The Journal of Laryngology & Otology

cambridge.org/jlo

Barrier enclosure in tracheostomy: a protective box for healthcare workers during the coronavirus disease 2019 pandemic

N P Nair[1], V Sharma[1], A Dixit[2], S Goyal[3], S G Dixit[4], A Goyal[1] and S Misra[5]

Departments of [1]Otorhinolaryngology, [2]Physiology, [3]Anaesthesiology and Critical Care, [4]Anatomy and [5]Surgical Oncology, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India

Short Communication

Dr A Goyal takes responsibility for the integrity of the content of the paper

Cite this article: Nair NP, Sharma V, Dixit A, Goyal S, Dixit SG, Goyal A, Misra S. Barrier enclosure in tracheostomy: a protective box for healthcare workers during the coronavirus disease 2019 pandemic. *J Laryngol Otol* 2022; 1–3. https://doi.org/10.1017/S0022215122000214

Accepted: 22 January 2022

Key words:
Aerosols; Tracheostomy; COVID-19

Author for correspondence:
Dr Amit Goyal,
Department of Otorhinolaryngology,
All India Institute of Medical Sciences,
Jodhpur 342005, Rajasthan, India
E-mail: meetugoyal@yahoo.com

Abstract

Background. Tracheostomy, being a high aerosol-generating procedure, poses a great challenge to surgeons, especially during the coronavirus disease 2019 pandemic. It is important to preserve staff numbers as this fight may go on for a long time. Personal protective equipment plays a key role in the protection of healthcare workers. Barrier enclosure has been attempted in procedures such as intubation and tracheostomy. The use of boxes became popularised for intubation and they have been utilised in many centres.
Methods. This paper describes the box designed by our team and presents our surgical experience with the box. The box is made of transparent acrylic. It is sealed at all ends, with a negative-pressure environment. The hand ports were designed to allow maximum manoeuvrability for surgeons, without restricting hand movements.
Conclusion. The proposed box will provide more protection to healthcare workers during tracheostomy. However, the box is yet to be validated.

Introduction

Open tracheostomy poses a high-risk for healthcare workers given that it is an aerosol-generating procedure. The aerosol produced during such procedures may suspend infectious agents in the surrounding environment for up to a few hours.[1]

Many guidelines have been proposed during the pandemic to reduce the risk of infection, to healthcare workers especially. Adequate personal protective equipment (PPE) measures should be adopted.[2] An aerosol box is a recently recommended barrier protection device for use during endotracheal intubation, which provides added protection and contains the potentially infectious agents.[3] The use of such barrier protection will benefit regions where there is a shortage of PPE and will give protection against asymptomatic false-negative cases.

Filho *et al.* proposed a protective box (a Covid box) for open tracheostomy.[4] This box comprised a metallic frame covered with a transparent sheet. Ports were made on the side according to the comfort of the surgeon, with cross-shaped incisions in the sheet. However, the authors concluded there is a chance of air leak through the base of the box and hand ports. Moreover, the risk of plastic sheets getting torn during the procedure may lead to aerosol leakage.

Bertroche *et al.* attempted tracheostomy in a negative-pressure environment created with the help of plastic sheets.[5] The sheets were readily available, and the surgeon again could make ports according to comfort. However, the risk of leakage through these ports remained a concern. Further, the transparent plastic sheets have an inherent disadvantage of suboptimal vision, associated with the distortion created by the uneven surface due to the material's flexibility, which is undesirable in any surgical procedure. Acrylic boxes used in intubation, however, have not been used for any surgery to date.

Materials and methods

Protective box description

We present a prototype of a barrier enclosure made of transparent acrylic material for tracheostomy. Institute ethical clearance (approval code: AIIMS/IEC/2020/3192) was obtained prior to using the box.

The box was designed to provide a seal all around, including at the base and front of the box, with the help of detachable sheets fixed by an adhesive margin on the box. The patient lies on the base sheet. The box is affixed onto the table, to prevent it from falling off. The base and front sheets can be removed quickly and the box can be taken away, if any need arises.

