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Editorial

Flow Wave Interpretation of High-Flow Nasal Cannula

Interpretación de la curva de flujo de las cánula nasales de alto flujo

In recent years there has been a growing interest in the use of High-Flow Nasal Cannula (HFNC).[1] HFNC was associated with lower mortality and lower risk for intubation in subsets of patients with hypoxemic respiratory failure, or in those who were immunocompromised, in comparison with noninvasive ventilation (NIV) or standard oxygen.[2] It has also been studied in COVID pneumonia.[3] For this reason, HFNC is a respiratory support system that has become prominent in the treatment of respiratory failure.[4] There is less data for its application in acute hypercapnic respiratory failure. Published studies indicate beneficial effects of HFNC in COPD. Patients HFNC can reduce arterial CO_2 and work of breathing in patients with stable COPD.[5] HFNC has been used to provide respiratory support in patients with acute exacerbations of COPD, who were intolerant to NIV, with successful outcomes.[6] There is ongoing study with hypothesis that HFNC respiratory support will be non-inferior to NIV in patients with AECOPD, and mild-to-moderate acute or acute on chronic hypercapnic respiratory failure.[7]

Up to date of this editorial, HFNC devices do not have alarms such as high and low respiratory rate (RR), pressure, or minute ventilation. Otherwise, some devices warn that the target flow has not been reached. Other mechanism notice the patient circuit is occluded or that the external oxygen flow input is too high. When a HFNC is connected it is necessary to provide external monitoring. The combination of respiratory rate and pulse oximetry informs us of the patient's condition.[8] With the appearance of the Phillips Respironics V60+® ventilator, we discovered the first real-time flow wave. In terms of wave interpretations, we should consider it as an open gas circuit, we will not be able to have real calculations of the real flow or the total tidal volume that enters the patient. There are previously unpublished findings on clinical interpretations of these flow curves. The aim of this editorial is showing some clinical interpretation of our research group of this novel HFNC flow waves, and the future possible clinical applications. We first have observed the flow graph recorded on the screen of the device during its use in patients. We have made the calculations of total flow administered through the software itself with the "play" tool. Subsequently, the maneuvers have been verified in healthy volunteers, members of the research group. Major part of them has been represented and measured using manual insufflation of limited artificial lung. We used the artificial lung connecting a 22 mm smoothbore bi-level breathing system with monitoring line, 1.6 m to a 3 l reservoir bag 22 F neck. The maximum flow supported by this system without detecting a flow obstruction is 35 l/min. Since we do not have a flow volume simulator, muscle pressure needed for forced inspiration could neither be programed nor measured.

The maximum nasal inspiratory flow in a calm breathing situation is around 30 l/min.[9] For this reason, it is recommended to administer this flow initially. If the inspiratory demand does not exceed the configured inspiratory flow, we observe a flat line. We could interpret that the patient is not making inspiratory efforts and predict a good response to the administrated flow.

With the performance of a forced inspiration, simulating a situation of elevated work of breathing; we observe an intermittent flow increase over the flow line. Clinically, it seems reasonable that intermittent flow increase morphology allows us to calculate the respiratory rate and we can interpret a shortness of breath, which may require an increase in the flow pattern. Our hypothesis is that this curve occurs because, despite the fact that it is not possible to achieve a higher inspiratory flow than the administered by the device. The pressure differential made by at the distal end of the nasal cannula generates an increase in the flow administered by the device.

Although the simulation of the nasal expiration instead of mouth, can reverse the minimum prescribed flow. Positive pressure differential is generated at the distal end of the cannula and generates this decrease in the flow administered by the device. In that last case we also observe a flow line oscillation. We can calculate the real flow administrated by the device to differ which of two lasts situations we are observing using the play tool.

Considering that the HFNC does not have a leak-free interface, if the patient takes a forced inspiration with a mild flow configuration (10 l/min) we can calculate an approximation of the maximum in-patient inspiratory flow capacity. We use this configuration since it better shows the maximum flow demanded by the patient. Patients with lower inspiratory peak flow, may have a predisposing factor to a poor response to support. It can be the first indicator of an insufficiency of nasal inspiratory force, such as deviation of the nasal septum, nasal polyps, neuromuscular disease or myopathies.

These findings could be useful in HFNC titration. For instance, in terms of weaning or adjusting the flow demands in work of breathing situation. Besides, these conclusions management of respiratory failure could be considered. Flow curves have make us consider opening a line of research in this field focused on the development and improvement of this therapy. We would like to verify these findings in different pathophysiological situations, and for this it would be necessary to use a simulator, which we do not

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have at this time. With a correct real flow monitoring system, the inclusion of some clinical alarms that are familiar with the noninvasive management of respiratory failure, could be considered. Flow curves have been a map to know how to explicitly titrate the respiratory needs of our patients. Non-invasive mechanical ventilation has been a clear example.[10] Should we give importance to the flow curve of HFNC? Is there information we haven't read yet? With this editorial we want to introduce the desire to give prominence to these curves.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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