Case Report

Prolonged of Non-Invasive Ventilation in COVID-19 Patient: Intubate or not – A Case Report

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Abstract

Noninvasive ventilation (NIV) is one of the alternative therapies for patients with respiratory failure or acute respiratory distress syndrome to avoid endotracheal intubation and its adverse effects. COVID-19 is a disease attacking respiratory system, inducing hypoxic-type respiratory failure. This case report describes that NIV application is somewhat useful in a number of patients with COVID-19 pneumonia suffering from respiratory failure. Nevertheless, in some cases, endotracheal intubation was done. Meticulous observation on deteriorating clinical and laboratory signs is required to make an immediate decision to switch into invasive ventilator to avoid further worsening.

Keywords: Acute respiratory distress syndrome, COVID-19, noninvasive ventilation, respiratory failure

Introduction

Noninvasive ventilation (NIV) is indicated for patients with acute respiratory failure requiring ventilation support, but intubation is yet to be done. NIV is done by administering ventilation through a tight face mask without performing endotracheal intubation to avoid risk and complications related to the procedure. Several common NIV modes are continuous positive airway pressure (CPAP), bilevel positive airway pressure, and pressure-support ventilation.[1] NIV application in acute preoperative respiratory failure cases is highly effective; however, in pneumonic patients, using NIV for 2–10 days indicates a low success rate.[2]

Criteria for implementing NIV include (a) respiratory distress/failure marked by tachypnea (respiratory rate [RR] >30) and/or PaO_2/FiO_2 ratio <200 or $PaCO_2$ >45 mmHg, (b) no hemodynamic instability, (c) conscious and cooperative, (d) no airway obstruction and airway protection reflex is intact, (e) no facial anomaly which potentially complicates mask application, and (f) no gastrointestinal symptom namely vomiting, hematemesis, and abdominal distension.[1]

COVID-19 is caused by coronavirus attacking respiratory system inducing acute pneumonia and acute respiratory failure as a result of endothelial cell disruption in alveoli, inflammation, and thrombosis in pulmonary capillary.[3,4] COVID-19 patients with acute respiratory distress require inpatient hospitalization and 41% of those need oxygen therapy, of whom 4%–14% develop severe respiratory failure and 5%–12% require invasive and noninvasive mechanical ventilation support.[5,6]

Surviving sepsis campaign recommendation in patients with COVID-19 is: (1) oxygen supplementation in patients with SpO2 <92%, (2) maintain SpO2 96% with or without oxygen supplementation, (3) high-flow nasal the cannula (HFNC) is preferred over NIV in patients with hypoxic-type respiratory failure, (4) in cases where HFNC is not available, and endotracheal intubation is yet strongly indicated, NIV is an option, along with closed observation for deterioration signs or respiratory failure, and (5) early intubation when deterioration occurs.[6] NIV is also considered in patients with mild hypercarbia; nonetheless, oxygenation is still sufficient. For these cases, closed observation is required.

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Case Report

A 65-year-old female was hospitalized with COVID-19 pneumonia and respiratory failure. During history taking, the patient suffered from fever, cough, and sore throat for 5 days, followed by shortness of breath 2 days before hospitalized. The patient lives in local transmission area. The patient suffered from hypertension for the last 20 years and did not check up regularly.

The patient was hospitalized due to her heaviest symptoms, aggravating shortness of breath. Her COVID-19 rapid and polymerase chain reaction (PCR) test were positive. During physical examination, the patient was found to be fully conscious, blood pressure measurement 120/70 (90) mmHg, heart rate of 98 beats/min, RR of 30 breaths/min, and pulse oximetry reading of 94%–96% using nonrebreathing oxygen mask 15 L/min [Figures 1 and 2]. Chest X-ray revealed cardiomegaly and bilateral consolidation [Figure 2]. Laboratory examination revealed neutrophile–lymphocyte ratio of 9.7, leukocytosis (13,100/mm^3), and hypoalbuminemia (3.1 g/dL), and blood gas analyses reflected acute respiratory distress syndrome (ARDS) with PaO_2/FiO_2 ratio of 90. Medications given are antibiotics (levofloxacin), anticoagulant (heparin), oral supplementation of albumin, hydroxychloroquine, and Isoprinosine.

On day two, the patient remained in shortness of breath with RR of 28–30 breaths/min. The patient was given 15 L/min oxygen face mask and awake prone position was implemented. On laboratory examination, D-dimer was found to be elevated (34,720 ng/mL) and blood gas analysis reflected oxygenation improvement with PaO_2/FiO_2 ratio of 151.

