

Possible silent hypoxemia in a COVID-19 patient: a case report

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Case Report

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Abstract

Background: It has been hypothesized that silent hypoxemia is the cause of the rapid progressive respiratory failure with severe hypoxia that occurs in some patients with COVID-19 without warning. Here, we reported one COVID-19 case with the possibility of silent hypoxemia.

Case presentation: A 60-year-old male presented with complaints of cough that he felt starting two weeks before admission without any breathing difficulty. Complaints were accompanied by fever, runny nose and sore throat. Vital signs examination showed blood pressure 130/75 mmHg, pulse 84 times per minute, normal respiratory rate (RR) of 21 times per minute, body temperature 36.5 C, and 99% oxygen saturation with oxygen via nasal cannula 3 liters per minute were recorded. On physical examination, an increase in vesicular sounds and crackles in both lungs were identified. Chest x-ray showed bilateral pneumonia. Nasopharyngeal and oropharyngeal swab real-time polymerase chain reaction tests for COVID-19 were positive. On the third day of treatment, the patient complained of worsening of shortness of breath, but his RR was still normal with 22 times per minute. On the fifth day of treatment, the patient experienced severe shortness of breath with a RR of 38 times per minute. The patient was then intubated and his blood gas analysis showed respiratory alkalosis (pH 7.54, PaO₂ 58.9 mmHg, PaCO₂ 31.1 mmHg, HCO₃ 26.9 mEq/L, SaO₂ 94.7%). On the eighth day of treatment, his condition deteriorated starting in the morning, with blood pressure 80/40 mmHg with norepinephrine support, pulse 109 times per minute, and 72% SpO₂ with ventilator. In the afternoon, the patient experienced cardiac arrest and underwent basic life support, then resumed strained breathing with return of spontaneous circulation. Blood gas analysis showed severe respiratory acidosis (pH 7.07, PaO₂ 58.1 mmHg, PaCO₂ 108.9 mmHg, HCO₃ 32.1 mEq /L, SaO₂ 78.7%). Three hours later, he suffered cardiac arrest again, but was unable to be resuscitated. The patient eventually died.

Conclusions: Silent hypoxemia might be considered as an early clinical sign of deterioration of patients with COVID-19, thus, the physician may be able to intervene early and decrease its morbidity and mortality.

Background

The SARS-CoV-2 virus that causes Coronavirus disease 2019 (COVID-19) was declared a pandemic since the WHO decree on March 11, 2020, and has infected more than 10 million people and caused more than 508,055 deaths as of July 1, 2020 [1,2].

The early sign of severe disease of SARS-CoV-2 infection is pneumonia with respiratory failure, similar to acute respiratory distress syndrome (ARDS). Although hypoxic acute respiratory failure causes an increase in respiratory rate (RR), in some patients, a persistent normal RR was found and inconsistent with the severity of hypoxia. Some patients with COVID-19 reported experiencing rapid deterioration without warning. This reaction might be caused by 'silent hypoxemia'. Research has shown that failure of

pulmonary oxygen diffusion causes a gradual decrease in oxygen saturation [3,4]. Here, we reported one COVID-19 case with the possibility of silent hypoxemia.

