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Case Report

Surgical stabilization of rib fractures in symptomatic COVID-19: A case report

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ABSTRACT

Severe chest wall injury following trauma is a significant contributing factor to respiratory failure and need for mechanical ventilation in multiply injured patients. Surgical stabilization of rib fractures (SSRF) is increasingly considered to be advantageous in this population. Surgical stabilization has been shown to improve multiple outcomes including ventilator avoidance, liberation from mechanical ventilation, and diminished pulmonary complications in the trauma population, particularly when performed early. During the coronavirus disease 2019 (COVID-19) pandemic, ventilators have become a scarce resource, and conservative strategies have become a critical component of intensive care. We present a report of the perioperative outcome of SSRF in a geriatric polytrauma patient who initially presented after a mechanical fall and co-existing symptomatic COVID-19.

Introduction

Severe chest wall injury (CWI), namely flail chest and multiple displaced fractures, can cause significant morbidity and mortality in the trauma patient. Deleterious effects of these injuries on outcomes have been well documented, such as prolonged intensive care unit (ICU) admission, prolonged mechanical ventilation (>24 h), pneumonia, tracheostomy, increased length of hospital stay (LOS), need for inpatient rehabilitation, and mortality [1]. SSRF is increasingly considered a management tool in these patients given lower rates of tracheostomy, decreased incidence of pneumonia, and shorter duration of mechanical ventilation as compared to non-operative management, particularly when performed early [2–6]. During the coronavirus disease 19 (COVID-19) pandemic, invasive positive pressure ventilation is a critical resource, and strategies to conserve ventilators have become paramount. Pieracci and Shiroff recently proposed strategic and careful implementation of SSRF during the pandemic with attention to specific injury patterns (flail versus displaced) and likelihood of ventilator utilization [7]. COVID-19 causes a wide spectrum of clinical sequelae, from asymptomatic to acute respiratory distress syndrome and multi-system organ failure [8]. Surgical intervention in symptomatic patients confers elevated risk based on early studies [9]. We present a report of successful surgical stabilization of left-sided flail chest in a geriatric polytrauma patient who initially presented after a mechanical fall and co-existing symptomatic COVID-19.

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Case report

An 82-year-old male presented after being found down 24 h following a fall down stairs. Primary survey was unremarkable, including a Glasgow Coma Scale (GCS) of 15. Secondary survey noted tenderness to the thorax bilaterally, right shoulder, and along the thoracic and lumbar spine. Initial vital signs were heart rate 109, blood pressure 127/64, respiratory rate 35, temperature of 39.4 °C, and oxygen saturation of 92% on room air. A focused assessment with sonography in trauma (FAST) was negative. Pertinent medical history included hyperlipidemia and gastroesophageal reflux disease. Patient was functionally independent prior to injury. He was amnesic to events preceding his injury but reported a cough, fever, and general malaise for two days prior to the incident without known COVID-19 exposure. Laboratory evaluation was notable for creatinine 1.88 mg/dL, creatinine kinase 15,620 U/L, bicarbonate 19 mmol/L, and a positive molecular SARS-CoV-2 test. Initial chest x-ray showed displaced rib fractures left 3rd-8th and right 5th-7th with foci of peripheral opacities within bilateral mid-lung fields (Fig. 1, left). Computed tomography (CT) of the head, spine and abdomen were negative. Chest CT demonstrated minimally displaced right anterolateral 3rd-10th rib fractures, moderately displaced left 2nd-12th rib fractures with multiple segmental fractures consistent with a flail chest, and bilateral areas of ground-glass opacities consistent with COVID-19 (Fig. 2).

The patient was admitted to the intensive care unit for negative pressure isolation and started on dexamethasone, convalescent plasma, and remdesivir. During the first 72 h following admission, supplementary oxygen requirements gradually worsened from 4 L/min nasal cannula to heated high-flow nasal cannula. Mechanics of respiration were persistently poor with observed paradoxical left chest wall motion and accessory muscle use consistent with patient's flail chest injury. Pain control was inadequate despite multimodal therapy. Patient became afebrile after 48 h. However, remdesivir therapy was aborted due to worsening renal function after three days of treatment. The patient also developed new onset atrial fibrillation with rapid ventricular rhythm but was asymptomatic and hemodynamically stable. A rate control strategy with diltiazem infusion was initiated instead of rhythm control with chemical cardioversion and anticoagulation given the need for possible surgical intervention.

