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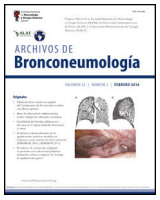

Editorial

Where are we With Home-Based Noninvasive Mechanical Ventilation and How Can we Go Further?

Home-based non-invasive mechanical ventilation (NIV) is a therapy for end-stage respiratory failure. It generates two pressure levels: an expiratory positive airway pressure (EPAP) that helps prevent collapse of the upper airways (and in some cases, auto-PEP), and an inspiratory pressure (or pressure support [PS]) that reduces the work of breathing.

The first patients to benefit from this treatment were those suffering from sequelae of poliomyelitis, neuromuscular disease, or chest wall deformities. Today, it is the reference treatment as soon as pump failure appears, as evidenced by alveolar hypoventilation. However, there have been no randomised controlled trials supporting this practice to improve survival! Only "History" confirmed it.[1]

In the field of neuromuscular diseases, one disease has attracted particular interest: amyotrophic lateral sclerosis (ALS). Characterised by rapidly progressive neuromuscular failure, NIV had long been a subject of debate. A randomised controlled trial published in 2006[2] demonstrated significant improvements in survival and quality of life in the NIV arm, reshaping clinical practises. Since then, NIV has become the cornerstone of ventilatory management for these patients. It is probably the most studied population in terms of ventilation. However, two issues remain subjects of debate and research: where should the treatment take place and when should it be started? Traditionally initiated in the hospital under polysomnography, initiation has gradually become more ambulatory. Since the first demonstration of home NIV initiation in Spain,[3] several teams have begun implementing this with entirely satisfactory results.[4] The second issue currently under study is the timing of initiation. Many teams have begun proposing increasingly early intervention, before alveolar hypoventilation appears. However, the benefits remain debated: initiation too early may result in non-utilisation of the treatment, as previously showed in Duchenne patients[5]; too late could increase mortality.

Given its effectiveness in patients with restrictive disease, this treatment has also been proposed for patients with obesity hypoventilation syndrome. Although apnoeic events can play a significant and harmful role in the treatment of these patients, the *Pickwick trial* confirmed that CPAP in such patients, further complicated with severe obstructive sleep apnoea, is as effective as NIV.[6] Some uncertainties remain, however: management of patients' post-acute exacerbation, the definition of CPAP failure (persistent daytime alveolar hypoventilation is acceptable but are persistent clinical symptoms or the presence of nocturnal alveolar hypoventilation indications for home NIV?), and finally, the phenotype of patients for whom CPAP will not work.

Last but not least, the role of NIV in COPD patients must be discussed. COPD remains the primary indication for home NIV,[7] yet it is also the condition for which there is the most uncertainty and debate. Until 2014, while the role of NIV in acute cases was well established, numerous randomised controlled trials on long-term NIV in COPD had failed to demonstrate a benefit. The treatment was not recommended, but was still implemented, implying a clinical benefit based on medical reasoning, albeit not supported by studies. It is in this context that a new concept of ventilation emerged: high-pressure ventilation, or "high intensity" ventilation. Initially theorised by German teams, this strategy increases the settings (especially PS) to reduce or normalise capnia, thereby correcting hypoventilation.[8] This goal has been a shared aim of pulmonologists for years in other diseases, but has been self-censored in COPD patients due to the recommendation to keep IPAP settings low in intensive care units to avoid distension and auto-PEP.[9] However, in 2014, the ground-breaking trial of Könhlein et al.[10] demonstrated for the first time the benefit of NIV in terms of mortality in stable COPD patients with severe hypercapnia. This trial was later confirmed by the HOT HMV study, which showed the same benefit in patients with persistent hypercapnia following an acute exacerbation.[11]

Since then, high-pressure ventilation, with high PS and a goal of reducing capnia, has been recommended by various medical societies.[12,13] However, questions and uncertainties remain. Indeed, the lack of benefit in these two studies on quality of life raises questions. While the goal of reducing capnia seems unquestionable, might there be other parameters to take in account? As in neuromuscular diseases, should asynchrony or distension not be considered?

Many patients exhibit poor ventilation quality in the months following initiation. The SOMNOVNI group proposed several algorithms for monitoring and adjusting equipment, ranging from simple tools such as nocturnal oximetry under NIV, to more advanced monitoring such as polygraphy under NIV.[14] Increasing evidence shows more and more that normalising capnia, improving compliance, enhancing overall ventilation quality, and correcting asynchrony can improve quality of life and survival.

