

## Prone position in patients in spontaneous ventilation with respiratory failure by COVID-19: case report

### Posição prona em pacientes em ventilação espontânea com insuficiência respiratória por COVID-19: relato de caso

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**ABSTRACT | INTRODUCTION:** The Prone Position (PP) is generally used in cases of Acute Respiratory Insufficiency (IRPA), in patients with Acute Respiratory Distress Syndrome (ARDS) and in invasive mechanical ventilation, in order to improve oxygenation, but it can be used useful in cases of mild IRPA, using the need for invasive mechanical ventilation and complications associated with the ventilator. **OBJECTIVES:** To describe or report the case of using the prone position (PP) in patients with spontaneous ventilation with mild respiratory failure secondary to COVID-19. **METHODS:** this is a case of a patient diagnosed with COVID-19, with an IRPA level, with dyspnea, cough, hypoxemia and desaturation, which includes treatment techniques that use a prone position protocol for two hours, twice a day for the entire hospital stay. **RESULTS:** The patient presented hypoxemia (SpO<sub>2</sub> -94% and PO<sub>2</sub>- 62.9), associated with a food (Borg 6) on admission, having received improvements in food (Borg 4) and 96% saturation in pulse oximetry after 24 hours from the beginning of the protocol and after 48 hours it improves the gasometric and SpO<sub>2</sub> and PaO<sub>2</sub> values of 96.5% and 80.6 mmHg, respectively. **CONCLUSION:** The prone position in patients on spontaneous ventilation, with respiratory failure secondary to COVID-19 is safe and can be used as adjunctive therapy to treatment in this patient profile.

**KEYWORDS:** COVID-19. Respiratory insufficiency. Prone position.

**RESUMO | INTRODUÇÃO:** A Posição Prona (PP) geralmente é utilizada em casos de Insuficiência Respiratória Aguda (IRPA) grave, em pacientes com Síndrome da Angústia Respiratória Aguda (SARA) e em ventilação mecânica invasiva, com o objetivo de melhorar a oxigenação. Entretanto, pode ser útil em casos de IRPA leve secundária ao COVID-19 reduzindo a necessidade de ventilação mecânica invasiva e as complicações associadas ao ventilador. **OBJETIVO:** Descrever o relato de caso do uso da posição prona (PP) em pacientes em ventilação espontânea com Insuficiência Respiratória Leve secundária ao COVID-19. **MÉTODO:** Trata-se de um relato de caso de um paciente com diagnóstico de COVID-19, com IRPA leve, com dispneia, tosse, hipoxemia e dessaturação, que dentre as técnicas de tratamento utilizou um protocolo de posição prona por períodos de duas horas, duas vezes ao dia, durante todo o período de internação. **RESULTADOS:** O paciente apresentou hipoxemia (SPO<sub>2</sub> -94% e PO<sub>2</sub>- 62,9), associada a dispneia (Borg 6) na admissão, tendo apresentado melhora na dispneia (Borg 4) e saturação na oximetria de pulso de 96% após 24 horas de início do protocolo. Após 48 horas apresentou melhora gasométrica com valores e SPO<sub>2</sub> e PO<sub>2</sub> de 96,5% e 80,6 mmHg respectivamente. **CONCLUSÃO:** A posição prona em pacientes em ventilação espontânea, com insuficiência respiratória leve secundária ao COVID-19 é segura e pode ser utilizada como terapia adjuvante ao tratamento desse perfil de pacientes.

**PALAVRAS-CHAVE:** COVID-19. Insuficiência respiratória. Decúbito ventral.

## Introduction

In December 2019 a previously unknown beta coronavirus was discovered using impartial sequencing in samples from a group of patients with pneumonia of unknown cause. This virus was named 2019-nCoV, being this the seventh member of the family of coronaviruses that infect humans<sup>1</sup>.

Until then, six species of coronavirus that caused human diseases were known, four of which generally cause common cold symptoms in immunocompetent individuals, and the other two other strains, which became known as severe acute respiratory syndrome (SARS-CoV) and coronavirus of the Middle East respiratory syndrome (MERS-CoV), have been associated with diseases that are sometimes fatal<sup>1</sup>.

On January 7, 2020, Chinese health authorities confirmed the emergence of a new coronavirus (2019-nCoV) and epidemiological data indicated that respiratory and contact transmission was taking place<sup>2</sup>. This new disease caused by the coronavirus (Covid-19), is an emergency situation, whose clinic and epidemiology are not yet fully known and are still being documented<sup>3</sup>.

