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A case of large volume pneumomediastinum, extending to and surrounding the thecal sac, in a COVID-19 positive ventilated patient

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Abstract

A widespread prevalence of barotrauma among ventilated COVID-19 positive patients was observed during the pandemic. Some studies have associated COVID-19 related barotrauma with a longer length of hospitalization, longer ICU stay, and higher mortality.

Pneumorrhachis is the presence of intra-spinal air, it is a rare finding and is associated with different etiologies and possible pathways of air entry into the spinal canal. Air within the spinal canal can be separated into primary and secondary pneumorrhachis, and then further classified into extra- or intradural pneumorrhachis.
We present a case of severe COVID-19 infection requiring mechanical ventilation, proning, and subsequent barotrauma in the form of pneumomediastinum, and pneumorrhachis, that resolved with careful watching.

This case demonstrates the ongoing challenges of mechanical ventilation and barotrauma in COVID-19 patients. Although uncommonly associated with viral pneumonia, a higher incidence of barotrauma is being observed with COVID-19 infection. Given how rare and the different causative factors are, no standardized guidelines exist for the treatment of pneumorrhachis. It is however, thought to be associated with an increased morbidity and mortality. In this case, the air appeared to be contained by the dural sac and there was no resulting pneumocephalus. Although in general, this phenomenon is usually self-limiting and without further consequences, prompt consideration of the underlying cause is of extreme importance.

Keywords: Pneumorrhachis, Barotrauma, COVID-19

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Background

Pulmonary barotrauma refers to the spontaneous rupture of alveoli and the subsequent dissection of air into the various extra alveolar spaces. A widespread prevalence of barotrauma among ventilated COVID-19 positive patients was observed during the pandemic. Some studies have associated COVID-19 related barotrauma with a longer length of hospitalization, longer ICU stay, and higher mortality. [1]

Pneumorrhachis is the presence of intra-spinal air, it is a rare finding and is associated with different etiologies and possible pathways of air entry into the spinal canal. Air within the spinal canal can be separated into primary and secondary pneumorrhachis, and then further classified into extra- or intradural pneumorrhachis. Etiologically this can be separated into iatrogenic, traumatic, and non-traumatic. Specific conditions may directly or indirectly cause pneumorrhachis which include; trauma, respiratory pathologies and conditions that produce high intrathoracic pressure and barotrauma. It is most commonly associated with recent iatrogenic interventions including surgical, anaesthesia and diagnostic interventions, malignancy and its associated therapy or it may occur spontaneously. [2]

Case Presentation

A 31 year old male with a significantly elevated body mass index (BMI), presented to our institution with symptomatic hypoxic respiratory failure secondary to COVID-19. Apart from elevated BMI, he had no other co-morbidities and was a non-smoker. One week after developing symptoms, the patient presented to our emergency department in type 1 respiratory failure, with noted tachypnea.

The patient was commenced on non-invasive ventilation, intravenous antimicrobial and steroid therapy and admitted directly to our intensive care unit. On admission to the ICU, the patient had one session of self-proning, for approximately 4 hours.

However, due to worsening hypoxaemia and tachypnea, our patient required intubation and sedation along with neuromuscular blockade. By this time point a high inspired oxygen (FiO_2) requirement was required, and the patient was receiving a positive end expiratory pressure (PEEP) of 16 cmH_2O, with an accompanying plateau pressure of 29 cmH_2O and peak airway pressure of 33 cmH_20. Refractory hypoxaemia was evident on changing from prone to supine position.

A modest recruitment manoeuvre (20 seconds at 20 cmH_2O) was performed on the second day, immediately after turning from prone to supine. This was done to optimise oxygenation, attain some additional lung recruitment, and primarily to facilitate a transfer for an urgent CT pulmonary angiogram (CTPA).

On CTPA, diffuse ground glass opacification was seen bilaterally, consistent with COVID-19 infection. Large volume pneumomediastinum extending inferiorly below the level of the diaphragm, superiorly into the neck and upper chest wall and surrounding the thecal sac, was also noted (Figures 1-2).

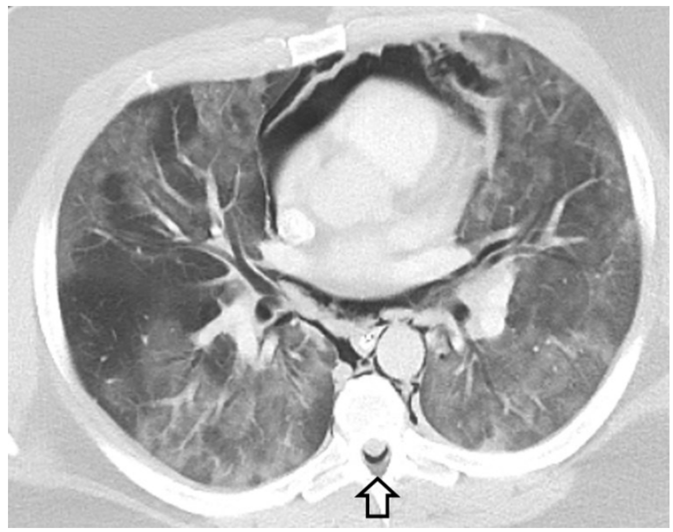

Figure 1: Large volume pneumomediastinum with highlighted air around thecal sac.

