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*Original Article*

# Reintubation during COVID-19 pandemic: a simple self-made guiding device facilitates reintubation and minimizes transmission

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**Abstract:** Consensus guidelines to protect airway managers during COVID-19 were developed to encourage safe, accurate and swift performance in intubation and extubation, but reintubation was not considered. With the massive surge of patients requiring mechanical ventilation in this COVID-19 pandemic, great incidence of difficult airways may necessitate reintubation. Equipments could be used now in extubation and reintubation are either too expensive and time-consuming in decontamination, or have not gained wide acceptance. Here, we adapted an extubation device from an intubating stylet, which is provided as accessory of endotracheal tube. Such stylet could provide safe access for expediting reintubation both during and after the COVID-19 pandemic, which is inexpensive, single-use, readily available, straightforward to handle, and well-tolerated, thereby benefiting both the patients and healthcare providers.

**Keywords:** COVID-19, extubation, reintubation, airway exchange catheters

## Introduction

The ongoing COVID-19 pandemic has led to unprecedented demands on intubation and invasive mechanical ventilation (IMV), and the highly contagious virus has caused concerns of contamination during medical care [1, 2]. Among health care workers, airway managers endure extreme risks of being contaminated by high potential exposure to respiratory droplets and aerosols during intubation and extubation. To make matters worse, some extubated patients may necessitate an emergent reintubation, which would double the risk of transmission for the medical personnel. Consensus guidelines to protect airway managers during COVID-19 were developed to encourage safe, accurate and swift performance in intubation and extubation [3]. However, reintubation was not considered previously.

## Surge of contagious reintubation during COVID-19

The literature of reintubation reveals significant variability in published rates. The prevalence of reintubation is 3% to 30% depending on the population [4], and about 10% in nationwide ICU settings in U.S. [5]. The first-pass success rate of tracheal intubation in the critically ill patients is often less than 80%, with up to 20% of tracheal intubations taking more than two attempts. The increased risk of infection during multiple airway manipulations necessitates the use of airway techniques, which are reliable. Patients with the need for reintubation tend to have longer stays, extended time under mechanical ventilation, and a higher likelihood of chronic care if survived [6].

Obesity is an independent risk factor for difficult airway and intolerance of extubation [7-10].

