A young severe COVID-19 case complicated with repeat pneumothorax

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Abstract

As you would be aware, COVID-19 has rapidly spread to a number of countries around the world. In our letter, we have reviewed chest imaging from a 36-year male with severe COVID-19. We found that his lung lesions started to gradually diminish after about a month. Besides, we found that invasive mechanical positive pressure ventilation had both positive and negative effects. Lung-protective ventilation strategies should be adopted and full attention given to iatrogenic injuries in the diagnosis and treatment of patients with COVID-19. This case report may have a significant impact on the clinical management of patients with COVID-19.

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Coronavirus disease (COVID-19) has rapidly spread around the world and has resulted in over four hundred twenty thousand deaths as of June 2020.[1-3]. Many patients with mild COVID-19 have minimal or no clinical symptoms. However, patients with severe COVID-19 can rapidly deteriorate and die from acute respiratory distress syndrome and multiple organ dysfunction syndrome [4,5]. Mechanical ventilation treatment and extracorporeal membrane oxygenation (ECMO) can be efficacious for severe and critical cases.

In the current case, a 36-year old male presented to a fever clinic on Jan 27, 2020, with a fever, cough, and headache. He had traveled to Wuhan, Hubei Province, China, on Jan 19, 2020. On Feb 3, 2020 (day 8 of illness), he was diagnosed with COVID-19 by real-time revere transcription-polymerase chain reaction assay. He was admitted to a specialist infection ward and received supplemental oxygen, antiviral treatment, and other symptomatic treatment. The patient's hypoxemia and shortness of breath worsened despite receiving high-flow nasal cannula oxygen therapy (67% concentration) on day 11. Due to this, he was transferred to the intensive care unit, where he received invasive mechanism ventilator support. While an intestinal feeding tube was being placed by gastroscopy on day 15, his heart rate increased, and systemic pressure dropped. A bedside chest radiograph showed right lung pneumothorax accompanied by subcutaneous emphysema of the chest wall, and that the right lung was compressed to less than 10% of the original volume (Figure 2a). The patient urgently received closed thoracic drainage. Six hours later, the chest X-ray showed that the lung had mostly recovered. However, over the next couple of days, because of severe lung lesions, repeated pneumothorax, and failure of wound healing due to the positive pressure ventilation, ECMO was started on day 19. After this, his oxygen saturation values increased to 90-95%, and the patient's clinical condition improved. On day 23, a lung X-ray showed new right lung pneumothorax accompanied by subcutaneous emphysema of the chest wall and that the lung was compressed to approximately 30% (Figure 2c). The endotracheal tube was removed on day 24, after which the pneumothorax gradually improved (Figure 2d). The patient was weaned off ECMO on day 31. A week later, lung computed tomography (CT) showed significant improvements in both lung lesions.

Discussion:

Regarding the disease course and imaging characteristics of the current case, a number of clinical implications are discussed below. The lung CT imaging suggested that the lesions in both lungs progressed in the first month of the disease course, with the last CT images showing significant improvements in both lung lesions (Figure 1). For most patients with COVID-19, especially younger or middle-aged patients, the clinical course may be self-limiting if they are provided with adequate symptomatic relief and supportive treatment. In patients recovering from COVID-19 (without severe respiratory distress during the disease course), lung abnormalities on chest CT were the most severe approximately 10 days after the initial onset of symptoms. The lesions were then gradually absorbed after two weeks [5]. In this case, the lung lesions started to gradually diminish one month after the onset of symptoms. This suggests that mechanical ventilation treatment and ECMO should be sustained for a more extended time period in some patients with severe or critical COVID-19.

