

# Oxygen Administration under Surgical Face Mask in COVID-19 Patients: A Game Changer

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## ABSTRACT

COVID-19 is a multifaceted infectious disease. The development of hypoxemic respiratory failure is not uncommon during the course of illness in some of them. The objectives of the present study were to assess the effect of the addition of a surgical face mask while delivering oxygen via nasal cannula in hypoxemic COVID-19 patients and highlight on the advantages and patient's comforts. We prospectively assessed 30 consecutive conscious and hypoxemic COVID-19 patients, requiring oxygen via nasal cannula. The mean PaO<sub>2</sub> without and with surgical face mask were 52 (+9) and 83 (–12) mm Hg respectively in the cohort, and the elevation in oxygen saturation was statistically significant ( $p < 0.001$ ). The present results encourage the delivery of oxygen under the surgical face mask in symptomatic COVID-19 patients, as it improves oxygen saturation and prevents aerosol dispersion with no change in PaCO<sub>2</sub>. The other advantages of this method are a reduction in the total requirement of oxygen per patient, better utilization of scarce resources, and lessening of the expenses incurred for oxygen.

**Keywords:** Acute hypoxemic respiratory failure, COVID-19, COVID-19 patient, Oxygen saturation, Pulse oximeter.

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## BACKGROUND

COVID-19 is a multifaceted infectious disease. The development of hypoxemic respiratory failure is not uncommon during the course of illness in some of them. Such cases require hospitalization and oxygen administration in addition to other medications. As many patients need oxygen support, there is a need to find out an efficient way of utilizing the scarce/limited supply of oxygen without compromising patient care. Moreover, these patients were explained and motivated to wear surgical face mask even while in the hospital so as to reduce the risk of viral transmission from exhaled air to other patients, care providers, and caregivers. Hence, the objectives of the present study were to assess the effect of the addition of a surgical mask while delivering oxygen via nasal cannula in hypoxemic COVID-19 patients and highlight on the advantages and patient's comforts.

## MATERIALS AND METHODS

A total of 30 consecutive conscious and hypoxemic COVID-19 patients, requiring oxygen via nasal cannula but not urgent endotracheal intubation and ventilator support, were considered for the study. Patients with altered sensorium, impending respiratory arrest, shock, and associated comorbid illnesses were excluded. Smokers were eliminated from this study. All these patients were continuously monitored during their stay in the hospital. Written informed consent was obtained from the participants before including them in the study. This work was approved by the institutional ethics board.

On admission, a complete clinical examination was done. Their blood chemistry and hematological profile were determined. Their arterial blood gas (ABG) was estimated on admission and again 1 hour after administration of oxygen at a rate of 4 L/minute via nasal cannula without a surgical face mask. After that, the patient's face was covered by a surgical face mask encircling the nose and chin; oxygen was administered as above for 1 hour underneath the surgical face mask without changing the flow rate; and their ABG was determined at the end of 1 hour. The procedure was carried out for each case considered

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for the study by the principal investigator so as to ensure correct placement of the face mask and for the adherence to it throughout the study period. Later, the surgical face mask was removed, but oxygen therapy continued for an hour and ABG has repeated. The partial pressure of oxygen (PaO<sub>2</sub>) and carbon dioxide (PaCO<sub>2</sub>), hemodynamic parameters, respiratory rate, clinical parameters, and patients' sense of well-being were assessed. The data were analyzed statistically.

## RESULTS

There were 21 males and 9 females. Their mean age and body mass indexes were 45 (±10.5) years and 20 (±3) kg/m<sup>2</sup>, respectively. All the 30 patients accepted and adhered to oxygen administration

underneath a surgical face mask. The mean PaO<sub>2</sub> without and with surgical face mask were 52 (±9) and 83 (±12) mm Hg, respectively, in the cohort, and the elevation in oxygen saturation was statistically significant ( $p < 0.001$ ). On the contrary, the PaCO<sub>2</sub> without and with surgical mask were 28 (±2) and 30 (±2) mm Hg, respectively, among them, and the changes were minimal but not significant. Further, the PaO<sub>2</sub> dropped to 51 (±5) from 83 (±12) mm Hg when the surgical face mask was removed and the difference was significant statistically. The hemodynamic parameters and the clinical status were stable during the study period. The patients were comfortable during and after the study period.

## DISCUSSION

Our observations are in agreement with those of Montiel et al.,<sup>1</sup> Hamada et al.,<sup>2</sup> and Matsui et al.<sup>3</sup> who demonstrated the advantages of a surgical face mask in COVID-19 patients on high-flow nasal cannula for oxygen administration. Though oxygen saturation was satisfactory in all of them, there were interpatient variations in oxygen saturation. These may be attributable to the position of surgical face mask, entrapment of air, and availability of oxygen beneath the face mask, physiological dead space, and the state of gas exchange.<sup>2,3</sup> In addition, the presence of a surgical face mask creates a positive end-expiratory pressure (PEEP) to the lower airways.<sup>2</sup> The increase in the end-expiratory lung volume might have contributed to PEEP effect which were in turn contributed by an elevated resistance in the inward airflow and airway as demonstrated in hydrodynamic model and others.<sup>4,5</sup> Present results encourage the delivery of oxygen under the surgical face mask in symptomatic COVID-19 patients, as it improves oxygen saturation and prevents aerosol dispersion,<sup>6</sup> with no change in PaCO<sub>2</sub> which was observed in the study similar to that of Montiel et al.<sup>1</sup> The oxygen saturation returned to pretreatment values when the surgical mask was removed confirming the effect rather than a spontaneous positive evolution.<sup>7</sup> The difference in oxygen saturation with or without surgical face mask is attributable to the continuous oxygen flow and the availability of accumulated oxygen in the space beneath the surgical face mask which might have enhanced not only oxygen flow in the airway but also oxygen diffusion across the alveolar capillary membrane.

Hence, it is suggested that this method may be adopted in healthcare centers handling COVID-19 cases. Good communication skills between care providers and patients have helped to enhance acceptance and adherence of this method among our patients. The other advantages of this method are a reduction in the total requirement of oxygen per patient, better utilization of scarce resources, and lessening of the expenses incurred for oxygen as noted during the study.

The limitation of this work is that the subjects of the study were COVID-19 with hypoxemia only, and hence, further studies are required to find out the applicability of this method in another category of cases requiring oxygen therapy.

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