



High-flow nasal oxygen: a safe, efficient treatment for COVID-19 patients not in an ICU

To the Editor:

The new severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing coronavirus disease 2019 (COVID-19), now recognised by the World Health Organization as a pandemic, emerged in late 2019 in China [1]. Patients infected with SARS-CoV-2 can develop severe pneumonia and respiratory failure, which often require treatment in intensive care units (ICU) in Western European countries [2]. Oxygen therapy and supportive care are still the main forms of therapy for SARS-CoV-2 pneumonia until suitable anti-infective therapies become available.

Three large clusters of SARS-CoV-2 infected patients were detected in France at the end of February 2020, in the East (Mulhouse, Strasbourg), around Paris (Creil, Compiègne) and in the West (Auray and Crac'h, near Vannes in Brittany). High-flow nasal oxygen (HFNO) (Airvo2; Fisher & Paykel Healthcare, East Tamaki, New Zealand) has been a standard therapy for nonhypercapnic acute hypoxaemic respiratory failure in Vannes hospital since the publication of the FLORALI trial in 2015 [3]. This report describes the use of HFNO to manage SARS-CoV-2 infected patients with respiratory failure on the pulmonology ward rather than in an ICU.


34 consecutive patients who tested positive for COVID-19 by reverse transcriptase PCR were admitted to the respiratory department. HFNO was systematically initiated when the oxygen flow exceeded 5 L·min⁻¹; 14 single rooms dedicated to HFNO were rapidly set up ("HFNO unit") with continuous monitoring of pulsed oxygen saturation. HFNO was required by 27 out of the 34 patients, and this report focuses on them.

The median (interquartile range) age of patients on HFNO was 77 (77–79) years, 81% (22 out of 27) were male and their median body mass index was 25.9 (23.3–29.4) kg·m⁻². They were admitted within a median 7 (3–8) days after the first SARS-CoV-2 symptoms appeared.

The median arterial oxygen tension/inspiratory oxygen fraction (F_{iO_2}) ratio was 203 (198–286) at admission, and 124 (120–158) immediately prior to HFNO initiation. The median time from admission to HFNO initiation was 2 (1–3) days and the median duration of HFNO was 6 (2–10) days. The median Airvo2 total flow was 55 (50–60) L·min⁻¹ and the median F_{iO_2} was 65 (60–70)%. We used "targeted" oxygen therapy to avoid over-oxygenation, and our targeted oxygen saturation measured by pulse oximetry was 94–96%.

As of March 31, 2020, 19 (70%) patients were weaned off HFNO, four (15%) were still on HFNO and four (15%) had died (figure 1). Of the 19 patients weaned from HFNO, nine had returned home after a median hospital stay of 17 (14–22) days, six were transferred to a rehabilitation unit and four remained on the ward with reduced oxygen (<3 L·min⁻¹). Of the four unweaned patients, two remained on the HFNO unit and two were transferred to the ICU. Of the four deceased patients, one died after 6 days of mechanical ventilation (decision to limit life-sustaining therapy in ICU), while the other three were not transferred to the ICU due to severe comorbidities. Altogether, the respiratory status of seven (26%) out of 27 patients deteriorated on HFNO and they were transferred to the ICU where they were mechanically ventilated for a median of 7 (5–12) days.

As HFNO can generate infectious aerosols, all healthcare workers in contact with patients treated with HFNO were taught airborne precautions. The personal protection equipment was composed of FFP2 masks (reference M52010-WH; Kolmi, St Barthélemy d'Anjou, France), hospital suits (fabric pajamas changed

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SARS-CoV-2 infected patients with nonhypercapnic acute hypoxaemic respiratory failure can benefit from high-flow nasal oxygen outside an ICU. The technique appears to be safe for healthcare workers and could well liberate critical ICU resources. <https://bit.ly/2Xq80iu>

