

Intubation May Be Avoided by Using NIV with Dexmedetomidine for Respiratory Failure with COVID-19

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Abstract

As respiratory conditions deteriorate with COVID-19, high flow nasal cannula (HFNC) therapy is often first used as nonintubated ventilation. However, if the respiratory condition continues to deteriorate, it remains unclear whether treatment should be changed to noninvasive ventilation (NIV) or intubation. A 47-year-old man was hospitalized for pneumonia due to COVID-19. After hospitalization, we started HFNC therapy. His respiratory condition worsened, so we changed treatment from HFNC to NIV with dexmedetomidine. Afterwards, his dyspnea, respiratory rate, and oxygenation gradually improved and he could change pronation position himself. On day 14, he transferred from the ICU to the general ward and was discharged on day 21. We found that treatment of exacerbated respiratory failure with COVID-19, even after HFNC treatment, may be able to avoid intubation by using NIV with dexmedetomidine. Moreover, this treatment could reduce the burden on hospital staff as it allowed the patient to change prone position himself.

Keywords

COVID-19, Dexmedetomidine, Noninvasive Ventilation

1. Introduction

The major morbidity and mortality caused by COVID-19 is due to acute viral pneumonia that evolves to acute respiratory distress syndrome (ARDS). As patients' disease process progresses, respiratory support as intubated ventilation or nonintubated ventilation is required. Early intubation, occurring within 24 h from ICU admission, tends to have higher mortality rates than late intubation [1]. Therefore, nonintubated ventilation is considered the first line of respiratory sup-

port. Noninvasive ventilation and high flow nasal cannula are both modalities for nonintubated ventilation. While these modalities improve oxygenation or dyspnea for respiratory failure with COVID-19, there are no robust data that consistently demonstrate that either of these modalities are successful at preventing progression to intubation. However, regarding non-COVID-19 acute respiratory failure, a previous study reported that HFNC improves mortality and intubated rate compared with NIV [2]. Other studies have also reported a high failure rate with NIV in patients with Middle East respiratory syndrome and other non-COVID-19 related causes of ARDS [3] [4]. For this reason, HFNC as nonintubated ventilation is primarily preferred for respiratory failure with COVID-19. However, when the respiratory condition deteriorates even after introduction of HFNC, it is still unclear whether treatment should be changed to NIV or intubation.

Moreover, NIV is more uncomfortable than HFNC and may be used with dexmedetomidine as sedation. Dexmedetomidine is a centrally acting sedative and anxiolytic, which may promote relief of anxiety from dyspnea and promote adherence to respiratory support from HFNC and NIV [5].

Here, we report the case of a 47-year-old man who had respiratory failure with COVID-19, where intubation was avoided by sedation management with dexmedetomidine and NIV after his status worsened with HFNC.

2. Case Presentation

A 47-year-old man was hospitalized for pneumonia due to COVID-19. He had no past medical or smoking history. On admission, his height and weight were 179 cm and 98 kg, respectively, and he had a BMI of 30. His vital signs were as follows: blood pressure of 122/79 mmHg; heart rate of 100 bpm; body temperature of 38.4°C; a respiratory rate of 20 breaths/min; and SpO₂ of 92% with oxygen delivered through a face mask (6 L/min). Physical examination showed no crackles. Remdesivir and dexamethasone 6 mg were started from day 1 of hospitalization. On day 2, his vitals were: body temperature of 37.1°C; and SpO₂ of 87% with oxygen delivered through a face mask (6 L/min). On day 4, his respiratory condition worsened, so HFNC therapy was started with FiO₂ 0.65%, and an oxygen flow rate of 40 L/min. On day 6, even though the HFNC setting was at FiO₂ 0.65% and oxygen flow rate was at 40 L/min, his SpO₂ was 90% or less, so he was transferred from the ICU to the general ward. On admission, laboratory tests showed white blood cells (WBC), 6,500/μL; hemoglobin, 14.5 g/dL; platelet count, 15,300/μL; C-reactive protein (CRP), 12.4 mg/dL; LDH, 437 IU/L; and ferritin, 2186.47 ng/mL. An X-ray scan of his chest showed a ground glass shadow in his lungs bilaterally (**Figure 1(A)**). A CT of his chest showed a ground glass shadow with dorsal peripheral dominance (**Figure 2**). At the time of transfer to the ICU, laboratory tests showed: WBC, 10,100/μL; CRP, 5.0 mg/dL; LDH, 364 IU/L; and an x-ray scan of his chest showed that the ground glass shadow was getting worse (**Figure 1(B)**). Intravenous methylprednisolone pulse was started after he was admitted to the ICU. We changed the oxygen from HFNC to NIV combined with dexmedetomi-

