 Barrier Techniques to Reduce Aerosolization During Cardiopulmonary Resuscitation

Abstract: Preventing the dispersion of virulent particles during aerosol generating procedures has never been more relevant than during the current coronavirus pandemic. The American Heart Association released interim guidelines to assist in limiting exposure during advanced cardiovascular life support. These include maintaining a closed circuit on the ventilator for intubated patients and to use a high-efficiency particulate air filter during airway management of non-intubated patients. We developed additional modifications to the suggested guidelines such that providers are even further protected from unnecessary aerosolization, and illustrate a sample protocol for provider safety during advanced cardiovascular life support in the coronavirus pandemic. For the intubated patient, our protocol maintains the patient to the ventilator in addition to being draped with a plastic barrier over the mouth and nares. In the nonintubated patient, a plastic drape or a non-rebreather mask is used to help reduce aerosolization during manual chest compressions. Our modified protocol allows providers to perform advanced cardiac life support by further minimizing exposure risk.

Key Words: cardiac arrest; cardiopulmonary resuscitation; coronavirus disease

To the Editor:

The risk of transmission of severe acute respiratory syndrome coronavirus 2 in aerosol generating interventions remains a topic of much debate, including with respect to cardiopulmonary resuscitation. In the midst of this pandemic, institutions have modified their response to cardiopulmonary arrest. The American Heart Association (AHA) released interim advanced cardiovascular life support (ACLS) guidelines for coronavirus disease 2019 (COVID-19) cases; these guidelines promote keeping a closed circuit with an intubated patient remaining on asynchronous mechanical ventilation. For the nonintubated patient, the AHA suggests using a bag-valve-mask (BVM) device attached to a high-efficiency particulate air filter or passive oxygenation with a non-rebreather (NRB) mask (1). Considering AHA recommendations for airway management during ACLS for COVID-19, we devised a protocol and conducted a simulation illustrating aerosolization of particles during ACLS with and without aerosol reducing techniques including those suggested by the AHA.

In Video 1 (Supplemental Digital Content 1, http://links.lww.com/CCX/A233), sequence 1, a nonintubated simulated patient is donned with an NRB mask and a translucent plastic drape barrier prior to starting ACLS protocol. Examination with the ultraviolet light showed particles entirely contained within the NRB mask, with no visible particles on the providers. A control sequence (sequence 2) illustrates particle dispersion during standard ACLS including BVM use. Particles are noted on both the BVM providers’ gloves and gown and the chest compression provider’s gloves.

Next (sequence 3), we examined particulate aerosolization in the simulated intubated patient. An intubated manikin was donned with a plastic barrier drape and the ventilator circuit was kept intact. Particles were noted to be confined to the oropharynx and minimally on the drape. No particle contamination was noted to either provider. In sequence 4, a control simulation of standard ACLS including disconnection from the ventilator circuit for BVM use was conducted. Disconnection from a functioning ventilator was simulated by a manual pump system and resulted in contamination of the gown of the airway provider along with contamination of the face mask of the provider performing chest compressions. This was not seen when the ventilator circuit remained intact with rate reduced allowing the ventilator to deliver recommended ventilation asynchronously during ACLS (sequence 3).

We have developed a modification of ACLS protocols which incorporate guidance from the AHA for the reduction in particle aerosolization during ACLS. We share our protocol such that providers may take into consideration an illustration of methods to reduce their own exposure during ACLS of highly transmittable aerosol-based disease.

Key elements from our barrier protocol which appears to reduce exposure during ACLS include, for the nonintubated patient: Passive oxygenation with NRB until controlled intubation can take place. A NRB appears sufficient to reduce identifiable aerosolization of secretions during manual chest compressions. For the intubated patient: maintaining an intact ventilator circuit and allowing for asynchronous ventilation at the usual 8–10 breaths per minute during the resuscitation event and again placing a simple plastic barrier drape over the nares and mouth of the patient.

There are limitations to the extent to which we were able to simulate secretion aerosolization during ACLS. Our simulations used tubing inside the manikin that ran up to the oropharynx and was propelled forward with compressed oxygen during each compression. We found that particles remained inside the oropharynx during chest compressions and were expelled out of the oropharynx only in use of BVM. Our set up may have inherently some limitations in mimicking virulent particles’ speed, distance,
velocity, and trajectory. There also remains a limitation in detection of fine aerosolized particles by ultraviolet light illumination, although large depositions were readily detected.

Not much is known about the true threat to aerosolization of virulent secretion during ACLS. We have illustrated several considerations which may allow for the reduction of exposure to caregivers to virulent secretions particles during ACLS for both the intubated and nonintubated patient.

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Azzam A. Paroya, DO, Department of Medicine, Stony Brook University Hospital, Stony Brook, NY; Kinner M. Patel, MD, Sahar Ahmad, MD, Division of Pulmonary, Critical Care and Sleep Medicine, Department of Medicine, Stony Brook University Hospital, Stony Brook, NY

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REFERENCES
1. Edelson DP, Sasson C, Chan PS, et al; American Heart Association ECC Interim COVID Guidance Authors: Interim guidance for basic and advanced life support in adults, children, and neonates with suspected or confirmed COVID-19: From the Emergency Cardiovascular Care Committee and Get With The Guidelines-Resuscitation Adult and Pediatric Task Forces of the American Heart Association. Circulation 2020; 141:e933–e943

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