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.

Anaesth Crit Care Pain Med 41 (2022) 101065

Contents lists available at ScienceDirect

Anaesthesia Critical Care & Pain Medicine

journal homepage: www.elsevier.com

Letter to the Editor

Heat moisture exchange/high-efficiency particulate filters and the risk of contamination of the ventilatory circuit and patient environment with SARS-CoV-2: A brief report

ARTICLE INFO

Keywords:
COVID-19
SARS-CoV-2
Filter
HME
Ventilatory circuit

Dear Editor,

During the COVID-19 pandemic, the efficiency of the filtering devices used in ventilated patients returned to the forefront, notably because the protection from cross-contamination of the intensive care unit (ICU) staff quickly appeared as an important challenge. In the ICU, it is recommended to use a filter between the patient and the ventilator [1], providing both microbiological filtration and heating and humidification of the inspired gases (Heat and Moisture Exchange – HME – function). The high efficiency of filtration (going up to the High-Efficiency Particulate Air – HEPA – qualification) [2] is certified by manufacturers following bench tests. To our knowledge, few studies were conducted in clinical settings, particularly considering the COVID-19 context. Thus, the precautionary principle took precedence and some ventilator manufacturers [3] or learned societies [4] suggested the use of a second HEPA filter at the expiratory port of the ventilator for enhanced safety.

We performed an observational multicentre study with the aim of testing the potential contamination of the ventilatory circuit with SARS-CoV-2. We included all the patients hospitalised in the 3 participating ICU for severe COVID-19 confirmed by RT-PCR on a lower respiratory tract sample, requiring invasive mechanical ventilation between the 27th of April 2020 and the 07th of May 2020, and in whom the attending physician prescribed a bronchial aspirate to document a suspicion of ventilator-associated pneumonia. Then, contamination of the respiratory circuit with SARS-CoV-2 was assessed thanks to three swabs performed: 1) in the closed suctioning system (CSS) that was placed between the intubation tube and the HME/HEPA filter just after its change for a clean device before sampling the bronchial aspirate; 2) at the Y-piece between the HME/HEPA filter and the expiratory limb of the circuit; 3) at the expiratory valve of the ventilator downstream the additional HEPA filter (Fig. 1A).

Forty-three patients were included in the study. HME/HEPA filters were Humid-Vent® (Teleflex® medical) in one centre (n = 11 patients) and DAR™ (Covidien, Medtronic®) in the remaining two centres (n = 34 patients). Tracheobronchial aspirates were sampled in median 9 IQR [0–13] days after intubation. At this time, 10/43 (23%) had a positive CSS swab, while all the 43 swabs performed at the Y-piece and at the expiratory valve were negative (Fig. 1B).

Although larger studies are needed to detect a possible default that would occur with an exceptional rate, these results are reassuring regarding the efficiency of HME filtration of SARS-CoV-2 in real-life conditions. They also confirmed the preliminary results by Reifart et al. who reported that among 4 patients with positive

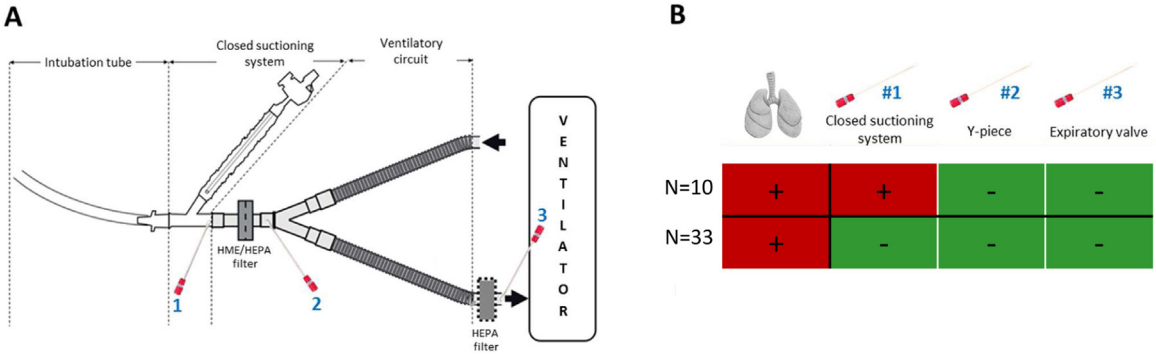

Fig. 1. Summary of the swabbing protocol and main results of the study.
(A) The ventilatory circuit of each SARS-CoV-2 positive patient was sampled at the 3 following sites: in the closed suctioning system placed between the intubation tube and the HME/HEPA filter; at the Y-piece between the HME/HEPA filter and the expiratory limb of the circuit; at the expiratory valve of the ventilator downstream the additional HEPA filter. **(B)** Among the 43 patients, 10 had a positive close suctioning system RT-PCR sample, while all the 43 swabs performed at the Y-piece and at the expiratory valve were negative.

https://doi.org/10.1016/j.accpm.2022.101065

SARS-CoV-2 samples of the lower respiratory tract, only 1 had a positive PCR of the exudate sampled at the patient side of the HME filter [5]. Indeed, in our study, only 23% of patients had positive CSS samples, whereas the devices have not been changed periodically since patient's intubation as usually recommended due to the worldwide shortage of respiratory devices that occurred during the first wave of the pandemic.

