Efficacy, safety and tolerability of early prone positioning in COVID-19 patients requiring high-flow nasal cannula: a case report.

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Abstract

A recent study shows the efficacy of early prone positioning (PP) in patients with acute respiratory distress syndrome (ARDS) requiring high flow nasal cannula (HFNC) or non-invasive mechanical ventilation. The effects of PP in Covid-19 patients on HFNC have not been reported.

Case Report: A 54-year-old man was admitted to our University Hospital with fever (39ºC) for eight days and progressive shortness of breath within the last 24h. A chest X-ray revealed bilateral infiltrates. Nasopharyngeal smear PCR for SARS-CoV-2 was positive. The patient was admitted to the ICU due to the progressive hypoxemia that required HFNC (FiO2 80%; 60 liters per minute). The patient rotated into lateral and PP for 4 hours each day for 4 days. Rotations to lateral and PP were well tolerated and improved markedly the PaO2/FiO2 ratio. Five days after ICU admission HFNC was changed by a venturi mask (FiO2 40%).

Conclusion: Awake prone and lateral positioning is well tolerated in COVID-19 patients requiring HFNC and could prevent invasive mechanical ventilation. This technique is simple and requires a very short learning curve, feature that represents a major advantage in a pandemic scenario, in which inexperienced healthcare professionals are treating an increasing number of severely ill patients.

Keywords: SARS-CoV-2, Covid-19, Non-invasive ventilation, High-flow nasal cannula, Prone positioning, Intensive care nursing.

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Introduction

In the pandemic SARS-CoV-2 outbreak around 20% of symptomatic cases present severe forms of Covid-19 requiring hospitalization [1,2]. Approximately 5% to 10% of patients require admission to an intensive care unit (ICU) and mechanical ventilation [3]. To date there is no specific treatment available and the main goal of supportive therapy is to ensure adequate oxygenation. Recommendations for ventilator support in Covid-19 patients are as follows: to start supplemental oxygen if peripheral oxygen saturation (SpO2) is<90%, maintain SpO2 no>96%, and to use a high-flow nasal cannula (HFNC) for acute hypoxemic respiratory failure despite conventional oxygen therapy [4]. The use of the prone positioning (PP) has also been recommended for patients with Covid-19 receiving mechanical ventilation [5]. HFNC prevents the use of invasive mechanical ventilation, reduces length of hospitalization and health cost resources and mortality [6,7]. A very recent prospective observational cohort study proposed that early use of HFNC plus PP in patients with moderate acute respiratory distress syndrome (ARDS) and baseline SpO2>95% may help to avoid invasive intubation [7]. We describe the case of a patient admitted to our hospital with SARS-CoV-2 infection and respiratory failure who was managed using HFNC and awake PP.

Case Report

A 54-year-old man presented in a university hospital emergency department with fever with fever (39ºC) for eight days and progressive shortness of breath within the last 24h. Vital signs were: blood pressure 150/80, heart rate 80 beats/minute, respiratory rate 14 breaths/minute and body temperature 35.9ºC. At physical examination, chest sounds on auscultation were normal, the abdomen was soft with no palpable mass and there was no hypoactive bowel sound and no peritonism. On admission, disease severity according to the Acute Physiology and Chronic Health Disease Classification System II (Apache II) was 4 and the Sequential Organ Function Assessment (SOFA) score was 4. The patient had a medical history of Lynch syndrome and gastroesophageal reflux disease which had been regularly followed up.

Laboratory tests revealed a normal hemogram, serum C reactive protein (CRP) of 13.73 mg/dL, normal troponin, normal kidney function, D-dimer 1300, aspartate aminotransferase 106 IU/L, alanine transaminase 55 IU/L and gamma glutamyl transferase 182 IU/L. Arterial blood gas analysis in ambient conditions disclosed the following results: pH: 7.48 mmHg, p02 53 mmHg, pC02 30 mmHg, and oxygen saturation of 95%. A chest X-ray revealed bilateral lung infiltrates, suggestive of COVID-19 pneumonia.