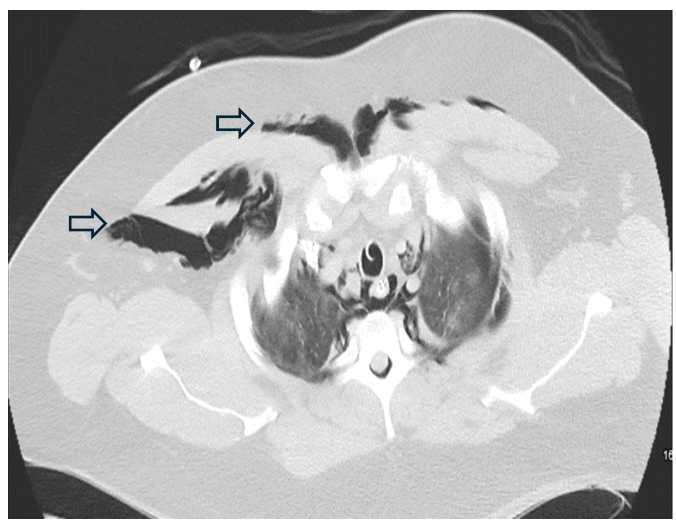

Figure 2: Significant subcutaneous emphysema (arrows) notable on CT.

By this stage intravenous sedation (propofol, morphine infusion) and neuromuscular blockade (atracurium infusion) were ongoing for almost 48 hours to facilitate lung protective ventilation, to minimize ventilatory dyssynchrony and to facilitate the proning regime. The volume of air around the thecal sac raised concerns about potential cephalad extension, with potential to cause pneumocephalus.

We felt could not reliably establish whether the patient was intact neurologically by clinical examination given his confounding sedative regime. A non-contrast CT brain was performed urgently, which showed no acute abnormality; particularly no pneumocephalus.

During the following week, the patient had multiple proning sessions and had a repeat CT scan, which demonstrated improving pneumomediastinum and resolving air around thecal sac. Two days post repeat CT scan, the patient was extubated to high flow nasal oxygen, and in the following days was discharged from critical care.

Discussion

This case demonstrates the ongoing challenges of mechanical ventilation and barotrauma in COVID-19 patients. Although uncommonly associated with viral pneumonia, a higher incidence of barotrauma is being observed with COVID-19 infection. Based on currently available statistics, the barotrauma incidence among COVID-19 patients requiring invasive mechanical ventilation ranges from 9%-32%. [1]

COVID-19 has been shown to induce an elevated level of tumor necrosis factor alfa (TNF-alfa) and Interleukin-6 (IL-6). [3] In animal models, TNF-alfa has been shown to induce apoptosis-driven alveolar damage. In the setting of mechanical ventilation, there is a proportional association between cytokine production, PEEP, and tidal volume. This would suggest that a high PEEP strategy and higher tidal volumes can further enhance the cytokine response, therefore worsening alveolar damage and predisposing to barotrauma. [1]

Due to pneumorrachis being a rare finding with different causative mechanisms, no empiric guidelines for treatment or standards of care exist. Some reports have proposed potential therapies including intravenous dexamethasone, administration of high concentrations of inspired oxygen with the concept of promoting reabsorption of air from the space and even potentially trials of hyperbaric oxygen therapy. [4]

Despite this, pneumorrachis is however thought to be associated with an increased morbidity and mortality. In this case, the air appeared to be contained by the dural sac and there was no resulting pneumocephalus. Although in general, this phenomenon is usually self-limiting and without further consequences, prompt consideration of the underlying cause is of extreme importance. [2]

References

1. Shrestha DB, Sedhai YR, Budhathoki P, et al. Pulmonary barotrauma in COVID-19: A systematic review and meta-analysis. Ann Med Surg (Lond). 2022; 73:103221.

2. Oertel MF, Korinth MC, Reinges MH, et al. Pathogenesis, diagnosis and management of pneumorrhachis. Eur Spine J 2006; 15 Suppl 5(Suppl 5):636-643.

3. Giamarellos-Bourboulis EJ. Complex immune deregulation in severe COVID-19: More than a mechanism of pathogenesis. EBioMedicine 2021; 73:103673.

4. Krishna RM, Phaneendra KS, Kola VR. Traumatic air myelogram. J Mech Vent 2023; 4(4):160-163.

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