Home use of Non-invasive Ventilation for chronic obstructive pulmonary disease. Literature Review and Update

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Abstract

Non-invasive ventilation use in acute COPD exacerbation and acute respiratory failure is very strong, however the evidence beyond home non-invasive ventilation for COPD patients is less clear. In this review we summarize the literature on the effectiveness of home non-invasive ventilation on mortality, hospital admission rates, quality of life, lung functions, gas exchange, exercise tolerance as well as mood and anxiety.

Published guidelines from multiple societies mostly give weak and conditional guidelines on the use of home non-invasive ventilation.

High intensity home non-invasive ventilation was recently introduced and may further improve the outcomes. New research regarding high intensity home non-invasive ventilation and new technology are needed to define the role and the benefits of home non-invasive ventilation in patients with COPD.

Keywords: Home non-invasive ventilation, COPD, GOLD, High intensity non-invasive ventilation

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Introduction

COPD has been ranking within the top 5 leading causes of death globally ranking the third worldwide per the World Health Organization report in 2019, and the fourth in the US. [1]

The risk of rehospitalization within 5 years after discharge is 44%, and the re-admission rate within 30 days is 22.6%. [2] The mortality rate of COPD was 59.4 deaths per 100,000 population vs the mortality rate of the highest cause of death, ischemic heart disease was 153.4 in 2019 in the US. (World Health Organization, 2019). Accordingly, expenditures for treating COPD have been increasing; the total cost of COPD was $32.1 billion in 2010 and it is predicted to be $49.0 billion in 2020. [3] A hospital readmission reduction program was expanded to include COPD by the U.S. Centers for Medicare and Medicaid Services (CMS) in 2014; hospitals are charged a penalty including a decreased reimbursement for the treatment of Medicare beneficiaries if patients have unplanned readmission for a COPD exacerbation within 30 days. [4]

The use of non-invasive ventilation in acute exacerbation of chronic pulmonary disease is now considered the first line support in those with respiratory failure and included in most guidelines. [5] There is many physiologic rationale for using home non-invasive ventilation (H-NIV) in group of COPD patients including, reducing work of breathing, and improving respiratory mechanics. [6] The use of H-NIV is one of the methods which might support COPD patients and might reduce the re-admission rate of hospitalization. There have been a significant research enthusiasm about H-NIV in the last two decades. The european respiratory society published recent guidelines on using home non invasive ventilation for COPD patients in four conditions, [7] additionally the american thoracic society also recommends nocturnal H-NIV for stable patients with chronic hypercapnia. [8]

Mortality benefits:

Multiple studies have shown survival benefits for use of H-NIV after an episode of acute exacerbation of chronic obstructive pulmonary disease (AECOPD) patients requiring NIV. [9, 10, 11] On the other hand some studies have not replicated those survival benefits. [12, 13]

Nocturnal H-NIV have also shown some improved survival in stable patients with chronic hypercapnia with and without sleep disorders, and is given conditional recommendation with moderate certanity in some guidelines. [8]

Hospital re-admission benefits:

Simillar to the mortality findings above, multiple studies showed reduction in hospital and ICU readmission for patients using H-NIV after hospital discharge from AECOPD. [9, 10] Other studies showed reduction of readmission through the intervention of nocturnal NIPPV initiated and cared by a respiratory therapist, medication adjustment by a pharmacist, adequate oxygen therapy. [14] on the other hand, same findings of reduction in readmission rates could not be replicated by other researchers. [12, 13]

Effects on gas exchange

Improved day time as well as nocturnal $PaCO_2$ was documented by using nocturnal NIV at six months, [15]one, [12] and two years. [16] Those improvements were linked to improved mortality.

