

# COVID-19 and restrictive lung disease: A deadly combo to trip off the fine balance

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## Abstract

Coronavirus Disease (COVID-19) pandemic has so far led to innumerable deaths worldwide. The risk factors so far that have been most studied as poor prognostic factors are old age, individuals with multiple comorbidities and immunocompromised patients. Amongst the chronic lung diseases, most patients with COVID-19 reported so far had asthma, chronic obstructive pulmonary disease (COPD), and interstitial lung disease. Herein, we discuss the significance of restrictive lung disease during the COVID-19 pandemic as a potential risk factor via an example of a patient with kyphoscoliosis who succumbed to death due to COVID-19 pneumonia.

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## Case Report

A 57-year-old non-smoker, with a history of severe kyphoscoliosis associated with the severe restrictive defect, hypertension, hyperlipidemia, presented with chief complaints of fever, nonproductive cough, and worsening shortness of breath of 2 days duration (Figure 1A).

On arrival his vitals were blood pressure 123/56 mmHg, pulse rate 88 per min, respiratory rate 36 per min, temperature 101.3 F, oxygen saturation 86% on 6 liters nasal cannula. He continued to become more tachypneic, with labored breathing and use of accessory respiratory muscles as well as paradoxical abdominal breathing. Soon he was intubated because of increased work of breathing, respiratory fatigue, drowsiness, and hypoxia despite being on 15 liters nonrebreather in addition to a high-flow cannula with 100% FIO<sub>2</sub>. His initial blood gas showed a Ph of 7.289 with a PCO<sub>2</sub> of 68.2 mmHg, PO<sub>2</sub> of 53.4 mmHg, O<sub>2</sub> saturation of 81.8%. His labs were notable for leukocytosis of 14,700 cells/mcL, neutrophilia of 88%, lymphocytes 1300 /mcL, creatinine of 6.06, anion gap 19 mEq/L, bicarbonate 32 mmol/L, glucose of 320 milligrams per deciliter, calcium 7.9 mg/dL, albumin of 2.4 g/dL, lactate 1.6 mmol/L, serum ferritin 854 ng/mL, LDH 847 units per liter, and CRP 321 mg/L.

His Chest CT without contrast revealed multifocal predominantly ground glass and peripherally based opacities with additional confluent consolidation of the right base (Figure 1B). His chest x-ray showed increased opacity in the right mid to lower Lung (Figure 1C). The COVID-19 PCR test from the nasopharyngeal swab came back as positive. His EKG showed classical features of dextrocardia due to the anomaly of thoracic bone architecture (Figure 2). Treatment with hydroxychloroquine, azithromycin, and ceftriaxone was initiated. Unfortunately, his oxygen requirement kept increasing (FiO<sub>2</sub> 100%, PEEP of 16 cm H<sub>2</sub>O, Peak pressure of 46 cm H<sub>2</sub>O, Plateau pressure of 43 cm H<sub>2</sub>O), with neuromuscular blockade and triple vasopressor support (epinephrine, norepinephrine, and vasopressin). He succumbed to illness on the 5<sup>th</sup> day of hospital stay.

## Discussion

This case was our unique experience as we are seeing more COPD or interstitial lung disease as a factor for compromised lung function. The common CT chest findings of COVID-19 are bilateral patchy shadows or ground-glass opacities in the bilateral lungs [1,2]. We reviewed a few of the major studies reported from China and did not find any description of the restrictive lung disorders [3-5]. Almost all studies have quoted chronic lung disease as one of the

important risk factors. However, most of them have not specified the type of lung disease they suffer from. So far, we have evidence of smoking and COPD as risk factors mentioned in these studies. But do we have any potentials significant difference of mortality, mechanical ventilation, or intensive care requirement amongst different types of chronic lung disorders? This is very much possible that most of the studies so far are not focusing on the thoracic anatomical anomalies as risk factors compromising lung functions and thereby impacting COVID-19 pneumonia outcome.

