Aerosol Retention Barriers

Roles and Limitations

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The coronavirus disease 2019 (COVID-19) pandemic has spotlighted the increased risk of infection among healthcare workers performing aerosol-generating medical procedures such as airway instrumentation to provide life-saving ventilatory support. Healthcare providers worldwide scrambled to develop protocols and techniques to minimize the occupational exposure risk to themselves in the setting of a limited global supply of personal protective equipment. Reports on the innovative design and use in clinical practice of aerosol barrier devices intended to contain bioaerosols such as severe acute respiratory syndrome coronavirus 2 (SARS–CoV-2), bacteria, and other pathogens generated from infected patients began to appear in clinical practice, publications, and social media as early as March 2020.[1,2] The U.S. Food and Drug Administration issued an emergency use authorization for these devices in May 2020, which was revoked in September 2020.[3,4] The clinical circumstances in the early phases of the pandemic enabled the introduction of these devices into clinical practice despite limited evidence to support their benefit and safety.

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In this issue of Anesthesiology, Fidler *et al.*[5] conducted a simulation study of six barrier devices assessing the protection of the healthcare provider from aerosol and vapor spread during simulated intubation, extubation, and coughing. The investigators conducted experiments simulating aerosol and vapor spread during expiration and coughing, including quantitative and qualitative assessment of aerosol and vapor spread patterns. The experiments focused on evaluating the clinician's exposure to vapor and aerosols by measuring aerosol particles at the manikin's mouth, the operator/laryngoscopist's mouth and chest, the left armhole of the barrier device, and the caudal end of the barrier devices. The authors also evaluated the role that smoke evacuation techniques played when combined with the aerosol barrier devices.

The authors observed that the closed and semiclosed barrier devices reduced particle counts measured at the laryngoscopist's mouth compared to no barrier. However, it is of interest that some devices performed worse than the control (no barrier) in the cough experiment. The study challenges the prevailing "common sense" that a barrier device offers protection from aerosols. Furthermore, the study provides new information on the impact of negative pressure on the patterns of aerosol distribution from the barrier device enclosures. This information is timely and adds to the growing body of evidence surrounding the mitigation of aerosol spread during simulated aerosol-generating medical procedures and is highlighted in an updated communication from the U.S. Food and Drug Administration on August 21, 2020.[3] The Food and Drug Administration alerted healthcare facilities of the potential increased health risk to patients and healthcare providers, specifically from barrier enclosures without negative pressure.[3] The communication also highlighted the potential hazard of impaired access to patients during critical procedures.

Although aerosol barrier devices may confer some protection to the healthcare provider, the clinical scenario may limit their utility. For example, the induction of anesthesia and instrumentation of the airway may be more challenging with a device that restricts physical access to the patient. Healthcare workers may actually be exposed to increased risk while using barrier devices because the device may

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damage personal protective equipment.[3] Conversely, aerosol barrier devices may be useful during patient transport or while performing aerosol-generating procedures that require minimal access to the patient, such as nebulizer administration. The report of Fidler *et al.*[5] aligns with the Food and Drug Administration's message and states that aerosol barrier devices are not a replacement for personal protective equipment. Further, they recommend that healthcare providers electing to use aerosol barriers should employ a mechanism to generate negative pressure within the enclosure.

An essential aspect of the work by Fidler *et al.*[5] is the collaboration with bioaerosol scientists. The science of bioaerosols and their role in infection through inhalation and at times ingestion has drawn great interest among anesthesiologists and other healthcare professionals performing aerosol-generating medical procedures. The study of bioaerosols and their impact on disease transmission is a complex field with multiple factors affecting the bioaerosol content and concentration. The challenge of conducting and interpreting data from bioaerosol studies is further compounded by the variability in the foci of bioaerosol exposure studies and variations in experimental design. Despite these complexities, the need to understand the potential impact of airborne viral particles has led to a plethora of mostly simulated studies during aerosol-generating medical procedures.[6,7] Compared to most of these studies, Fidler *et al.*[5] have approached this subject systematically and iteratively. The spread of aerosols (even viral ones) is complex and dependent on numerous factors that include particle size, airflow, ambient temperature, ambient humidity, and the heat generated by machinery or bodies in the environs. In the absence of an aerosolized viral particle model, vapor, essential oils, ammonia sulfate, and other substances have been used as bioaerosol surrogates.[2,5] Such bioaerosol surrogates as smoke and vapor do not perform as real bioaerosols and so limit the interpretation of these experiments. Collaboration with bioaerosol scientists and using standardized methodology may provide rich data and results, allowing further understanding of the role of bioaerosols and disease transmission during aerosol-generating medical procedures.

Although associating exposure of bioaerosols, disease transmission, and health problems is challenging, we believe that adequate exposure monitoring during real-world aerosol-generative procedures should be a top priority for both anesthesiologists and bioaerosol researchers and will yield much needed real-world evidence.

Competing Interests

The authors are not supported by, nor maintain any financial interest in, any commercial activity that may be associated with the topic of this article.

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