dine for sedation. Moreover, we encouraged the patient to change his pronation state, such as moving to a prone position and Sims position himself. The NIV setting was first started with FiO_2 0.65% and an intrinsic positive end expiratory pressure (PEEP) of 8 at the time of transfer to the ICU, with a SpO_2 of 96%, and a $\text{PaO}_2/\text{FiO}_2$ ratio (P/F) of 129.0. Self-prone position and self-Sims position also started at the same time. After administration of NIV with dexmedetomidine as sedation, his dyspnea improved and respiratory rate improved from an average of 35 breaths/min to 20 breaths/min. P/F was in the range of 110 - 130 from day 7 to day 9, with the NIV setting at FiO_2 0.65% and PEEP 8 (Figure 3). We tried to change the treatment from NIV to HFNC once a day but returned to NIV due to tachypnea and a decline in SpO_2 . After a methylprednisolone pulse, prednisolone 50 mg/day was started and CPR began to improve. On day 10, we were able to change from NIV to HFNC at a setting of FiO_2 0.65% and an oxygen flow rate of 40 L/min. Afterwards, P/F improved to a range of 140 - 160. On day 13, we were able to change from HFNC to nasal canula with an O_2 of 4 L/min. On day 14, he transferred from the ICU to the general ward. Afterwards, we tapered steroids, and an X-ray scan of his chest still showed an infiltrative shadow in his lungs bilaterally (Figure 1(C)). The patient was discharged on day 21 since his respiratory state improved. On day 49, a CT of his chest showed the ground glass shadow with dorsal peripheral dominance improved (Figure 4).

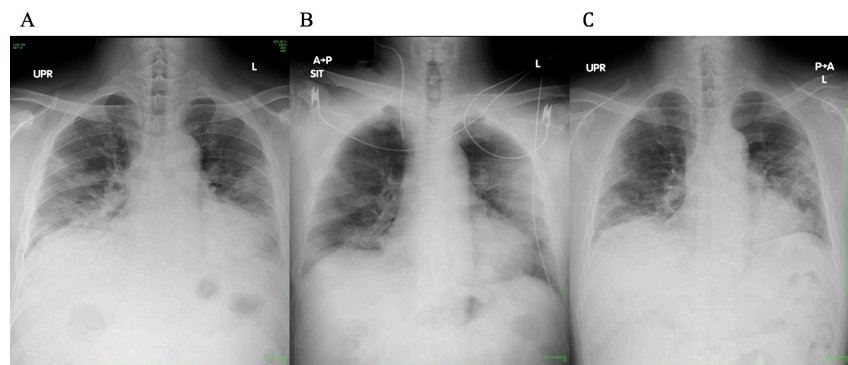


Figure 1. A: On admission, an x-ray scan of the patient's chest showed a ground glass shadow bilaterally in the lungs; B: At the time of transfer to the ICU, an x-ray scan of his chest showed deterioration of the left lung field; C: Before discharge, an x-ray scan of his chest still showed an infiltrative shadow in the lungs bilaterally.

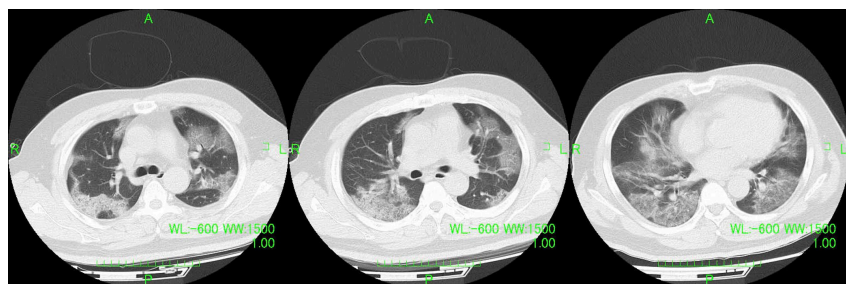


Figure 2. A CT of the patient's chest showed a ground glass shadow with dorsal peripheral dominance.

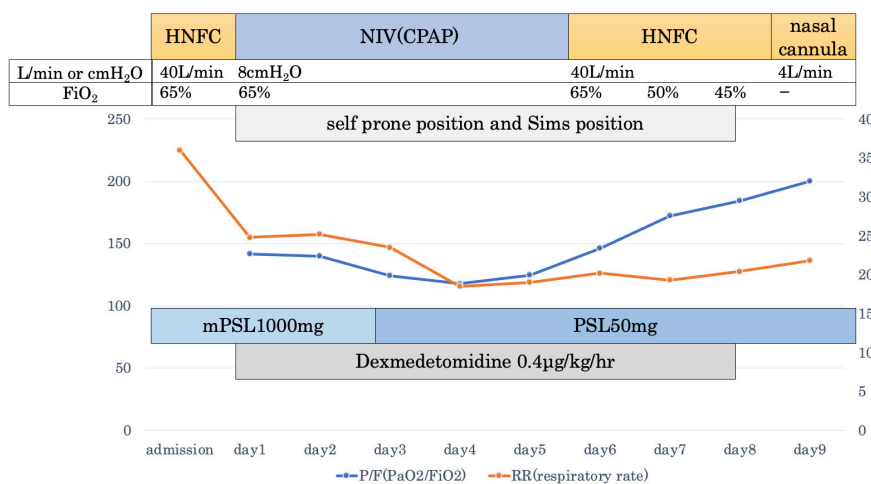


Figure 3. After using NIV together with dexmedetomidine, the respiratory rate decreased and P/F improved, and we were able to change from NIV to HFNC.