Our observations reinforce bench test results regarding the filtration performance of HME/HEPA filters, allowing a second filter at the expiratory port of the respirator to be dispensed with a fairly high level of safety.

Ethics approval and consent to participate

This work has been approved by the French Society of Anaesthesia and Intensive Care Medicine (SFAR) ethical committee (CERAR - IRB00010254 #2020-109). According to French law and due to the non-interventional design of the study, patient's consent was waived by the ethical committee. Thus, oral and written information was given to patients who survived their critical COVID-19, who could then decline inclusion in the study.

Consent for publication

Not applicable.

Disclosure of interest

All the authors declare that they do not have any competing interest with the current work.

Funding

This work has not been funded by any external source.

Authors' contribution

MG: conceptualisation, investigation, methodology, writing original draft, writing review, and editing.

NJ: investigation, writing original draft.

LV: conceptualisation, investigation, methodology, writing original draft.

All authors have read and approved the final manuscript.

Availability of data and materials

Data are available from the corresponding author on reasonable request.

Acknowledgements

Not applicable.

References

[1] Lorente L. Respiratory filters and ventilator-associated pneumonia: composition, efficacy tests and advantages and disadvantages. In: Esquinas AM, editor. Humidification in the Intensive Care Unit [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2012. p. 171–7. [cited 2021 Dec 20]. Available from:http://link.springer.com/10.1007/978-3-642-02974-5_20.

[2] British standards. High efficiency air filters (EPA, HEPA and ULPA) - Part 1: Classification, performance testing, marking [Internet]. 2009 [cited 2021 Oct 28]. Available from: http://www.gttlab.com/uploads/soft/161025/EN1822-1-2009Highefficiencyairfilters(EPA,HEPAandULPA)Part1Classification,performance.pdf.

[3] Dräger. SARS-CoV-2 and handling of Dräger Anesthesia Workstations: System setup and reprocessing recommendations for confirmed or highly suspected SARS-CoV-2- patients [Internet]. 2020 [cited 2021 Oct 28]. Available from: https://www.draeger.com/Library/Content/SARS-CoV-2-and-handling-of-Draeger-Anesthesia-Workstations.pdf.

[4] SFAR Experts, Montravers P, Servin F, Bourgain J-L, Manuelle P, Nouette-Gaulain K. Filtration sur le circuit des ventilateurs en contexte de ventilation pour Covid-19 [Internet]. 2020 [cited 2021 Oct 28]. Available from: https://sfar.org/download/tout-ce-que-vous-devez-savoir-sur-les-filtres/?wpdmdl=25571&refresh=617a9234cb5d01635422772.

[5] Reifart J, Liebetrau C, Troidl C, Madlener K, Rolf A. Noninvasive sampling of the distal airspace via HME-filter fluid is not useful to detect SARS-CoV-2 in intubated patients. Crit Care 2021;25:126.

Marc Garnier[a,*], Nathan Julian[b,c], Lionel Velly[d,e]

[a]*Sorbonne Université, GRC29, Assistance Publique-Hôpitaux de Paris, DMU DREAM, Service d'Anesthésie-Réanimation et Médecine Périopératoire « Rive Droite », Site Tenon, 75020 Paris, France*

[b]*Assistance Publique-Hôpitaux de Paris, DMU PARABOL, Service d'Anesthésie-Réanimation et Médecine Périopératoire, Hôpital Lariboisière, 75010 Paris, France*

[c]*Université de Paris, INSERM U942 MASCOT, 75006 Paris, France*

[d]*Université Aix-Marseille, Assistance Publique Hôpitaux de Marseille, Service d'Anesthésie-Réanimation et Médecine Périopératoire, Hôpital Universitaire de la Timone, 13005 Marseille, France*

[e]*Université Aix-Marseille, CNRS, Institut Neuroscience Timone, UMR7289, Marseille, France*

*Corresponding author at: Anaesthesiology and Critical Care Department – Tenon Hospital, 4, rue de la Chine, 75020 Paris, France

E-mail address: marc.garnier@aphp.fr (M. Garnier)

Available online 26 April 2022