



Is it feasible to collect exhaled breath condensate in COVID-19 patients undergoing noninvasive ventilatory support?

To the Editor:

The article recently published by HJEMBAEK-BRANDT *et al.* [1] focused on humidification during the collection of exhaled breath condensate (EBC) in patients undergoing invasive mechanical ventilation (IMV). Indeed, in the current guidelines, it is still unclear which standard humidification setting and technique should be used [2, 3]. In some studies, the EBC has been performed with active humidification [4], while others have removed it before collection [5]. HJEMBAEK-BRANDT *et al.* [1] demonstrated that diverse settings of active humidification may vary the amount of sample collected quite remarkably. The authors concluded that the EBC collection should be performed with no humidification, turning off the humidifier 10 min before starting the exam [1].

Following their suggestion, we speculated about the potential to translate EBC collection to the field of support *via* noninvasive ventilation (NIV). Indeed, NIV use has tremendously increased in the support of patients suffering from respiratory failure, in particular among patients with severe respiratory coronavirus disease 2019 (COVID-19) infection [6–8]. The question is: “Would it be feasible to perform EBC collection among COVID-19 patients supported *via* NIV?”

On the one hand, EBC is a noninvasive, easy-to-perform collection of biological fluid, condensed in a refrigerated device, from the airways’ exhaled air. It allows detection of the presence of active inflammation in the airways of spontaneously breathing patients [9]. On the other hand, the technique has been recently adapted to IMV patients [10]. However, technically, EBC collection could also be of great importance in patients on NIV. Among the favourable potential indications for EBC use are the following: assessment of correct timing for start of NIV; to survey the effectiveness of NIV treatment; to downgrade or upgrade NIV pressure treatment; to guide the weaning off NIV or, conversely, to detect NIV failure early by monitoring the escalation of treatment and correctly identifying the time for IMV.

However, there are a few differences that have to be taken into account during NIV. First is the presence of a face mask instead of an endotracheal tube. The former increases the amount of dead space present before the site of EBC collection, hence potentially reducing the amount of sample collected. Secondly, there is a lower amount of moist air compared to using an endotracheal tube. The tube can directly supply warm and humidified air at body temperature from the deep airways. Thirdly, there are more leaks, which can be dispersed over the longer circuit of NIV and from the mask, and which can further amplify the turbulent airflow, reducing the moisture in the entire system. Consequently, all these factors may potentially reduce the amount of EBC volume collected.

In this COVID-19 pandemic, NIV has been of great aid for patients affected by severe hypoxic acute respiratory failure. EBC could be valuable to analyse the levels of inflammatory markers associated with patients suffering from COVID-19 acute respiratory failure, and to monitor the effects of prolonged high



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In patients with #COVID19-related acute hypoxic respiratory failure requiring noninvasive ventilatory support, EBC collection with adequate precautions may be feasible and future studies will be needed to explore this research field <https://bit.ly/39OxufF>

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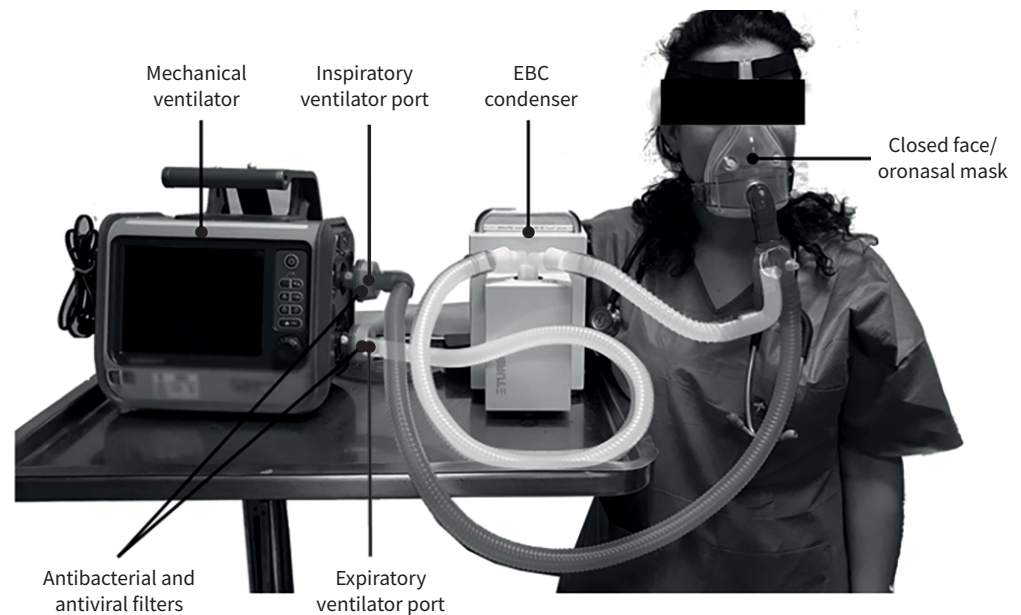


FIGURE 1 How to set the collection of exhaled breath condensate (EBC) samples from the airways of patients undergoing noninvasive ventilation *via* oronasal mask.

positive pressure applied to the airways *via* continuous positive airway pressure or NIV. However, the active humidification that was usually adopted during prolonged NIV use has been avoided to stop further dispersion of viral droplets, and to protect the healthcare providers involved in the care of infected patients [11]. Hence, the collection of EBC could be complicated in this specific setting.

Given the potential future field of interest, we propose a setting for EBC collection during NIV as shown in figure 1, to optimise resources. As shown, for better EBC collection during NIV, a double tube circuit is needed. The patient should be breathing through the smallest oronasal face mask that fits their face, to reduce the air dead space inside the mask. To avoid blockages to the exhaled air flow, the filters should be placed at the ventilator inspiratory and expiratory ports. The EBC condenser should be inserted immediately after the Y-piece in the expiratory limb, to further reduce the space between the patient's mouth and the site of collection. Given the absence of active humidification during NIV use in patients with COVID-19, the EBC should be drawn in the early phases of NIV application, as later the absence of humidification may reduce the amount of the sample, thus invalidating the collection. Another NIV option that could be considered for EBC collection is the high-flow nasal cannula (HFNC), which frees the patient to collect the sample *via* the mouthpiece provided in the EBC circuit; also, a higher level of humidity is guaranteed by the HFNC support itself. During the EBC collection, the patient should always wear a surgical mask to avoid viral droplet dispersion while using the HFNC nose interface. The mask can be lifted above the mouthpiece connected to a closed circuit, during EBC collection.

In conclusion, in patients with COVID-19 respiratory infection and related acute respiratory failure requiring NIV, EBC collection with adequate precautions as described may be feasible and future studies will be needed to explore this research field.

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