Received: 31 May 2020 | Accepted: 8 June 2020
DOI: 10.1002/hed.26347

ORIGINAL ARTICLE

WILEY

Respiratory droplet generation and dispersal during nasoendoscopy and upper respiratory swab testing

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Abstract

Respiratory particle generation and dispersal during nasoendoscopy and swab testing is studied with high-speed video and laser light illumination. Video analysis reveals droplet formation in three manoeuvres during nasoendoscopy - sneezing, vocalization, and nasal decongestion spray. A capillary bridge of mucus can be seen when a nasoendoscope exits wet nares. No droplet formation is seen during oral and nasopharyngeal swab testing. We outline the following recommendations: pull the face mask down partially and keep the mouth covered, only allowing nasal access during nasoendoscopy; avoid nasal sprays if possible; if nasal sprays are used, procedurists should be in full personal protective equipment prior to using the spray; withdrawal of swabs and scopes should be performed in a slow and controlled fashion to reduce potential dispersion of droplets when the capillary bridge of mucus breaks up.

KEYWORDS
aerosol, COVID-19, precautions, prevention, transmission

The current COVID-19 pandemic has major implications on the examination of the respiratory tract. Due to the high viral load, there are concerns regarding potential aerosol generation during upper respiratory procedures such as nasoendoscopy and swab testing.[1] Various safety recommendations have been proposed for such procedures.[2,3]

High-speed video with laser light illumination has been used to study respiratory particle dispersal patterns during coughing and sneezing.[4] Here, we used a similar technique to assess respiratory droplet generation and dispersal during nasoendoscopy and swab testing.

1 | METHODS

The sagittal plane dispersal patterns of respiratory droplets were captured using a digital camera (Panasonic Lumix GH4) at 60 frames per second in a low-airflow light-controlled laboratory. Illumination was provided

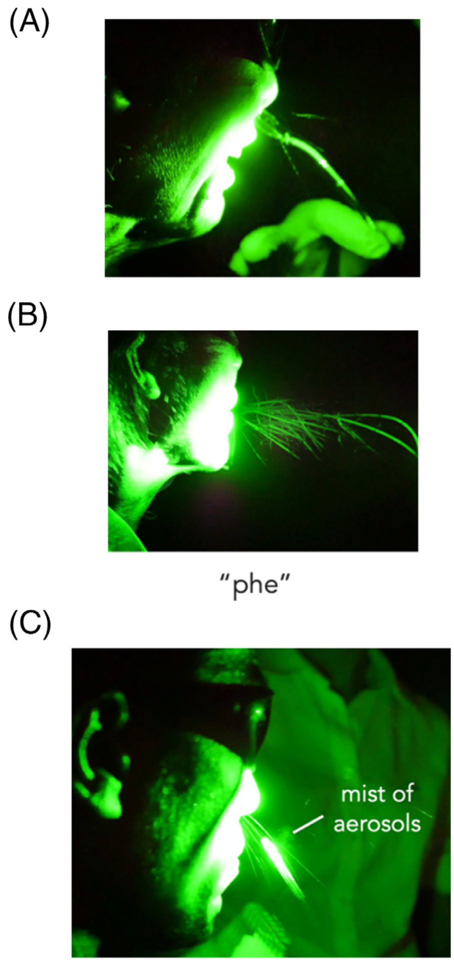

FIGURE 1 A, Sneeze; B, vocalization. Bilabial plosives "*per*" created the most droplets, followed by lingual alveolar plosives "*tee*," and fricatives "*fer*." Common sounds patients were often made to elicit during nasoendoscopy such as "eee," tonal glides, and "sniff-hee," maneuver did not produce droplets. C, most droplet production occurred with nasal expiration immediately after nasal decongestion spray [Color figure can be viewed at wileyonlinelibrary.com]

through a green laser light (535 nm wavelength, 20 mW, 30 cm beam-size). To visualize the droplets' trajectories, we combined the relevant frames into one image.

Nasal, nasopharyngeal, and oral swab testing were first performed, followed by nasoendoscopy with and without cophenylcaine spray decongestion, on three volunteers. Maneuvers performed during nasoendoscopy included swallow, tongue protrusion, vocalization, cough, and sneeze.

2 | RESULTS

Video analysis revealed droplet formation only in three maneuvers during nasoendoscopy—(a) sneezing (Figure 1A), (b) vocalization (Figure 1B), and (c) nasal decongestion spray (Figure 1C). A capillary bridge of mucus was seen when the nasoendoscope exited the wet nares in one volunteer. No droplet formation was demonstrated during oral and nasopharyngeal swab testing.

Video S1 shows the droplets produced when the patient exhales out through the nose following nasal spray. Video S2 shows the droplets produced when the patient sneezes during nasoendoscopy. Video S1 and Video S2 have been slowed down 12 times. Video S3 shows the droplets produced while vocalizing plosives and a cough. There are more droplets seen while vocalizing than coughing.

3 | DISCUSSION

COVID-19 is transmitted through droplet spread, with limited evidence of aerosol spread through droplet nuclei.[5] Polymerase chain reaction testing of nasal, nasopharyngeal, and oropharyngeal swabs remain the gold standard for diagnosis, and is performed worldwide. Nasoendoscopy is a common procedure performed by otolaryngologists. Till date, there has been no definitive evidence of droplet or aerosol generation during nasoendoscopy or upper respiratory tract swabs.

Our study demonstrates that droplets clearly form only under three scenarios during nasoendoscopy. From this, we suggest the following ways to reduce droplet dispersal. Firstly, when only nasal access is required, the face mask should only be pulled down enough to expose the nares. Secondly, while adequate topical nasal decongestion and anesthesia can reduce the tendency of sneezing, nasal sprays are in itself an aerosol generating procedure, and exhalation through the nose during a spray results in large amounts of droplet production. Hence, use of nasal sprays should be avoided if possible, and if used, procedurists should be in full personal protective equipment prior to performing the nasal spray. Patients should be instructed to inhale gently during the spray and avoid immediate exhalation. Adequate time should be given for sufficient anesthesia prior to commencement of nasoendoscopy. Thirdly, droplets formed from speech can be mitigated with the face mask over the patient's mouth. Lastly, withdrawal of the swabs and scope should be performed in a slow and controlled fashion, to reduce potential dispersion of droplets when the capillary bridge of mucus breaks up.

A technical limitation of our study is that our equipment can only adequately assess droplet formation. Aerosols below 10 μm (10 μm) are unlikely captured in the images. Studies on aerosol production during similar procedures are ongoing, with the caveat that significant aerosol transmission has yet to be proven in the spread of COVID-19.[5] Nonetheless, this will provide crucial complementary information as aerosols remain suspended in air longer and have a higher risk of penetrating deeper in the airway.[6]

ACKNOWLEDGMENTS

Dr Loh Xian Jun—Director, Institute of Materials Research and Engineering, A*STAR, Singapore; A/Prof Mariko Koh Siyue—Senior Consultant, Respiratory and Critical Care Medicine, SGH; Olympus (Singapore).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Tan VYJ, Zhang EZY, Daniel D, et al. Respiratory droplet generation and dispersal during nasoendoscopy and upper respiratory swab testing. *Head & Neck*. 2020;42:2779–2781. https://doi.org/10.1002/hed.26347