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Noninvasive Ventilation to Breathe but Not to Leak: That Is the Question!

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We read with interest the paper by Fernandez et al. [1] reporting the usefulness of measuring leakage as an adjuvant in evaluating noninvasive ventilation (NIV) efficacy. This approach is all the more important because NIV is provided by a nonhermetic system.

Bilevel ventilators are most commonly used for NIV. These devices do not have an exhalation valve and use a single-limb circuit with a calibrated leak (called 'intentional leak'). Therefore, most noninvasive ventilators are subject to 'a leak paradox': while some degree of leakage is required, a greater degree could compromise NIV efficacy.

Unintentional leaks in NIV are extremely frequent [2]. Leaks could impair the effectiveness of NIV by decreasing effective ventilation. This is more important in the volumetric mode, as barometric ventilators are able to compensate for leakage. Moreover, leakage may also affect the trigger function, either by preventing the detection of the patient's inspiratory effort or by mimicking an 'inspiratory flow', leading to auto-triggering. In addition, when flow cycling is used, leaks may delay switching to expiration. Finally, leaks could impair sleep quality.

Therefore, measuring leakage in NIV is an important issue.

Nevertheless, some questions need to be raised. The first concerns the need to know and to subtract intentional leaks, as the level of intentional leakage varies not only according to the pressure but also to the type of mask used. Different masks are available for NIV, with levels of intentional leakage that may vary widely. Moreover, as the leakage level varies proportionally with pressure, it is difficult to define a fixed threshold of intentional leakage. Different portable ventilators allow estimation of the leakage level, but the accuracy of their algorithms varies [3]. Moreover, in most of them (as in the ventilator used by the authors), intentional leaks are included in the estimation. Thus, before defining a threshold for an 'unacceptable' leakage level, we need to know the intentional leakage at each pressure for the mask used and to subtract it.

However, even if one assumes that unintentional leakage estimation is accurate, a second issue must be raised. It concerns the level of unintentional leakage that a device can tolerate without compromising ventilatory effectiveness. It has been suggested that recent ventilators may compensate for leaks <0.4 l/s [4]. Nevertheless, to our knowledge, there are no published data validating this threshold. Moreover, as recently underlined [3, 5], leakage compensation capabilities are probably different for different ventilators, with some devices even unable to compensate properly for intentional leaks with some masks. Finally, as mentioned above, leaks may not only compromise pressurization. A recent study [6] showed that patient ventilator asynchrony is also strongly affected by unintentional leaks.

A final issue concerns the fact that the authors did not show any impact of leaks in terms of desaturation. Several hypotheses could explain that. Firstly, as they used a pressure mode, the ventilator could compensate for unintentional leakage. Moreover, do not desaturate does not mean do not hypoventilate. By the shape of the oxyhemoglobin curve, SpO₂ is not a very sensitive tool to evaluate hypoventilation, in particular in patients with a normal PaO₂ level, as these patients are in the 'plateau' portion of the curve. To evaluate the impact of leaks it would be better to measure their impact on a more appropriate ventilation marker such as transcutaneous PCO₂.

To summarize, further studies are needed to answer the many questions regarding the complex relationships between leaks and NIV effectiveness.

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