The head end side of the box has ports for accommodating both the ventilation tubing and the anaesthesiologist's hands for managing the endotracheal tube and mask. The anaesthesiologist can even assist the surgeon, if required. The two sides of the box

Fig. 1. Photographs showing the described protective box and setup.

were designed to accommodate the surgeon's and assistant's hands. The port for the chief operating surgeon's dominant hand was made to a large size, to enhance the mobility of the surgeon's hands.

In addition to the ports for hands, smaller ports have been provided for cautery wiring and suction tubing. Additional suction tubing, connected to a high-efficiency particulate air filtrate unit, is accommodated through one of the ports, to provide a continuous negative-pressure environment. All the ports are sealed with silicone seals to reduce the risk of air escape.

The roof is composed of slanted panels, providing excellent vision from all viewing angles. All instruments (including the tracheostomy tube) are placed inside the box with a fresh pair of gloves prior to the procedure. The box is disinfected and sterilised with alcoholic solutions, or by fumigated with hydrogen peroxide prior to the procedure.

The box can be used for tracheostomy care and suctioning of the tracheostomy tube. Figure 1 shows the box and setup, demonstrated with the help of a manikin.

Box utilisation for tracheostomy

We performed an open elective tracheostomy on a 36-year-old male for prolonged ventilation. Institutional ethical clearance was obtained prior to use of the box. Informed consent regarding the procedure and use of the box was obtained from the patient pre-operatively. All standard general precautions were taken during the procedure. The patient was paralysed throughout the surgery. Ventilation was withheld from the trachea stoma until the tracheostomy tube had been inserted.

Results

The procedure was performed completely within the box. The surgeon and assistant stood on either side of the box during the operation. All instruments required for the procedure and for intubation were also kept within the box, in case of an emergency. Fresh pairs of gloves were worn after inserting hands into the box, on all sides.

The entire procedure was performed within 20 minutes. No complications were noted during the procedure. Haemostasis was checked and secured. There was a minimal amount of discomfort noted by the surgeon and assistant, in terms of restricted hand movements during the procedure. The box, with its negative-pressure environment, was left over the patient for 2 hours, with continuous monitoring.

Discussion

As the box is made of rigid acrylic material, hand movements may be somewhat restricted. However, our first tracheostomy performed within the protective box was completed within 20 minutes. The hand movement restriction experienced was easily manageable.

The risk of surrounding contamination is expected to be much lower compared to previously described barrier enclosures. The base sheet helps to stabilise and seal the box at the base. The sealable ports and base sheet enforce the barrier enclosure and the negative-pressure environment.

The slanted roof panels provide adequate vision for the surgeon, assistant and anaesthesiologist. Continuous suctioning helped to prevent fogging within the box too.

We recommend use of this box during tracheostomies, in addition to existing recommendations. The box will be a useful adjunct in bedside tracheostomies too. We propose the use of this box for both open and percutaneous tracheostomies. The same box can be used for tracheostomy tube care, including tube changes.

The use of such barrier protection devices will also be beneficial in poor resource settings, as negative-pressure rooms and powered air-purifying respirators may not always be available.

As the device can be reused after appropriate disinfection and sterilisation, it is cost-effective. However, the device is yet to be validated for its efficacy and from an ergonomics perspective.

Acknowledgements. We wish to thank Mr N K Jain and the entire team of Iscon Surgicals (Jodhpur, Rajasthan, India) for transforming our idea into a reality by making the box.

Competing interests. None declared

References

1 van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN *et al.* Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med* 2020;**382**:1564–7

2 Mick P, Murphy R. Aerosol-generating otolaryngology procedures and the need for enhanced PPE during the COVID-19 pandemic: a literature review. *J Otolaryngol Head Neck Surg* 2020;**49**:29

3 Canelli R, Connor CW, Gonzalez M, Nozari A, Ortega R. Barrier enclosure during endotracheal intubation. *N Engl J Med* 2020;**382**:1957–8

4 Filho WA, Teles TSPG, da Fonseca MRS, Filho FJFP, Pereira GM, Pontes ABM *et al.* Barrier device prototype for open tracheotomy during COVID-19 pandemic. *Auris Nasus Larynx* 2020;**47**:692–6

5 Bertroche JT, Pipkorn P, Zolkind P, Buchman CA, Zevallos JP. Negative-pressure aerosol cover for COVID-19 tracheostomy. *JAMA Otolaryngol Head Neck Surg* 2020;**146**:672–4