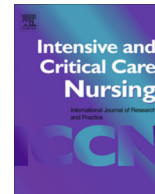




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Case Study

Use of high-flow nasal cannula in COVID-19 has improved effectiveness, safety and tolerability when applied in lateral position compared with prone positioning



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Implications for clinical practice

- Early prone positioning in COVID-19 patients with high-flow nasal cannula may be an alternative to invasive ventilation.
- This technique is feasible for the management of COVID-19 patients during a pandemic situation.

Case presentation

A 54-year-old man presented in a university hospital emergency department with fever (39 °C) for eight days and progressive shortness of breath within the last 24 hours. On admission, disease severity according to the Acute Physiology and Chronic Health Disease Classification System II (Apache II) was 9 and the Sequential Organ Function Assessment (SOFA) score was 4.

Arterial blood gas analysis in ambient conditions: pH: 7.48 mmHg, pO₂ 53 mmHg, pCO₂ 30 mmHg and oxygen saturation of 95%. A chest X-ray revealed bilateral lung infiltrates.

Under the diagnosis of Covid-19 pneumonia, the patient was treated with nasal oxygen at two litres per minute (lpm), received antiviral and antimicrobial therapy. The PCR test confirmed positive for SARS-CoV-2 on day three of admission. The patient's condition gradually deteriorated, with progressive respiratory insufficiency (PaO₂ of 68 mmHg with FiO₂ of 35%). The patient

was admitted to the ICU and required high-flow nasal cannula (HFNC) plus high-flow oxygen, administered as 80% FiO₂ at 60 lpm, with the patient rotated into awake prone position (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. After six days in ICU a total of 37 hours was in PP, 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 (Fig. 1).

Five days after admission to ICU, HFNC were changed to a venturi mask (FiO₂ 40%) with PaFiO₂ of around 200. A day later, the patient was discharged from the ICU and three days later from hospital.

Discussion

Among non-invasive options HFNC 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 (Marini and Gattinoni, 2020). In our case, the

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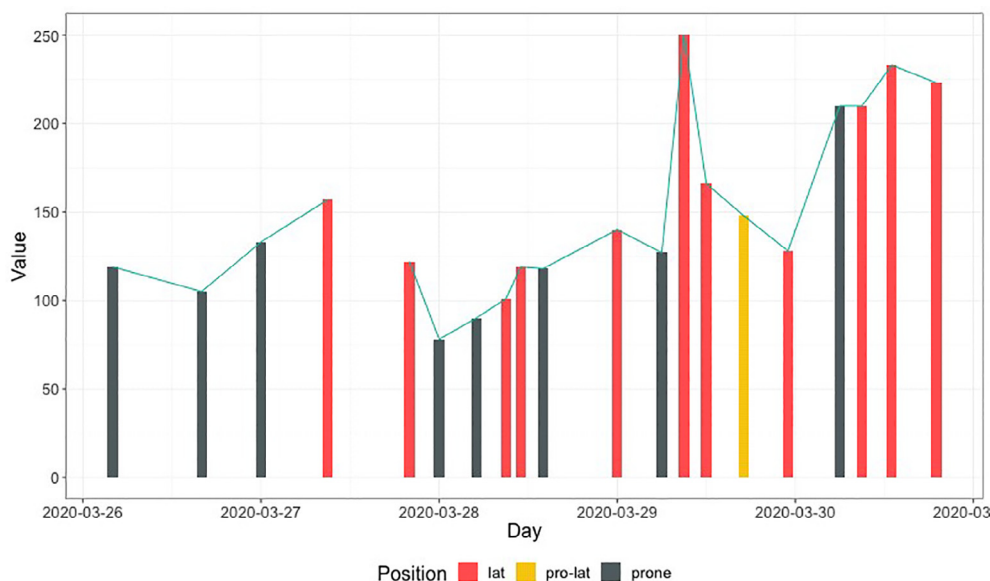


Fig. 1. Values of PaO₂/FiO₂ ratio and body positions of the patient during the ICU time.

patient improved progressively on HFNC combined with awake lateral and PP.

In a prospective observational study, Ding et al. (2020) 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. Scaravilli et al. (2015) described a series of 15 non-intubated patients with acute respiratory failure, observing that PP was associated with a significant improvement in oxygenation. These patients showed a high tolerance to PP with no cases of accidental removal of catheters or facial oedema and pressure ulcers typically observed in intubated patients in PP (Jové Ponseti et al., 2017). In their series of nine Covid-19 patients treated with HFNC and PP, Tu et al. (2020) changed the patients' position twice a day, thereby reporting improved oxygenation.

The position of our patient was changed every 4 hours. We also lateralized the patient, using pillows, as this position also maintained oxygenation. Lateral positioning helped to improve oxygenation and to maintain pronation for periods close to those proposed in clinical guidelines in sedated patients (Papazian et al., 2019). This autonomy prevented nurse interventions, recognized as very positive features in patients requiring highly restrictive isolation.

