SARS-CoV-2 pneumonia and Eisenmenger's syndrome: doubling the challenge

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Abstract

Eisenmenger's syndrome (ES) is the most severe phenotype of pulmonary arterial hypertension secondary to congenital heart disease. In these cases, significant systemic-to-pulmonary (left-to-right) shunting triggers the development of pulmonary vascular disease and pulmonary hypertension. In cases of acute hypoxemic respiratory failure in patients with ES, high-flow nasal cannula (HFNC) oxygen therapy should be considered as a first-line approach in order to avoid pulmonary complications and right ventricular overload related to positive pressure ventilation. Here, we report a case of HFNC use in a patient with COVID-19 infection and ES.

Introduction

Eisenmenger's syndrome (ES) is considered the most severe phenotype of pulmonary arterial hypertension (PAH) secondary to congenital heart disease. Ventricular septal defect, atrial septal defect, single ventricles anomalies, patent arterial duct, and several other alterations are responsible for its development [1].

In these cases, significant systemic-to-pulmonary (left-to-right) shunting triggers the development of pulmonary vascular disease and pulmonary hypertension, leading to a multi-systemic disorder with multiple complications and poor survival.

Case Report

Here, we report a case of severe COVID-19 infection in a woman affected by ES, where the use of high-flow nasal cannula (HFNC) oxygen therapy greatly contributed to her recovery. Informed written consent was obtained from the patient before publishing her clinical data. A SARS-CoV-2 non-vaccinated 67-year-old woman presented to the emergency department of the University Hospital of Bari with complaints of fatigue, dyspnea, and dry cough. The patient was affected by a ventricular septal defect leading to ES. She underwent periodical check-ups at the Regional Center for Pulmonary Hypertension of the University Hospital of Bari. Before admission, her medications included tadalafil, inhaled iloprost, maci-

tentan, bisoprolol, amiodarone, furosemide, and levothyroxine. In addition, home oxygen therapy (6 L/min *via* a non-Venturi oxygen facemask) was necessary 24 hours a day.

On arrival, the arterial blood gas parameters revealed a hypoxic-hypercapnic respiratory failure with a oxygen partial pressure (PaO_2) and fractional inspired oxygen (FiO_2) ratio of 137 (pH 7.4, carbon dioxide partial pressure 50 mmHg, PaO_2 45 mmHg HCO_3 32 mmol/L).

After a thorough assessment and a polymerase chain reaction swab confirming SARS-CoV-2 infection, she was commenced on oxygen therapy *via* a Venturi-mask FiO_2 0.35 to achieve a target oxygen saturation (SpO_2) of at least 90%.

Taking into consideration the potential high risk of complications, intubation was avoided, and the patient was admitted to the Respiratory Intermediate Intensive Care COVID-19 Unit (RICU). On RICU admittance, the patient was alert and conscious. Clinical examination revealed tachypnea (respiratory rate of 35/min), non-invasive blood pressure 100/65 mmHg, heart rate 65 bpm, SpO_2 84%, and peripheral cyanosis. PAH medications were continued, maintaining a target SpO_2 of 85-90% in consideration of her congenital heart disease [2]. Microbiological samples (blood, urine, and sputum) were collected to exclude bacterial superinfections [3]. The echocardiographic assessment revealed marked dilatation of both the right atrium and ventricles with severe pulmonary hypertension. Table 1 compares right heart catheter measurements before and after hospital admission. Chest computed tomography scan showed bilateral and diffuse ground-glass opacities, with bilateral consolidations in the upper pulmonary lobes (Figure 1), confirming the diagnosis of moderate acute respiratory distress syndrome (ARDS). According to the indications of the physician-in-charge on the admission day, the patient was commenced on noninvasive ventilation (NIV) [4] (settings - pressure support: 11 cmH_2O, positive end-expiratory pressure: 8 cmH_2O) with an interface rotational strategy and alternating prone positioning (at least 12 hours a day) and light sedation with dexmedetomidine (up to 0.5 mcg/kg/h) [5,6]. The decision to start an NIV attempt was based on the progressive deterioration of gas exchanges in an attempt to avoid invasive mechanical ventilation, which may lead to increased pulmonary vascular resistance and worsening of hypoxemia.

As poor interface tolerance forced to discontinue NIV, the patient was switched to HFNC therapy (60 L/min, temperature 31°C) with a SpO_2 target above 85% monitoring respiratory rate oxygenation index [7]. FiO_2 and flow were reduced according to clinical improvements. After 5 weeks, the patient was progressively weaned off from HFNC therapy and was discharged home at 7 weeks after admission with indications to follow her homecare as before the acute event [8] (Figure 2).