Clinical deterioration occurred on day three when oxygen saturation dropped to 88%–90% and compensated metabolic alkalosis was revealed (pH 7.44, PaCO2 43 mmHg, and BE 5.0) and PaO2 /FiO2 ratio decreased to 88. NIV therapy was implemented (PS 15, positive end-expiratory pressure [PEEP] 7 and FiO2 60%), resulting in Ppeak 18 mmHg, MV 11.2 L/min, TV 383 mL, RR 26, and SpO2 98%. After tight mask was confirmed sealed, peak pressure increased to 21–22 mmHg and RR was 24–26 breaths/min [Table 1].

On days four and five, the patient was fully conscious and communicative with respiratory support of NIV (PS 15 PEEP 7 and FiO2 60%), resulting in RR of 22–24 breaths/ min. Oxygenation was improved with PaO2 /FiO2 ratio of 210, and the patient was in respiratory acidosis condition (pH 7.27, PaCO2 57 mmHg, and BE 0.7) [Table 1]. The patient's cumulative balance was in excess of 1600 ml and furosemide pump was administered. PCR swab examination was done twice in different days and the results were negative.

On day six, the patient was found to be fully conscious and communicative with RR of 20–22 breaths/min, and blood gas analyses revealed compensated metabolic alkalosis (pH 7.35, $PaCO_2$ 54 mmHg, and BE 4.2) with PaO_2/FiO_2 ratio 0f 201.

On day seven, the patient was found to be fully conscious and communicative with RR of 20–22 breaths/min, and blood gas analyses revealed compensated metabolic alkalosis (pH 7.36, $PaCO_2$ 62 mmHg, and BE 9.6) with PaO_2/FiO_2 ratio of 164. Oxygen fraction was lowered to 40%–50%, and oxygen saturation was above 96%. Acetazolamide was administered while furosemide was incrementally reduced.

The patient's clinical condition was improved on days eight and nine with RR of 18–20 breaths/min. The patient was weaned from NIV and was given oxygen supplementation of 8 L/min via face mask. Oxygen saturation reading was 99%–100%. Blood gas analysis showed improved respiratory alkalosis (pH 7.39, $PaCO_2$ 42.7 mmHg, and BE 1.9) and PaO_2/FiO_2 ratio of 326. Acetazolamide and furosemide were discontinued.

The patient was given oxygen supplementation of 3 L/min via nasal cannula. RR was 18–20 breaths/min with SpO_2 reading of 98%–99%. Cumulative fluid balance was in a deficit state as much as 2000 mL.

On days thirteen to fourteen, the patient was not on any oxygen supplementation. RR was 20 breaths/min and pulse oximeter reading was 96%–98%; wound was found at the patient's face where the mask had been placed. The patient was sent to home.

Discussion

Acute respiratory failure in COVID-19 pneumonia was established based on ARDS criteria by Berlin definition in 2012: (1) oxygenation disorder with PaO_2/FiO_2 ratio <300 mmHg, (2) opacity in chest X-ray, and (3) heart failure and fluid overload are unlikely causing the condition.[4,7,8] Nevertheless, several criteria are unsuitable for non-COVID-19 ARDS, so the onset of the disease, which is more than 1 week, average lung compliance in several patients and clinical symptoms inconsistency with the severity of radiological and laboratory examination results.[8]

Berlin ARDS classification probably is not fully applicable for COVID-19, particularly in determining the severity of the disease course throughout the management, which is not identical to ARDS in general. Thus, COVID-19 management requires different individualized approach for each patient.[8]