The advantages of HFNC with PP, as previously described for other patients (Papazian et al., 2016), also apply to patients with Covid-19 and make it preferable to other NIV therapies (Geng et al., 2020). 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 (Renda et al., 2018), 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 (Raurell-Torredà et al., 2020). 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.

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 HFNC use should be highly restricted or even contraindicated in the treatment of patients with Covid-19 (Ñamendys-Silva, 2020; Lyons and Callaghan, 2021). As a possible solution, to reduce the risk of transmission through droplets or aerosols, He et al. (2020) propose that the patient wears a surgical mask during HFNC use and when healthcare workers (HCW) enter in the room they make use of appropriate personal protective equipment (PPE) as also suggested by Lormans et al. (2021). Our standard operating procedures (SOPs) recommend using PPE with FFP2, FFP3 or SN95 masks. In the case of our patient, subsequent PCR testing in our healthcare professionals discarded infection by SARS-CoV-2.

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, due the recruitment of inexperienced healthcare professionals.

Consent

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

Declaration of Competing 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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.iccn.2021.103061>.

References

- Ding, L., Wang, L., Ma, W., He, H., 2020. Efficacy and safety of early prone positioning combined with HFNC or NIV in moderate to severe ARDS: a multi-center prospective cohort study. *Crit. Care* 24 (1), 28.
- Geng, S., Mei, Q., Zhu, C., Yang, T., Yang, Y., Fang, X., Pan, A., 2020. High flow nasal cannula is a good treatment option for COVID-19. *Heart Lung*. S0147-9563(20)30113-8.
- He, G., Han, Y., Fang, Q., Zhou, J., Shen, J., Li, T., Pu, Q., Chen, A., Qi, Z., Sun, L., Cai, H., 2020. Clinical experience of high-flow nasal cannula oxygen therapy in severe coronavirus disease 2019 (COVID-19) patients. *Zhejiang Da Xue Xue Bao Yi Xue Ban* 49 (1).
- Jové Ponseti, E., Villarrasa Millán, A., Ortiz Chinchilla, D., 2017. Analysis of complications of prone position in acute respiratory distress syndrome: quality standard, incidence and related factors. *Enferm Intensiva* 28 (3), 125–134.
- Lormans, P., Blot, S., Amerlinck, Devriendt Y., Dumoulin, A., 2021. COVID-19 acquisition risk among ICU nursing staff with patient-driven use of aerosol-generating respiratory procedures and optimal use of personal protective equipment. *Intensive Crit. Care Nurs.* 63, 102993.
- Lyons, C., Callaghan, M., 2021. The use of high-flow nasal oxygen in COVID-19. *Anaesthesia* 76, 118–127.
- Marini, J.J., Gattinoni, L., 2020. Management of COVID-19 respiratory distress. *JAMA* 323, 2329–2330.
- Namendys-Silva, S.A., 2020. Respiratory support for patients with COVID-19 infection. *Lancet Respir Med.* 8, (4) e18.
- Papazian, L., Corley, A., Hess, D., Fraser, J.F., Frat, J.P., Guitton, C., Jaber, S., Maggiore, S.M., Nava, S., Rello, J., Ricard, J.D., Stephan, F., Trisolini, R., Azoulay, E., 2016. Use of high-flow nasal cannula oxygenation in ICU adults: a narrative review. *Intensive Care Med.* 42 (9), 1336–1349.
- Papazian, L., Aubron, C., Brochard, L., Chiche, J.D., Combes, A., Dreyfuss, D., Forel, J. M., Guérin, C., Jaber, S., Mekontso-Dessap, A., Mercat, A., Richard, J.C., Roux, D., Vieillard-Baron, A., Faure, H., 2019. Formal guidelines: management of acute respiratory distress syndrome. *Ann. Intensive Care* 9 (1), 69.
- Raurell-Torredà, M., Martínez-Estalella, G., Frade-Mera, M.J., Carrasco Rodríguez-Rey, L.F., de San, R., Pío, E., 2020. Reflections arising from the COVID-19 pandemic. *Enferm Intensiva*. S1130-2399(20)30038-9.
- Renda, T., Corrado, A., Iskandar, G., Pelaia, G., Abdalla, K., Navalesi, P., 2018. High-flow nasal oxygen therapy in intensive care and anaesthesia. *Br. J. Anaesth.* 120 (1), 18–27.
- Scaravilli, V., Grasselli, G., Castagna, L., Zanella, A., Isgrò, S., Lucchini, A., Patroniti, N., Bellani, G., Pesenti, A., 2015. Prone positioning improves oxygenation in spontaneously breathing nonintubated patients with hypoxemic acute respiratory failure: a retrospective study. *J. Crit. Care* 30 (6), 1390–1394.
- Tu, G.W., Liao, Y.X., Li, Q.Y., Dong, H., Yang, L.Y., Zhang, X.Y., Fu, S.Z., Wang, R.L., 2020. Prone positioning in high-flow nasal cannula for COVID-19 patients with severe hypoxemia: a pilot study. *Ann. Transl. Med.* 8, 598.