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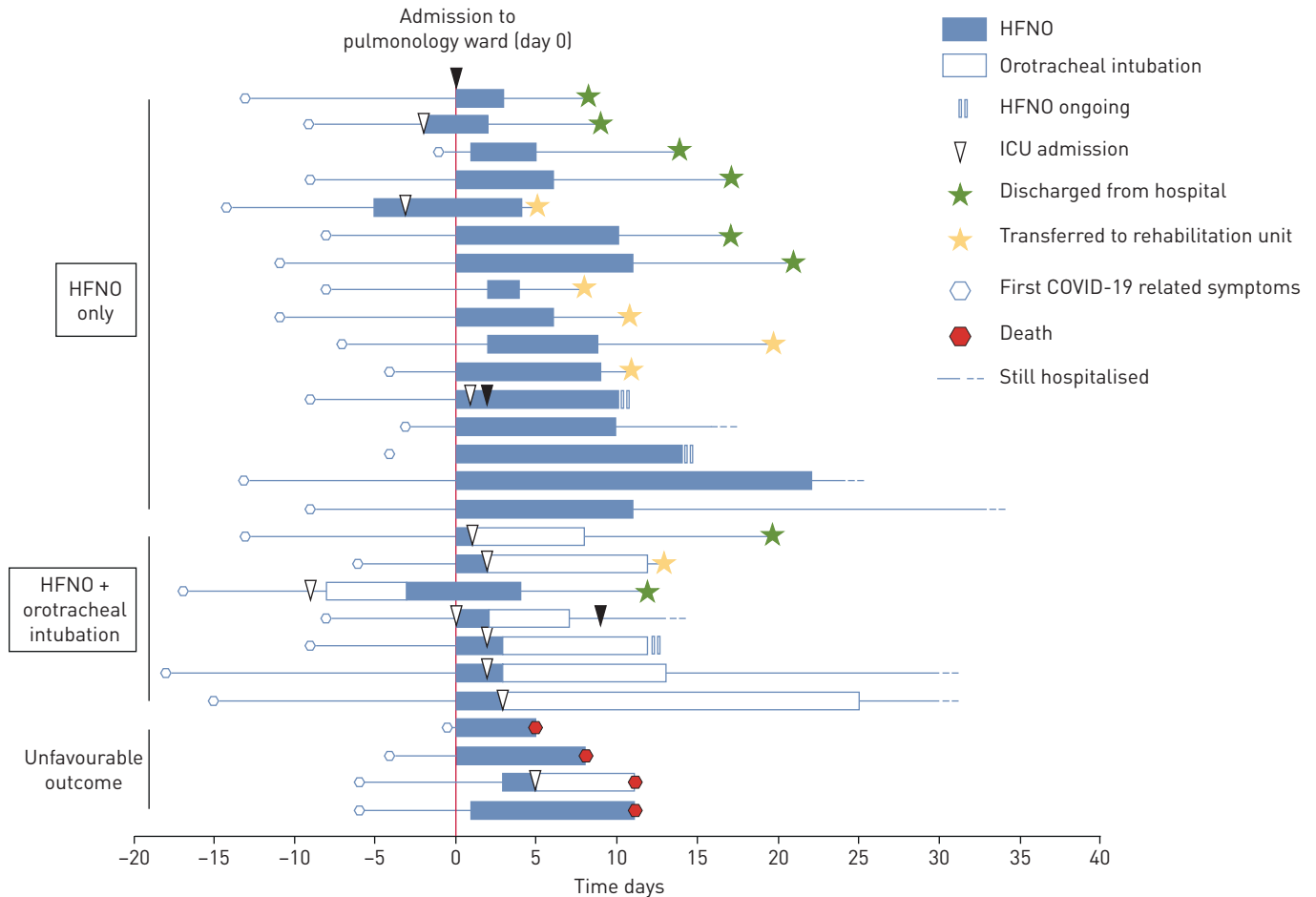


FIGURE 1 Graphic representation of the 27 coronavirus disease 2019 (COVID-19) patients treated with high-flow nasal oxygen (HFNO) in the pulmonology department of Vannes Hospital, France. Main outcomes are reported, such as intensive care unit (ICU) admission, orotracheal intubation and death.

every day), disposable gowns with waterproof aprons, gloves, overshoes, and eye and head protection. In addition, the patients themselves wore surgical masks when a healthcare worker entered their room. Surgical masks have been mandatory for all healthcare workers within the Vannes hospital site since March 2, 2020. Only one of the 44 healthcare workers (seven pulmonologists, 20 nurses, 12 caregivers, three physiotherapists, one dietician and one psychologist), a nurse, had become infected by April 5, 2020. However, domestic contamination is suspected since this nurse was living with his parents, who had previously been infected *via* the Eastern France cluster. All three of them tested positive for SARS-CoV-2. No other healthcare worker was absent from work or presented any symptoms of COVID-19.

The use of HFNO in COVID-19 raises two issues: its safety and its effectiveness. The theoretical risk of virus aerosolisation resulted in early published reports of critically ill SARS-CoV-2 infected patients in China which did not recommend the use of HFNO or noninvasive ventilation until the patient had been cleared of COVID-19 [4]. However, clinical evidence is scarce. Recent guidelines for the clinical management of severe pneumonia following a SARS-CoV-2 infection do not exclude the use of HFNO with maximal precautions to exclude airborne transmission (weak recommendation) [5]. A 2012 meta-analysis found no increased risk of healthcare workers being infected with SARS when using HFNO [6]. In fact, HFNO seemed to have a protective effect, suggesting that avoiding intubation reduced the risk of transmission. More recently, some have recommended using HFNO for patients with moderately severe hypoxaemia, which might make intubation unnecessary, or at least delay it [7].

The only nurse infected with SARS-CoV-2 in the present study was probably contaminated by his parents. If so, none of the healthcare workers on this 14-bed unit were infected with HFNO after a 30-day follow-up. As the median incubation time is 5 days [8], it seems likely that using HFNO to treat COVID-19 patients requiring oxygen ($>5 \text{ L}\cdot\text{min}^{-1}$) was safe for healthcare workers at our institution. However, there is still a risk of aerosolisation and all healthcare workers were required to wear personal

protective equipment, not just FFP2 masks, when using HFNO. Hydro-alcohol handwash and “social distancing” are also major tools for avoiding infection. Above all, the experience of healthcare workers with HFNO management and continued training in airborne precautions undoubtedly help minimise the risk of contamination in the respiratory unit.

The results of this monocentric study (23 out of 27 patients recovered, 19 out of 27 patients weaned from HFNO, including nine discharged) suggest that HFNO is effective. However, further confirmatory studies at other centres are urgently needed. Our 15% in-hospital mortality rate is similar to the 14% recently published from a French 3-year multicentre prospective study which included adults admitted with influenza and influenza-like illness [9]. Managing infected patients with HFNO could save critical ICU resources, including access to mechanical ventilation, in the context of a large-scale COVID-19 outbreak. HFNO allows patients to feed more easily than when on other forms of oxygen supplementation, particularly mechanical ventilation, and facilitates respiratory/bronchial physiotherapy and muscle rehabilitation. Mechanical ventilation may require curarisation and thus induce additional muscle loss. Another positive feature of HFNO is that patients can continue talking and interacting with their family and healthcare workers. This is psychologically very important for everyone involved.

While these results should be confirmed in larger studies, we believe that our data strongly suggest that SARS-CoV-2 infected patients with nonhypercapnic acute hypoxaemic respiratory failure can benefit from HFNO outside an ICU. The technique appears to be safe for healthcare workers and could well liberate critical ICU resources.

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