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RESPIRATORY CASE REPORTS

Management of COVID-19-Associated Pleural Empyema

COVID-19 ile İlişkili Plevral Ampiyemin Yönetimi

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Abstract

The highly contagious and rapidly spreading coronavirus 2 (SARS-CoV 2) has been associated with the development of severe acute respiratory syndrome, a potentially fatal disease. A patient who underwent coronary artery bypass surgery for an acute myocardial infarction developed acute respiratory failure due to coronavirus 2 (SARS-CoV-2) pneumonia in the early postoperative period. The patient was placed on mechanical ventilation (MV) and V-V (veno-venous) ECMO (Extracorporeal Membrane Oxygenation) support. Here we discuss the application of decortication in the patient due to the development of pneumothorax and prolonged air leak empyema in the follow-up, and the subsequent development of pleural thickening.

Key words: Lung Decortication, COVID-19, Empyema.

Öz

Son derece bulaşıcı ve hızla yayılan koronavirüs 2 (SARS-CoV 2) hastalığı, potansiyel olarak ölümcül bir hastalık olan şiddetli akut solunum sendromuna neden oldu. Akut miyokard enfarktüsü nedeniyle koroner arter baypas ameliyatı olan hastada ameliyat sonrası erken dönemde koronavirüs 2 (SARS-CoV-2) pnömonisine bağlı akut solunum yetmezliği gelişti. Hastaya mekanik ventilatör (MV) ve V-V (veno-venöz) ECMO (Ekstrakorporeal Membran Oksijenasyonu) desteği verildi. Takipte pnömotoraks, uzamış hava kaçağını takiben ampiyem ve plevral kalınlaşma gelişmesi nedeniyle dekortikasyon uygulanan olguyu sunduk.

Anahtar Sözcükler: *Akciğer Dekortikasyonu, COVID-19, Ampiyem.*

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Coronavirus disease 2019 (COVID-19) was first identified in December 2019 after an outbreak of pneumonia epidemic in Wuhan, China and was declared a global pandemic by the World Health Organization (WHO). There have since been over 22 million cases and over 780,000 deaths worldwide (1).

The severity of COVID-19 symptoms can differ depending on the viral load and the immune response of the individual. The clinical course can range from asymptomatic or mild upper respiratory tract infection, to respiratory failure and death due to viral pneumonia. The condition is more severe in the elderly and in people with comorbidities. COVID-19 is a significant cause of morbidity and mortality (2). This study presents a case in which the patient was found to be positive for the novel coronavirus after heart surgery, and discusses the empyema and other devastating effects that developed.

CASE

A 42-year-old male patient was admitted to the cardiology outpatient clinic with complaints of atypical chest pain and shortness of breath for a year. He had a history of epilepsy, coronary artery disease, hypertension, diabetes mellitus and cerebrovascular disease. Vital signs were within normal limits and the patient's electrocardiography (ECG) revealed a normal sinus rhythm. Single-photon emission computed tomography myocardial perfusion imaging was performed on the patient who had been fitted with a stent in the right coronary artery 7 years earlier. Ischemia was reported in the lower wall, and a coronary angiography revealed stent occlusion for which coronary artery bypass grafting (CABG) was planned. The patient had an uneventful early postoperative period after three-vessel CABG surgery. He was extubated on the first postoperative day in the intensive care follow-up.

The patient complained of worsening dyspnea on the third postoperative day, even at rest and was in poor general condition, with fever, tachycardia and tachypnea. The vital signs were: blood pressure 105/62 mm Hg, heart rate 128 beats/min, respiratory rate 26 breaths/min and oxygen saturation 91% in room air. The laboratory results were: platelet count 160000 μL, hemoglobin 10 g/dl, leukocyte 17200/mm^3, lymphopenia $0.06 \times 103/\mu$L (5%), ferritin 944 μg/L, C-reactive protein (CRP) 167 mg/L, d-dimer 80 Ng/ml, a cytokine 300 pg/ml, alanine aminotransferase (ALT) 90 U/L, total bilirubin 1.2 mg/dl, albumin 2.6 gr/dl and pro-calcitonin 1.06 ng/mL. The patient's nasopharyngeal swab test produced a positive COVID-19 result. Diffuse opacity was seen on a chest X-ray, and a thorax computed tomography scan confirmed bilateral ground-glass opacities (Figure 1).

