Case Report

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A Case Series of COVID-19 ICU Patients who Improved without Requiring Intubation

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Abstract

The SARS-CoV-2 virus, more commonly known as coronavirus 2019 (COVID-19), is a novel respiratory virus that was first recognized in China and has now spread across the world. The outbreak of the "Coronavirus Disease 2019" (COVID-19) started in December 2019 and quickly became a sweeping and unprecedented challenge to different stakeholders in mainland China. Although the epidemic of COVID-19 is not yet over, it has already outpaced the previous severe acute respiratory syndrome (SARS) in 2003 and Middle East respiratory syndrome (MERS) in 2012. Approximately 3.2% of patients with COVID-19 required intubation and invasive ventilation at some point in the disease course. Providing best practices regarding intubation and ventilation for an overwhelming number of patients with COVID-19 amid an enhanced risk of cross-infection is a daunting undertaking. By putting patients on ventilators comes with risks, too, including infection and unintentional damage to the lungs. Very often, patients require heavy sedatives to paralyze them so doctors can get the breathing tube into the patients' windpipe. That procedure, called intubation, also carries the risk of infection and lung complications, and can expose health care workers to virus-filled respiratory droplets. This is a case series that explains the clinical outcomes of COVID-19 patients who have required high amounts of supplemental oxygen, but were able to improve without intubation.

Keywords: COVID-19; Respiratory therapy; Hypoxemia

Introduction

Thousands of individuals worldwide are unfortunately experiencing varying symptoms from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. While clinical trials are underway to test antiviral and immunomodulatory agents as treatment options, oxygen therapy is currently the main means of supporting patients with respiratory symptoms of coronavirus disease 19 (COVID-19). In moderate to severe cases, this virus has led to hypoxemic respiratory failure requiring various modes of oxygen delivery, including conventional supplemental oxygen via nasal cannula (NC), high flow nasal cannula (HFNC), non-invasive positive pressure ventilation (NIPV), and mechanical ventilation [2]. Here, we present three cases of COVID-19 patients in the intensive care unit (ICU) who received oxygen support via HFNC, but improved without requiring intubation.

Objective

To share clinical outcomes of COVID-19 patients who have required high amounts of supplemental oxygen, but were able to improve without intubation.

Case Series

Case 1

A 38-year-old patient with asthma on fluticasone/salmeterol and montelukast was admitted to the ICU with ongoing fevers and shortness of breath despite trial of oseltamivir, amoxicillin/clavulanic acid, and doxycyline at home. She denied any history of tobacco use or sick contacts. CT Chest showed multifocal ground glass opacities. Her nasopharyngeal swab test for SARS-CoV-2 came back positive. Upon transfer to the ICU from the medical floor, she required 8 liters of HFNC for oxygen saturation >92%. She had crackles at the bases of her lungs bilaterally with no appreciable wheezes. Venous blood gas (VBG) around that time showed pH 7.46 and pCO_2 38. No prior or subsequent blood gases were collected as she continued to do well clinically. Home montelukast was continued, but home fluticasone/salmeterol was replaced by budesonide/formoterol as the latter was available on

hospital's formulary. No additional standing bronchodilators or steroids were given. She required 8-10 liters of supplemental oxygen via HFNC for a total of three days, but this was soon weaned down. At discharge, she had normal oxygen saturation at rest on room air, but required supplemental oxygen with exertion.

Case 2

A 68-year-old patient with asthma on budesonide/formoterol, tiotropium, montelukast, and chronic steroids presented with days of fatigue and altered mental status. She had recently come into contact with a group of friends who returned from a trip abroad. At the time of ICU admission to an outside hospital, she had an oxygen saturation of 100% on 3 L by NC. Lung sounds were noted to be decreased with crackles in the bases bilaterally. VBG showed pH of 7.42 and pCO_2 is 42. She was initially given budesonide/formoterol, fluticasone nasal spray, and standing hydrocortisone (initial dose of 100 mg IV, then 50 mg IV three times daily) because she was also hypotensive and had been on chronic steroids. An arterial blood gas three days into the admission, at which point she required NIPV, showed pH of 7.47, pCO_2 is 30, and pO_2 is 156. Given this acute decompensation in her respiratory status, she was transferred to our hospital. At our hospital, NIPV was switched to 15 liters of HFNC. Lungs were noted to be clear on physical exam at the time. Steroids were discontinued as her hypotension improved with fluids. At maximum, she required between 10-15 liters of HFNC for a total of three days, but continued to appear well. At discharge, she required 1 liter of supplemental oxygen at rest.