In the index case, the plateau and peak pressures were high, and this could have been just because of the patient's thoracic cage abnormality. In the absence of esophageal pressure monitoring, it is difficult to definitively suggest whether poor compliance was because of the thoracic cage or the lungs. Disproportionately higher PCO<sub>2</sub> in acute on chronic respiratory acidosis, as compared to hypoxemia, also suggests the possibility that the kyphoscoliosis could be the primary culprit than the COVID pneumonia (which could be just a precipitating factor).

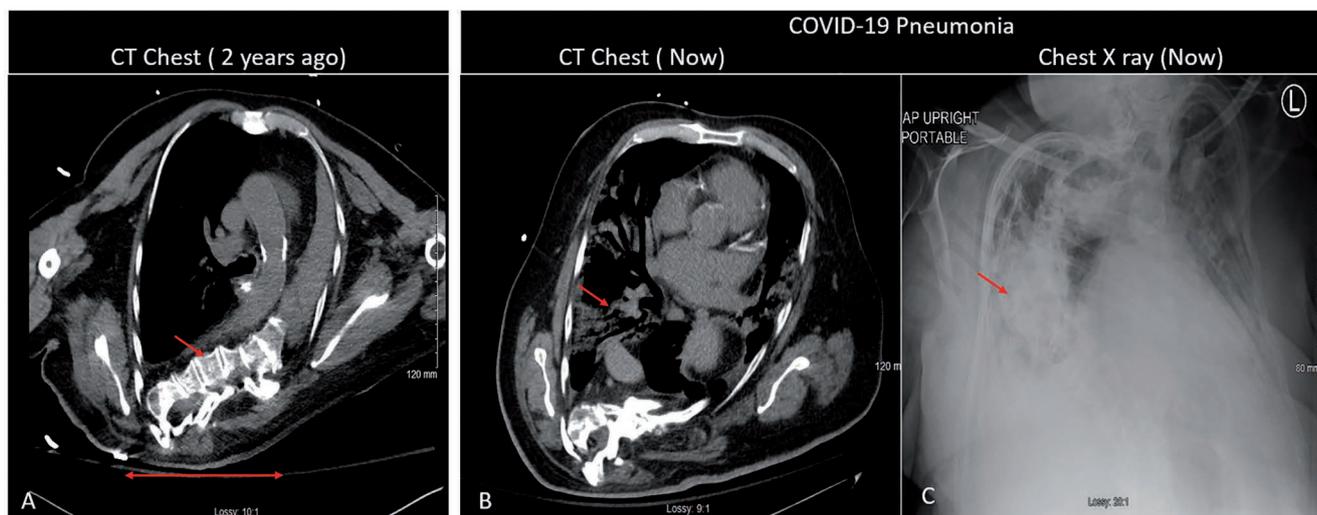


Figure 1. A) Baseline CT chest, 2 years ago (sagittal view) showing skewing of the thoracic framework with dextrocardia (mediastinal window) with significant loss of lung volume. B) CT chest (sagittal view) done during COVID-pneumonia showing consolidation, and breakdown. C) Chest X-ray showing opacities significantly involving the right lower and middle opacities.

