Aerosol Exposures among Healthcare Personnel Performing Endoscopy Procedures

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ABSTRACT

Gastrointestinal procedures, including endoscopy, can splash body fluids and bacteria onto healthcare personnel (HCP), but the magnitude of aerosol generation remains poorly understood. Particle mass concentrations were measured in the breathing zones of HCP during 16 upper endoscopy procedures, 3 lower endoscopy procedures and 2 motility studies using a SidePak Personal Aerosol Monitor (AMS20, TSI, Inc.). Mean concentrations were < 0.015 mg/m\textsuperscript{3} in all procedures studied, and were not statistically significantly different than concentrations measured in the two minutes prior to the procedure (mean paired difference: -0.002 mg/m\textsuperscript{3}, p = 0.372). Temporal variability in particle mass concentration was observed, but was not consistently associated with procedure events. These data suggest that HCP do not encounter elevated aerosol concentrations during gastrointestinal procedures, and thus are at relatively low risk of infection. Ventilation in the procedure rooms may mitigate exposure to aerosols generated by the procedure and general human activity.

INTRODUCTION

The COVID-19 pandemic re-ignited concerns that aerosol-generating medical procedures may pose a risk to healthcare personnel when performed on patients with an infectious disease. Aerosols are a collection of liquid droplets or particles suspended in air, and when generated from or by infected persons, may contain pathogens.

At the advent of the COVID-19 pandemic, it was known that body fluids containing bacteria, splash onto healthcare personnel during gastrointestinal procedures, and that the concentration of Gram-negative bacteria increased in colonoscopy procedure rooms over the course of a day, but was lowered when suctioning was used during forceps removal (3). The extent of healthcare personnel exposure to aerosols small enough to be inhaled, however, was unknown.

The objective of this study was to characterize the aerosols generated during common endoscopy procedures. Herein, data related to aerosol exposures in the breathing zone of healthcare personnel are described. Data of aerosol size distribution and number concentration measured in the area of procedures will be reported elsewhere.

METHODS

This study was performed in the Endoscopy Lab at University Hospital, Salt Lake City, UT. Participants included personnel that perform endoscopy procedures or motility studies. Participants provided verbal informed consent prior to participation. No information about patients was recorded. This study was reviewed by the University of Utah Institutional Review Board (IRB 00131929).

Participants wore a SidePak AM 520 (TSI, Inc., Shoreview, MN) attached to a belt, with tubing attached to the exterior of gown and that sampled air in the breathing zone at the rate of 1.8 L/min. The standard inlet used, such that aerosols sampled were not of a specific size range. The aerosol mass concentration (mg/m\textsuperscript{3}) was recorded every 20 seconds. Summary statistics were tabulated. The investigators observed the procedure and recorded aspects that could contribute to aerosol generation, such as scope insertion, patient cough, suction, etc. These events were noted to the aerosol sampling data and inspected qualitatively for association with high aerosol concentrations. Analysis was performed using the R Project for Statistical Computing (Vienna, Austria).

RESULTS

Personal exposure measurements were collected during 22 procedures over four days, including: 16 upper endoscopy procedures, 3 lower endoscopy procedures and 2 motility studies. One procedure type was not recorded and was excluded from analysis. Each procedure involved a unique patient was performed by one of three participants (attending physicians and a nurse). Table 1 summarizes the aerosol measurements. The figures show the time-series of the aerosol concentration for selected procedures. While high aerosol concentrations occur periodically during the procedures for short durations, these events are not consistently associated with procedure activities. Peak concentrations occur more frequently and at higher concentrations during lower endoscopy procedures and motility studies than during upper endoscopy procedures.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>N</th>
<th>Mean (Range) Duration (minutes)</th>
<th>Mean (Range) Particle Concentrations (mg/m\textsuperscript{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Endoscopy</td>
<td>16</td>
<td>8.79 (4.23-13.33)</td>
<td>0.017 (=0.001-0.015), 0.055 (0.006-0.231)</td>
</tr>
<tr>
<td>Lower Endoscopy</td>
<td>3</td>
<td>40.64 (27.55-55.53)</td>
<td>0.002 (0.002-0.003), 0.123 (0.068-0.190)</td>
</tr>
<tr>
<td>Motility Study</td>
<td>2</td>
<td>27.52 (20.90-34.13)</td>
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DISCUSSION

This study found that aerosol concentrations in the breathing zone increased periodically during procedures. In contrast, Garbey et al. (4) found that aerosol concentrations in gastroenterology procedure rooms increased during procedures relative to pre-procedure levels consistently. Neither this study nor Garbey et al., however, could distinguish aerosols generated by the patient/procedure from those generated by healthcare personnel.

Sagami et al. (5) placed the heads of patients in a plastic enclosure and sampled aerosols within this enclosure. Sixty of 103 (60%) endoscopy patients were found to have increased aerosol concentrations during the procedure compared to controls, on the order of 10\textsuperscript{3} particles/m\textsuperscript{3} for particles with diameter < 10 \mu m. Chan et al. (6) also observed aerosol emission from patient mouths, measured 10 cm from the mouth, and found a dental suctioning device reduce the concentration of particles with diameters < 10 \mu m.

A limitation of this and other studies of endoscopy aerosol is the measurement of aerosols, rather than pathogens. As a result, it is not known how the aerosol concentrations may relate to pathogen concentrations. Viral respiratory and many gastrointestinal pathogens are highly infectious, such that the presence of very low concentrations in air may pose a significant risk for healthcare personnel.

Rates of general dilution ventilation are high in the Endoscopy Laboratory at University Hospital, which can reduce aerosol concentrations. Thus, aerosol concentrations may be lower in endoscopy procedure areas at other facilities.

CONCLUSIONS

The American Gastroenterology Association (AGA) now recommends against pre-procedure testing for SARS-CoV-2 regardless of vaccination status (7). At the height of the pandemic, the AGA recommended use of N95 filtering facepiece respirators during procedures (8). Though occupationally-acquired infections of COVID-19 may be infrequent (7), the emission of aerosols during procedures may put healthcare personnel at risk of infection from respiratory and gastrointestinal pathogens and warrant use of respiratory protection.

REFERENCES


ACKNOWLEDGEMENTS

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Table 1. Summary of aerosol concentrations measured in the breathing zone of healthcare personnel during gastrointestinal procedures

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