Effects on quality of life and symptoms:

Many studies have examined the role of H-NIV on the quality of life in COPD patients. [15, 16,] 17 Severe COPD patients with NIPPV and pulmonary rehabilitation showed the improvement of Health-Related Quality of life (HRQoL), mood, dyspnea, gas exchange, exercise tolerance, and lung function compared to severe COPD patients treated with pulmonary rehabilitation only. [16] Additionally H-NIV was found to improve HRQoL in COPD patients with sleep disorders. [17]

Effects on anxiety/Mood:

Anxiety issues are highly prevelant in COPD and appear strongly related to worsening of symptoms, hospital admissions, costs, and mortality for COPD patients. Specific fears are social isolation, dyspnea-related fear, fear of movement, and fear of progression of the disease which exists in COPD patients. [18, 19] The process of diagnosing is complex due to overlap or close relation of physical and psychiatric symptoms in COPD who has symptoms of anxiety and depression. It is not simple to grasp all elements behind the relation between anxiety, depression, and acute exacerbation. [20]

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) Guideline 2021 states that COPD is very common in patients with other psychiatric illness, often under-diagnosed and treated, and a

recent systematic review has shown that COPD patients are 1.9 times more likely to commit suicide than people without COPD, but there is no evidence that anxiety and depression should be treated differently in the presence of COPD; the potential impact of pulmonary rehabilitation should be stressed as studies have found that physical exercise has a beneficial effect on depression in general. [19]

Only few studies have shown a beneficial effect of H-NIV on the reduction of respiratory complaint, sleep and attendant symptoms, and Anxiety related subscales. [21]

Guidelines

Multiple guidelines have recommended H-NIV in set of patients with COPD. [7,8,22]

The European society task force issued those new guidelines regarding home long term NIV [7] for: *1)* be used for patients with chronic stable hypercapnic COPD (conditional recommendation, low certainty evidence). 2) be used in patients with COPD following a life-threatening episode of acute hypercapnic respiratory failure requiring acute NIV, if hypercapnia persists following the episode (conditional recommendation, low certainty evidence). 3) suggests titrating LTH-NIV to normalize or reduce P_{aCO2} levels in patients with COPD (conditional recommendation, very low certainty evidence). 4) suggests using fixed pressure support mode as first-choice ventilator mode in patients with COPD using LTH-NIV (conditional recommendation, very low certainty evidence).

The American thoracic society also published recent guidelines [8] about long term NIV in chronic stable hypercapnic COPD stating: *1*) We suggest the use of nocturnal NIV in addition to usual care for patients with chronic stable hypercapnic COPD (conditional recommendation, moderate certainty). *2*) we suggest that patients with chronic stable hypercapnic COPD undergo screening for obstructive sleep apnea before initiation of long-term NIV (conditional recommendation, very low certainty). *3*) we suggest not initiating long-term NIV during an admission for acute-on-chronic hypercapnic respiratory failure, favoring instead reassessment for NIV at 2–4 weeks after resolution (conditional recommendation, low certainty). *4*) we suggest not using an in-laboratory overnight polysomnogram to titrate NIV in patients with chronic stable hypercapnic COPD who are initiating NIV (conditional recommendation, very low certainty). *5*) we suggest NIV with targeted normalization of Pa_{CO2} in patients with hypercapnic COPD on long-term NIV (conditional recommendation, low certainty).

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) report 2021 states it remains unclear benefits to support long-term NIV, but it is probably beneficial after a recent hospitalization for severe COPD patients who have daytime hypercapnia (PaCO2> or = 52mmHg) (Evidence B). On the other hand, it is advantageous to use continuous positive airway pressure (CPAP) for patients who have obstructive sleep apnea as well as COPD to improve survival and the risk of hospital admissions.

