary center, comparing postoperative spine patients who either received a VTE prophylaxis protocol with no chemical anticoagulation (encouraging early ambulation and using sequential compression devices) or with chemical anticoagulation (aggressive protocol with heparin) there was a statistically significant reduction in DVT incidence in the aggressive protocol group, without increasing morbidity (risk for acute epidural hematomas) [16]. These findings are important to consider when formulating a postoperative VTE prophylaxis plan for patient who either have COVID-19, or have had a history of the disease.

The importance of this case cannot be undertaken, as we are still in a pandemic, and have much to learn about SARS-CoV-2. The ability to identify a potential new postoperative VTE risk factor may help reduce the incidence in these patients, if addressed appropriately. Studies have shown patients with COVID-19 have thrombotic events including but not limited to limb ischemia, pulmonary embolisms, deep vein thrombosis while both actively infected with COVID-19, or by having a history of such [18]. There have been some described theories behind how the virus affects the coagulation pathway, one such being by the formation of anti-phospholipid antibodies which can mimic certain processes such as disseminated intravascular coagulation, heparin-induced thrombocytopenia, and thrombotic microangiopathy [17]. Overall more larger-scale studies are needed to better address both of these issues.

This case also represents the importance of preoperative planning in the current environment we are faced with. Currently, at our institution, all preoperative patients must be screened for COVID-19 prior to proceeding with an elective procedure. We believe potentially recording those who have had a history of COVID-19 into a higher risk category for developing postoperative VTE may help reduce the incidence for selected patients. For this reason, it is critical to determine the incidence of VTE following spine surgery (especially historically low-risk surgeries i.e ACDF) and further larger scale studies are needed to address the safety of chemical anticoagulation use for those at high-risk patients [16]. Further larger-scale research is needed to support whether patients with a history of COVID-19 compared to those without, have a higher incidence of postoperative VTE. Further research is needed to better understand the biomechanical pathway by which this process occurs, in hopes to one day be able to recommend a more targeted anticoagulation medicine. We hypothesize that along with the known multiple risk factors for developing postoperative VTE, having a history of COVID-19 could be added to that list.

As with our case presentation, there is literature that has shown a potential link between increasing levels of D-Dimer and pulmonary embolism in COVID-19 patients [19]. Further larger-scale studies are encouraged to explore this lab value's importance, and relevance if any, in potentially screening for and/or predicting VTE incidence in patients with a history of COVID-19. Unfortunately, COVID-19 is still prevalent in the United States and around the world, thus it is contemporary that we as physicians and surgeons will continue to see and treat more patients who have had a history of COVID-19 infection. It is our duty as physicians to help determine whether having a history of COVID-19 is a risk factor for developing postoperative VTE, and if so, implementing preoperative assessments to identify such patients at risk, as well as postoperative treatment protocols (even in traditionally low-risk procedures i.e ACDF). These are the questions we need to keep asking until the answers are found.

Conclusion

The incidence of VTE following ACDF surgery is relatively low when compared to other spine and orthopedic procedures. In this case, we presented an otherwise healthy 45-year-old patient, without significant VTE risk factors who developed a pulmonary embolism eleven days post-op from a one level ACDF. This patient had a history of COVID-19, along with lab values and imaging that have been shown in other case series to help support the link between covid-19 and hypercoagulability. We hope to support this hypothesis, and bring light

to future larger-scale studies, in order to better understand this disease and effectively create a preoperative assessment to identify such patients at risk, along with post-operative protocols for these patients having procedures in the future.

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