

Case Report

Safety tent for enhanced personal protection from aerosol-generating procedures while handling the COVID-19 patient airway

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Abstract

The world is going through the COVID-19 pandemic, which has high virulence and transmission rate. More significant the viral load during exposure, the greater is the likelihood of contracting a severe disease. Healthcare workers (HCWs) involved in airway care of COVID-19 patients are at high risk of getting exposed to large viral loads during aerosol-generating actions such as coughing or sneezing by the patient or during procedures such as bag-mask ventilation, intubation, extubation, and nebulization. This viral load exposure to airway caregivers decreases considerably with the use of an aerosol box during intubation. The safety tent proposed in this article is useful in limiting the viral load that HCWs are exposed to during airway procedures. Its role can be expanded beyond just intubation to protect against all aerosol-generating actions and procedures involving the patient's airway.

Keywords: Aerosol generating procedures, COVID-19, intubation box, safety tent

Introduction

The SARS-CoV-2 virus has high virulence and transmission rate. More significant the viral load during exposure, the greater is the likelihood of contracting a severe disease.^[1] Healthcare workers (HCW) managing patient airways are at significant risk for exposure to high viral load during aerosol-generating procedures (AGPs) such as bag-mask ventilation, intubation, extubation, nebulization and aerosol-generating actions such as coughing or sneezing by the patient.^[2]

An aerosol box/intubation box may minimize such viral load.^[3] Different models are available - acrylic boxes with insertion ports for hands and airway devices, plastic sheeting draped from a horizontal bar that hovers over the patient's face forming a triangle-shaped tent, or simply having transparent plastic drape under which intubation can be performed.^[3,4] We propose another inexpensive model made by using equipment available inside standard operating rooms, which provides good comfort to both the patient and airway manager. We propose to term this device as "safety tent" rather than "intubation box" as its use and benefits are not just limited to intubation during general anesthesia but extend throughout the procedure including extubation, as well as all procedures where the HCW is stationed around the patient's airway. Thus, it can enhance safety for the HCW tending to the airway of these patients.

Method

The "safety tent" set up involves a Mayo stand with its tray removed. The stand is positioned to extend over the patient face, neck, and upper thorax. A transparent plastic sheet ($\approx 1.5 \times 1.5$ meter) is draped to cover the Mayo frame as

well as to fall on all four sides thus enclosing the patient's head, neck, and upper thorax. The transparent plastic at the head end of the patient will have two cruciform incisions ($\approx 10 \times 10$ cm each, 25 cm apart on a horizontal plane, 25 cm above operating table) deliberately made to allow airway procedures [Figure 1a and b]. The cruciform incisions of the safety tent nearly self-seal after removal of the airway device/hands, thus limiting the egress of gases. A rectangular shaped transparent plastic sheet (from same material used for the safety tent) is cut to the dimensions of the side of the tent facing the anesthesiologist. One side of this sheet is secured with adhesive tape to the top part of the tent. Immediately after the airway manager withdraws hands from the tent, the additional plastic layer is rolled down to cover this aperture thus further minimizing the egress of gases contained inside the tent [Video 1]. If necessary, another single cruciform incision of the same dimensions can be created on the side where the assistant's help is required during airway care. The height of the Mayo stand can be adjusted, and the position of the cruciform incisions can further be adjusted by sliding the plastic drape as necessary.

The airway manager is advised to look from over the Mayo frame [safe viewing position, Figure 1a] to limit the risk of viral load exposure directly onto face during preoxygenation, videolaryngoscopy guided intubation, suctioning and extubation. However, during direct laryngoscopy, the airway manager may have a slightly higher risk of aerosol exposure to the face as one has to view from the same side of the tent where cruciform incisions are located, though the gap between the hands and the plastic drape is minimal. [Figure 1a and Video 1].

Suction catheter, breathing circuit/oxygen tube are introduced into the tent from over the table surface (under the plastic drape) which is then tucked under the table mattress. The tubings are further secured in place by clamping onto table fabric cover, so that the weight of the tubes does not dislodge plastic sheeting [Video 1]. The suction catheter will suck out exhaled gases which are carried to a two bottle suction system. The suctioned gases enter the first bottle via suction tubing that dips into 1%