High intenisty NIV

High intenisty NIV referes to receiving home ventilation with high inflation pressures and back-up respiratory rates to achieve the lowest $PaCO_2$ possible. [23]High-intensity NIV is efficient to decrease CO_2 levels and improve the survival rate for chronic hypercapnia COPD patients. [24] The combination of a full-face mask and high IPAP level influences the success of the application to high-intensity NIV. [25] Respiratory therapists' autonomy is a keyword to initiate NIV in an optimal timely manner and make NIV useful for COPD patients. [26] NIV will be developed with a more adjustable design to patients' needs and software-based settings to synchronize patients' ventilation. [27]
The controversial discussion about the effectiveness of long-term NIV has been ongoing in the last two decades and the reason for failing the evidence of long-term NIV could be using low-intensity NIV. [28] The authors call "It is time to evaluate high-intensity NIV which differs from low-intensity NIV for long-term use in aspects of physiological (e.g. blood gases, lung function) and clinical outcomes to explain why high-intensity NIV is recommended instead of low-intensity NIV".

Future

Technological advances, with more sophisticated modes and home portable machines for H-NIV, and telemonitoring of home NIV have grown consistently. It will require large sample quality studies to evaluate the impact of those technologies on patient outcomes. [29]

Conclusion

Through this literature review, home NIV seems useful to improve mortality, hospital admisssions and readmissions, quality of life by choosing the right COPD patients and the right timing but might not be

useful for all COPD patients and not all the time. Most of the published guidelines are weak and conditional recommendations. It might be helpful to establish physical as well as psychological criteria such as baseline $PaCO_2$ and PO_2, the existence of recent hospitalization, the severity of COPD, and other quality scores to assess benefits of home NIV from those parameters multilaterally for each patient.

References

1. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med. 2009 Apr 2;360(14):1418-28.

2. Portillo EC, Wilcox A, Seckel E, et al. Reducing COPD Readmission Rates: Using a COPD Care Service During Care Transitions. *Fed Pract*. 2018;35(11):30-36.

3. Ford ES, Murphy LB, Khavjou O, et al. Total and state-specific medical and absenteeism costs of COPD among adults aged ≥ 18 years in the United States for 2010 and projections through 2020. Chest 2015; 147(1):31-45.

4. Feemster LC, Au DH. Penalizing hospitals for chronic obstructive pulmonary disease readmissions. Am J Respir Crit Care Med. 2014 Mar 15;189(6):634-639.

5. Wedzicha JA, Miravitlles M, Hurst JR, et al. Management of COPD exacerbations: a European Respiratory Society/American Thoracic Society guideline. Eur Respir J 2017;49(3):1600791.

6. Coleman JM, Gates KL, Kalhan R. Home Noninvasive Ventilation for Patients with Chronic Obstructive Pulmonary Disease and Chronic Respiratory Failure. JAMA 2020; 323(5):421–422.

7. Ergan B, Oczkowski S, Rochwerg B, et al. European Respiratory Society guidelines on long-term home non-invasive ventilation for management of COPD. Eur Respir J 2019; 54:1901003.

8. Macrea M, Oczkowski S, Rochwerg B, et al. Long-Term Noninvasive Ventilation in Chronic Stable Hypercapnic Chronic Obstructive Pulmonary Disease. An Official American Thoracic Society Clinical Practice Guideline. Am J Respir Crit Care Med. 2020;202(4):e74-e87.

9. Galli J, Krahnke J, Mamary J, et al. Home non-invasive ventilation use following acute hypercapnic respiratory failure in COPD. Respiratory Medicine; 2014:108, 722-728.

10. Murphy PB, Rehal S, Arbane G, et al. Effect of Home Noninvasive Ventilation with Oxygen Therapy vs Oxygen Therapy Alone on Hospital Readmission or Death After an Acute COPD Exacerbation: A Randomized Clinical Trial. JAMA 2017 6;317(21):2177-2186.

11. Heinemann F, Budweiser S, Jorres R., et al. The role of non-invasive home mechanical ventilation in patients with chronic obstructive pulmonary disease requiring prolonged weaning. Respirology 2011; 16, 1273-1280.