Case 3

A 53-year-old patient with hypertension and hyperlipidemia presented with fevers and shortness of breath. He had tested positive for SARS-CoV2 when he initially presented to the emergency room five days prior with fevers, dry cough, and abdominal pain/diarrhea that had since resolved. At the time of his second visit, he required 7 liters of oxygen, but this quickly escalated up to 15 liters within several hours of admission. Similar to prior cases, he was monitored on HFNC as his oxygen requirement slowly came down during his hospital stay. At discharge, he required 2 liters of supplemental oxygen at rest.

Variables	Case 1	Case 2	Case 3
Date of symptom onset	03-06-2020	3-14-2020	3-22-2020
Interventions for COVID-19 inpatient	Supportive care	Remdesivir	Remdesivir
Antibiotics received inpatient	Vancomycin, Piperacillin/Tazobactam	Vancomycin, Cefepime, Azithromycin	Ceftriaxone, Azithromycin
Maximum oxygen requirement (duration)	8-10 L (3 days)	10-15 L (3 days)	7-15 L (2 days)
Oxygen requirement on discharge	2 L	1 L	2 L
Discharged to	Home	Home	Home

Discussion

Early intubation was discussed during the earlier phases of the COVID-19 outbreak when the disease was spreading fast and mortality rate was already high in Wuhan, China [3]. There were concerns that intubations were adversely delayed and used as a salvage therapy, resulting in prolonged periods of hypoxia and potentially adverse outcomes. In addition, early intubations and avoidance of HFNC or NIPV were commonly advocated as potential methods to minimize hospital-acquired COVID-19 and transmission to healthcare workers [4]. Anticipating increased need for intubations, institutions across the world were even preparing for ventilator shortages, especially as the turnaround time for patients with COVID-19 on ventilator support have been long.

The discussions regarding early intubation, however, have continued to evolve over the past two to three months because observations were being made similar to ours [5]. Patients may have needed high levels of oxygen for goal oxygen saturation of >90%, but they looked clinically well and were able to avoid challenges and complications of mechanical ventilation, including sedation, pain, anxiety, delirium, and ventilator-associated lung injury and pneumonia [6,7].

There has been understanding that increased respiratory drive, volumes, and mechanical ventilation itself could also cause extra stress to the lung tissues and ventilator-induced lung injury [8]. In fact, among the first critically ill COVID-19 patients in the United States, mechanical ventilation was initiated in 15 out of 21 patients (71%) [9]. All the patients on ventilators developed acute respiratory distress syndrome and had 67% mortality.

Non-invasive oxygen therapy can be delivered via NC, HFNC, or NIPV. HFNC has been shown to be efficient as it delivers heated, humidified gas at a higher FiO_2 and flow than NC would and further reduces anatomic dead space, work of breathing, and respiratory rate [10]. In fact, there have been studies that showed reduction in intubation with HFNC over NC, although it did not affect mortality or ICU length of stay [2]. HFNC has also been recommended over NIPV as there has been evidence for decreased risk of intubation with HFNC and greater risk of viral transmission of healthcare providers with NIPV [2]. In our case series, our patients were able to maintain good oxygen saturation without significant respiratory distress or worsening hypoxia, so we did not need to consider trial of NIPV. Our patients were managed in negative pressure rooms

and there was no transmission of COVID-19 to our healthcare workers from these patients [11].

Conclusion

This case series alone cannot really tell us what about these patients enabled them to tolerate high levels of HFNC without escalation and what distinguishes them from those who develop severe respiratory distress and multi-organ failure. All we have observed thus far is that these patients required two to three days of HFNC, up to 15 liters for goal oxygen saturation of >90%, before this was successfully weaned down over the next several days without significant respiratory distress. We hope to have a better explanation of this phenomenon as we continue to learn more about the pathophysiology of COVID-19, its impact on the lungs, and the hosts that improve without ventilation. Simultaneously, investigation of interventions that may defer mechanical ventilation, such as optimization of high flow oxygen, general diuresis, and proning are just as essential.

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