



The Importance of Happy Hypoxemia in COVID-19

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Abstract

Background: Nowadays, the new coronavirus (SARS-CoV-2) and its complications are one of the main concerns of the world. One of the most severe complications of COVID-19 is hypoxemia.

Objectives: This study aimed to assess the importance of happy hypoxemia in COVID-19.

Methods: We systematically searched web of science, PubMed, and Google scholar databases to find articles related to COVID-19 and happy hypoxemia.

Results: COVID-19 causes a type of hypoxemia named silent (happy) hypoxemia, which has an atypical clinical presentation. This type of hypoxemia has not been noted before in viral pneumonia, and there is no specific treatment for this serious complication. Patients with silent hypoxemia may develop severe hypoxemia without dyspnea and with near-normal lung compliance. These patients are awake, calm, and responsive. Although their lungs are not oxygenated efficiently, they are alert and cooperative. Their condition may be deteriorated rapidly without warning and causes death.

Conclusions: According to the findings, paying attention to happy hypoxemia is important for improving the health status of COVID-19 patients.

Keywords: COVID-19, Coronavirus, Hypoxemia

1. Background

Nowadays the COVID-19, an infectious disease caused by SARS- COV-2, and its complications are major concerns of the whole world (1, 2). The most common symptoms of COVID-19 are fever, cough, fatigue, shortness of breath, and insomnia. Acute respiratory distress syndrome (ARDS), caused by cytokine storm, occurs in some patients with COVID-19. These patients are prone to develop multi-organ failure, septic shock, and blood clots as well (3-5). The main transmission method of COVID-19 is close contact with small droplets produced by coughing, sneezing, talking, or singing (4, 5). There are some known methods of prevention such as staying at home, washing hands, avoiding touching the eye, nose, and mouth, covering the mouth and nose with a proper mask, proper hand hygiene after cough or sneezing, social distancing, and using antiseptic solutions (6, 7). The lungs are the most affected organ because of the access of the virus to the host cells via the angiotensin-converting enzyme 2 (ACE-2) receptor (3, 4). The virus destroys the alveolar-capillary tissue and causes

edema, hemolysis, hemorrhage, and in some cases, superinfection (8). Endothelial damage through ACE-2 receptors leads to inflammation and coagulation cascade activation (5).

Diagnosis of COVID-19 is based on laboratory tests and chest CT-scan. The real-time reverse transcription-polymerase chain reaction (rRT-PCR) by nasopharyngeal swab is the standard test for diagnosing COVID-19 (5). On the other hand, chest CT scans may be helpful to diagnose COVID-19 in patients with a high suspicion of infection, but it is not recommended as a routine method. In early infection, bilateral atypical irregular multilobar ground-glass opacities with a posterior distribution are common (9). Lung ultrasound can detect COVID-19 earlier than chest X-ray (10).

2. Objectives

This study aimed to assess the importance of happy hypoxemia in COVID-19.

3. Methods

To prepare this brief report, we systematically searched web of science, PubMed, and Google scholar databases to find articles related to COVID-19 and happy hypoxemia.

4. Results

Hypoxemia is a condition that occurs when cells do not have enough access to oxygen. Normal arterial oxygen level is approximately 75 to 100 mmHg, and if falls below 90 percent, the patients may encounter hypoxemia. Generally, it leads to carotid body stimulation and sends signals to the medulla, and consequently causes increased phrenic activation and minute ventilation (11). Hypoxemia is one of the most important and deadly complications of COVID-19, which causes by pulmonary disorders (12). It is multifactorial (high permeability-type pulmonary edema, a significant venous admixture concomitant with a loss of hypoxic vasoconstriction) and may be occurred as a result of fluid-filled lungs leading to pneumonia or ARDS (3, 4). COVID-19 presents initially with a dry irritating cough and fever that accelerate heart rate and may be aggravated by hypoxemia (13). It causes a kind of hypoxemia named silent or happy hypoxemia. Patients with happy hypoxemia have severe hypoxemia without dyspnea and with near-normal lung compliance (14). These patients are awake, calm, and responsive. They may be quite sick. However, their presentation is not like typical ARDS. Their lungs are not oxygenated efficiently, but they are alert and feeling well. They may deteriorate rapidly without warning (15). It is noteworthy that in these patients, oxygen saturation level is in the range of 70 or 80. Even in drastic cases, it declines to below 65% of the normal level (16). To minimize the risk of hypoxemia, physicians frequently prescribe oxygen (12).

One of the most important issues about treating happy hypoxemia is how well they present with extreme hypoxia (15). The first step to reverse hypoxemia is increasing FiO_2 . Supplemental O_2 in moderate to severe COVID-19 can be used with a simple nasal prong or facemask with an oxygen flow, up to 5 - 6 L/minute. If desaturation presents (less than 88%) for a prolonged period, O_2 delivery can be increased up to 10 - 15 L/minute. The prone position facilitates ventilation to posterior lung zones and leads to improved ventilation-perfusion mismatch. High flow rates with nasal oxygen, in turn, result in increased FiO_2 . Although using a non-rebreathing mask does not create positive end expiratory pressure (PEEP) to open the collapse of small airway and alveoli, PEEP can be used with continuous positive airway pressure. It can be delivered by devices with PEEP valves that are resistant to exhalation, such as the linkage to a tight-fitting oro-nasal or full face mask or CPAP or helmet (16).

Tracheal intubation is essential for invasive ventilation. The most appropriate timing for intubation in severe types is not well known and depends on the patients' condition. It seems that younger patients can better tolerate hypoxemia and do not show severe respiratory distress or exhaustion. With current experience, the triage for intubation should not be based on hypoxemia alone and should be based on respiratory distress and fatigue (7).

5. Discussion

There are three hypotheses regarding silent hypoxemia in COVID-19 patients. The first hypothesis: SARS-COV-2 invades protein receptors on ACE-2 cells. This virus action can be a barrier to the passage of oxygen from alveoli to the blood while carbon dioxide is less impacted. This action causes early-onset inflammation of the tissue around the alveoli (16). The second hypothesis: SARS-COV-2, relates to the mismatch between oxygen movement in the lungs and the flow of blood. Blood flow to oxygen-rich zones of the lung may be stopped by tiny clots in blood vessels (16). The third hypothesis; SARS-COV-2 may act as a neural route through the facial, glossopharyngeal, and vagus nerves and causes inflammation in the nucleus of the salivarius. Moreover, the incidence of happy hypoxemia depends on the viral load, degree of inflammation, and brain stem damage (17).

It has been illustrated that some medications should be used to treat complications, but so far, there have been various controversies over the use of drugs. In summary, the commonly prescribed medicines include favipiravir, hydroxychloroquine, chloroquine, lopinavir, or darunavir plus ritonavir, remdesivir, acalabrutinib, meticillin, heparin therapy (for hypercoagulability and treatment of V/Q mismatch as the main causes of happy hypoxemia), and plasminogen (8). In a previous case report, investigators concluded that dexamethasone was associated with reduced need for mechanical ventilation by improving compliance and promoting better oxygenation (17).

Footnotes

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