The patient was started on favipiravir, hydroxychloroquine and supportive treatment. The patient was intubated on the eighth postoperative day after experiencing a decrease in saturation and dyspnea, providing mechanical ventilator support. On the second day of mechanical ventilator support, the patient's blood oxygen saturation decreased upon high positive pressure ventilation (Peak Inspiratory Pressure 38 H_2O, Positive End-Expiratory Pressure 10 cm H2O, Inspired Oxygen Fraction 100%). An arterial blood gas analysis revealed pH, PaO_2 and PaCO2 to be 7.28, 61mmHg and 115 mmHg, respectively. We established V-V ECMO as the patient had developed hypoxia and hypercarbia, despite optimal treatment (Figure 2). A 19 Fr heparin-coated cannula was used for the cannulation of the right internal jugular vein, and a 23 Fr heparin-coated cannula was used for the right femoral vein. The ventilator settings were set to rest lung mode with a 2 ml/kg tidal volume, PEEP 10 cmH_2O and a respiratory rate of 10 bpm. On day the 13th of V-V ECMO, a chest X-ray revealed a large pneumothorax on the right and a chest drain was inserted. At the patient with persistent air leak, exudative pleural effusion was detected. *Acinetobacter baumannii* complex was grown in the culture from the pleural fluid, and antibiotic treatment was started based on the antibiogram. On the 39th day, V-V ECMO was weaned and the patient was followed up with mechanical ventilator support. The patient weaned from ventilatory support 15 days later and followed with nasal oxygen. A computed tomography of the thorax due to continued air leakage revealed a thickening of the visceral pleura of the right lung that had resulted in a trapped lung. Total decortication was planned (Figure 3). A thoracotomy was performed through the 5th intercostal space in the left lateral decubitus position, and air leakage was observed at the lung's apex, where the pleura had become thickened, preventing the expansion of the lung parenchyma tissue. The thickened visceral pleura was stripped, allowing lung expansion, and a wedge resection was performed in the area with air leakage at the apex. Pleural pathology revealed chronic nonspecific inflammation, interstitial fibrosis and organized granulation tissue fibrosis (Figure 4).

The need for nasal oxygen decreased in the postoperative follow-up and the air leakage reduced. The patient began to complain of abdominal pain on the 7th postoperative day, and an abdominal examination revealed rebound and defense. The patient underwent emergency surgery during which bowel perforation was detected. He was placed on mechanical ventilation support due to a deterioration in general condition and respiratory depression and the air leaks increased due to the high pressure of the mechanical ventilation. As the air leak could not be controlled, the patient was evaluated surgically, and it was observed that his lung had been destroyed during the operation. A right pneumonectomy was performed, but after the first surgery the patient died of septic shock on the 193rd day.

DISCUSSION

COVID-19 infection has in rare cases been found to cause spontaneous pneumothorax, and usually in patients with barotrauma due to mechanical ventilation treatment or a pre-existing cardiopulmonary comorbidity (3). An alveolar-pleural fistula may develop causing persistent air leak, leading to prolonged hospital stay and high morbidity (4). Complications of persistent air leaks include pleural space infection, hypoxia and incomplete lung expansion.

The optimum approach to the treatment of prolonged air leaks and pleural thickening in COVID-19 disease remains controversial, and Current publications are limited to a number of case reports. A wide spectrum of treatments are suggested, from bleb resection to salvage lobectomy (5,6). While major surgeries, such as decortication and lobectomy, are not recommended as the first choice in treatment, successful results can be obtained in selected and necessary situations.

Pneumothorax is defined as a rare (1%) finding in patients diagnosed with COVID-19 (7). Although iatrogenic pneumothorax resulting from mechanical ventilation is rare, a fatal complication of high mortality of 15% (8). Previous studies have reported this rare complication to be associated with underlying lung disease (chronic obstructive pulmonary disease, acute respiratory distress syndrome) (9) On the other hand, pneumothorax may be the only reason for hospitalization during the medical treatment of COVID-19 (10).