Case Presentation

A 60-year-old male presented with complaints of cough that was felt for two weeks before admission without any breathing difficulty. Complaints were accompanied by fever, runny nose and sore throat. He had a comorbid condition of uncontrolled diabetes mellitus. His vital signs examination showed blood pressure 130/75 mmHg, pulse 84 times per minute, normal respiratory rate (RR) of 21 times per minute, body temperature 36.5 C, and 99% oxygen saturation with oxygen via nasal cannula 3 liters per minute were recorded. On physical examination, an increase in vesicular sounds and crackles in both lungs were identified. Laboratory tests showed an increase in C-reactive protein, neutrophil-lymphocyte ratio, aspartate transaminase, and alanine aminotransferase of 140 mg/L, 8.7, 88 μ /L, and 116 μ /L, respectively. Chest x-ray showed bilateral pneumonia (Fig. 1). Sputum and GeneXpert tests were performed, and the results were negative for tuberculosis infection. The nasopharyngeal and oropharyngeal swab real-time polymerase chain reaction tests for COVID-19 were positive. After admission, the patient received antibiotics and antiviral therapy based on the COVID-19 Prevention and Control guidelines by the Indonesian Ministry of Health [5], namely azithromycin, lopinavir/ritonavir, chloroquine sulphate, and medication for his diabetes. On the third day of treatment, the patient complained of worsening of shortness of breath, but his RR was still normal with 22 times per minute. On the fifth day of treatment, the patient experienced severe shortness of breath with a RR of 38 times per minute. The patient was then intubated and his blood gas analysis showed respiratory alkalosis (pH 7.54, PaO₂ 58.9 mmHg, PaCO₂ 31.1 mmHg, HCO₃ 26.9 mEq/L, SaO₂ 94.7%). On the following day, his blood gas analysis showed compensated respiratory alkalosis (pH 7.45, PaO₂ 64.6 mmHg, PaCO₂ 42.9, HCO₃ 29.9 mEq/L, SaO₂ 93.6%). On the eighth day of treatment, his condition deteriorated starting in the morning, with blood pressure 80/40 mmHg with norepinephrine support, pulse 109 times per minute, and 72% SpO₂ with ventilator. In the afternoon, the patient experienced cardiac arrest and underwent basic life support, then resumed strained breathing with return of spontaneous circulation. Blood gas analysis showed severe respiratory acidosis (pH 7.07, PaO₂ 58.1 mmHg, PaCO₂ 108.9 mmHg, HCO₃ 32.1 mEq/L, SaO₂ 78.7%). Three hours later, he suffered cardiac arrest again, but was unable to be resuscitated. The patient eventually died.

Discussion

Most of the patients with COVID-19 suffer from minor, acute pulmonary infections, and the mortality is around 2-7%. Some patients experience decompensation due to respiratory failure hypoxemia, and often without warning. This condition is caused by diffuse alveolar damage, alveolar fluid accumulation, and occasional hyaline membrane disease, leading to ARDS [6].

Hypoxemia itself is defined as a potential life-threatening condition characterized by a decrease in arterial PO₂ below the normal value. Hypoxemia documentation can be done by checking pulse oximetry and

arterial blood gas analysis. Hypoxemia occurs when PaO₂ is less than 80 mmHg, and severe hypoxemia is when it is less than 60 mmHg. There are four main factors that can impair pulmonary gas exchange and cause hypoxemia when breathing room air at sea level: hypoventilation, diffusion limitation, shunt, and ventilation-perfusion mismatch [7-9].

This unusual 'silent hypoxemia' phenomenon showed it is possible that the virus has an idiosyncratic effect on the respiratory control system. Angiotensin-converting-enzyme 2 (ACE2) receptors are highly expressed in the carotid bodies, which are also the same sites where chemoreceptors sense oxygen. ACE2 receptors are also widely expressed in the nasal mucosa. Symptoms of anosmia-hyposmia are experienced by a third of patients with COVID-19, and the olfactory bulb can be the entrance of the virus to the brain and may also play a role in depressed dyspnea response [10-11].

Moreover, ACE2 counteracts the physiological functions of ACE and results in the activation of the renin-angiotensin-aldosterone system (RAAS) related to blood pressure regulation through the conversion of Angiotensin I to Angiotensin II and the electrolyte homeostasis. During the hypoxia condition, Angiotensin II induces vasoconstriction to improve the ventilation-perfusion mismatch, however, at the same time also stimulates the pro-fibrotic effect, and both effects are aggravated by the concomitant upregulation of ACE2 [10-12].

Gattinoni *et al.* [13] suggested two primary phenotypes of hypoxemia in patients with COVID-19: type L and type H. Type L is caused by loss of respiratory regulation and loss of hypoxic vasoconstriction. The condition of hypoxemia is due to an increase in minute ventilation, mainly by increasing the tidal volume (up to 15-20 ml/kg). Meanwhile, type H is a transition from type L, which is associated with a more negative intrathoracic inspiratory pressure. Diffuse pulmonary microvascular thrombosis is also believed to be the cause of hypoxemia in patients with COVID-19 [14].

