Case Report

Experience with Mechanical Ventilation of COVID-19 Patients at a Treatment Center in Nigeria: A Case Series

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Abstract

Despite the global burden of coronavirus disease 2019 (COVID-19), the experience of intubation and mechanical ventilation among severely ill COVID-19 varies worldwide. This study shares our experience on mechanically ventilated COVID-19 patients admitted into the intensive care unit of an isolation and treatment center of Federal Medical Center Katsina, North-western Nigeria. The clinical data obtained from a review of patient's medical record and folder include clinical presentation, radiological and laboratory findings, treatment and outcome. All the patients were males with ages ranging from 47 to 89 years. All the patients had severe disease with fever and difficulty with breathing being the most common presenting symptoms. All the patients were mechanically ventilated for a period spanning 1–5 days. There was a 75% case-fatality rate. This study showed that a few critically ill patients with COVID-19 in developing countries such as Nigeria may benefit from mechanical ventilation. The most common indication for mechanical ventilation among COVID-19 patients during the period of the survey was acute respiratory distress syndrome. Comorbidities are associated with a high mortality rate.

Keywords: Coronavirus disease 2019, endotracheal intubation, mechanical ventilation, mortality

Introduction

The novel coronavirus disease-2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); it has remained unabated despite the global effort at slowing down the infection. As at October 6, 2021, there were 236,726,720 confirmed cases worldwide, claiming nearly 4,834,213 lives.[1] The first case of COVID-19 reported in Nigeria was on February 27, 2020 and as at October 6, 2021, there were 206,920 confirmed cases with 2,740 deaths[2] with most of the confirmed cases (81%) being of the mild form.[3] Available data show that about 15%–20% of COVID-19 patients experience severe illness that may require intensive care management including mechanical ventilation.[4]

The use of mechanical ventilation in patients with COVID-19 has been reported to generate controversy.[5] This is not unexpected considering the uncertainty about the disease (COVID-19) and poor outcomes from earlier studies.[6] In Wuhan China where the disease was first reported, among the 2.3% of their patients that required mechanical ventilations, mortality rate was as high as 81%.[7,8] Similarly, in the United States of America, the mortality rate for ventilated COVID-19 patients was as high as 50%.[9] However, a study in Italy[10] and Georgia[11] found a much lower mortality rate of 26% and 36%, respectively, suggesting the plausible role of mechanical ventilation. The few studies conducted on mechanical ventilation among severe COVID-19 patients were mostly from developed countries with a paucity of data from developing countries including Nigeria. Hence, we share our experience on the management of four cases of COVID-19 that were mechanically ventilated during the first wave of the pandemic at a designated COVID-19 treatment center in Katsina, North-western Nigeria.

Access this article online

Quick Response Code:

Website: www.njmonline.org

DOI: 10.4103/NJM.NJM_177_21

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How to cite this article: Ibrahim S, Salisu I, Salahu D, Ibrahim O, Yusuf M, Iskilu U, *et al*. Experience with mechanical ventilation of COVID-19 patients at a treatment center in Nigeria: A case series. Niger J Med 2021;30:724-8.

Submitted: 10-Oct-2021 **Revised:** 10-Nov-2021
Accepted: 17-Nov-2021 **Published:** 27-Dec-2021

Patients and Methods

This study was a retrospective survey done on four patients admitted into the intensive care unit (ICU) of a designated COVID-19 treatment center in Katsina, North-western Nigeria between April and September 2020. All the patients were confirmed positive for COVID-19 with the real-time reverse transcriptase polymerase chain reaction test using oropharyngeal and nasopharyngeal swabs for the sample collection. The tests were conducted at the National Reference Laboratory in Abuja, Nigeria. Approval of the hospital's research ethical committee was sought for this study. We looked at the patients' demographic variables, clinical findings, and investigations which include full blood count, random blood glucose, and chest radiograph. We also examined the various treatment modalities offered to the patients including mechanical ventilation and finally the outcome of the interventions. A descriptive analysis was done using Microsoft Excel version, 2016.

Case Report

Case one

A 47-year-old male patient with Type-1 obesity (body mass index [BMI]-37 kg/m^2) was admitted into our ICU on account of suspected acute respiratory distress syndrome (ARDS) due to SARS-COV-2 infection. A clinical assessment revealed an axillary temperature of 36.8°C, respiratory rate of 36 cycles/min, an oxygen saturation ($SpO_{2)}$ of 88% while on room air. The pulse rate was 134 beats/min and the noninvasive blood pressure (NIBP) reading was 120/70 mmHg. He had a Glasgow Coma Scale (GCS) of 15/15.

