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Early View

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Is it feasible to collect EBC in COVID-19 patients undergoing noninvasive ventilatory support?

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Title page

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Running head: EBC in COVID-19 patients during NIV

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TITLE: Is it feasible to collect EBC in COVID-19 patients undergoing noninvasive ventilatory support?

Dear Editor,

the article recently published by Hjembaek-Brandt et al focused on humidification during the collection of Exhaled Breath Condensate (EBC) in invasively mechanically ventilated (IMV) patients[1]. Indeed, in the current guidelines it is still unclear the standard humidification setting and technique that should be used [2, 3]. In some studies the EBC has been performed with active humidification (AH) on [4] while others removed it before collection [5]. Hjembaek-brandt demonstrated that diverse settings of AH may remarkably vary the amount of sample collected. The authors concluded that the EBC collection should be performed in no humidification (H-), turning off the humidifier 10 minutes before starting the exam. [1].

Following their suggestion we speculated about the potential to translate the EBC collection to the field of noninvasive ventilatory support (NVS). Indeed, the NVS use has tremendously increased in support of patients suffering from respiratory failure in particular among patients with severe respiratory COVID19 infection[6-8].

The question is: would it be feasible to perform EBC collection among COVID-19 patients supported via NVS?

From one side the EBC is a noninvasive, easy to perform collection of biological fluid condensed in a refrigerated device from airways' exhaled air, it allows to detect the presence of active inflammation in the airways of spontaneously breathing patients [9]. On the other side, the technique has been recently adapted to IMV patients. [10]. However, technically, the EBC collection could be also of great importance in patients on NVS. Among favourable potential indications for EBC use it can be encountered: the assessment of correct timing for NVS start, to survey the effectiveness of NVS treatment, to downgrade or upgrade NVS pressure treatment, to guide the weaning off NVS, or conversely, to early detect NVS failure 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 NVS; first, the presence of a face mask instead of the endotracheal tube. The first one increases the amount of dead space present before the site of EBC collection hence potentially reducing the amount of sample collected, second, the lower amount of moistured air compared to the tube which can directly supply warm and humidified air at body temperature from the deep airways, third, the higher amount of leaks that can be dissipated in the NVS longer circuit and from the mask that 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 COVID19 pandemic NVS has been of great aid for patients affected by severe hypoxic acute respiratory failure (ARF). The EBC could be valuable to analyse the amount of inflammatory markers associated to patients suffering from COVID19 ARF, and to the monitor the effects of prolonged high positive pressure applied to the airways via CPAP/NVS. However, the AH which was usually adopted during prolonged NVS use has been avoided to stop further dispersion of viral droplets, and to protect the health care 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 the EBC collection during NVS as showed in the Figure to optimize resources. As shown, for better EBC collection during NVS, a double tube circuit is needed. The patient should be breathing trough to the smallest oro-nasal face mask that fits for the patient's 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 patients' mouth and the site of collection. Given the absence of AH during the NVS use in patients with COVID-19, the EBC should be drawn in the early phases of NVS application as later on the absence of humidification may reduce the amount of the sample, thus, invalidating the collection. Another NVS option which could be considered for EBC collection is the High Flow nasal Cannula (HFNC) which free the patients to collect the sample via the mouthpiece provided in the EBC circuit and also, higher amount of humidity is guaranteed by the HFNC support itself. During the EBC collection, the patient should always wear a surgical mask to avoid viral droplets dispersion while using the HFNC nose interface. The mask can be lifted above the mouthpiece connected to a closed circuit during exhale collection. In conclusion, in patients with COVID19 respiratory infection and related ARF requiring NVS the EBC collection with the adequate precautions described may be feasible and future studies will be needed to explore this research field.

References

1. Hjembaek-Brandt J, Hindborg M, Jensen AK, Dalby Sørensen CA, Rasmussen BS, Maltesen RG, Bestle MH. The influence of active and passive air humidification on exhaled breath condensate volume. *ERJ open research* 2020: 6(4): 00009-02020.
2. Horváth I, Barnes PJ, Loukides S, Sterk PJ, Högman M, Olin AC, Amann A, Antus B, Baraldi E, Bikov A, Boots AW, Bos LD, Brinkman P, Bucca C, Carpagnano GE, Corradi M, Cristescu S, de Jongste JC, Dinh-Xuan AT, Dompeling E, Fens N, Fowler S, Hohlfeld JM, Holz O, Jöbsis Q, Van De Kant K, Knobel HH, Kostikas K, Lehtimäki L, Lundberg J, Montuschi P, Van Muylem A, Pennazza G, Reinhold P, Ricciardolo FLM, Rosias P, Santonico M, van der Schee MP, van Schooten FJ, Spanevello A, Tonia T, Vink TJ. A European Respiratory Society technical standard: exhaled biomarkers in lung disease. *The European respiratory journal* 2017: 49(4).
3. Carter SR, Davis CS, Kovacs EJ. Exhaled breath condensate collection in the mechanically ventilated patient. *Respiratory medicine* 2012: 106(5): 601-613.
4. Vaschetto R, Corradi M, Goldoni M, Cancelliere L, Pulvirenti S, Fazzini U, Capuzzi F, Longhini F, Mutti A, Della Corte F, Navalesi P. Sampling and analyzing alveolar exhaled breath condensate in mechanically ventilated patients: a feasibility study. *Journal of breath research* 2015: 9(4): 047106.
5. Fernandez-Bustamante A, Klawitter J, Repine JE, Agazio A, Janocha AJ, Shah C, Moss M, Douglas IS, Tran ZV, Erzurum SC, Christians U, Seres T. Early effect of tidal volume on lung injury biomarkers in surgical patients with healthy lungs. *Anesthesiology* 2014: 121(3): 469-481.
6. Ergan B, Oczkowski S, Rochwerg B, Carlucci A, Chatwin M, Clini E, Elliott M, Gonzalez-Bermejo J, Hart N, Lujan M, Nasilowski J, Nava S, Pepin JL, Pisani L, Storre JH, Wijkstra P, Tonia T, Boyd J, Scala R, Windisch W. European Respiratory Society guidelines on long-term home non-invasive ventilation for management of COPD. *The European respiratory journal* 2019: 54(3).
7. Rochwerg B, Brochard L, Elliott MW, Hess D, Hill NS, Nava S, Navalesi PMOTSC, Antonelli M, Brozek J, Conti G, Ferrer M, Guntupalli K, Jaber S, Keenan S, Mancebo J, Mehta S, Raoof SMOTTF. Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. *The European respiratory journal* 2017: 50(2).
8. Raoof S, Nava S, Carpati C, Hill NS. High-Flow, Noninvasive Ventilation and Awake (Nonintubation) Proning in Patients With Coronavirus Disease 2019 With Respiratory Failure. *Chest* 2020: 158(5): 1992-2002.
9. Kharitonov SA, Barnes PJ. Exhaled biomarkers. *Chest* 2006: 130(5): 1541-1546.
10. Gessner C, Hammerschmidt S, Kuhn H, Seyfarth HJ, Sack U, Engelmann L, Schauer J, Wirtz H. Exhaled breath condensate acidification in acute lung injury. *Respiratory medicine* 2003: 97(11): 1188-1194.

11. Ferioli M, Cisternino C, Leo V, Pisani L, Palange P, Nava S. Protecting healthcare workers from SARS-CoV-2 infection: practical indications. *European respiratory review : an official journal of the European Respiratory Society* 2020: 29(155).

Figure legend: How to set the collection of EBC sampling from the airways of patients undergoing NVS via oro-nasal mask