Pneumonia analysis of COVID-19 shows that the air sacs in the lungs of patients are not filled with fluid or pus as in pneumonia infections in general but instead the virus causes the air sacs to collapse, thereby reducing the oxygen level and causing hypoxia in the patient, but the reaction still enhances the normal lung ability to expel carbon dioxide. Since carbon dioxide removal is still effective, patients do not feel shortness of breath [15]. Risk factors for silent hypoxemia are old age and having diabetes [9]. Therefore, early detection of silent hypoxemia such as using prehospital pulse oximetry [5], or radiology imaging [16,17] might be used as a red flag sign of impending danger of eminent cardiac arrest or sudden respiratory failure.

Conclusions

Silent hypoxemia might be considered as an early clinical sign of deterioration of patients with COVID-19, thus, the physician may be able to intervene early and decrease its morbidity and mortality.

Abbreviations

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; COVID-19: coronavirus disease 2019, RR: Respiratory rate; ACE2: Angiotensin-converting-enzyme 2; RAAS: renin-angiotensin-aldosterone system.

Declarations

Ethics approval and consent to participate

The Ethical Committee of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada/Dr. Sardjito Hospital ruled the study exempt from approval because this study was a case report. The authors attest that full and informed consent was obtained from the patients who had undergone medical treatment in our hospital.

Consent for publication

Written and informed consent was obtained from the patients' parent for publication of this case report and the associated images.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

S and G conceived the study. ARF and G drafted the manuscript, S, MG, BN, and DA critically revised the manuscript for important intellectual content. S, MG, BN, ARF, and G facilitated all project-related tasks. All authors have read and approved the manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Figures

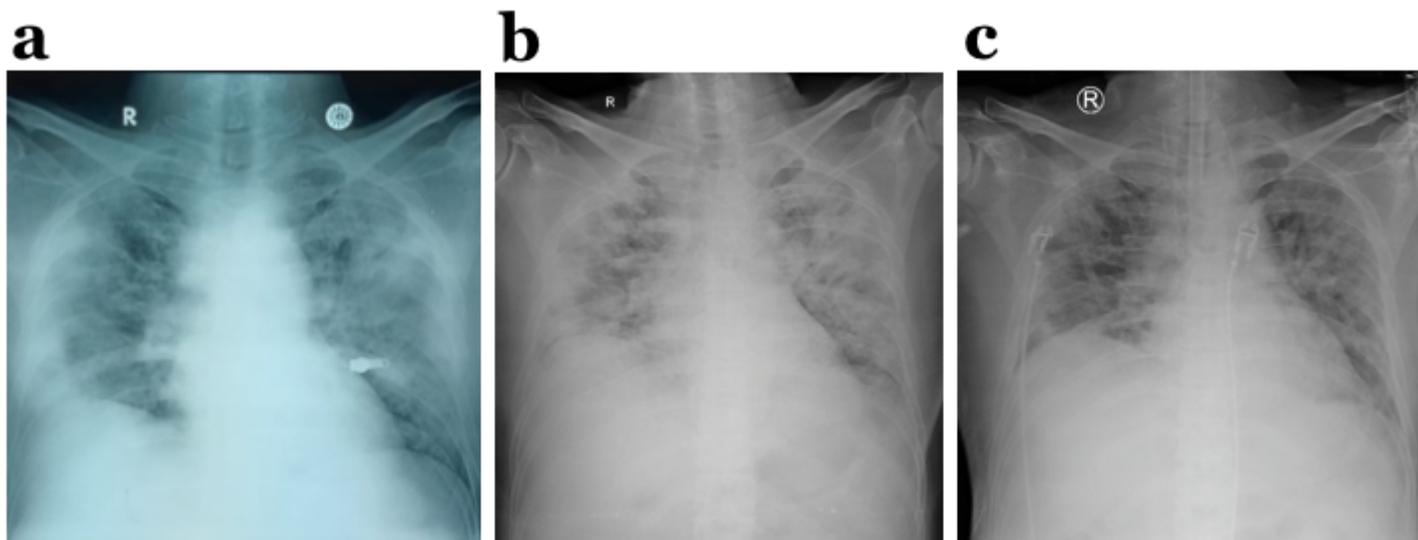


Figure 1

Chest x-rays: a) on the admission day indicated bilateral pneumonia, which is not compatible with the relatively slight clinical manifestations of patient, b) on the third day, and c) on the eighth day also showed bilateral pneumonia.