The full blood count showed leukopenia with neutrophilia [Table 1]. Random blood glucose level was 8.8 mmol/l, chest radiograph could not be done due to logistic reasons.

Oxygen therapy was initiated using a nonrebreathing mask at 10 L/min and then increased to 15 L/m. At about 24 h into ICU admission, the SpO_2 dropped to 75% despite high flow oxygen therapy with a necessity for endotracheal intubation and commencement of mechanical ventilation. The ventilator setting was as follows: volume control mode, tidal volume of 6 ml/kg (600 mls), positive end expiratory pressure (PEEP) of 10 cmH_2O, and FiO_2 of 1.0. Oxygen saturation improved to 96% while on mechanical ventilation in the prone position. He however subsequently developed worsening oxygen saturations ranging from 78% to 85%, the patient died the following day.

Case two

An 89-year-old male patient known to have Parkinson's disease was admitted into our ICU with fever (axillary temperature of 39.5°C), difficulty in breathing and reduced level of consciousness with a GCS of 12/15. At presentation, he had a respiratory rate of 30 cycles per minute and an SpO_2 of 89% on room air. He had a pulse rate of 120 beats/min with a blood pressure of 100/60 mmHg. He was diagnosed with a case of sepsis in the elderly with a background of Parkinson's disease to rule out COVID-19.

Blood tests showed leukopenia with neutrophilia and deranged electrolytes, urea and creatinine [Table 1]. Chest X-ray revealed bilateral ground-glass opacities [Figure 1]. Random blood sugar was 9.0 mmol/l. SARS-CoV-2 test result turned out to be positive.

Earlier, the patient had been commenced on intravenous ceftriaxone and oxygen therapy at 6 L/min via simple face mask. The patient's clinical condition deteriorated 24 h into ICU admission with an episode of generalized tonic – clonic seizure, SpO_2 dropped to 83% with a further reduction in GCS to 6/15. Following the deteriorating clinical state, the patient

Table 1: Demographic, clinical presentation, laboratory finding, oxygen saturation, mode of ventilation, and survival outcome

Variable	Case 1	Case 2	Case 3	Case 4
Age (years)	47	89	57	69
Gender	Male	Male	Male	Male
Presenting complaints	Cough and difficulty of breathing	Fever and difficulty in breathing	Fever, difficulty in breathing, and loss of consciousness	Fever and seizure
Examinations finding (SpO_2/RR)	88%	92%	76%	72%
	36 cpm	30 cpm	40 cpm	32 cpm
WBC ($\times 10^9$/l)	N/A	5.5	12.8	4.4
Lymphocyte (%)	N/A	15	16.8	44.4
Neutrophil (%)	N/A	82	78.5	52
Hemoglobin (g/l)	N/A	11.8	13.6	7.5
Platelet ($\times 10^9$/l)	N/A	88	213	136
Ventilating mode and setting	Vt-600 mL, Freq-12, PEEP-10 cmH20, FiO_2-1.0	Vt-380 mL, Freq-12, PEEP-10 cmH20, FiO_2-1.0	Vt-400 mL, Freq-12, PEEP-10 cmH20, FiO_2-1.0	Vt-420 mL, Freq-12, PEEP-10 cmH20, FiO_2-1.0
Time spend on ventilation (days)	2	2	1	5
Survival	Died	Died	Died	Survived

RR: Respiratory rate, WBC: Whole blood count, Vt: Vital volume, PEEP: Positive end expiratory pressure, FiO_2: Fractional inspire oxygen concentration, Freq: Frequency or rate, N/A: Not available, SpO_2: Oxygen saturation

was intubated, and mechanical ventilation commenced with the volume control mode of ventilation, and tidal volume of 6 ml/kg (380 ml), PEEP of 10 cmH_2O, and FiO_2 of 1.0. The patient died 2 days later while on mechanic ventilator from multiple organ dysfunction syndrome.

Case three

A 57-year-old male who was known to be hypertensive was admitted into our ICU on account of ARDS caused by SARS-CoV-2 infection.

Admitting GCS was 15/15, vital signs revealed an axillary temperature of 36.1°C, respiratory rate of 40 cycles per minute, SpO_2 of 76%, pulse rate of 126 beats per minute and NIBP of 108/60 mmHg. Full blood count showed leukopenia with neutrophilia [Table 1]. Chest radiograph identified bilateral ground-glass opacities [Figure 2]. Random blood sugar was 9.3 mmol/l.

