

CO₂ narcosis in a COVID-19 patient in prone position due to twisting of reservoir bag of a non-rebreathing mask: a case report.



Neeraj Kumar ¹  ORCID <https://orcid.org/0000-0002-9161-7000>, Abhyuday Kumar ²  ORCID <https://orcid.org/0000-0002-9247-6713>,
Amarjeet Kumar ¹  ORCID <https://orcid.org/0000-0002-4272-5750>, Sanjeev Kumar ³  ORCID <https://orcid.org/0000-0003-4867-9326>,
Prabhat Kumar Singh ²  ORCID <https://orcid.org/0000-0003-1888-4679>.

¹ Department of Trauma and Emergency, AIIMS Patna, India

² Department of Anaesthesiology, AIIMS Patna, India

³ Department of CTVS, AIIMS Patna, India

ADDRESS FOR
CORRESPONDENCE:

Neeraj Kumar, MD

Department of Trauma
and Emergency,
Room no.503, 5th Floor
OT Complex, B Block
AIIMS Patna, Bihar, India;

e-mail:
neeraj.jlnmc@gmail.com

ABSTRACT

We know that oxygen therapy plays one of the important role for treating hypoxemia and it is widely used across a whole range of specialties and it involves administration of oxygen at concentrations greater than that in ambient air. We are reporting the first case of twisting of reservoir bag on using non-rebreathing face mask for providing supplemental oxygen in awake prone position in a 60 year old male tested COVID-19 positive. To prevent this twisting we recommend if a manufacturer do slight modification in making of these non-breathing face mask by adding a 1-2 cm L- shaped Plastic connector to the neck end of the oxygen reservoir bag. The sudden deflation of these reservoir bag not only increase the dead space, decrease alveolar ventilation but substantially compromised the gas exchange. So any twisting of these non-rebreathing face mask should be avoided. This twisting may compromise the patient condition due to rapid increase in PaCO₂ and detrimental in patients with restrictive airway disease. On keeping the patient in prone position the twisting of the reservoir bag frequently occurs and this simple and useful modification may be beneficial for supplementation of oxygen therapy to COVID-19 patients requiring high fractional inspired oxygen concentration.

KEY WORDS: COVID-19, Non rebreathing face mask, Twisting, Prone position

INTRODUCTION

Oxygen therapy plays one of the important role for treating hypoxemia and it is widely used across a whole range of specialties and it involves administration of oxygen at concentrations greater than that in ambient air (21%). The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) recommended supplemental oxygen therapy as the first-line therapy for treating COVID-19-induced respiratory distress and hypoxia [1]. The oxygen mask with reservoir bag is useful in providing an oxygen supply which is based on the fraction inspired oxygen fraction (FiO_2) and is described as 0.6 at an oxygen flow rate of 6.0 L/min, 0.8 at 8.0 L/min and 0.9 at 10.0 L/min [2]. The volume of reservoir bag is (~1000 mL) and it is used to deliver a higher concentration of oxygen.

CASE

A 60-year old male, detected COVID-19 positive were admitted to our intensive care unit, in view of shortness of breath for last 2 days. His vitals at the time of admission were HR 94 bpm, BP 110/77 mmHg, RR 30 rate/minute, oxygen saturation (SpO_2) 90 % on plain face mask at 5 litre/minute. After admission to our intensive care unit, in view falling oxygen saturation below 90, oxygen therapy using non rebreathing face mask (Hi Mask ® Romson,Agra,India) at 15 litre/minute was advised. On the same day in awake prone position we noticed twisting of reservoir bag of non-rebreathing face mask (NRM) – Figure 1, Panel A. The NRM have one unidirectional inspiration valve and two unidirectional expiration valves. On using this mask patient only inhales through the reservoir bag and exhales through the separate valves on either side of the mask. The recommended flow is 10–15 L/min for continuously diluting the carbon dioxide exhaled by the patient. The Partial nonbreathing masks can provide an FiO_2 of 80% to 85%.

During supplementation of oxygen therapy using non rebreathing face mask especially in prone position these twisting of reservoir bag frequently results. To prevent such twisting we recommend if the manufacturer do slight modification in production of these non-breathing face mask by adding a 1-2 cm L-shaped Plastic connector to the neck end of the oxygen reservoir bag. A schematic representation of NRM with L connector and reservoir bag has been shown in Figure 1 Panel B.

These non-rebreathing facemasks are most commonly used and simultaneously it can safely provide supplemental oxygen to COVID-19 patients by limiting the dispersion of droplets. However, in our case we have not observed any complication or negative effect. As a routine practice in our intensive care unit we are aware, instruct and trained our nursing staff for proper wearing of these non-rebreathing face mask and each patient was explained about the detrimental effects of twisting of these reservoir bag as a part of our institutional policy.



Figure 1. Arrow showing the twisting of oxygen reservoir bag in prone position (Panel A), Schematic representation of NRM with L connector and reservoir bag (Panel B).

DISCUSSION

As per recommendations any patients with O_2 saturation $< 90\%$ with mild to moderately increased work of breathing, supplemental oxygen via non rebreathing facemask is to be preferred with goal of O_2 saturation greater than 90% [1]. If we are using non-rebreathing masks with O_2 reservoir bags in any patient the O_2 flow should be higher than patient's minute ventilation ($> 6-10$ L/min.)

As it will lead to delivery of small amount of oxygen which dramatically increases the risk of CO₂ rebreathing leading to CO₂ narcosis. As suggested by Herren T. et al. [3] the significance of reservoir bag of the non-rebreathing mask and its recommended not to deflate by more than one third during inspiration. This deflation not only increase the dead space, decrease alveolar ventilation but substantially compromised the gas exchange. So any twisting of these non-rebreathing face mask should be avoided.

This twisting may compromise the patient condition due to rapid increase in PaCO₂ and detrimental in patients with chronic obstructive pulmonary disease (COPD) and a hypoxic ventilatory drive with COVID-19. The Intensive care Society recommends timed position changes for patients undergoing conscious proning process in COVID-19 with a aim to achieve a prone time as long as possible [4]. On keeping the patient in prone position the twisting of the reservoir bag may occurs and this simple and useful modification may be beneficial for a COVID-19 patients requiring high FiO₂ concentration using non rebreathing face mask with reservoir bag.

CONCLUSION

So always more attention is required if a health care worker is providing supplementation of oxygen therapy using non rebreathing face mask especially in prone position these twisting of reservoir bag may be possible. As it not only lowers the amount of oxygen delivery but also increases the risk of CO₂ rebreathing leading to CO₂ narcosis especially during COVID-19 pandemic.

Disclosure statement

The authors did not report any potential conflict of interest.

REFERENCES

- [1] World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected: interim guidance, 28 January 2020 (No. WHO/nCoV/Clinical/2020.3). World Health Organization, 2020.
- [2] Abe Y, Kondo T, Yamane Y, KIKUCHI M, ABE Y, ISHII H, et al.. The efficacy of an oxygen mask with reservoir bag in patients with respiratory failure. *Tokai J Exp Clin Med*, 2010; 35(4): 144-147.
- [3] Herren T, Achermann E, Hegi T, Reber A, Stäubli M. Carbon dioxide narcosis due to inappropriate oxygen delivery: a case report. *J Med Case Rep*. 2017; 11(1): 204.
doi: <https://doi.org/10.1186/s13256-017-1363-7>
- [4] Bamford P, Bentley A, Dean J, Whitmore D, Wilson-Baig N. ICS guidance for prone positioning of the conscious COVID patient 2020. ICS Council, 2020.