Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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COVID-19 CORRESPONDENCE

Humidification via high-flow nasal cannula oxygen therapy does not generate aerosols

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Editor—High-flow nasal cannula (HFNC) oxygen therapy is a recently introduced alternative to conventional oxygen therapy, such as oxygen delivered via traditional nasal cannula and regular or Venturi face masks. An HFNC device consists of an air/oxygen blender connected through an active heated humidifier to a nasal cannula. HFNC oxygen therapy can deliver flow of up to 60 L min^{-1} of gas that is heated and up to 100% humidity at a controlled concentration of oxygen (fraction of inspired oxygen: 21–100%).[1]

Aerosol-generating procedures (AGPs), such as those used during the COVID-19 pandemic, require personal protective equipment and might increase the transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2).[2] Humidification is believed to be an AGP.[2] Because HFNC oxygen therapy delivers up to 100% humidified gas, humidification with this therapy might directly generate aerosols. We describe an experimental trial based on an aerosol spectrometer in which we evaluated whether humidification through HFNC oxygen therapy can generate aerosol particles.

We used an HFNC device (AIRVO™2 device with an Optiflow™ nasal interface; Fisher & Paykel, Auckland, New Zealand) without oxygen at 20, 40, and 60 L min^{-1} flow rates and a temperature of 37°C. We used an aerosol spectrometer (AQ Guard®; Palas Gmbh, Karlsruhe, Germany) that allowed us to measure the aerodynamic diameter of particles of 0.18–20 μm. The spectrometer absorbed air at a flow rate of 1 L min^{-1}; 1-s spectral data were collected repeatedly for 60 s. The HFNC device was connected to an acrylic box (40×50×60 cm) attached to a Hydro-Guard™ Mini breathing filter (Intersurgical, Wokingham, UK), where the spectrometer was placed. We collected data for 60 s (n=1)×2 at each flow rate three times (n=6 for each flow rate). Data are expressed as median with inter-quartile range. All statistical analyses were performed using a statistical software package (JMP Pro 14 software; SAS Institute, Cary, NC, USA). For multiple comparisons, we used the Kruskal–Wallis test. Differences were considered statistically significant at $P<0.05$.

After we eliminated background particle concentrations ranging from 0.18 to <0.51 μm and from <20 to 0.51 μm, the concentration of particles released through the HFNC device was almost 0 particles cm^{-3} and did not differ among flow rates for 0.18 to <0.51 μm; median concentrations were 0.53 particles cm^{-3} (0.1–0.88) at 20 L min^{-1}, −0.35 particles cm^{-3} (−0.83 to 0.7) at 40 L min^{-1}, and −0.79 particles cm^{-3} (−3.4 to 0.76) at 60 L min^{-1} (P=0.26); and for <20 to 0.51 μm, median concentrations were 0 particles cm^{-3} (−0.04 to 0.055) at 20 L min^{-1}, 0.02 particles cm^{-3} (−0.0025 to 0.13) at 40 L min^{-1}, and 0 particles cm^{-3} (−0.12 to 0.05) at 60 L min^{-1} (P=0.53) (Fig. 1).

Thus humidification through HFNC oxygen therapy did not directly generate aerosol particles. In the airways, fine aerosol particles <0.5–1 μm in size undergo Brownian motion, settle very slowly, and may be exhaled.[3] Therefore, under normal breathing conditions, inhaled and exhaled aerosol particles <0.5–1 μm may pose a risk of SARS-CoV-2 transmission. However, in our study, under the conditions of HFNC oxygen therapy, these small particles could not be generated by humidification.

In theory, a gas flowing at a high velocity across the epithelium of the upper respiratory tract and delivered through HFNC oxygen therapy could generate aerosol and droplets as a result of such shear forces.[4] However, previous studies showed that HFNC oxygen therapy did not increase aerosol concentration in exhaled breath.[4–6] Therefore, the hypothesis just described is unlikely to be true. Our results and previous evidence[4–6] revealed that HFNC oxygen therapy might not generate aerosols; instead, it may disperse aerosols.[7] Thus, it is unlikely that HFNC oxygen therapy can increase the risk of local SARS-CoV-2 transmission.

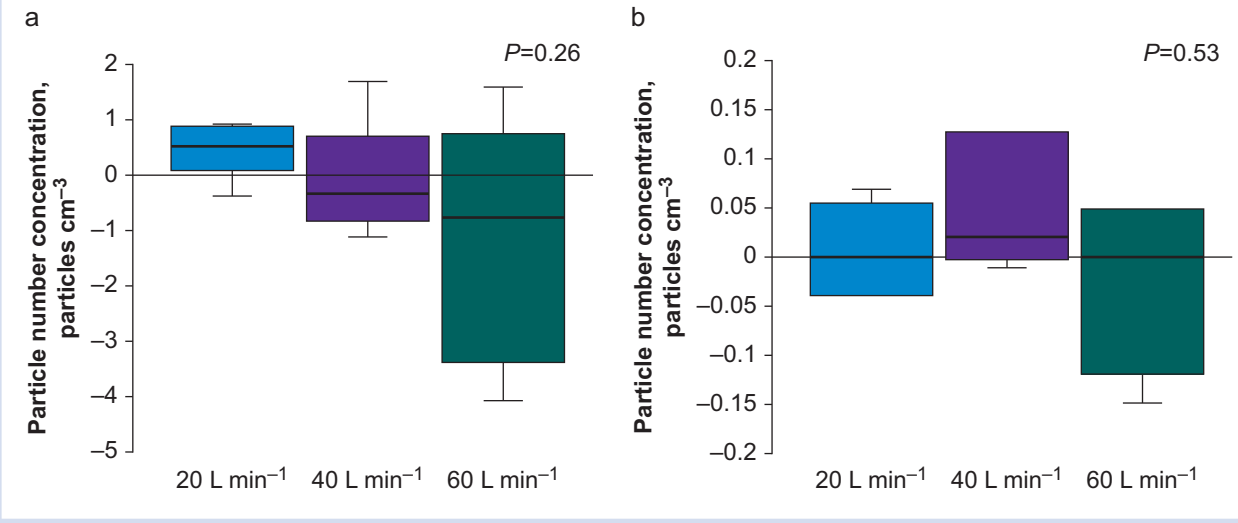

Fig 1. Box plots of particle number concentration for particles ranging from 0.18 to <0.51 μm (a) and from <20 to 0.51 μm (b) at flow rates of 20, 40, and 60 L min^{-1} with a high-flow nasal cannula.

Because of the scale of the COVID-19 pandemic, intensive care resources are increasingly limited. HFNC oxygen therapy can reduce the need for tracheal intubation in patients with COVID-19.[8] The proper use of HFNC oxygen therapy might help in dealing with this pandemic situation worldwide.

Authors' contributions

Designed this study: SH, NT
Analysed data and wrote the manuscript: SH, NT, TH
Read and approved the final manuscript: SH, NT, TH

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Declarations of interest

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