Oxygen therapy was initiated using a nonrebreathing mask at 10–15 l/min. Oxygen saturation did not improve despite high flow oxygen. This necessitated his intubation and mechanical ventilation with the following settings: volume control mode, tidal volume of 6 ml/kg (400 ml), PEEP of 10 cmH_2O, and an FiO_2 of 1.0. The patient died the following day due to suspected persistent hypoxemic respiration failure.

Case four

A 69-year-old male with no known comorbidity was admitted to our ICU on account of ARDS due to SARS-CoV-2 infection. He presented with fever (axillary temperature of 39.5°C), convulsion, and loss of consciousness; GCS was 3/15. He had a respiratory rate of 32 cycles per minute and SpO_2 of 72%. The pulse rate was 126 beats per minute while the blood pressure was 140/100 mmHg. Full blood count showed leukopenia with neutrophilia [Table 1]. Chest radiograph showed bilateral ground-glass opacities, [Figure 3] and random blood sugar was 6.0 mmol/l.

Oxygen therapy was initiated using a nonrebreathing mask at 10–15 L/min. Due to a nonimprovement in the oxygen saturation (SpO_2 fluctuated between 72% and 76%), he was intubated and mechanically ventilated with the following settings: volume control mode, tidal volume of 6 ml/kg (420 mls), PEEP of 10 cmH_2O, plateau pressure of 30 cmH2O and FiO_2 of 1.0. The FiO2 was gradually reduced from 1 to 0.6. The patient was gradually weaned off mechanical ventilation with the weaning mode of pressure support/ continuous positive airway pressure (PS/CPAP) after 5 days following improvements in oxygen saturation (SpO_2-96%) and consciousness level (GCS-12/15). He was discharged from the ICU 2 days after extubation and with significant improvement.

All four patients were given intravenous normal saline 1 L 8 hourly, intravenous Rocephine 1 g 12 hourly, tab lopinavir/ Ritonavir 400/100 mg 12 hourly, tab zinc sulfate 220 mg daily, tab Vitamin C 1 g daily, tab azithromycin 500 mg daily via NG tube, subcutaneous clexane 40 mg 12 hourly, and intravenous methylprednisolone 40 mg daily.

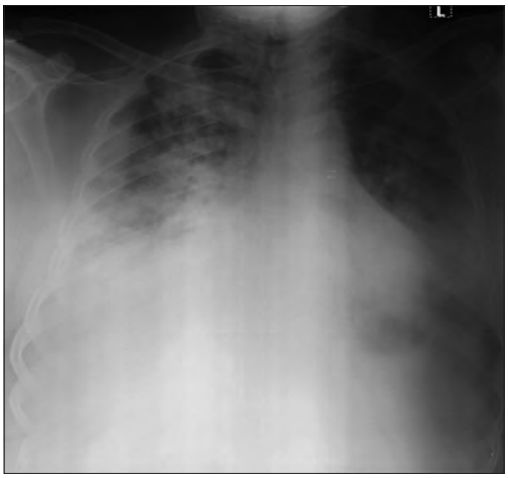

Figure 1: Chest X-ray for case series 2

Figure 2: Chest X-ray for case series 3

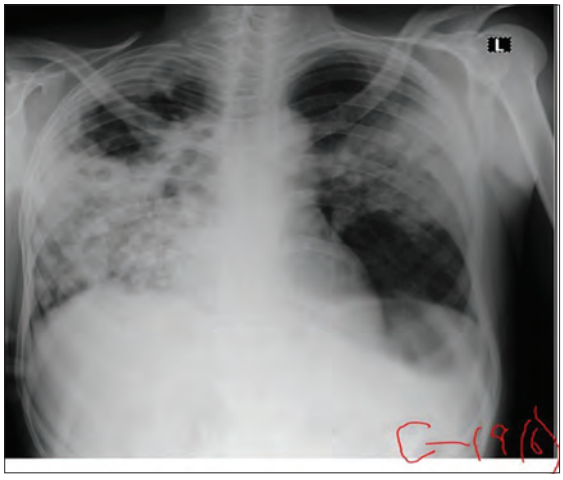

Figure 3: Chest X-ray for case series 4

Discussion

All our patients here reported are of the male gender with a mean age of 65.5 years. Of the four patients that required mechanical ventilation, three had comorbidities. The clinical

manifestations seen include fever, shortness of breath, increased respiratory rate, desaturation, and coughs. Two patients exhibited cerebrovascular manifestation with seizure and reduced GCS. Patients had abnormal full blood counts with leukopenia and neutrophilia, and chest X-ray findings all showed ground-glass opacities.

