Preventing Severe Acute Respiratory Syndrome Coronavirus-2 Exhalation Upon Tracheal Extubation in the Intensive Care Unit: A Case Series

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Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a highly infectious virus transmitted by inhalation of infected matter containing live virus or by exposure from contaminated surfaces. Aerosol-generating procedures (AGPs) create an increased risk of airborne transmission of infection. Tracheal extubation of coronavirus disease 2019 (COVID-19) patients in the intensive care unit (ICU) is a risky AGP procedure owing to the proximity of the staff members to the patients’ mouths and the exposure to airway secretions. We describe the use of a disposable openable mask (Janus Mask, Biomedical Srl, Florence, Italy) that might limit aerosol generation in the periextubation phase of COVID-19 cardiac surgical patients. (A&A Practice. 2021;15:e01466.)

GLOSSARY

AGP = aerosol-generating procedures; COVID-19 = coronavirus disease 2019; EQUATOR = Enhancing the QUAlity and Transparency Of health Research; ICU = intensive care unit; NIV = noninvasive ventilation; PCR = polymerase chain reaction; PPE = personal protective equipment; SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a highly infectious virus transmitted by inhalation of infected matter containing live virus or by exposure from contaminated surfaces. Health care providers show a higher prevalence of SARS-CoV-2 infection than nonhealthcare providers (7.3% vs 0.4%).2 Aerosol-generating procedures (AGPs) create an increased risk of airborne transmission of infection so health care providers involved in AGP need to wear personal protective equipment (PPE). Recently, several methods have been proposed to reduce the risk from AGP, including transparent physical barriers made of acrylic or polycarbonate sheeting aiming1,6,7 to protect health care workers from droplet or aerosol exposure during tracheal intubation. However, tracheal extubation in the intensive care units (ICUs)—also a risky AGP owing to the proximity of the ICU staff members to the patients’ mouths and the exposure to airway secretions1,6,7—has not been specifically addressed yet. Because expiration and coughing on extubation produce aerosol, from the beginning of the pandemic, we have dedicated attention to extubation in the ICU to minimize the exposure of health care providers to viral infected secretions.

Closed systems are safer with regard to aerosol spread because they physically contain droplet or aerosol exposure during and after extubation maneuvers. We, therefore, used a disposable mask (Janus Mask, Biomedical Srl, Florence, Italy)8 designed to provide noninvasive ventilation (NIV) during endoscopic procedures under sedation. The mask (Figure A) is made of 2 halves fixed in the upper portion so that it can be opened and then closed around an endoscopic tool. Each half of the device has a semicircular hole in the middle. Once the mask is closed, the 2 semicircular holes merge into a single circular hole with a gasket through which an endoscope can be manipulated while leak-free ventilation occurs. The hole can be closed with a dedicated cap to allow NIV after an endoscopic procedure. Two ports are present on both sides of the mask to allow connection to the ventilator circuit or to a manual ventilation bag. The mask has fastening straps to secure it to the patient’s head.

We report the use of the openable mask that presumably can limit aerosol generation during extubation of coronavirus disease 2019 (COVID-19) cardiac surgical patients in the ICU.

This article adheres to the applicable Enhancing the QUAlity and Transparency Of health Research (EQUATOR) guideline. The Research Ethic Committee approved this publication. All patients gave written consent, and the patient shown in the figure gave written consent to the publication of the photos and Supplemental Digital Content, Video, http://links.lww.com/AACR/A433.

CASE DESCRIPTIONS

We report our experience in 4 cardiac surgical patients with SARS-CoV-2 infection confirmed by swab test for
coronavirus polymerase chain reaction (PCR) undergoing postoperative tracheal extubation in the ICU. All 4 patients had undergone urgent cardiac surgery.

We have a lengthy experience using the Janus mask during endoscopic procedures. We use it to assist patient's ventilation during transesophageal echocardiography or bronchoscopy in the ICU. We performed several simulations of the extubation procedure on a mannequin before applying the technique to COVID-19 patients. We tested tracheal tubes sized 6.5 to 8.5 mm. This allowed us to evaluate all details involved in the several steps: positioning the mask on the patient’s face and securing it, connecting the ventilation bag with a high efficiency particulate air filter to the side port of the mask, stopping the mechanical ventilation, removing the tracheal tube, promptly discarding the contaminated tube into a separate bag and closing it, immediately closing the mask valve, and providing oxygen to the spontaneously breathing patient after extubation. Interestingly, the valve seal performed similarly when the mask was closed around a tracheal tube as compared to an endoscope. We did not perform a simulation with mannequins to specifically test the aerosol spread; therefore, the efficacy of the mask in limiting the risk from AGP is unproven.

In all patients, the Janus mask was positioned on the patient’s face immediately before extubation (Figure C). We closed the 2 halves around the tracheal tube and secured the mask to the patient’s head. Then, after setting the ventilator on standby mode, we connected a ventilation bag to the mask, deflated the tube cuff with a syringe, gently removed the tracheal tube (Figure D–F), and immediately closed the mask hole. With this procedure, a patient breathed oxygen-enriched air delivered through the mask and coughed inside the mask, presumably without droplet or aerosol spread. The spontaneously breathing patients received oxygen delivered through the mask (Figure G; Supplemental Digital Content, Video, http://links.lww.com/AACR/A433) until coughing. Thereafter, the patients received oxygen administered via nasal cannula while wearing a surgical mask to prevent exhaled aerosol dispersion.

Three of the 4 patients were discharged from the ICU to the cardiac surgical ward on day 2 according to protocol. One of

Figure. Mask protected extubation. A, Mask in an open position. B, Mask closed around a tracheal tube. C–F, Extubation sequence. G, Spontaneously breathing patient assisted through the mask.
the patients had an ICU stay of 4 days due to hemodynamic instability on day 2. All patients were discharged home from the hospital. No ICU staff members tested positive in the 2 weeks following the described patients’ extubations.

**DISCUSSION**

To the best of our knowledge, this is the first time such a technique has been used during the COVID-19 pandemic to reduce the risk of infection to health care workers during extubation. Anesthesia and intensive care staff members are involved in AGP when taking care of patients. Tracheal extubation is a major AGP. Staff members are close to the patient’s airway, and the patient usually coughs on extubation producing droplets and aerosol that can be spread at a distance around the bed. For these reasons, from the start of the COVID-19 pandemic, we have dedicated specific attention to extubation of suspected or confirmed COVID-19 patients in our ICU to limit the risks for health care providers using full PPE.

In our experience, the use of an openable mask during extubation in the ICU does not have any negative consequences, but rather it is easy to use as it does not require special training, does not restrict the operator’s hand movements and does not complicate the already complex extubation maneuvers. Furthermore, it allows us to administer oxygen after extubation in the spontaneously breathing patient until coughing has subsided, presumably limiting aerosol spread. Finally, the cost of the mask (~80 USD) seems reasonable in light of the potential benefits. No patient reported any discomfort from wearing the mask. Based on our preliminary experience, we suggest its application in COVID-19 ICU patients as a supplementary physical barrier to presumably prevent viral aerosol spread but not as an alternative to standard airborne PPE precautions when performing tracheal extubation.

**DISCLOSURES**

**Name:** Fabio Guarracino, MD.

**Contribution:** This author helped conceive and run the simulation sessions, draft the manuscript, and revise and approve the final version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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**Contribution:** This author helped run the simulation sessions, draft the manuscript, review the language as English is her mother tongue, and approve the final version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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**Contribution:** This author helped draft the manuscript, take the photos and the video, and review and approve the final version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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