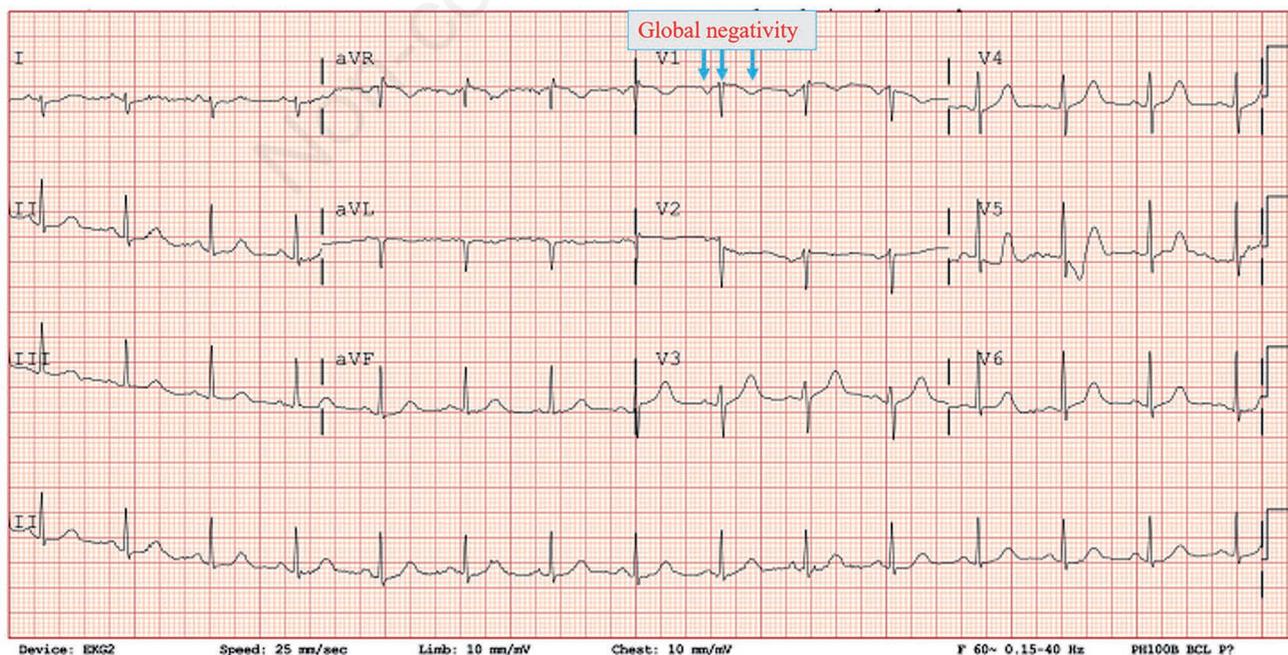


Figure 2. EKG showing inversion of all complexes, 'global negativity' (inverted P wave, negative QRS, inverted T wave).

In addition, it is essential to endorse the importance of NIV trial in patients with COVID-19 in whom it can be safely and successfully used [6]. This is also supported by the evidence from previous studies on coronavirus outbreaks. The literature has conflicting reports with epidemiological data suggesting that NIV could promote nosocomial transmission. In contrast, human laboratory data suggests that it does not generate enough aerosols [7-9]. In a 20-patient series of SARS related pneumonia, timely use of NIV effectively prevented endotracheal intubation in 70% cases [10]. During the initial few weeks of the COVID-19 pandemic, there was a scarcity of appropriate protective equipment (PPEs) to the health care providers [11]. In addition, few studies also suggested the benefits of early intubation to prevent patient self-induced lung injury [12]. However, considering the potential benefit of avoiding intubation, ensuring a good interface fitting for NIV, and appropriate use of PPE, intensivists need to use clinical judgment if patients could be benefitted from noninvasive strategies without compromising the health of health care providers [13]. Phua *et al.* recently suggested intensive care management recommendations which discussed the feasibility and potential benefits of NIV use [9].

Another unique characteristic of COVID-19 pneumonia is the recognition of different respiratory phenotypes [6,14,15]. The special population of COVID-19 is often described as COVID-19's 'happy hypoxia' in which patients are presenting with oxygen saturation well below 90%, but still without any respiratory discomfort or shortness of breath [6,15]. Gattinoni *et al.* described COVID-19 pneumonia disease spectrum in two primary "phenotypes", namely COVID-19 pneumonia, Type L, and COVID-19 pneumonia, Type H and proposed a different respiratory treatment for each of them [6].

Apart from the respiratory system, impact of COVID-19 on various other organ systems and their functioning are currently being studied by various basic science researchers and scholars [16]. Based on the available literature or proposed pathophysiological mechanisms, various newer diagnostic and therapeutic modalities are being studied for COVID-19.

## Conclusions

Hence, our case is an attempt to sensitize the research bodies to look for the association between the other lung pathologies (in addition to usual COPD, ILD) like scoliosis, kyphosis, and sleep apnea with COVID-19 pneumonia. While the COVID-19 pandemic is still evolving, understanding the correct pathophysiological mechanism of COVID-19 and ARDS is essential for appropriate treatment.

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