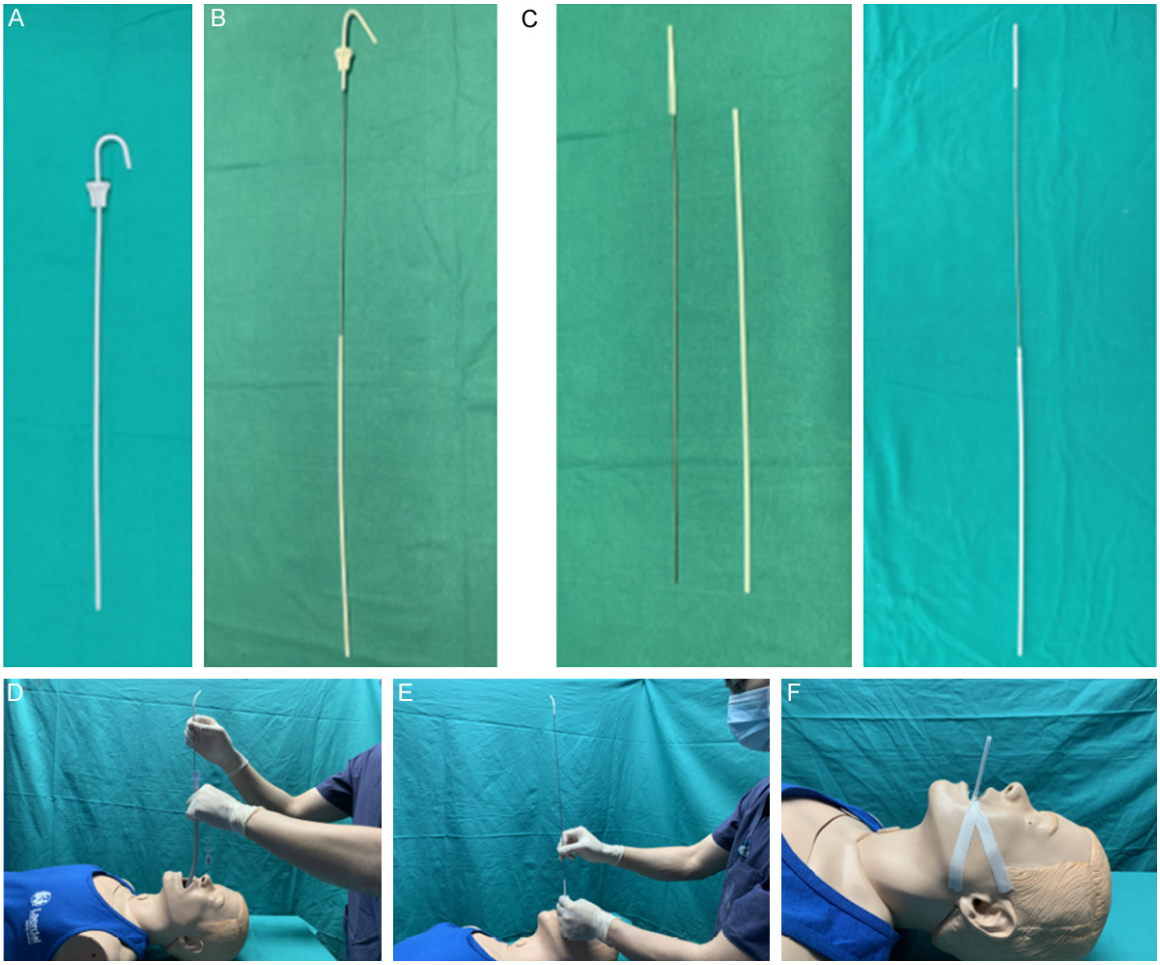


**Figure 1.** The schematic diagram of the making and implement of the self-made equipment. (A-C) The making of the equipment from endotracheal tube stylet is shown (A). The catheter was cut and pulled out (B). Subsequently, the proximal end was straightened, connected with the guidewire core and secured with tape (C). (D-F) During extubation, the device was introduced through the existing ETT prior to its removal (D). Then the guidewire was dismantled (E) and the catheter was indwelled with security (F). See Supplementary Video 1 for details.

With the massive surge of obese patients requiring IMV in this COVID-19 pandemic [11], we should expect significantly increased incidence of reintubation. Thus, COVID-19 patients planned for extubation always run high risks of reintubation and possess difficult airways, which would prevent successful reintubation. Furthermore, there is evidence that COVID19 patients indeed have a higher incidence of unplanned extubation that requires reintubation than other patients [12]. Further research is needed on clinical strategies that can reduce reintubation. A consideration of short-term use of a device in the extubation of suspected difficult airways, which serves as a guide for expedited reintubation, could minimize aerial transmission, reduce the intubation accompanied complications and benefit both the patients and healthcare providers.

Airway exchange catheters (AECs) were recommended for unlicensed use during staged extubation to ensure rapid airway access in case of reintubation [13, 14]. However, bronchial injury and pneumothorax have been reported. In addition, reusable AEC needs appropriate and time-consuming decontamination. Cook staged extubation set is an alternative single-use device dedicated to maintaining airway access after extubation [15]. Nevertheless, it has not gained wide acceptance or been routinely adopted in all hospitals, let alone the increased healthcare cost.

### Self-made device expedites reintubation

Here, we would like to share a method for easily preparing a disposable device in the extubation of COVID-19 patients (**Figure 1** and Supple-

mentary Video 1). The device is adapted from an intubating stylet (**Figure 1A**), which is provided as accessory of endotracheal tube (ETT). It consists of outer PVC catheter and a malleable guidewire core. First, the catheter part should be cut at about 5cm from the proximal end, and then the distal catheter can be striped and pulled along the guidewire (**Figure 1B**). Subsequently, the curved end of the stylet needs to be straightened. To prevent guidewire from slipping out of the catheter, adhesive tape can be used to secure the joint part (**Figure 1C**). Such a device is used as AEC and introduced through the existing ETT prior to its removal (**Figure 1D**). After extubation, the sheathless guidewire should be dismantled (**Figure 1E**), while the indwelling catheter is secured (**Figure 1F**).

With no anoxia, the indwelling catheter can be removed at proper timing. Once the patient endures hypoxemia and needs to be reintubated, the stylet should be reconnected and secured with adhesive tape, and the ETT should be railroaded into tracheal through the conduit (Supplementary Video 1). The stylet is simple to adapt, cheap, readily available, and can be in abundant supply during COVID-19 pandemic. As the pandemic ends in China, we have tried it in conventional postoperative patients who are well-tolerated (Supplementary Figure 1). The study was approved by the Ethics Committee of Naval Medical University.