The most common symptoms found were fever (98%), cough (76%) and myalgia or fatigue (44%) and less frequent sputum production (28%), headache (8%), hemoptysis (5%) and diarrhea (3%), with more than half of the patients (55%) developing dyspnea<sup>4</sup>. In addition, the duration between the onset of the disease until the onset of dyspnea was on average eight days, the average time from the onset of symptoms to the first hospital stay was seven days, until the onset of ARDS was nine, the mechanical ventilation was 10.5 days and ICU admission was 10.5 days<sup>4</sup>.

With regard to acute respiratory failure (ARF), it can be defined as an insufficient supply of oxygen or inadequate removal of carbon dioxide, which represents the inability of the respiratory system to meet the metabolic needs of the body and eliminate CO<sub>2</sub>, it can be hypoxemic or hypercapnic and, in some cases, both problems simultaneously, with acute dyspnea being one of the main symptoms that you are not breathing normally<sup>5</sup>. It can also be classified as mild, moderate and severe acute hypoxemic respiratory failure<sup>6</sup>. In patients with COVID-19, IRpA is hypoxemic.

Among the techniques for the treatment of IRPA is the position in prona (PP), which aims to use gravity and the repositioning of the heart in the chest to recruit pulmonary alveoli and improve the ventilation / perfusion ratio and arterial oxygenation, where the gravitational gradient of pleural pressure is reduced, transpulmonary pressures are more uniform and alveolar recruitment can be achieved in atelectatic regions without harming regions that had already been recruited<sup>7</sup>. Treatment will be related to the underlying cause, but the goal will always be to improve oxygenation or ventilation<sup>5</sup>.

Therefore, the aim of the present study was to describe the case report of the prone position in patients on spontaneous ventilation with mild respiratory failure secondary to COVID-19.

## Clinical case

The research project was submitted to evaluation by the Research Ethics Committee involving human beings, in accordance with Resolution No. 466/12 and CONEP Circular Letter No. 166/18, under the number of CAAE: 31227720.1.0000.5028 and approved under opinion number 4.036.996.

The case report refers to a 31-year-old male patient, previously healthy, with reports of episodes of fever, myalgia, diarrhea, chills beginning on the night of April 9, 2020. He sought the emergency care unit on April 10, 2020 referring recent contact with confirmed and suspected cases of COVID-19. The nasal and oropharyngeal SWAB collection was evaluated and discharged with prescription of symptomatic medications and Amoxicilina.

On April 15, 2020, he returned to the unit, with a positive result for COVID-19, evolving for 3 days with a predominantly dry cough, slight yellowish secretion, chest pain and dyspnea at rest. He presented episodes of desaturation, with values of Oxygen Saturation (SPO<sub>2</sub>) of 92%, with persistence of the initial symptoms. He denies syncope, palpitations, loss of consciousness, prostration, convulsions and headache. Physical examination showed stable hemodynamics, tachypneic (22 ipm), blood pressure (BP) 125 x70 mmHg, borderline SPO<sub>2</sub> (92% to 94%).

Chest tomography revealing opacities with ground-glass attenuations and small scattered foci of consolidation in the lungs, predominantly distributed in the lower and peripheral lobes. It also presents small perilobular consolidating opacities in the basal segments of the lower lobes, with a moderate extent of pulmonary involvement (50%). Arterial blood gas analysis (HGA) with pH 7.45, PCO<sub>2</sub> 33.5, PO<sub>2</sub> 62.9, BE 0.1, Bicarbonate (BIC) 23.1 and SPO<sub>2</sub> 94%. The initial procedures adopted were respiratory isolation, drug treatment with Rocefin, Azithromycin and Hydroxychloroquine and respiratory and hemodynamic surveillance.

Day 04.16.2020 continued with a stable clinical picture, appearing lucid, oriented and collaborative, referring to dyspnea at rest, where dyspnea was quantified through a subjective effort perception scale that has a score ranging from 0 to 10 points, the Modified Borg Scale, validated and easily applicable to quantify dyspnea<sup>8</sup>, with the patient classified the Borg in six points, in spontaneous ventilation with low flow oxygen supplementation via nasal catheter (3 liters / min), SPO<sub>2</sub> 94% , dry and effective cough, lung auscultation with reduced breath sounds and no adventitious sounds. No apparent motor deficit heated and perfused extremities without edema. Having started the PP protocol, instructing the patient to remain in the prone position for periods of 02 hours and then return to the supine position with the headboard elevated to 30 degrees, having to repeat the PP twice a day in opposite shifts according to the protocol of the service, since in the literature the typical protocols include 30 to 120 minutes in a prone position, followed by equal periods in the other decubitus positions (left side, right lateral position and upright position in the sitting position), with the positioning being guided by the patient's wishes<sup>9</sup>.

