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Letter to the Editor

The Frankfurt COVID aErosol pRotEction Dome—COV-ERED—a consideration for personal protective equipment improvement and technical note

1. Introduction

The actual pandemic situation of SARS-CoV-2 is a challenge for healthcare systems all over the globe. The main transmission route for this virus in population seems to be a droplet infection. In the context of medical care, the aerosol effect is of crucial importance and can cause contamination and infection of medical staff, especially during airway management [1–3]. Even standard personal protective equipment (PPE) cannot guarantee complete protection. Therefore, extending the protective barriers could improve the personal protection.

Because of a potentially impaired supply situation of protective equipment in crisis situations, our approach is to use raw materials that are still available in a pandemic situation. After examining the available material, we decided to use a packaging tray used for heart-lung-machine-sets (Packaging tray Midi Clear 760 × 405 × 205 mm, Medtronic®, Meerbusch, Germany). This material seems suitable to be transformed into a patient dome with openings for airway management and airway intervention (Fig. 2A and B).

In addition to a sufficient barrier function, the device was expected to be easy to manufacture and offer surfaces that can be completely disinfected. In this constellation, it was only necessary to use an oscillating saw to cut the material into two parts and then connect them with standard plastic glue. In order to achieve a smooth surface on the cut edges, these were polished off. The bond points were then sealed with silicone.

2. Methods

For construction of the patient dome we use a packaging tray made of clear hard-plastic used for Medtronic® heart-lung-machine sets ("Midi Clear 760 × 405 × 205 mm"). The first step is to cut the tray into two pieces (upper and lower part) by using an oscillating saw (Figs. 1, 3A and B, 4 and 5).

An opening for airway management and interventions is cut out on both sides in the cranial area of the upper part of the helmet (Fig. 3A and B). After all that, cut edges are rounded off with sandpaper. In the next step, upper and lower parts are merged together to a helmet using plastic glue. After the recommended drying time of the used plastic glue, the fusion sites are sealed with silicon (Figs. 6, 7, 8A and B).

After the first prototype was constructed, the model was improved to receive the optimal dimensions of the two parts for the best possible barrier function. The dimensions we recommend can be found in the construction instructions (Figs. 1–10).

3. Results

The COVid aErosol pRotEction Dome ("COVERED") was developed as a barrier for additional protection dedicated to the medical staff during airway management and other aerosol generating procedures. Direct laryngoscopy and videolaryngoscopy both can easily be performed. Assistance during the airway management can be offered preferably trough the side openings of the dome or alternatively through the caudal opening if more space is required. In case no further interventions like puncture of cervical veins are required, the dome can be left on the patient’s head (Figs. 2 and 3).

The construction of a single dome took about 60 minutes. The cost of the materials used was less than 20 EUR (approx. 22 USD, 17 GBP).

4. Discussion

During the planning and creation of the dome, the dimensions and configurations used here were deliberately chosen. Some incisive differences are observed in comparison to other previously published devices.

First of all, the objective was to use a raw material that is readily available in this crisis situation, in sufficient numbers and, at best, has no other use value. This was made possible thanks to the use of packaging material. Next, the product had to be easy to manufacture with only a few design steps, without the use of special assembly materials or expertise.

For practical use in airway management, the access openings had to be created at the optimised position to allow the usual handling during intubation process. In contrast to the protective barrier published in the paper of Canelli et al., the openings were not placed on the back, but rather at the cranial side area (Figs. 6–9) [4]. Very good experiences were obtained with this in practical use. In addition, we have chosen the openings slightly larger to enable simultaneous assistance through those access openings if required. In optimised use, handling in the dome is only carried out by the airway manager. In this way, the assisting staff can stay behind the barrier in the protected area (Figs. 6–9). A disadvantage of the larger opening is a theoretically larger leakage and thus a higher probability of contamination. In this context, reducing aerosol leakage by sealing the openings with transparent film was considered. To use the helmet, an incision in the transparent film of approximately 5 cm length has to be done and the openings are expanded to the required width for inserting the arms of the practitioner. So, in turn, the opening is reduced to the minimum width required in the respective situation (Figs. 1 and 4).

Furthermore, unlike in other models, we specifically designed a version with a bottom. The main advantage is that the dome is fixed by the patient’s head and cannot slip as a result of manipulation and remains stable.

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It is important that airway management with such an additional barrier has to be practiced to optimise important steps as well as the assistance in order to guarantee the best possible protection. The best skilled practitioner in securing the airway, as intended in the current recommendations, should not be affected by the dome in his actions [5].

Within the scope of the intubation, patients should be critically evaluated. Patients requiring high-flow oxygen therapy or non-invasive ventilation are not suitable for intubation under the dome. When intubating obese patients, positioning the tray can be difficult. In general, intubation should only be performed under deep anaesthesia and with adequate muscle relaxation to avoid undesirable patient movements or coughing.

Current recommendations on airway management for patients with COVID-19 should always be taken into account [6]. The protective barrier is only an additional device to further protect medical staff without replacing PPE.

Sources of support

There are no sources of support to declare.

Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.accpm.2020.04.016.

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