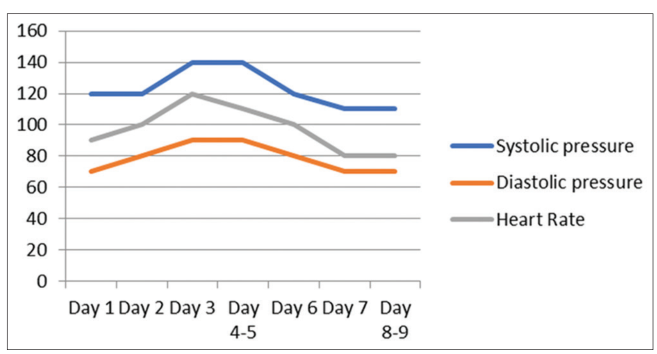

Figure 1: Hemodynamics of the patient

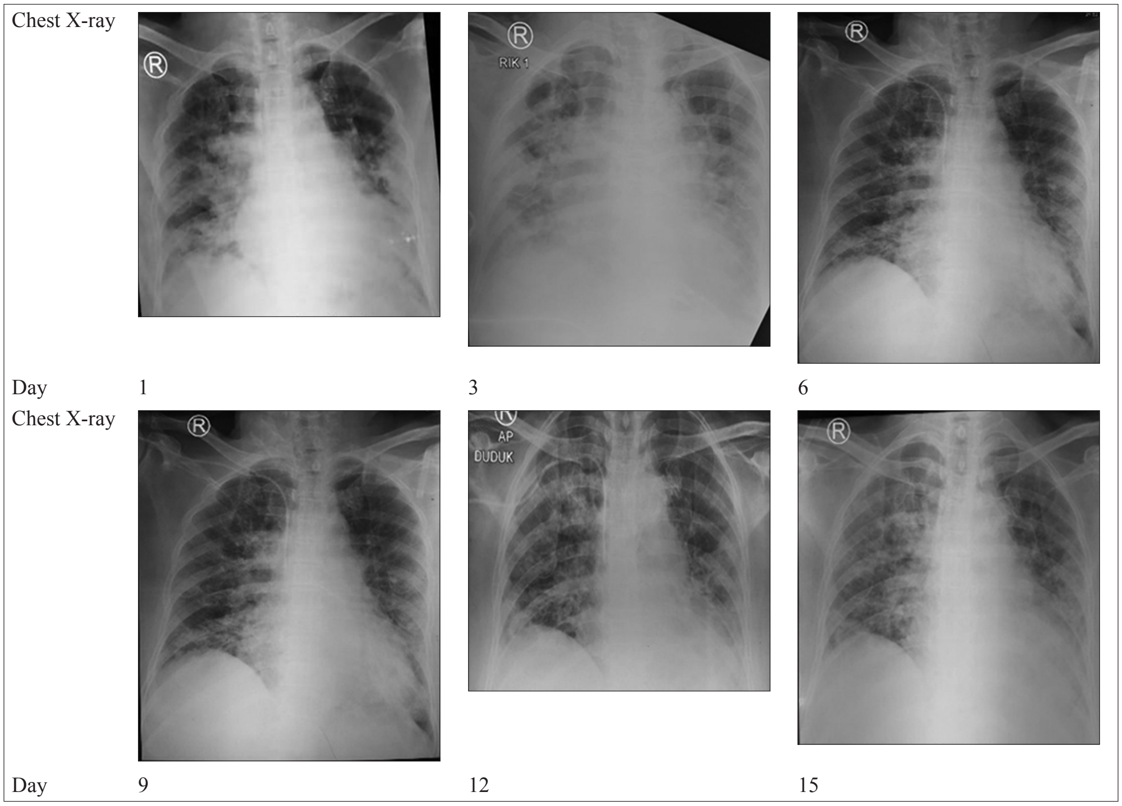

Figure 2: Serial chest X-ray

Table 1: Clinical and blood gas analysis progress

Day	Respiratory rate (breaths/min)	Saturation (%)	Oxygenation therapy	Blood gas analysis
1	30–32	94–96	NRM 15L/min	PH 7.39 PO_2 72 PCO_2 35 BE - 3.8 SaO2 94 % (PaO_2/FiO_2 ratio 90)
2	30	96–98	NRM 15 L/min + awake prone position	PH 7.39 PO_2 121 PCO_2 36 BE -3.2 SaO_2 99 PaO_2/FiO_2 ratio 151
3	24–26	98	NIV PS 15 PEEP 7 FiO_2 60%	PH 7.44 PO_2 53 PCO_2 43 BE 5.0 SaO_2 88 PaO_2/FiO_2 ratio 60% (before NIV)
4-5	22–24	99	NIV PS 15 PEEP 7 FiO_2 60%	PH 7.27 PO_2 126 PCO_2 57 BE-0.7 SaO_2 98 PaO_2/FiO_2 ratio 210
6	20–22	99	NIV PS 15 PEEP 7 FiO_2 60%	PH 7.35 PO_2 121 PCO_2 54 BE 4.2 SaO_2 99 PaO_2/FiO_2 ratio 201
7	20–22	99	NIV PS 15 PEEP 7 FiO_2 40%	PH 7.36 PO_2 82 PCO_2 62 BE 9.6 SaO_2 96 PaO_2/FiO_2 ratio 164
8-9	18–20	98–99	Oxygen mask	PH 7.39 PCO2 42.7 PO2 153.5 BE 1.9 PaO2/FiO2 ratio 326