On April 17, 2020, the patient maintains a stable clinical condition, reporting improvement in dyspnea (Borg 4), in spontaneous ventilation with low flow oxygen therapy via nasal catheter at 1 liter per minute, SPO<sub>2</sub>-96%, Fr 18 ipm. He reported having been in the 02 02-hour periods, according to the guidelines, referring to improvement in respiratory distress when in the prone position. Being instructed to maintain this position twice a day, for periods of up to 02 hours.

Day 04.18.2020, evolves lucid, collaborative, reporting improvement of dyspnea (Borg 4), in spontaneous ventilation in room air, Fr 17 ipm, comfortable ventilatory muscle pattern, symmetric chest expansion, well-distributed pulmonary auscultation without adventitious sounds, dry cough, 97% SPO<sub>2</sub>. She reports staying in PP 02 times a day for 02 hours, as directed, reporting improvement in her respiratory condition, but she referred pain in her spine during positioning in PP, which improves after leaving positioning. HGA with pH 7.46, PO<sub>2</sub> 80.6, pCO<sub>2</sub> 38.4, BIC 27.2, SPO<sub>2</sub> 96.5%.

On 19.04.2020, the patient continues with a stable clinical picture, with improvement of the respiratory condition, without the need for supplemental oxygen therapy, laboratory exams without significant alterations, without findings suggestive of the severity of the disease, being discharged, with instructions for respiratory isolation, using medications to treat possible bacterial pneumonia (Rocefin and Azithromycin).

## Discussion

The case report shows that the patient initially presented fever, myalgia, diarrhea, chills and subsequently predominantly dry cough, slight yellowish discharge, chest pain, dyspnea at rest and episodes of desaturation. According to the study by Huang et al., who found that the most common symptoms in patients with COVID-19 are fever, cough and myalgia or fatigue and less frequent sputum production, headache, hemoptysis and diarrhea, being that more than half of the patients develop dyspnea<sup>4</sup>.

In addition, the patient presented chest CT with a radiological characteristic compatible with the "Low" phenotype, described as a low-elastance lung, high compliance and hypoxemia associated with worsening the control of ventilation perfusion mechanisms and vascular changes<sup>10</sup>.

In patients with COVID-19, two types of pulmonary presentation are identified, phenotype L (LOW), or type 01, and phenotype H (HIGH), or type 2.

Patients with phenotype L, have low elastance, a mechanical respiratory system with static compliance close to normal and ground glass predominance in the computed tomography image. Patients with phenotype H have altered respiratory mechanics, with high elastance and low compliance, making the lungs more rigid and larger areas of alveolar consolidation<sup>11</sup>.

Hypoxemic patients are characterized by an increase in respiratory rate as a physiological response, however, patients affected by COVID-19 with Low phenotype usually present hypoxemia with a low level of dyspnea, due to the fact that they have high pulmonary compliance, thus allowing large lung volumes, without large lung volumes. Increases in respiratory rate, however, this tidal volume generated in a high way, demands a "silent" effort from the respiratory musculature, which can generate a mechanism of self-inflicted injury by the patient (P-SILI), contributing to a worsening of the inflammatory condition<sup>12</sup>.

Arterial blood gas analysis at admission showed SPO<sub>2</sub> and PO<sub>2</sub> of 94% 62.9 respectively, which can be classified as mild hypoxemia, where hemoglobin saturation in O<sub>2</sub> is classified as normal (95%), mild hypoxemia (between 91% and 95% ), moderate (between 90% and 86%) and intense (<85%)<sup>13</sup>.

The Prone Position is generally used in cases of severe IRPA in patients with Acute Respiratory Distress Syndrome (ARDS), who are on invasive mechanical ventilation, in order to improve oxygenation, being indicated for patients with a PO<sub>2</sub> / FiO<sub>2</sub> ratio ≤ 150 mmHg , having demonstrated a significant decrease in mortality in patients with severe ARDS<sup>14</sup>. However, the prone position can be useful in cases of mild and moderate hypoxemic respiratory failure, avoiding the need for mechanical ventilation and complications associated with the ventilator<sup>15</sup>.