Multi-disciplinary discussion was held with critical care, trauma, patient, and family with regards to the multifactorial nature of his respiratory decline and impending need for mechanical ventilation. In addition to COVID-19 infection, the left chest wall flail injury was felt to be a key contributing factor to his ongoing respiratory failure. On hospital day three, a left muscle sparing thoracotomy, evacuation of retained hemothorax, and open reduction internal fixation of the left chest was performed (Fig. 3). Anterolateral left 3rd-8th ribs and posterolateral left 4th-9th ribs were internally fixated to appropriately stabilize the flail segment. Given that the right sided fractures were noted to be only minimally displaced and not the main contributing factor to patient's pain and respiratory failure, the decision was made to pursue non-operative management. Intercostal nerve block with liposomal bupivacaine was then administered at the end of the procedure. The patient returned to the ICU intubated postoperatively with positive end-expiratory pressure of eight and FiO₂ 80% and was extubated to standard nasal cannula postoperative day one. Tube thoracostomy was removed on postoperative day three (Fig. 1, right). Patient was eventually weaned to room air on postoperative day 13.

Postoperative course was complicated by several events, most notably abdominal distension with ileus and left lower lobe segmental pulmonary embolism and bilateral lower extremity venous thromboembolism for which he received full anticoagulation. Patient temporarily required intermittent non-invasive positive pressure ventilation, but did not require re-intubation, mechanical ventilation, nor tracheostomy. Later, urinary tract infection was confirmed and there was concern in the delayed postoperative period for silent aspiration for which he received percutaneous endoscopic gastrostomy placement on postoperative day 16. Patient was ultimately discharged to a skilled nursing facility on postoperative day 20 on room air without need for narcotics for pain control. Four months postoperatively, the patient is currently at home recovering well with ongoing outpatient physical therapy needs.

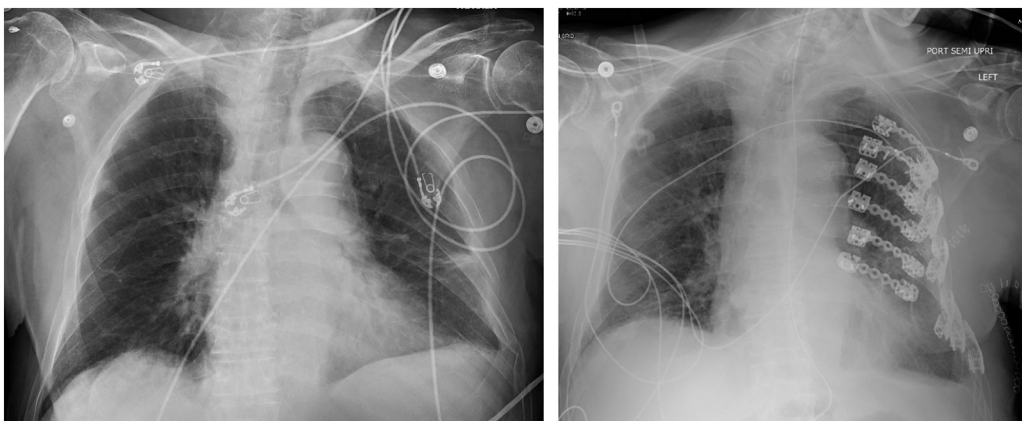


Fig. 1. Preoperative chest x-ray (left). Postoperative chest x-ray following SSRF, extubation and chest tube removal (right).

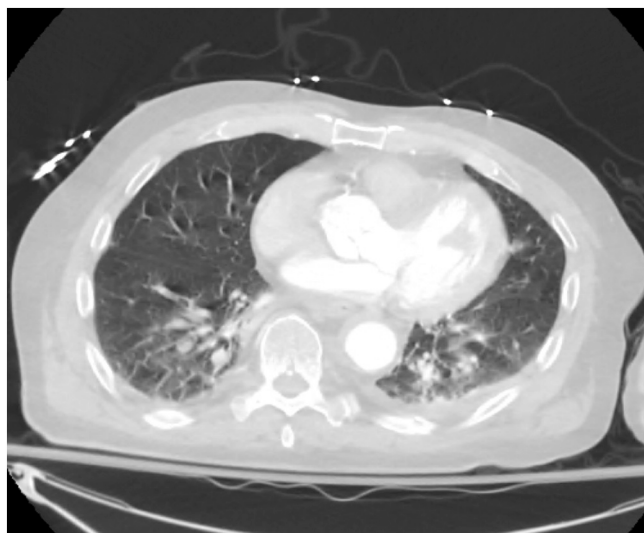


Fig. 2. Preoperative chest CT demonstrating bilateral areas of ground-glass opacities.