NIV: Noninvasive ventilation, PEEP: Positive end-expiratory pressure, BE: Base Excess, PS: Pressure Support

Hypoxemic respiratory failure in COVID-19 differs from ARDS generally, wherein the severity of hypoxemia is incompatible with the respiratory system's mechanical function.[4]

Based on its pathology, COVID-19 hypoxemia is grouped into two types and established based on computed tomography scan image or lung compliance and response to PEEP when the patient is connected to the ventilator. NIV and CPAP are potential first-line therapy in improving oxygenation in conditions where HFNO is unavailable.[4,6]

Considerations to intubate and implement mechanical ventilation are as follows: (1) cardiopulmonary arrest, (2) airway patency disorder, (3) severe shunting (PaO_2/FiO_2 ratio < 100–150 mmHg), and (4) respiratory distress (RR >30 breaths/min) with work of breathing signs such as retraction, altered mental status, diaphoresis, tachycardia (heart rate >120 beats per minute), or hypoxemia (SpO_2 <93%) deteriorating after 2 h using HFNO or NIV.[8,9] Another indication for intubation is clinical deterioration signed by increased respiratory effort. Intubation was done to avoid hypoxemia transition from type 1 to type 2 caused by patient self-induced lung injury.[4]

Exaggerated respiratory effort leads to stress and strain changes in lung parenchyma inducing advanced lung trauma (atelectrauma–biotrauma) including healthy lung tissue.[10] Applying NIV facilitates respiratory process, improving oxygenation–ventilation, decreasing work of breathing, avoiding the risk of intubation, reducing excessive stress–strain, and inhibiting transition from type 1 (L type) to type 2 (H type).[4,11,12]

Patients with NIV required closed observation, and when clinical deterioration occurs, namely decreasing SpO_2, increasing RR, and altered mental status, intubation must be done immediately. In this case, significant clinical deterioration does not occur, and on the contrary, clinical symptoms (RR and oxygen saturation) and blood gas analyses improved. Increasing $PaCO_2$ and decreasing PaO_2 is caused by changes in ventilation/perfusion ratio, and over the course of compensating phase, pH is found to be normal. In general, PaO_2 will improve when NIV is implemented in this condition. Diuretics administration (furosemide) was done to maintain nonpositive fluid balance to meet one recommendation in COVID-19 patients, namely conservative fluid management. One of the risks of administering furosemide is metabolic alkalosis.[6,13]

Initially, fluid balance was found to be in excessive side; thus, diuretics was administered to achieve a more negative fluid balance. On the other hand, metabolic alkalosis in this patient might be advantageous combined with elevated $PaCO_2$ that maintains pH within normal range. The preferred diuretics in metabolic alkalosis is carbonic anhydrase inhibitor.[14] When clinical and blood gas analyses improved, diuretics were discontinued to achieve body normal balance.

The case-fatality rate for COVID-19 patients with geriatric comorbidity, cardiovascular disease, diabetes, chronic obstructive pulmonary disease, hypertension, and cancer using invasive mechanical ventilation is above 50%.[6,15] In this case, one of the reasons to postpone intubation is no clinical (respiratory and hemodynamic) as well as radiologic deterioration did not occur; thus, adverse risk of intubation could be avoided.

When treating patients with NIV, it is considered to take off NIV periodically, particularly when the patient is having meal. During this time, oxygen supplementation can be done via mask or nasal cannula and most importantly the patient must be informed and closely observed for any deterioration.

Microthrombi and elevated D-dimer in COVID-19 patients are common features and related to inflammation process and ischemia period. Anticoagulant administration and routine coagulation parameter assay are required during intensive care unit treatment. COVID-19 course in this patient is appropriate to the classic COVID-19 course, marked by oxygenation and ventilation disturbance. The state of “Happy Hypoxia” in these patients responded well to the management of NIV, as did other drugs such as anticoagulants, antibiotics, and other supporting drugs.[6,11]

Conclusion

Management of COVID-19 pneumonia differs from ARDS in general. Managing these patients needs to be tailored to patient’s clinical presentation and the type of hypoxemia as well as responds to therapies administered. Clinical presentation is determined by the type of hypoxemia and patient’s comorbidities, which means a very individual therapeutical approach. NIV implementation in patients with COVID-19 is done along with closed observation to any clinical, radiological, and laboratory deterioration. Intubation must immediately be done when the followings take place: altered mental status, increased work of breathing, hemodynamic instability, and severe worsening of blood gas analyses.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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