12. Struik FM, Sprooten RTM, Kerstjens HAM, *et al*. Nocturnal non-invasive ventilation in COPD patients with prolonged hypercapnia after ventilatory support for acute respiratory failure: a randomised, controlled, parallel-group study. *Thorax* 2014; 69:826-834.

13. Sellares J, Ferrer M, Anton A, et al. Discontinuing noninvasive ventilation in severe chronic obstructive pulmonary disease exacerbations: a randomised controlled trial. Eur Respir J 2017; 50(1):1601448.

14. Coughlin, S., Liang, W., Parthasarathy, S. (2015). Retrospective assessment of home ventilation to reduce rehospitalization in chronic obstructive pulmonary disease. Journal of Clinical Sleep Medicine 2015; 11(6):663-670.

15. Duiverman M, Vonk J., Bladder G, et al. Home initiation of chronic non-invasive ventilation in COPD patients with chronic hypercapnic respiratory failure: a randomized controlled trial. Thorax 2020; 75, 244-252.

16. Duiverman ML., Wempe JB, Bladder G et al. Two-year home-based nocturnal noninvasive ventilation added to rehabilitation in chronic obstructive pulmonary disease patients: A randomized controlled trial. Respir Res 2011; 12:112.

17. Grassion L, Gonzalez-Bermejo J. Sleep and Mechanical Ventilation in Stable COPD Patients. COPD 2017; 14(4):411-417.

18. Zockler N, Rief W, Kuhl K, et al. COPD-specific anxiety and depressive symptoms in COPD patients. Pneumologie 2012; 66(5):290-296.

19. Panagioti M, Scott C, Blakemore A, et al. Overview of the prevalence, impact, and management of depression and anxiety in chronic obstructive pulmonary disease. Int J Chron Obstruct Pulmon Dis 2014; 13; 9:1289-306.

20. Pooler A, Beech R. Examining the relationship between anxiety and depression and exacerbations of COPD which result in hospital admission: a systematic review. International Journal of Chronic Obstructive Pulmonary Disease 2014; 9:315-330.

21. Valko L, Baglyas S, Gyarmathy VA, et al. Home mechanical ventilation: quality of life patterns after six months of treatment. BMC Pulm Med 2020; 20: 221.

22. Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2021 GOLD reports (2021 global strategy for prevention, diagnosis, and management of COPD) https://goldcopd.org/2021-gold-reports/ Accessed May 2021.

23. Windisch W, Storre JH, Köhnlein T. Nocturnal non-invasive positive pressure ventilation for COPD. Expert Rev Respir Med. 2015 Jun;9(3):295-308.

24. Blankenburg T, Benthin C, Pohl S, et al. Survival of hypercapnic patients with COPD and Obesity hypoventilation syndrome treated with high intensity noninvasive ventilation in the daily routine care. Respiratory Medicine Journal 2017; 11(6):31-40.

25. Callegari J, Magnet F, Taubner S, et al. Interfaces and ventilator settings for long-term noninvasive ventilation in COPD patients. Int J Chron Obstruct Pulm Dis 2017; 12(6):1883-1889.

26. Fisher KA, Mazor KM, Goff S, et al. Successful Use of Noninvasive Ventilation in Chronic Obstructive Pulmonary Disease. How Do High-Performing Hospitals Do It? Ann Am Thorac Soc. 2017; 14(11):1674-1681.

27. Cortegiani A, Russotto V, Antonelli M, et al. Ten important articles on noninvasive ventilation in critically ill patients and insights for the future: A report of expert opinions. BMC Anesthesiol 2017; 17(1):122.

28. Schwarz SB, Magnet FS, Windisch. Why High-Intensity NPPV is Favorable to Low-Intensity NPPV: Clinical and Physiological Reasons. COPD 2017; 14(4):389-395.

29. Borel J, Palot A, Patout M. Technological advances in home non-invasive ventilation monitoring: Reliability of data and effect on patient outcomes. Respirology 2019; 24:1143-1151.