As in cases of acute respiratory distress syndrome, the lungs of COVID-19 patients with significant interstitial involvement appear small due to low compliance and low elasticity (11) which may explain the prolonged air leaks and the reason for lung failure to fill the thorax. Excessive swelling and high PEEP in fibrotic and hypoelastic lungs can cause alveolar or pre-existing bleb rupture. Iatrogenic pneumothorax is seen only with disease progression in intubated COVID-19 patients, but is rare (12). Although the first-line treatment is chest tube placement, prolonged air leak should be investigated with thoracoscopy performed by venting the lungs with low tidal volume (13,14). The ideal time of such a procedure is uncertain, and we believe each case should be evaluated by a multidisciplinary team, with the procedure and timing decided upon considering the patient-specific pros and cons (6).

The traditional treatment of thoracic empyema is decortication (15) given the greater risk of mortality associated with nonsurgical treatment (16). Acinetobacter baumannii complex grew in the culture sample taken from the pleural drainage of our patient with ECMO support and general condition disorder, and antibiotic treatment was started based on the culture antibiogram. A chest tube was inserted to support the healing of the patient's parenchyma, while a "wait-and-see" strategy was applied in the identification of the effectiveness of the treatment.

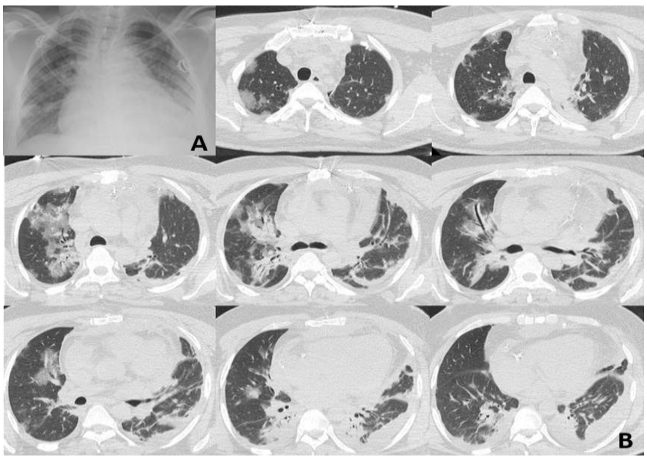

Figure 1: Bedside chest X-rays of suspected COVID-19 (A) and a chest computed tomographic scan revealed the presence of bilateral peripheral ground-glass opacities (B)

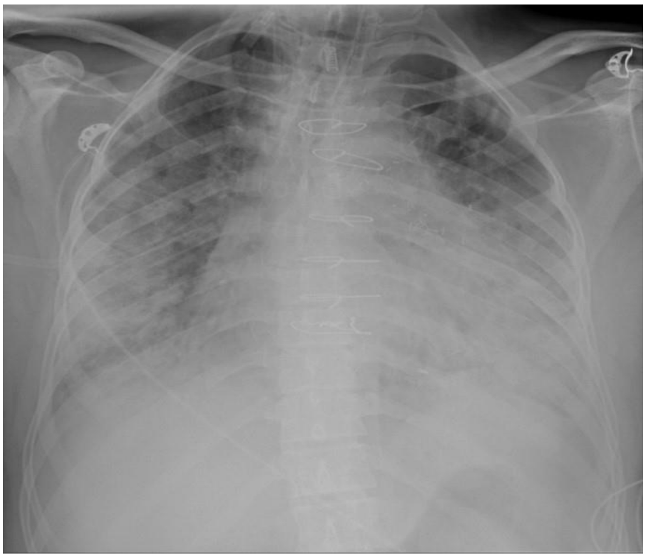

Figure 2: Chest X-ray before extracorporeal membrane oxygenation (ECMO) cannulation

