

Long-Term High-Flow Nasal Cannula in Chronic Respiratory Failure in a Patient with Bronchiectasis

Terapia Nasal de Alto Fluxo no Controlo da Insuficiência Respiratória Crónica do Doente com Bronquiectasias

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ABSTRACT

High-flow nasal cannula (HFNC) is a gas delivery system that provides heated and humidified air at higher flow rates than conventional oxygen therapy. While studies on the role of HFNC as a long-term treatment for chronic respiratory failure are limited, most of them focus on patients with chronic obstructive pulmonary disease. We present the case of a woman with severe bronchiectasis and chronic hypercapnic respiratory failure under nocturnal non-invasive ventilation (NIV) and 24-hour conventional oxygen therapy, who experienced multiple and prolonged hospital admissions. Long-term day-time HFNC was initiated, maintaining nocturnal NIV, resulting in significant improvements in dyspnea, better secretion management, and a reduction in exacerbation rates. While more research is needed, HFNC should be considered for long-term management of chronic respiratory failure in patients with bronchiectasis.

Keywords: Bronchiectasis/therapy; Cannula; Oxygen Inhalation Therapy; Respiratory Insufficiency/therapy

RESUMO

A terapia nasal de alto fluxo (TNAF) é um sistema de suporte respiratório que fornece ar aquecido e humidificado, com FiO₂ parametrizável a taxas de fluxo mais elevadas do que a oxigenoterapia convencional. Os estudos sobre o papel da TNAF como tratamento a longo prazo para a insuficiência respiratória crónica são limitados e a maioria incide sobre doentes com doença pulmonar obstrutiva crónica. Apresentamos o caso de uma mulher com quadro grave de bronquiectasias e insuficiência respiratória hiperbápnica crónica sob ventilação não invasiva (VNI) noturna e oxigenoterapia convencional 24 horas, que apresentou múltiplas e prolongadas admissões hospitalares. Foi iniciada TNAF diurna de longa duração, mantendo VNI noturna, resultando em melhorias significativas na dispneia, melhor controlo das secreções e redução das taxas de exacerbação. Embora sejam necessários mais estudos, a TNAF deve ser considerada no tratamento a longo prazo da insuficiência respiratória crónica em doentes com bronquiectasias.

Palavras-chave: Bronquiectasias/tratamento; Cânula; Insuficiência Respiratória/tratamento; Oxigenoterapia

INTRODUCTION

High-flow nasal cannula (HFNC) delivers heated, humidified oxygen at high flow rates (up to 60 L/min), mimicking physiological conditions more effectively than other systems. In acute respiratory failure, HFNC enhances comfort, meets inspiratory demand, reduces CO₂ rebreathing, provides airway pressure, and eases breathing.^{1,2}

The role of HFNC in chronic respiratory failure, especially chronic obstructive pulmonary disease (COPD), has gained increasing evidence in decreasing exacerbation and improving quality of life.^{3,4} However, fewer studies focus on bronchiectasis. Rea *et al* first studied long-term HFNC in patients with both COPD and bronchiectasis, finding fewer exacerbation days and longer time to first exacerbation, though total exacerbation numbers were unchanged, which was the primary outcome of the study.⁴ Although this study did not analyze patients with COPD and bronchiectasis separately, a *post-hoc* analysis focused solely on bronchiectasis patients.⁵ The rationale for using HFNC in chronic bronchiectasis patients is based on improved mucociliary clearance, reducing infections and inflammation.³ Indeed, studies show HFNC reduces exacerbations and enhances quality of life even with brief daily use.⁵ A small retrospective

study reported fewer exacerbations and hospitalizations, and slight lung function improvements.⁶ The largest study to date (78 patients, two-year follow-up) showed reduced exacerbations and dyspnea at both two months and two years, though lung function remained unchanged.⁷ Despite these positive outcomes, large-scale studies on the long-term use of HFNC in bronchiectasis patients remain limited.

Furthermore, HFNC is also being explored in exercise training (ET) and pulmonary rehabilitation (PR), with improved endurance and dyspnea in COPD and some interstitial lung diseases.⁸ High-flow nasal cannula-induced hyperoxia enhances gas exchange and tissue oxygenation, supporting muscle recovery and endurance while mitigating exertional dyspnea factors.⁹ However, its use in bronchiectasis during ET remains under-investigated.

CASE REPORT

We report the case of a 70-year-old non-smoker woman with asthma, bronchiectasis (post-obstructive and post-infectious), and chronic hypercapnic respiratory failure (CHRF). Her medical history included heart failure, hypertension, dyslipidemia, and insulin-treated type 2 diabetes.