High flow oxygen was initially used to improve oxygenation in our patients; this had to be promptly substituted with mechanical ventilation when increased work of breathing was observed. This was necessitated by the fact that all our patients showed no improvements with oxygen therapy, although an arterial blood gas (ABG) analysis and repeat chest X-rays were not done, this might have resulted from ARDS and acute hypoxic respiratory failure. In severe ARDS, damage to Type II alveolar cells not only renders surfactant inactive, but these edematous alveoli also compress alveoli in dependent regions, thereby contributing to alveolar collapse.[12] This is consistent with the findings from a previous study by Whittle *et al*.[13] where patients had to be mechanically ventilated to achieve oxygenation, this suggests that mechanical ventilation has some role to play in the management of critically-ill COVID-19 patients including those from Nigeria.

The COVID-19 pandemic caused by the new coronavirus "SARS-COV-2" is a new challenge for ICU caregivers because of the increased demand for respiratory supports including mechanical ventilation. Type one respiratory failure is a cardinal clinical feature of critically ill COVID-19 patients that may necessitate mechanical ventilation. COVID-19 causes ventilation perfusion mismatch, alveolar collapse, poor compliance resulting in acute hypoxemic respiratory failure, and ARDS.[8] Recent studies have highlighted two phenotypes in COVID-19 pneumonia, the L-type characterized by normal compliance, low ventilation perfusion ratio, and low lung weight. Over time, the lungs may either improve or evolve into the H-type pneumonia characterized by low compliance, high right-to-left shunt, and increasing pulmonary edema, which contribute to the deadly cycle of hypoxemia and strain on body organs.[14] In this report, 3 of our 4 patients continued to desaturate and deteriorate despite being ventilated with 100% oxygen thus might have progressed to severe ARDS and respiratory failure. This may be likened to the H-type COVID-19 pneumonia as the three patients died depicting a case-mortality rate of 75%. A study by King *et al*.,[15] similarly documented a high mortality rate among COVID-19 patients who had invasive mechanical ventilation with an overall mortality rate of 42.7%, their patients that were older than 70 years however had a mortality of 83.4%.

A study in Wuhan, China also showed high mortality with 30 (81%) out of 37 COVID-19 patients that required mechanical ventilation dying 28 days into intubation and ventilation.[8] Although the pathologies in the lung are still on going, early commencement of mechanical ventilation has been reported to be associated with poor outcomes.[16] In our cases, the patients were intubated early following worsening oxygenation despite being on high flow oxygen therapy. The presence of an underlying comorbidity has been identified to contribute to poor outcomes in ventilated patients as was seen in our patients.

One of our patients (case one) was ventilated while in the prone position. Prone positioning has the benefit of reopening collapsed alveoli, as the heart rests on the sternum and exerts less pressure on the pleura and lung. This together with the lung recruitment manoeuvre opens the dorsal parts of the lung and allows more homogeneous ventilation and perfusion.[17] We saw an initial improvement in oxygen saturation (from 75% to 96%) while in the prone position, this was however not sustained.

All the patients in this study had leukopenia and neutrophilia, thrombocytopenia was also documented in one of the patients, this was similarly reported by Liu *et al*.[18] who documented that as the illness progresses, neutrophilia emerges in several cases, and patients with severe critical pulmonary conditions show unusually higher neutrophils. Thrombocytopenia results from the consumption and reduced production of platelets in damaged lungs.

All our four patients were given lopinavir/Ritonavir, zinc sulfate, Vitamin C, azithromycin, and methylprednisolone. To date, no consensus guideline has been developed for COVID-19 treatment, various treatments with immunomodulators, antivirals, and interleukin inhibitors are given with hopes of halting the progression of the disease. More so, the disease displays atypical presentations ranging from gastrointestinal symptoms, neurologic complications, antiphospholipid syndrome, and acute myocardial injury to fatal ventricular arrhythmia thus making the management more challenging.[19]

Limitation

Our case series was limited by a lack of ABG monitoring, the small sample size of four patients was also a limitation in this study

Conclusion

We conclude that critically ill COVID-19 patients in developing countries such as Nigeria may require mechanical ventilation mainly on account of worsening oxygenation levels.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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