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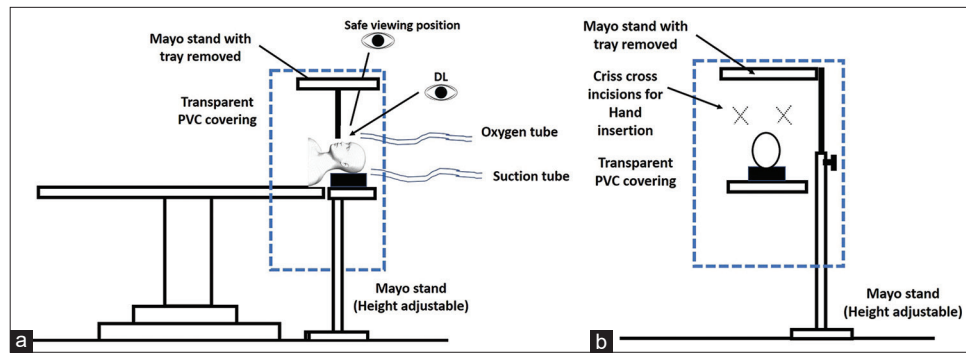


Figure 1: (a) Schematic diagram showing longitudinal view of the safety tent. (b) Schematic diagram showing horizontal view of the safety tent

Table 1: Comparison between Acrylic intubation/aerosol box and Safety tent

	Acrylic box	Safety tent
Device design	Rigid, heavy, fragile, made of transparent acrylic material with large ports for insertion of hands and airway devices	Transparent, large disposable plastic drape to which cruciform incisions can be made
Cost	To be prepared specifically from manufacturer, expensive	Made from locally available resources, inexpensive
Intubation process ^[5]	Maneuvering of hands within the rigid ports can be difficult and may delay the intubation process	No difficulty in hand movements
Single device applicable to all age groups	No	Yes
Adjustment of height of the device	Not possible	Possible
Adjustment of height of entry ports	Not possible	Possible
Risk and degree of aerosol escape	++ via insertion ports	+ via cruciform incisions
Modifications	Insertion ports covered with hydrophobic sleeves can seal the ports and prevent leak	Cruciform incisions self-seal to some extent
Back up or head up for preoxygenation, intubation, extubation	Needs to be supported by additional personnel	Mayo frame attached to the theatre table - moves with the table
PPE damage ^[5]	Can occur	Not observed
Disinfection	Recyclable - minimises plastic waste, easy to disinfect	Plastic drape for safe disposal after disinfection

sodium hypochlorite solution. After circulating through this solution, the gases (devoid of or reduced viral load) enter the second empty bottle connected to negative suction set at maximum.

Discussion

Most devices designed for protecting the HCW tending to patient airway concentrate mainly on their utility during intubation. However, the hazards of AGPs for a HCW exist throughout a patient's stay in the operating room during general anesthesia [preoxygenation, bag-mask ventilation, intubation, maintenance phase (accidental breathing circuit disconnection/damage, leak around the cuff of the airway device, a requirement for deflating the cuff for repositioning the airway device, etc.) and extubation].^[2] Similarly, aerosols can be generated by the patient by coughing, sneezing, crying, forceful breathing, screaming, etc. during regional anesthesia, monitored anesthesia care, or during preoxygenation/emergence from general anesthesia.^[2] Hence, HCWs positioned around the patient airway require to be protected from aerosols throughout the patient's stay

in the operating room, irrespective of the type of anesthetic, age of the patient or level of sedation provided to the patient. Continued maintenance of the safety tent in position throughout the duration of a patient's stay in theatre can, therefore, be beneficial in minimizing viral load exposure to HCWs. However, Personal Protective Equipment (PPE) should be worn at all times while using any devices to aid prevention of aerosol exposure. A comparison of utility, comfort, and limitations of safety tent and the rigid acrylic box is provided in Table 1.^[5]

Patients have expressed comfort when inside the safety tent during regional anesthesia procedures, and may find its place in other aerosol-generating procedures (e.g., management of difficult airway, bronchoscopy, nebulization, and in open tracheal suctioning).

Disinfection can be done by carefully gathering the drapes of the safety tent towards the vertical limb of the Mayo stand before shifting the patient onto an exit trolley. The internal surfaces of the safety tent are then sprayed with 1% sodium hypochlorite solution, without folding the drapes outward and with suction

off. This step aims to reduce the viral load on the inner surface and enhances safety for HCWs. About 5 min later, the Mayo frame is collapsed onto the table and then the drape is gently pulled down and disposed into an appropriate waste bin.

We conclude that the safety tent is user friendly and comfortable to both patient and HCW providing airway care. Its use can be extended for the entire duration of patients' stay inside an operation room or procedure room irrespective of the type of anesthesia. Further use of the device for a larger number of patients and procedures is required for understanding its limitations.

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Conflicts of interest

There are no conflicts of interest.

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