## Perspectives

This self-made stylet may be most valuable in the surge of abundant IMV patients in COVID-19 pandemic, especially in developing and underdeveloped regions with inadequate medical resources, without experienced airway managers or even video laryngoscopes. It can also be applicable in difficult airways in the ICU settings after the pandemic, and postoperationally as “deep extubation” recommended by the U.K Difficult Airway Society (DAS) [8, 14]. Patients with obesity, obstructive sleep apnea, major head/neck and upper airway surgery, obstetric, and cervical spine procedures have significantly increased risks of extubation failure and are frequently associated with difficult airway management [16]. As our ability to successfully predict the patients who will tolerate extubation is far from perfect even after a comprehensive evaluation, maintaining continuous airway access post extubation with the makeshift self-made stylet in those difficult airways could strongly strengthen the confidence of early and intraoperative extubation.

## Conclusion

The use of the self-made stylet could provide safe access for expediting reintubation both during and after the COVID-19 pandemic, which is inexpensive, single-use, readily available, straightforward to handle, well-tolerated, and can benefit both the patients and healthcare providers.

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## Disclosure of conflict of interest

None.

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## References

[1] Ñamendys-Silva SA. Respiratory support for patients with COVID-19 infection. Lancet Respir Med 2020; 8: e18.

[2] Yang M, Dong H and Lu Z. Role of anaesthesiologists during the COVID-19 outbreak in China. Br J Anaesth 2020; 124: 666-669.

[3] Cook TM, El-Boghdadly K, McGuire B, McNarry AF, Patel A and Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. Anaesthesia 2020; 75: 785-799.

[4] Lucchini A, Bambi S, Galazzi A, Elli S, Negrini C, Vaccino S, Triantafillidis S, Biancardi A, Cozzari M, Fumagalli R and Foti G. Unplanned extubations in general intensive care unit: a nine-year retrospective analysis. Acta Biomed 2018; 89: 25-31.

[5] Miltiades AN, Gershengorn HB, Hua M, Kramer AA, Li G and Wunsch H. Cumulative probability

and time to reintubation in U.S. ICUs. Crit Care Med 2017; 45: 835-842.
[6] Al-Hadidi A, Lapkus M, Karabon P, Akay B and Khandhar P. Respiratory modalities in preventing reintubation in a pediatric intensive care unit. Glob Pediatr Health 2021; 8: 2333794X21991531.
[7] De Jong A, Chanques G and Jaber S. Mechanical ventilation in obese ICU patients: from intubation to extubation. Crit Care 2017; 21: 63.
[8] American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2003; 98: 1269-1277.
[9] Moura ECR, Filho ASM, de Oliveira EJSG, Freire TT, da Cunha Leal P, de Sousa Gomes LMR, Servin ETN and de Oliveira CMB. Comparative study of clinical and ultrasound parameters for defining a difficult airway in patients with obesity. Obes Surg 2021; 31: 4118-4124.
[10] Shaw M, Waiting J, Barraclough L, Ting K, Jeans J and Black B; Pan-London Peri-operative Audit and Research Network. Airway events in obese vs. non-obese elective surgical patients: a cross-sectional observational study. Anaesthesia 2021; 76: 1585-1592.
[11] Simonnet A, Chetboun M, Poissy J, Raverdy V, Noulette J, Duhamel A, Labreuche J, Mathieu D, Pattou F and Jourdain M; LICORN and the Lille COVID-19 and Obesity study group. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obesity (Silver Spring) 2020; 28: 1195-1199.
[12] Chhina AK, Loyd GE, Szymanski TJ, Nowak KA, Peruzzi WT, Yeldo NS, Han X, Kerzabi LS, Galusca DM, Cazacu S, Brodie C and Penning DH. Frequency and analysis of unplanned extubation in coronavirus disease 2019 patients. Crit Care Explor 2020; 2: e0291.
[13] Cooper RM, O'Sullivan E, Popat M, Behringer E and Hagberg CA. Difficult airway society guidelines for the management of tracheal extubation. Anaesthesia 2013; 68: 217.
[14] Difficult Airway Society Extubation Guidelines Group, Popat M, Mitchell V, Dravid R, Patel A, Swampillai C and Higgs A. Difficult Airway Society Guidelines for the management of tracheal extubation. Anaesthesia 2012; 67: 318-340.
[15] McManus S, Jones L, Anstey C and Senthuran S. An assessment of the tolerability of the Cook staged extubation wire in patients with known or suspected difficult airways extubated in intensive care. Anaesthesia 2018; 73: 587-593.
[16] Cavallone LF and Vannucci A. Review article: extubation of the difficult airway and extubation failure. Anesth Analg 2013; 116: 368-383.


**Supplementary Figure 1.** The application of the self-made AEC equipment in a patient after maxillofacial surgery. (A) The device was introduced through the existing ETT prior to its removal. (B) The ETT was withdrawn over the self-made AEC. (C, D) After extubation, the guidewire was dismantled (C), and the indwelling catheter was secured with tape (D). Informed consent was obtained from the patients for this study.