



Unusual cause of hypoxia due to incomplete removal of the closed suction catheter system during COVID-19 ventilation

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Endotracheal suctioning by open or closed-suction systems is a common practice in caring for mechanically ventilated patients [1]. There are various advantages of using a closed-suction catheter system (CSCS) over the open-suction system. They are easy to use, less time consuming, and better tolerated by the patients [2]. The suctioning of an endotracheal tube in a patient with coronavirus disease 2019 (COVID-19) is an aerosol-generating procedure and is therefore at high risk of spreading infection [3].

A 63-year-old COVID-19 positive male patient was on mechanical ventilation in our intensive care unit with CSCS (Portex® Suction Pro 72™, Dual Lumen Closed ventilation suction catheter with T connector) size 14 French and 4.7 mm OD. The patient had an episode of desaturation while being ventilated on pressure-controlled ventilation mode. We quickly ruled out the common causes of hypoxia due to endotracheal tube such as kinking, displacement, disconnections, and leaks. While looking for the reason for desaturation, we noticed that there was an incomplete withdrawal of the suction catheter and a part of the suction catheter was present inside the endotracheal tube Fig. 1a. We noticed increased peak airway pressure and a remarkable drop of exhaled minute ventilation. A written informed consent was obtained from patient relative.

In daily practice, especially during COVID-19 Pandemic, trained health care workers and clinicians may be unaware of the incomplete withdrawal of suction catheter's, which may occur due to hampered vision while wearing PPE suites &

fogging of goggles. The common causes of acute hypoxia during ventilation are pulmonary edema, atelectasis, pneumothorax, pneumonia, Acute respiratory distress syndrome, endotracheal tube malfunction, Pulmonary embolism, and bleeding [4]. According to the principles of fluid dynamics, resistance can be calculated using the Hagen–Poiseuille equation. Airway resistance (Raw) depends on multiple factors that either increase or decrease resistance, and one of the elements is the radius or the cross-sectional area of the airway. So, Raw is high when the airway's diameter is small, and both lung compliance and airway resistance are affected by external factors such as the endotracheal tube and ventilator settings [5] In this case, the suction tube's incomplete removal would decrease the airway diameter, leading to an exponential rise in airway resistance according to fluid mechanics. This would lead to a decrease in delivered tidal volume, especially in pressure-controlled ventilation. Similar color of the suction catheter and endotracheal tube makes it difficult to visualize and distinguish, and even the tip of the suction catheter is not easily identified in the modified T-piece adaptor of the CSCS.

Thus, we recommend that this potential adverse event due to CSCS use can be prevented during the COVID-19 pandemic if the manufacturer does a minor change by dark color-coding 1–2 cm zones over the distal end of the suction catheter Fig. 1b. This change can prevent unfavourable consequences as it would act as a guide.

Possible benefits of this marking over the distal end of the suction catheter:

- (1) It would ensure the complete removal of suction from the endotracheal tube.
- (2) It is a very simple, cost-effective, and easy modification.
- (3) It would ensure early detection of the catheter's incomplete removal in conditions of catheter sheath shortening due to twisting.

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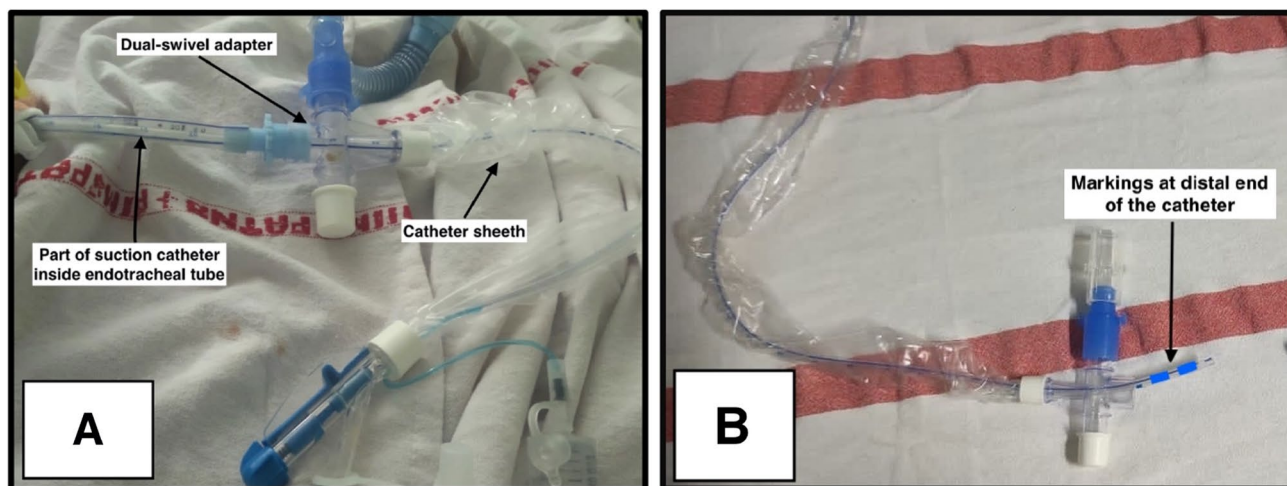


Fig. 1 **a** A closed suction catheter system with suction catheter lying insitu endotracheal tube. **b** Arrow showing marking at the distal end of Closed suction catheter system

- (4) Tracheal mucosal damage due to mechanical trauma following a closed suction catheter system can be prevented.

Suctioning by trained staff, preventing catheter sheath twisting, monitoring vital parameters, and peak airway pressures after suctioning can also help prevent the incomplete removal of the suction catheter.

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Declarations

Conflict of interest Authors declare no conflict of interest.

Informed consent Informed consent was taken.

Ethical approval Approval was obtained from the institutional ethics committee of AIIMS Patna, Bihar, India. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

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