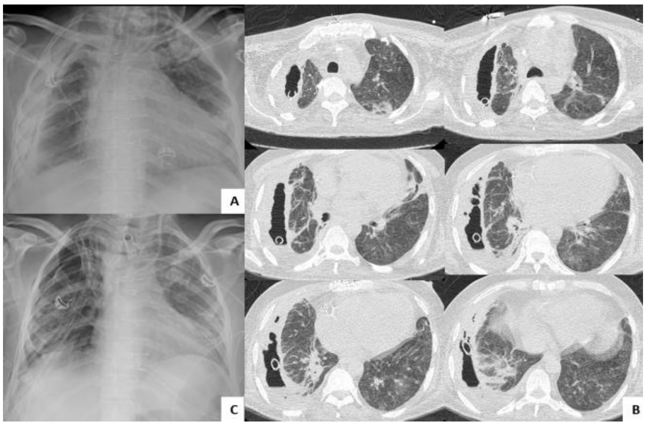

Figure 3: Chest X-ray before decortication (A), computed tomography of thick pleura before decortication (B), chest X-ray after decortication on the first day with three drains in the chest (C)

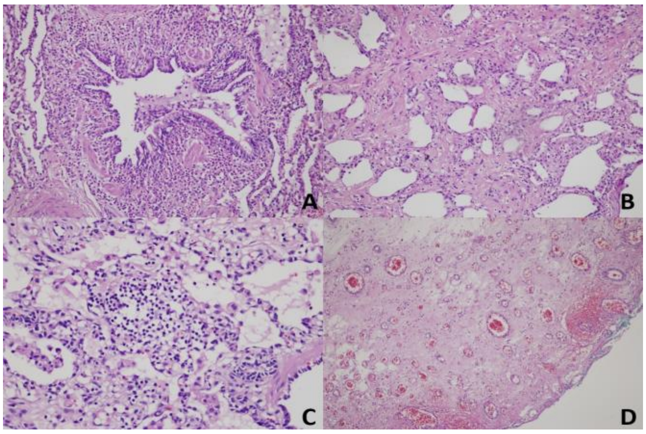

Figure 4: A. Bronchiolitis (A), fibrosis (B), lymphocytic infiltration (C), pleural edema and congestion (D)

Patient management was challenging due to an intestinal perforation that developed in the postoperative period that was one of the causes of mortality. Considering the etiology of such perforations, postoperative abdominal complications are closely related to the effect of extracorporeal circulation on gastrointestinal system blood flow. With both splanchnic hypoperfusion and impaired oxygenation in its pathogenesis, ischemia is thought to be the primary cause of most GI complications. Systemic inflammation and SIRS response occur as a result of reperfusion injury with the surgical stress response, contact with the CPB circuitry, mechanical ventilation and ischemia itself (which can activate and maintain SIRS). All these factors contribute to the improper distribution of blood flow and the disruption of mucosal oxygen delivery, and so patients with one or more of these factors should be carefully monitored for perforation (17).

CONCLUSION

Chest tube drainage is indicated as the first-choice treatment, and thoracoscopy may be necessary in persistent or recurrent pneumothorax cases. The timing of minimally invasive treatment is not certain, however, we believe early intervention with thoracoscopy should be attempted for the control of disease, and major surgery should not be avoided when deemed necessary. Early thoracoscopy ahead of complicated cases may result in better results and more effective air leak control.

COVID-19 infection has rarely been found to cause spontaneous pneumothorax, and patients usually have barotrauma as a result of mechanical ventilation treatment or a pre-existing cardiopulmonary comorbidity (3). An alveolar-pleural fistula causing persistent air leaks may develop and cause prolonged hospital stays and high morbidity (4).

Although chest tube drainage has been identified as a first-choice treatment, thoracoscopy may be necessary in persistent or recurrent pneumothorax cases. The timing of minimally invasive treatment is uncertain, although early intervention with thoracoscopy should be initiated to control the disease, and major surgery should not be avoided when deemed necessary. Early thoracoscopy ahead of complicated cases may lead to better results and more effective air leak control.

CONFLICTS OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

Concept - S.C., M.V., M.E.Ç., G.G., E.T., K.K.; Planning and Design - S.C., M.V., M.E.Ç., G.G., E.T., K.K.; Supervision - S.C., M.V., M.E.Ç., G.G., E.T., K.K.; Funding -; Materials -; Data Collection and/or Processing -; Analysis and/or Interpretation -; Literature Review -; Writing -; Critical Review -

YAZAR KATKILARI

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