In the context of the COVID-19 pandemic, Sartini C. et al conducted a study with 15 patients who were treated with noninvasive mechanical ventilation (NIV) in a prone position and found a reduction in respiratory rate during and after pronation, in addition, all patients showed improvement in SPO<sub>2</sub> and PO<sub>2</sub>, 12 patients showed improvement in SPO<sub>2</sub> and PO<sub>2</sub>, 11 patients showed improvement in comfort during pronation and 13 patients showed improvement in comfort after pronation<sup>16</sup>.

Despite pointing to the possibility of results favorable to the prone position, the study mentioned above used the prone position as an adjunct to NIV, which is a positive pressure therapy, in addition the authors included all patients who used NIV in decubitus ventral, regardless of the day they started using this technique, defining that therapy should continue if there was an improvement in the first hour, but did not define the maximum time of use, differing from the present study, which used a prone position protocol for periods of 02 hours, twice a day on opposite shifts for a patient on spontaneous ventilation using supplemental oxygen, via a nasal catheter, which preserves physiological ventilation, which is through negative pressure.

In a pilot study carried out in an emergency unit in New York City, 50 patients with suspected COVID-19 and hypoxemics at admission, who were lucid and capable of responding to requests, were evaluated. They were asked to change position, to the prone position, having been measured SPO<sub>2</sub> at admission and 5 minutes after being in a prone position, having considered that a patient failed to pronate if he had respiratory failure defined as persistent SPO<sub>2</sub> <90% in the scenario unresolved or aggravated tachypnea with accessory use of muscles, altered mental status or hypercarbia in blood gases. In the comparison between pre and post pronation, a significant improvement in SPO<sub>2</sub> was observed (P = 0.001), concluding that pronation in awake and spontaneous ventilation patients improved SPO<sub>2</sub> in this patient profile<sup>9</sup>.

Two days after starting PP therapy, the patient reported improvement in dyspnea (Borg 4) and "back pain" during positioning, which improves after leaving PP. Being on spontaneous ventilation in room air, Fr 17 ipm, comfortable ventilatory muscle pattern and HGA with pH 7.46, PO<sub>2</sub> 80.6, pCO<sub>2</sub> 38.4, BIC 27.2, SPO<sub>2</sub> 96.5. In agreement with a study that evaluated the viability and efficacy of PP in patients diagnosed with acute hypoxemic respiratory failure, awake and on spontaneous ventilation and concluded that PP was viable and improved the oxygenation of patients on spontaneous ventilation with IRPA<sup>17</sup>.

In another study, the authors conducted a prospective cohort of 56 patients on spontaneous ventilation, with the aim of evaluating the viability and gas exchanges in pneumonia secondary to COVID 19.

The prone position was maintained for a minimum period of 03 hours and the variables of the study were collected 10 minutes after prone positioning and 01 hour after returning to the supine position and concluded that the prone position is viable and effective for rapidly improving blood oxygenation in lucid patients and on spontaneous ventilation with COVID-19-related pneumonia who need oxygen supplementation, the effect being maintained after resupination in half of the patients<sup>18</sup>.

The basis for treatment with early PP in patients with infection with the new coronavirus, who have mild respiratory failure and are on spontaneous ventilation, is to improve the ventilation / perfusion ratio and arterial oxygenation.

The limitation of the present study is that it is a single case report and, therefore, it is not possible to make analytical inferences, being limited to only describing the clinical case and its main responses to the applied conduct.

## Conclusion

The use of the prone position in patients on spontaneous ventilation, with mild respiratory failure secondary to COVID-19 is safe and can be used as adjunctive therapy to treatment in this patient profile, since it contributes to the improvement of gas exchange and reduction of respiratory distress. In addition, it is a simple therapy, easy to perform and well tolerated in most cases, but further studies are needed to prove the effectiveness of this technique in this population.

## Author contributions

Anjos JLM and Durães AR participated in the conception, design, search and analysis of research data, interpretation of results and writing of the scientific article. Santo Junior FL and Rocha GA participated in the data collection of the research, writing of the article. Pires TQ participated in the conception, design, analysis of research data, interpretation of results and writing of the scientific article. Moreira, PDF, participated in the collection of research data, interpretation of results, writing of the article.

## Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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