The impact of NIV on sleep, which remains poorly understood, also warrants further investigation. Dreher et al.[15] showed that high-intensity NIV does not degrade sleep quality compared

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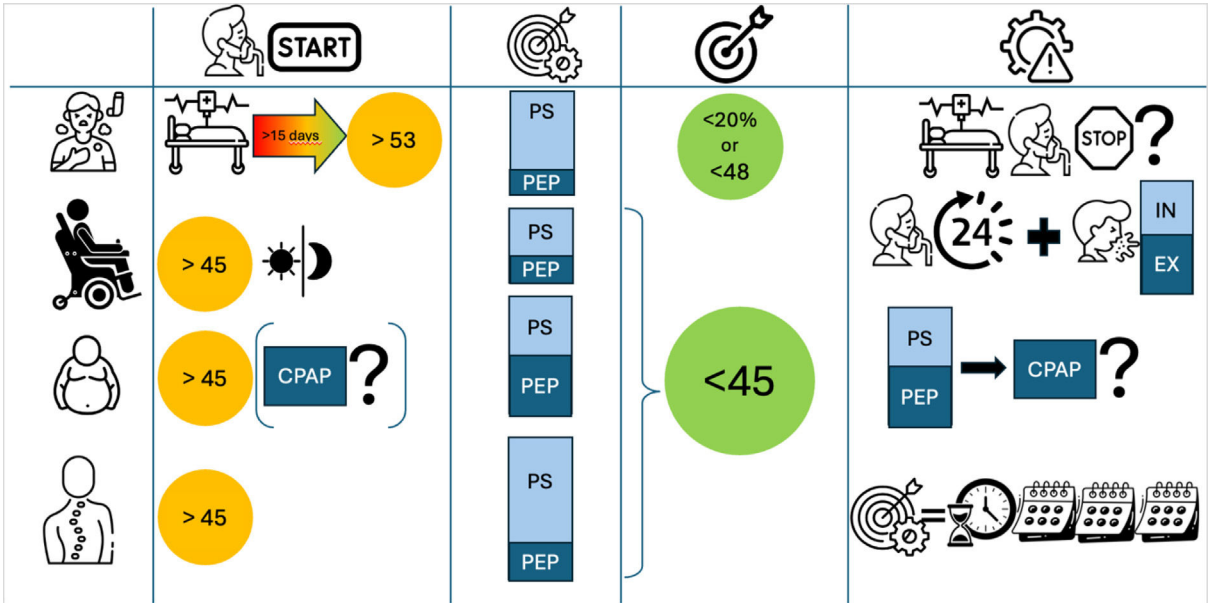

Fig. 1. Home-based non-invasive mechanical ventilation in different indications. The numbers in the circle are $PaCO_2$ (mm Hg), PS: pressure support, PEP: positive expiratory pressure, CPAP continuous positive airway pressure, IN/EX: in/exsuflator.

to low-intensity NIV. However, while important, for precautionary reasons, to demonstrate the absence of side effects, it would be interesting to explore ways to improve sleep quality in such patients.

Finally, the indication for NIV remains an area of uncertainty. For a COPD patient with severe hypercapnia in a stable state or following an exacerbation, the indication is clear. But what about patients with moderate hypercapnia following severe exacerbation? What about those who experience nocturnal alveolar hypoventilation or manage to maintain normocapnia, albeit at the cost of significant muscular effort?

In the context of NIV monitoring, the question of telemonitoring arises. Increasing data imply that telemonitoring could benefit patients, but many questions remain, and randomised controlled trials are still lacking.

Finally, we believe it is important to address one last point: sleep. As discussed in this brief review, NIV is primarily a nocturnal treatment. However, its indication is based on daytime criteria (hypercapnia, exacerbations). The lack of data on the sleep patterns of respiratory failure patients, the mechanisms they use to sleep despite impaired respiratory function, and the potential benefits of NIV for sleep seem to be important areas for better understanding patient needs and the potential benefits of NIV.

In summary, home NIV is both simplistic and very complex (Fig. 1): it is indicated when a patient exhibits hypoventilation due to chronic respiratory failure, yet it is a highly technical treatment that requires substantial expertise from both professionals and patients. It also consumes medical and hospital time, and thus its use at home is a promising alternative. Moving forward, home NIV will require innovative solutions in care management and/or technology to avoid hospital admissions.

Conflicts of Interest

JGB received fees from BREAS and LOWENSTEIN for courses and scientific boards in 2021 and 2022 and none from June 2022 to January 2025 as president of the SPLF.

LG has no conflicts of interest to declare related to the present work. He received grants from AADAIRC. He received speaker or advisory board fees from Asten, Air Liquide Medical Systems, Sanofi Genzyme, SOS Oxygene, AstraZeneca, ASV, Boerhinger, Vivisol, and ResMed, as well as support for attending meetings from SOS Oxygène, Alize Santé, and Asten.

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