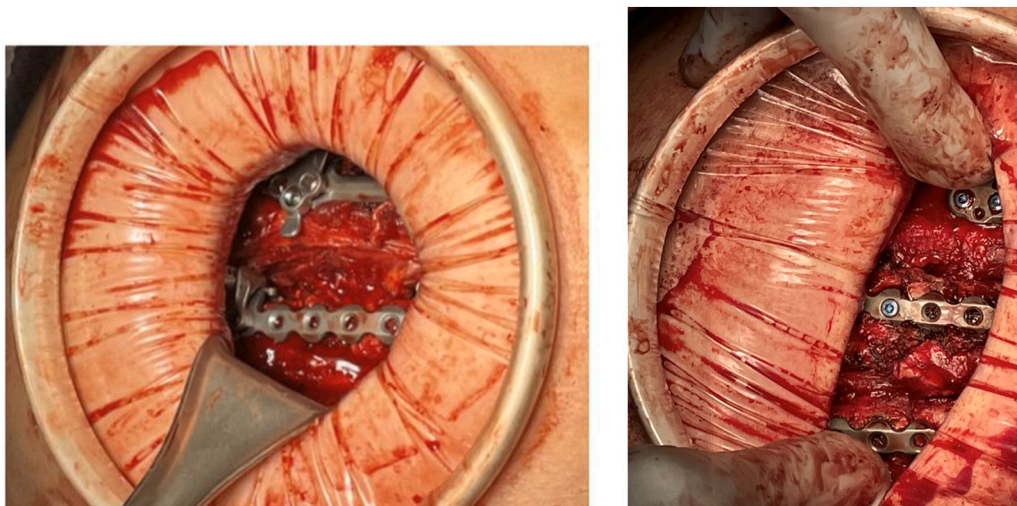


Fig. 3. Open reduction internal fixation of left chest.

Discussion

The COVID-19 pandemic has affected the medical and surgical management of a variety of conditions which require intensive care, necessitating significant alterations in established treatment algorithms in order to spare scarce resources. COVID-19, when severe, carries deleterious effects on multiple organ systems, most notably decompensated respiratory function. Efforts to conserve existing ventilator resources and maximize adjunctive pulmonary therapeutic modalities have been paramount.

Patients with traumatic chest wall injuries and concurrent symptomatic COVID-19 present a complex and difficult junction of care, as SSRF in trauma populations can facilitate rehabilitation without ventilator support while surgical intervention in symptomatic infection portends increased risk. Our case illustrates the intersection of rib fixation and symptomatic COVID-19 in the geriatric patient, by combining optimization of respiratory function and avoiding ventilator dependence through chest wall stabilization. In retrospect, this case demonstrated a positive surgical outcome during a pandemic where elective surgeries were delayed and conservative management was preferred to minimize postoperative complications if patients were positive and/or symptomatic for COVID-19. In addition, this surgical stabilization was performed during our region's exponential rise in ICU admitted COVID-19 patients and several weeks before cases plateaued; a time during which surge protocols were in place and ventilator resources were limited (Fig. 4). Admittedly, this result is limited to a single case and is not generalizable with additional research needed to substantiate such outcomes.

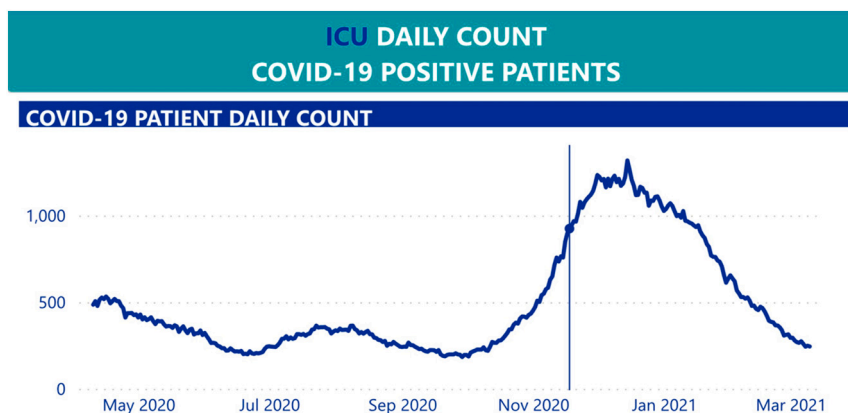


Fig. 4. Daily case count of ICU-admitted COVID-19 patients in institution's geographical region, with vertical line depicting date of surgical intervention.

Informed consent

Obtained.

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Declaration of competing interest

All co-authors have seen and agree with the contents of the manuscript. WBD is a consultant for Acute Innovations/Acumed. All other authors have no disclosures.

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