During the course of the disease, repeat and refractory pneumothorax presented. The main reasons and mechanisms for pneumothorax are summarized below. First, the patient had an intestinal feeding tube placed by gastroscopy, after which hypertension and sinus tachycardia presented. Then, chest radiography showed right lung pneumothorax. The attending doctors considered that because of severe nausea and breath-holding, the pressure in his airways had increased, causing the rupture of the tracheal membrane and mediastinal emphysema, which in turn caused pneumothorax. Second, for this patient, invasive mechanical positive pressure ventilation had both positive and negative effects. Excessive positive pressure ventilation led to the excessive expansion of the alveoli, causing severe damage to the barrier between the lung epithelium and the endothelium. This enabled gas to enter the lung parenchyma and leak from the interstitial space, causing pneumothorax and subcutaneous emphysema. Finally, COVID-19 caused direct damage to the

alveolar cells, and subsequently, the accumulation of inflammatory cells and the release of inflammatory mediators (IL-1, IL-6, and TNF-α) promoted the occurrence and development of lung injury.

Therefore, lung-protective ventilation strategies are required for patients with COVID-19, and could be implemented in the following order: limit tidal volume, limit peak airway pressure, and use suitable muscle relaxants. The patient was put on ECMO due to severe lung injury and reduced peak airway pressure. However, without pneumothorax in the right lung, the patient would not have required ECMO treatment. Therefore, in the clinical diagnosis and treatment of COVID-19, attention to iatrogenic injuries should be given.

Abbreviations:

COVID-19: Coronavirus disease 2019

SARS-CoV-2: Severe acute respiratory syndrome coronavirus-2

ECMO: Extracorporeal Membrane Oxygenation

ARDS : Acute Respiratory Distress Syndrome .

MODS: Multiple Organ Dysfunction Syndrome

ICU: Intensive Care Unit

RT-PCR: Reverse-transcription-polymerase chain-reaction

IL: Interleukin

TNF-α: Tumor Necrosis Factor-α

CT: Computed Tomography

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DH designed the study and draft the manuscript, QF participated in imaging collection, XW revised the manuscript and participated in imaging collection.

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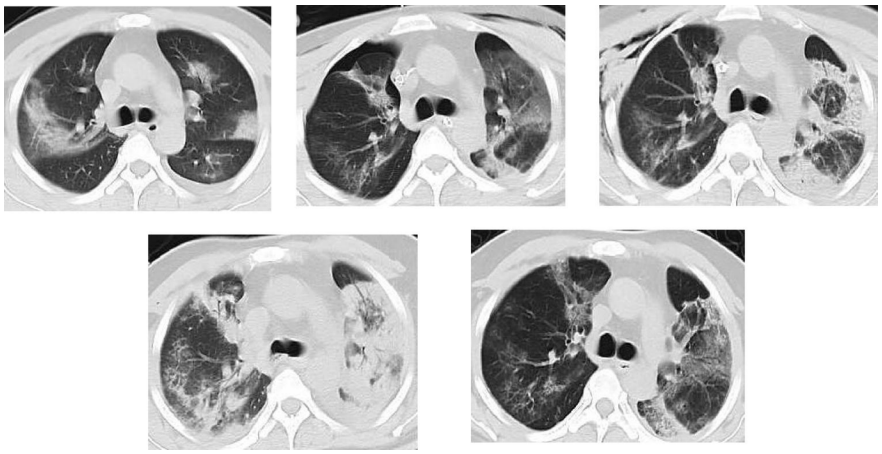

Figure 1 : Lung computed tomography (CT) from day 8, 21, 26, 31, and 37, respectively. These images suggest that the lesions in both lungs progressed in the first month of the disease course. The last CT shows significant improvements in both lung lesions.

Figure 2 : Right lung X-ray from day 15, 16, 23, and 25, respectively. The patient presented with right lung pneumothorax and subcutaneous emphysema of the chest wall. The right lung volume was compressed above 90% (Figure a), and he urgently received closed thoracic drainage. Six hours later, the chest radiograph shows that the lung had mostly recovered (Figure b). On day 23, the patient presented with new right lung pneumothorax (Figure c), and on day 25, the chest radiograph shows that the lung had largely recovered (Figure d).