Under the diagnosis of Covid-19 pneumonia and according to our internal protocol, the patient was treated with nasal oxygen at 2 litres per minute (lpm) and received antiviral and antimicrobial therapy. The PCR test confirmed positive for SARS-CoV-2 on day 3 of hospital admission. At that time the patient's condition gradually deteriorated, with progressive respiratory insufficiency (PaO2 of 68 mmHg with FiO2 of 35%). Laboratory tests revealed a white cell count of 7000/mm3 and a CRP increase to 20 mg/dL. Kidney function remained within normal limits. The patient was admitted to the ICU due to the progressive hypoxemia that required HFNC plus high-flow oxygen, administered as 80% FiO2 at 60 pm, with the patient rotated into awake PP for several hours each day due to a PaFIO2 <150. The treatment was better tolerated by the patient when PP was combined with lateral position what was associated with gradual respiratory improvement. During the six days that the patient was in the ICU a total of 37 hours was in prone position, 38 hours in lateral position and 9 hours in prone plus lateral position. During prone and lateral position hours, an improvement in the oxygenation parameters was observed (Figure 1).

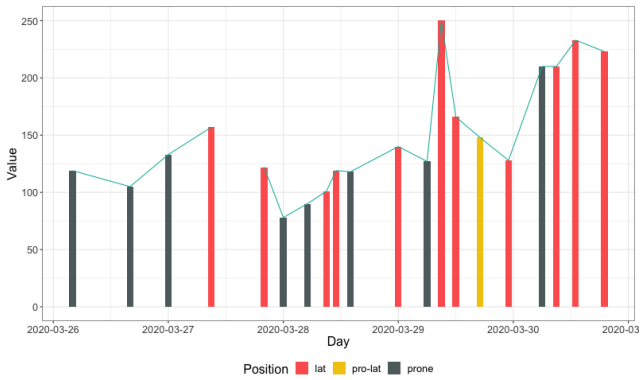

Figure 1. *Values of PAFI ratio and body positions of the patient during the ICU time.*

Five days after admission to ICU HFNC were changed by a venturi mask (FiO2 40%) with PaFIO2 of around 200. A day later, the patient was discharged from the ICU to a regular ward with the following arterial blood gases at FiO2 of 40%: pH 7.47, PaO2 89 mmHg, PaCO2 38 mmHg and PaFIO2 ratio of 222. Three days later the patient was discharged from hospital.

Discussion

Non-invasive ventilation (NIV) therapies have been recently proposed for the management of less severe cases of Covid-19 and ARDS, in order to avoid invasive ventilation. Among non-invasive options. HNFC and awake PP, continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BI-PAP) can be used provided the patient does not make excessive inspiratory effort. In our case, the patient improved progressively on HNFC combined with awake lateral and PP. Position changes were well tolerated and had no associated complications.

To date there have been few published experiences on the combined use of HNFC and awake PP. In a prospective observational study, Lin Ding et al. evaluated the early use of NIV or HFNC combined with awake PP, concluding that this approach is a safe and well tolerated option for a relevant portion of patients, as intubation was avoided in up to half of subjects with moderate-severe ARDS and the PaFIO2 ratio increased by 25-35 mmHg compared to the supine position (SP). Scaravilli described a series of 15 non-intubated patients with acute respiratory failure (ARF), observing that PP was associated with a significant improvement in oxygenation, whereas the PaFIO2 ratio of patients in supine positioning (SP) was poor. These patients showed a high tolerance to PP with no cases of accidental removal of catheters or probes or of the facial oedema and pressure ulcers typically observed in intubated patients in PP [1]. The absence of significant complications may be due to the fact that awake patients can themselves switch from PP to SP, ideally every 3 hours on average. Guo Wei Tu et al., in their series of 9 Covid-19 patients treated with HNFC and PP, changed the patients' position twice a day (leaving patients in PP between 1 and 4 hours daily), reporting improved oxygenation and the avoidance of intubation in 7 of their patients.