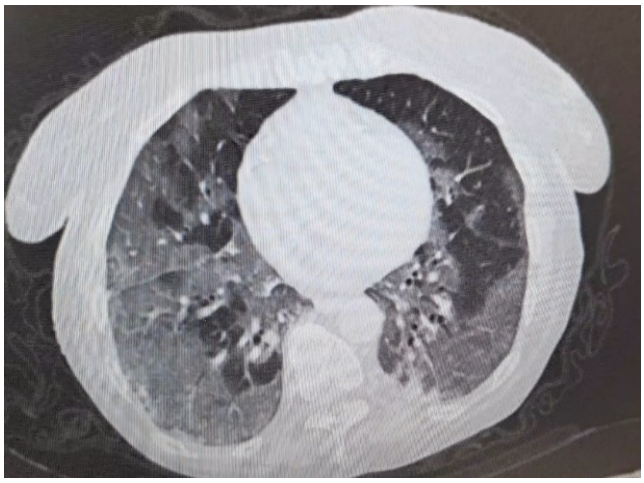

Figure 1. Chest computed tomography scan. Bilateral ground glass opacities and consolidations in middle and lower pulmonary lobes.

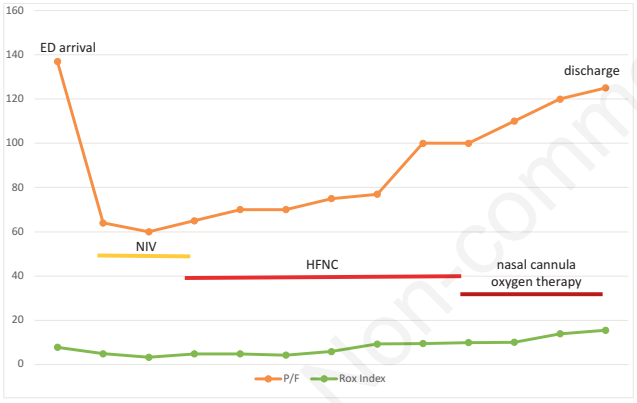

Figure 2. Oxygenation parameters trends (according to different therapeutic strategies). ED, emergency department; NIV, noninvasive ventilation; HFNC, high-flow nasal cannula; P/F, Horowitz index: arterial oxygen partial pressure/ fractional inspired oxygen ratio; ROX, respiratory rate oxygenation index.

Discussion

To the best of our knowledge, this is the first successful case of HFNC therapy after NIV failure in a patient with severe global respiratory failure and COVID-19. Only one previous study described

Table 1. Aortic pressure, pulmonary pressure and resistance, right ventricle pressure, pulmonary capillary wedge pressure, cardiac output, and stroke volume values of the patient before (2019) and after (2021) COVID-19.

	Aortic pressure S/D/M (mmHg)	Pulmonary pressure S/D/M (mmHg)	Pulmonary vascular resistance (WU)	Right ventricle pressure S/D/M (mmHg)	PCW mean (mmHg)	Right atrial pressure mean (mmHg)	Cardiac output (L/min)	Stroke volume (mL)
2019	166/67/97	124/37/71	6.5	128/11/27	17	12	8.23	137
2021	105/60/70	106/25/55	4.3	100/0/4	20	11	8.13	120

S, systolic; D, diastolic; M, mean; PCW, pulmonary capillary wedge pressure.

a limited series of hypoxemic ES patients with COVID-19, treated with low-flow oxygen therapy [9].

NIV has been extensively used with alternating results in COVID-19 hypoxemic patients. Lung overdistension related to positive pressure ventilation may cause hyperinflation, directly correlating to right heart overload [9]. Thus, the use of HFNC may have contributed to decreasing the patient's effort without increasing right ventricular afterload.

In addition, HFNC has been demonstrated to be a more tolerable therapeutic alternative when compared to NIV. While poor interface tolerance and the possible development of pressure ulcers often lead to NIV discontinuation, HFNC may be delivered continuously, improving patients' therapeutic adhesion [10].

The official European Respiratory Society/American Thoracic Society guidelines recommend NIV for acute hypercapnic respiratory failure with acidosis (pH≤7.35) secondary to chronic obstructive pulmonary disease [11]. The HFNC may be very useful for COVID-19 patients with respiratory distress, providing a small positive airway pressure, reducing the anatomical dead space, and increasing pharyngeal oxygen concentration [9,12]. Therefore, its action can counterbalance severe hypoxemia, improving hypercapnia, and both these mechanisms might have contributed to our patient's recovery.

Conclusions

In conclusion, treating PAH secondary to ES in the case of COVID-19-related ARDS doubles the challenge that physicians face. HFNC therapy reaffirms its benefits and, therefore, should be considered as a first-line approach.

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