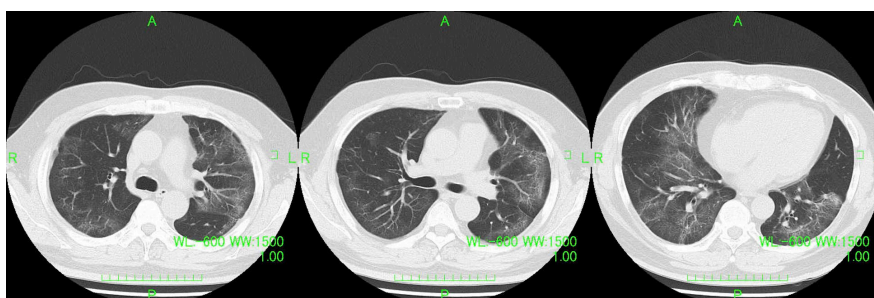


Figure 4. A CT of the patient's chest showed that the ground glass shadow with dorsal peripheral dominance.

3. Discussion

We found that some cases of exacerbated respiratory failure with COVID-19, even after the use of HFNC, may be able to avoid intubation by using NIV with dexmedetomidine as sedation.

In patients with respiratory failure with COVID-19, HFNC is generally preferred over NIV, as has been reported in cases of non-COVID-19 respiratory. However, it was also reported that between HFNC and NIV for respiratory failure with COVID-19, there was no difference in the number of free-respiratory-support days within 28 days of treatment; this report also stated that intubation was more so avoided with NIV treatment than with HFNC treatment [6]. Nevertheless, HFNC is preferred to NIV as it is a more comfortable and practical mode of support, during which patients can continue to converse and eat. However, when the respiratory condition deteriorates even after introduction of HFNC, it is unknown whether treatment should be changed to NIV or to intubate, and what the timing of such changes should be. If treatment is changed to intubation, resources such as personnel are required for positioning and care. NIV requires less personnel because it allows patients to change prone position themselves. In our case, treatment was changed from HFNC to NIV, and therefore intubation could be

avoided, and the patient could independently change his prone position.

In changing to NIV, we also used dexmedetomidine for sedation. NIV is more uncomfortable than HFNC and, in some cases, cannot be tolerated. Dexmedetomidine is a selective alpha-2 adrenergic agonist with sedative, anxiolytic, and modest analgesic effects, which may promote relief of anxiety from dyspnea. Moreover, dexmedetomidine has been thought to have less of a respiratory depressant effect than other sedatives [7]. In fact, when the amount of dexmedetomidine was increased to an extent that did not make the patient feel uncomfortable, dyspnea was reduced, and hypoxia tended to improve without excessive sedation. The mechanism of hypoxemia in COVID-19 is thought to be a disruption in pulmonary vasoregulation due to virally induced endothelial damage of pulmonary capillaries and ensuing V/Q mismatch [8]. Recent studies suggest that dexmedetomidine may enhance hypoxic pulmonary vasoconstriction, improve the ventilation/perfusion ratio, and consequently improve oxygenation [9]. Although it is possible that these effects may improve the respiratory state, in our case, we changed to HFNC once a day, and his respiratory condition worsened again. Although it is also reported that intubation could be avoided by using HFNC together with dexmedetomidine in exacerbated respiratory failure with COVID-19, it is possible that using NIV together with dexmedetomidine is more effective, considering this case [10].

As our patient's BMI was 30, he was considered obese. In previous reports of NIV treatment being better at avoiding intubation than HFNC, the average BMI was 27 - 28, which is considered overweight [6]. It is possible that this was also one of the factors that helped to avoid intubation. Moreover, side effects of dexmedetomidine include bradycardia, but no bradycardia was observed in this case.

The advantage of treatment with NIV and dexmedetomidine is that it was possible for the patient to self-prone without the need for many personnel. Awake pronation suggests a reduction of intubation rate and mortality rate for respiratory failure with COVID-19 [11]. Prone position under mechanical ventilation requires a large number of personnel. But if the patient can be in the awake pronation position, the burden on staff can be reduced. Moreover, although some patients have difficulty with this maneuver due to discomfort from the mask and position, it promotes overall relief of discomfort by using dexmedetomidine. However, the question remains of when to intubate when respiratory failure, even with the use of NIV and dexmedetomidine, is exacerbated. There are currently no factors that can reliably tell which course a patient will take and no criteria for intubation. It is important to not delay intubation until the patient has features of impending respiratory arrest. Therefore, it is necessary to carefully observe respiratory rate, accessory muscle use, and abdominal paradox. It is also important to make a decision to intubate immediately if conditions worsen.

4. Conclusion

Patients with exacerbated respiratory failure due to COVID-19 may avoid intuba-

tion through the use of non-invasive ventilation (NIV) with dexmedetomidine as sedation, even in cases where high-flow nasal cannula (HFNC) therapy has failed. This approach can also reduce the burden on medical staff, as it allows patients to independently assume the prone position. However, it is crucial to promptly decide on intubation if the patient's condition deteriorates despite the use of NIV with dexmedetomidine.

Consent

Informed consent was obtained from the patient to report this case.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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