The position of our patient was changed every 4 hours. We also lateralized the patient, using pillows for support, as this position also maintained oxygenation (effectiveness was monitored through oxygen saturation and blood gas analysis). Lateral position helped to improve oxygenation and to maintain pronation for periods close to those proposed in clinical guidelines in sedated patients [2]. In addition, since the patient was awake, he was able to make small movements to release pressure points. This autonomy prevented nurse interventions, a very positive feature in patients requiring highly restrictive isolation. Our protocols recommend minimizing the contact between patients and healthcare professionals (potential human vectors) in order to reduce exposure and avoid spreading of the virus.

The advantages of HFNC with PP, as previously described for other patients [3], also apply to patients with Covid-19 and make it preferable to other NIV therapies [4]. One major advantage of HFNC is that it does not require human-machine interactions and ongoing bedside monitoring and care. It requires also a very short learning curve, which is undoubtedly a major advantage in a pandemic scenario, as an exponential increase in the number of severely ill patients requires the recruitment of inexperienced health professionals [6]. Another interesting point of the use of HFNC with PP is that when the patient is awake and collaborative, fewer professionals are required for position changes, which, in turn, minimizes contact risk. For ventilated patients the recommended number of professionals is 5, whereas for patients with HFNC that number is reduced to [3]. For our collaborative Covid-19 patient, the number of daily position changes was reduced to 2 or even 1, as the patient was sometimes capable of making position changes by him. In a Canadian study, nurses used an intercom system to give instructions, from outside the isolation room, on how to make position changes for themselves to

patients with Covid-19 [7]. In our hospital we occasionally adopted the same practice, using a walkie-talkie for long-distance communications with patients in isolation to reduce the risks associated with contact.

A controversial issue with the use of HFNC in patients with Covid-19 is that healthcare workers could be at increased risk of infection due to potential aerosolization of virus particles, with some authors recommending that HFCN use should be highly restricted or even contraindicated in the treatment of patients with Covid-19. As a possible solution, to reduce the risk of transmission through droplets or aerosols, He G et al. propose that the patient wears a surgical mask during HFNC use and when healthcare workers enter in the room (cleaning, moving patients, performing interventions, etc). Our standard operating procedures (SOPs) recommend using personal protective equipment (PPE) with FFP2, FFP3 or SN95 masks, isolated rooms with minimum entry by personnel and cross-monitoring between professionals to detect possible errors and injuries and testing of personnel as appropriate. In the case of our patient, subsequent PCR testing in our healthcare professionals discarded infection by SARS-CoV-2.

Our successful experience using HFCN with PP for a patient with Covid-19 was inspired by indirect evidences reported by Sorensen for this approach in non-Covid-19 patients treated with NIV. Even if they often have to remain behind a glass to avoid infection, nurses are always present and are of paramount relevance in the care of awake patients with Covid-19, offering information, resolving doubts, giving advice, reassuring and encouraging the patient, inspiring trust and hope, strengthening self-esteem, providing emotional warmth and empathy and actively listening. All these care elements become especially relevant when the patient is admitted to the ICU due to Covid-19 related complications.

In conclusion, the use of HFNC and awake prone and combination with lateral position seems an effective alternative to invasive mechanical ventilation in this kind of patients. This technique requires a very short learning curve, which represents a major advantage in a pandemic scenario, as an exponential increase in the number of severely ill patients requires the recruitment of inexperienced healthcare professionals. As occurs in other clinical scenarios, nurses play a key role in the success of non-invasive ventilation, in our case HFNC and awake PP, in Covid-19 patients. Further large-scale studies are needed to confirm our results.

Conclusion

The use of HFNC and awake prone and combination with lateral position seems an effective alternative to invasive mechanical ven-tilation in this kind of patients. This technique requires a very short learning curve, which represents a major advantage in a pandemic scenario, due the recruitment of inexperienced health care professionals.

Acknowledgment

Written informed consent was obtained from the patient for the publication of this case report and the accompanying images.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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