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# Silent hypoxia: A harbinger of clinical deterioration in patients with COVID-19

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ABSTRACT

Patients infected with the SARS-CoV-2 virus can present with a wide variety of symptoms including being entirely asymptomatic. Despite having no or minimal symptoms, some patients may have markedly reduced pulse oximetry readings. This has been referred to as "silent" or "apathetic" hypoxia (Ottestad et al., 2020 [1]). We present a case of a 72-year-old male with COVID-19 syndrome who presented to the emergency department with minimal symptoms but low peripheral oxygen saturation readings. The patient deteriorated over the following days and eventually died as a result of overwhelming multi-organ system failure. This case highlights the utility of peripheral oxygen measurements in the evaluation of patients with SARS-CoV-2 infection. Self-monitoring of pulse oximetry by patients discharged from the emergency department is a potential way to identify patients needing to return for further evaluation.



Infection with the novel coronavirus, SARS-CoV-2, leads to development of the syndrome COVID-19 [2]. The clinical manifestations of infection range from entirely asymptomatic to severe respiratory failure and death [3]. The SARS-CoV-2 virus infects the host using the angiotensin-converting enzyme 2 (ACE2) receptor [4]. The ACE2 receptor is a membrane-bound aminopeptidase expressed in numerous organs such as the lung, brain, intestines, and heart [5,6]. Published reports of histopathological examination of lung tissue describe alveolar and interstitial exudative inflammation with macrophage and monocyte predominance, as well as focal respiratory epithelial desquamation, hemorrhage, and type 2 pneumocyte proliferation [7,8]. Patients may develop a hyperinflammatory syndrome with a cytokine profile similar to secondary hemophagocytic lymphohistiocytosis [9]. An unusual clinical picture has emerged in some patients with SARS-CoV-2 infection: the development of hypoxia that is out of proportion to the patient's symptoms. This has been called silent or apathetic hypoxia [1,10,11]. Gattinoni et al. proposed that this clinical picture may represent a phenotype of COVID pneumonia (Type L), where there is low elastance and near normal compliance. The alternative phenotype, Type H, is similar to what is seen in acute respiratory distress syndrome (ARDS) [12]. In contrast, Ziehr et al. described a cohort of patients intubated early in the disease process. This cohort had low compliance and a uniform presentation consistent with the Berlin definition for ARDS [13]. Undoubtedly, our understanding of the respiratory mechanics found in COVID-19 will continue to evolve as additional research is reported. In the following case summary, we describe a patient who presented with minimal symptoms but was found to have a dramatic decrease in oxygen saturation.

A 72-year-old male with a history of diabetes, hypertension, and obesity presented to the emergency department for evaluation of shortness of breath. Three weeks prior to presentation the patient was diagnosed with influenza based on clinical symptoms and treated with oseltamivir. The patient reports that his symptoms continued to be mild with cough productive of minimal blood-tinged sputum. He denied having fevers, myalgias, headache, diarrhea, or loss of taste or smell. On the day of presentation, the patient was visited by his daughter who felt that he was having difficulty breathing. On arrival to the patient's house, paramedics found him to have an oxygen saturation ($SpO_2$) of 85% with normal respiratory rate and effort. The patient was given supplemental oxygen and brought to the emergency department (ED). On arrival to the ED, his vital signs were as follows: blood pressure, 118/77 mm Hg; heart rate, 80 beats/min; respiratory rate, 14 breaths/min; $SpO_2$ 88% on room air, and temperature, 38.8 °C. On examination, he was in no acute distress and conversant with unlabored speech. His breath sounds were unremarkable. The remainder of his examination was absent of any acute abnormality. Supplemental oxygen via nonrebreather mask at 15 L/min was administered as well as albuterol via metered dose inhaler. His oxygen saturation improved to 97% after these interventions.

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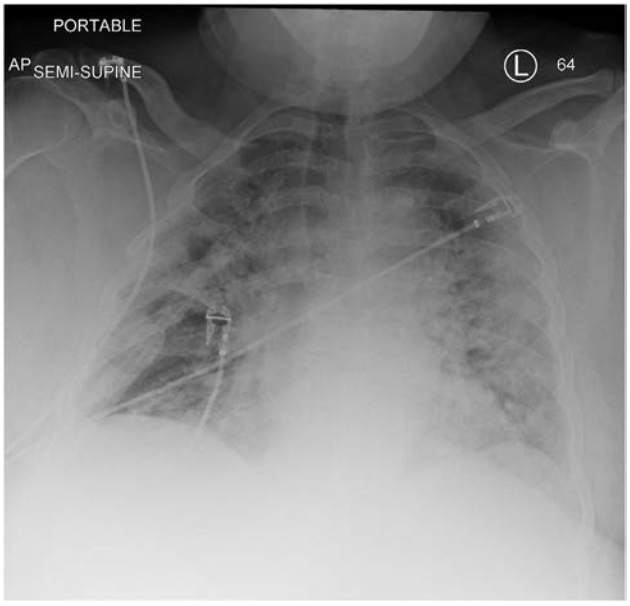


**Fig. 1.** Portable anteroposterior chest radiograph (CXR) demonstrating perihilar pulmonary opacities bilaterally.

Laboratory studies demonstrated the following values: blood glucose, 170 mg/dL; bicarbonate, 25 mEq/L; creatinine, 4.06 mg/dL; lactic acid, 0.4 mg/dL; white blood cell count, $6.6 \times 10^3/\mu L$. The white blood cell differential demonstrated lymphopenia of 10.5% (normal, 20–40%). A portable chest radiograph demonstrated perihilar pulmonary opacities bilaterally. The patient was admitted to the medical intensive care unit (MICU) for multifocal pneumonia, possible SARS-CoV-2 infection, and acute kidney injury (Fig. 1).

The following day the patient's SARS-CoV-2 test result was positive. His clinical course deteriorated while he was in the MICU and he was endotracheally intubated approximately 24-h after initial presentation. On the following days, he had interval development of shock requiring vasopressor support with multi-organ system failure. With consultation from the palliative care service, the family decided to no longer escalate care and the patient died on hospital day 8.

In this report, we have described a patient with COVID-19 due to SARS-CoV-2 infection who presented with hypoxia out of proportion to his clinical presentation. This "silent hypoxia" may be a clinical sign that providers can look for to determine if patients are at increased risk of sudden decompensation. Further study would be required to determine if home monitoring with pulse oximetry devices provides earlier recognition of patients requiring medical evaluation and supportive care.

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