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Regular medications included inhaled triple therapy, montelukast, aminophylline, 24h oxygen therapy (4 L/min at rest), and bilevel non-invasive ventilation (NIV) overnight and for two daily sessions.

She had multiple admissions over 2.5 years due to infected bronchiectasis and exacerbations of CHRF, including an intensive care unit stay and a necrotizing pneumonia requiring several antibiotic cycles. Ten days post-discharge, she returned with worsening resting dyspnea, productive cough and purulent sputum, and fever. Oxygen saturation was below 80% with exertion and 85% at rest, despite oxygen therapy and NIV. Inflammatory markers were elevated, and chest x-ray was compatible with infected bronchiectasis. A nosocomial infection and exacerbated CHRF with respiratory acidosis were assumed. She was treated with broad-spectrum antibiotics, bronchodilators, mucolytics, corticosteroids, and continuous NIV. Subsequent sputum cultures identified *Pseudomonas aeruginosa*, which persisted despite sensitivity-guided antibiotic treatments and was deemed a chronic infection. She received treatment with inhaled sodium colistimethate using eFlow® with good compliance. Despite near-continuous NIV, she desaturated even when speaking or eating on 6 L/min oxygen. As an attempt to reduce desaturation episodes and ventilatory effort, high-flow nasal cannula (HFNC) was initiated at 40 L/min, FiO₂ 31% during NIV short pauses, and titrated according to patient's comfort and clinical outcomes, with improvement in tolerance and gas exchange. Settings were later increased to 60 L/min, FiO₂ 31%. As a result, time on HFNC was gradually increased and, by day three, she was on daytime HFNC and nocturnal NIV with good tolerance. Respiratory physiotherapy was introduced, well tolerated, and aided sputum clearance.

The patient was proposed for domiciliary long-term HFNC and NIV. The patient and family were thoroughly instructed on equipment use, mode switching, maintenance, and troubleshooting. Respiratory care providers were involved in the process. After 46 days, she was discharged on inhaled colistin, chronic azithromycin, acetylcysteine, and tapering prednisolone. She continued home nocturnal NIV and daytime HFNC (35 L/min with 10 L/min O₂), and portable oxygen at 6 L/min during exertion. Follow-up appointments at the bronchiectasis and chronic respiratory failure department were scheduled, along with an evaluation for inclusion in a hospital-based PR program. She completed 29 PR sessions using HFNC, showing above-average gains. She continued home airway clearance techniques, including the Acapella® device, and nebulized hypertonic saline.

After completing the PR program, she reported significant improvements, including a reduction in dyspnea, a decrease in sputum volume and thickness, and quality of life. She became more confident, resumed household tasks and

social interactions. In contrast to the previous history of ten exacerbations (including five hospital admissions) over 2.5 years, she remained exacerbation-free for 34 months.

DISCUSSION

This case highlights the importance of HFNC not only in acute stages of disease, by managing exacerbations, but also as a key long-term strategy in the management of chronic respiratory failure in patients with severe bronchiectasis, by offering remarkable benefits in clinical outcomes, comfort, adherence, and quality of life. In this patient, HFNC contributed to a 34-month exacerbation-free period and was a precious adjunct to rehabilitation success.

Of the many physiological benefits of HFNC, its humidification and heating effects on inhaled air are particularly important for patients with abundant bronchorrhea and difficult-to-clear thick secretions. Chronic oxygen use can dry airways, increasing resistance and work of breathing. By providing optimal conditions for mucociliary transport and secretion clearance, HFNC helps decrease bronchoconstriction, reduce the work of breathing, and normalize respiratory rate. This improves comfort and tolerance, leading to a better quality of life.

While evidence for chronic HFNC is limited, the Danish Respiratory Society has issued national guidelines (the only current ones) supporting long-term use in COPD and bronchiectasis with frequent exacerbations.¹⁰ They recommend long-term HFNC for patients with COPD and bronchiectasis who experience frequent exacerbations, although evidence remains scarce.¹⁰ Furthermore, HFNC's benefits for dyspnea span COPD, bronchiectasis, and interstitial lung diseases, suggesting broad potential in chronic care.¹⁰

High-flow nasal cannula has emerged as an innovative and safe therapeutic option for difficult respiratory failure. It supports clinical stability, exercise tolerance, and quality of life. It should be considered for patients with bronchiectasis and respiratory failure, but broader studies and international guidelines are needed to solidify its role in long-term bronchiectasis management.

AUTHOR CONTRIBUTIONS

ALS: Study design, writing of the manuscript.

JCJ, DR: Study design, critical review of the manuscript.

All authors approved the final version to be published.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in October 2024.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

PATIENT CONSENT

Obtained.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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