In Reply to the Letter to the Editor Regarding "Coronavirus Neurosurgical/Head and Neck Drape to Prevent Aerosolization of Coronavirus Disease 2019 (COVID-19): The Lenox Hill Hospital/Northwell Health Solution"

LETTER:

The authors offer a simple method for reducing aerosol dissemination of the SARS-CoV-2 during high-speed drilling neurosurgical procedures. A thin, transparent plastic sheath, originally supplied with the disposable draping set, was utilized in this technique to cover the operative site and contain the aerosol particles generated by the drilling. The authors demonstrated the applicability of their technique in the transcranial resection of a pituitary macroadenoma via pterional craniotomy and a petrotentorial meningioma via retromastoid suboccipital craniotomy. Both cases resulted in aggregation of small aerosol clusters on the inner surface of the drape with the removal of larger particles via continuous suctioning underneath it. This idea focuses on procedures with posterior fossa involvement, and builds on recently published methods to reduce aerosolization of airborne SARS-CoV-2 from the oropharynx during intubation and extubation and during the entirety of neurosurgical procedures.[1] This simple, cost-effective method can be easily assembled and is flexible with minimal disruption of the surgery being performed, while offering the ability to shield essential personnel in the operating room during procedures involving drilling of air-cells potentially harboring SARS-CoV-2 virions. These drapes are also adaptable across multiple surgical protocols and specialties. Further optimization and validation of these methods is critical as our understanding of aerosolization and airborne transmission of SARS-CoV-2 in and out of the operating room evolves.

The research surrounding SARS-CoV-2 aerosolization has become well established since the outbreak of the pandemic, and several medical techniques have been found to be culprits of aerosol generation and airborne spread of the virus, including endotracheal intubation, airway suctioning, bag mask ventilation, cardiopulmonary resuscitation,[2,3] electrocautery with subsequent formation of "surgical smoke",[4] as well as occurrences as mundane as surgeons breathing and speaking to one another during cases.[5,6] For neurosurgery and related specialties, high-speed drills have been shown to generate and spread aerosols across a radius $\leq$3.5 feet from the source.[7] In addition, these tools are responsible for the production of aerosols with high-viral loads during the disturbance of nasal mucosa (e.g., transsphenoidal pituitary tumor excision).[1,8] One simulation study regarding extremely high-risk endonasal procedures, for example, determined a COVID-19-laden aerosol spread to a radius $\leq$66 cm, with maximal particle distribution measured at 30 cm.[9] The inherent risk of endonasal procedures was even determined to be severe enough to prompt the American Association of Otolaryngology-Head and Neck Surgery (AAO-HNS) to recommended cancellation of all nonemergent procedures of this subtype during the pandemic.[1] Even more so, drills can produce blood and hemoglobin-laden aerosols,[10] which in turn disperses HIV-1, hepatitis B virus, and hepatitis C virus particles from seropositive patients, and perhaps SARS-CoV-2 as well,[7] as it is known to have some small component of blood-bound transmission.[11] More specific to neurosurgery, the disruption of the blood and meninges of nasally colonized COVID-19 patients may result in additional exposure of surgeons to cerebrospinal fluid—bound aerosols, although further research is still necessary.[12,13]

The benefits of this simple and cost-effective technique are therefore multifaceted. First, it offers protection at high drill settings (70,000 rpm in this study), thus preserving the integrity and efficiency of drill use without sacrificing speed and mechanical power. HIV-1 aerosolization, for example, has been shown to occur at slower drill speeds (30,000 rpm), meaning a precautionary reduction in rotational speed likely does not protect against viral aerosol transmission.[1,10] This draping method may therefore provide additional protection to surgeons against multiple viruses aerosolized by a wide range of drill settings, although further research should be conducted regarding COVID-19 aerosol generation in relation to drill speed in neurosurgical and otolaryngology-based procedures. In addition, the high risk of COVID-19 transmission during endonasal procedures is addressed in this and prior draping methods developed and tested by surgical staff.[1] This should result in increased protection of neurosurgeons during emergent endonasal and other cases, while also accelerating the resumption of elective procedures currently being suspended. Finally, whereas other researchers have proposed various methods of mask modification or alternate materials to provide barrier protection against COVID-19 aerosol transmission,[9] this and prior draping techniques may offer additional simple, easy to assemble, and cost-effective intraoperative protection.[1]

As a result, a nonspecific, affordable, and easily disposable protective sheath, such as the one described here, show great promise in assisting surgical fields in their struggle to perform procedures during the COVID-19 pandemic. One area of concern with regard to this barrier, however, is its composition. Plastics and stainless steel, 2 materials ubiquitous throughout operating rooms, have been shown to be favorable fomites for SARS-CoV-2 with increased duration of aerosol stability for up to 72 hours after initial contamination.[14] Importantly, however, viral load on these materials significantly decreases in comparison to the initial inoculum. Because this plastic barrier is disposable, any fears with regard to the use of this new device as a potential fomite can be easily assuaged. Regardless, great care with the removal and disposal, as with all surgical and personal protective equipment, must be ensured.

To fully appreciate the capabilities and pitfalls of this method, further research into its use should be encouraged. Objective parameters assessing its efficiency in collecting and preventing transmission of aerosolized SARS-CoV-2 particles should be implemented, including postoperative testing of both the inner and outer surfaces of the drape, personal protective equipment of all practitioners involved, et cetera, with quantitative analysis of viral load per gold standard RT-qPCR.[15] Various forms of plastics should also be compared to other transparent materials to determine rate of fomite generation as well. Additionally, any combination of this technique with others that address different aspects of a surgical procedure (i.e. intubation/extubation, posterior fossa involvement, endonasal approach) could merit further benefit to patient and practitioner and should thus be investigated. Finally, intraoperative transmission to patients and the operative staff should be critically monitored as a component of local contact tracing protocols.

Overall, the method proposed by the authors stems from the simple idea of repurposing available resources of a standard operating room to provide an effective barrier against airborne COVID-19 transmission. The drape is universally available, requires no additional cost, and seems easy to implement. Specifically, this method provides protection to neurosurgical staff during high-speed drilling in the posterior fossa, whereas previously described drapes focus more on the restricted dissemination of COVID-19-laden aerosols during intubation, extubation, positive pressure ventilation, and endonasal endoscopic procedures.[1] Although the implementation of social distancing, the cancelling of elective procedures and substantial reduction in operative caseload,[16] and profound alterations to the practicing norms of neurosurgeons around the globe[17] have proven effective thus far, the high-acuity nature of neurosurgery demands a more sustainable approach in dealing with a pandemic without a clear end in sight. Even more, the cancellation of elective surgical procedures may protect surgical staff to a point, but they still incur substantial risk in the performance of emergent, nondelayable care. As a result, methods of protecting surgeons and staff are critical to safe postpandemic recovery. Finally, such devices will allow the resumed provision of timely patient care and hopefully mitigate further losses to hospital financial stability incurred by the cancellation of hundreds of neurosurgical cases per institution per week at a revenue cost of millions of dollars in that same short span of time.[18] These technological advancements will thus help revive a sense of normalcy in the medical community, ensure provision of medical care, allow surgical departments to potentially avoid financial ruin, and promote the health and safety of medical professionals and the public they serve.

Robert C.F. Pena, Deepak Khatri, Kevin Kwan, Randy S. D'Amico

Department of Neurological Surgery, Lenox Hill Hospital/Northwell Health, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, New York, New York, USA

To whom correspondence should be addressed: Randy S. D'Amico, M.D.

[E-mail: rdamico8@northwell.edu]

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