Bacterial Dispersal Associated With Speech in the Setting of Intravitreous Injections

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Objective: To investigate the amount of bacterial dispersal associated with speech in a simulated intravitreous injection.

Methods: Fifteen volunteers were recruited. Each volunteer was positioned over an open blood agar plate and did the following: read a 5-minute script with a face mask, read a 5-minute script without a face mask, read a 5-minute script with the face turned away from the plate without a face mask, and stood in silence for 5 minutes. Each volunteer then read a 5-minute script while reclined in a standard ophthalmic examination chair with an open blood agar plate secured to the forehead to simulate bacterial dispersal associated with a talking patient. Total numbers of colony-forming bacteria per plate were counted, and the bacteria were identified.

Results: Significantly less bacterial growth occurred in the face mask and silence conditions compared with the no face mask condition (both $P < .001$). Bacterial growth was significantly greater in the reclined condition compared with the room control ($P = .02$). Oral streptococcal species represented 66.7% to 82.6% of bacterial colonies in the no face mask, face turned, and reclined conditions.

Conclusions: During simulated intravitreous injection, wearing a face mask or remaining silent significantly decreases culture plate contamination from talking. Talking from above and talking in the reclined position were associated with a significant increase in culture plate contamination. Physicians performing intravitreous injections should be aware of these patterns of bacterial contamination, should consider either wearing a face mask or minimizing speech, and should encourage patients to minimize speech during the procedure.


Intravitreous injections have become an increasingly common modality for drug delivery in the treatment of numerous diseases of the retina and choroid. Endophthalmitis is a rare but serious complication of this procedure. In the United States, the incidence of endophthalmitis following an intravitreous injection has been reported to range from 0.009% to 0.541%. A recent meta-analysis compared the bacterial isolates in endophthalmitis following intravitreous injection vs endophthalmitis following intraocular surgery. Streptococcal species were isolated approximately 3 times more frequently in postinjection endophthalmitis compared with postoperative endophthalmitis. One explanation for this finding may be that aerosolized oral flora is dispersed onto the field or injection needle prior to or during the intravitreous injection, as most intravitreous injections occur in the semisterile office setting. With intraocular surgery, this dissemination is theoretically minimized with the face masks worn in the operating room.

Previous studies within the anesthesia literature have shown that face masks significantly decrease the amount of bacteria transferred to blood agar plates placed in front of a talking subject. Similarly, a study by Alwitry et al demonstrated that significantly fewer organisms were cultured from agar plates placed next to a patient’s head during cataract surgery when the surgeon wore a face mask. The purpose of this study was to assess the amount of bacteria dispersed onto an agar test plate during simulated intravitreous injections. This study also sought to assess whether a patient disperses a significant amount of bacteria by talking in conditions similar to a typical intravitreous injection.

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The numbers of bacterial colonies per plate from the various collection conditions are summarized in the Figure. Without a face mask, 12 of 15 plates had growth of at least 1 bacterial colony (mean, 10.5 colonies/plate; range, 0–63 colonies/plate). When a face mask was worn, 3 of 15 plates had growth (mean, 0.3 colonies/plate; range, 0–2 colonies/plate). With the face turned away from the agar test plate, 10 of 15 plates had growth (mean, 1.8 colonies/plate; range, 0–6 colonies/plate). When the volunteer stood in silence, 4 of 15 plates had growth (mean, 0.3 colonies/plate; range, 0–2 colonies/plate). With the volunteer reclined in the patient’s position, 7 of 15 plates had growth (mean, 1.5 colonies/plate; range, 0–13 colonies/plate).

Statistical analysis using the Kruskal-Wallis test demonstrated significantly lower bacterial colony counts in the mask and silence conditions compared with the no face mask condition (both \( P < .001 \)). There were also significantly lower bacterial colony counts in the mask and silence conditions compared with the face turned condition (\( P = .008 \) and \( P = .02 \), respectively). The no face mask and face turned conditions were not significantly different (\( P = .99 \)). No statistically significant difference in bacterial colony counts was found between the conditions face mask and silence (\( P = .69 \)), face mask and room control (\( P > .99 \)), and silence and room control (\( P = .69 \)). By the Wilcoxon rank sum test, there was a statistically significant increase in the number of bacterial colonies observed in the reclined condition compared with the room control plates (\( P = .02 \)).

The Table summarizes the bacteria that were isolated in each condition. The proportion of bacterial colonies represented by oral streptococcal species ranged from 66.7% to 82.6% of bacterial colonies among the no face mask, face turned, and reclined conditions. No streptococcal species were isolated from the face mask and silence conditions.

These results demonstrate that significantly more colony-forming bacteria are dispersed onto an agar plate when speaking without a face mask compared with when speaking while wearing a face mask or remaining silent in the setting of a simulated intravitreous injection. Simply turning the face to avoid the agar test plate was insufficient in reducing the amounts of bacterial plate contamination significantly. This study also shows that speaking in a reclined position results in significantly more colony-forming bacteria on the culture plate than on the background control plate.

Some limitations of this study include the small sample size of 15 as well as the selection of 46 cm as the distance between the speaker and the test plate. In reality, the distance from a clinician’s mouth to the sterile field likely fluctuates for each clinician with each injection as well as among various clinicians. However, our findings corroborate similar studies published within the anesthesia literature, which included 10 to 25 volunteers per study and used a test distance of 30 cm. These studies likewise reported a significant decrease in the amount of bacterial contamination of agar plates with the use of a face mask.

Continuously speaking for 5 minutes directly over the patient is probably more time than most clinicians spend speaking during their intravitreous injections. However, the risks for bacterial dispersal are likely present even with less time spent speaking. In the study by Alwitry et al., their data suggested a linear increase in the number of colony-forming bacteria with the longer the test plates were left under an unmasked surgeon. If one assumes a linear rate of bacterial dispersion, then at the upper end of our data range, one of our volunteers dispersed at least 1 colony-
forming bacteria every 5 seconds (63 colonies in 5 minutes). Alternatively, the bacterial dispersal may occur in large bursts intermittently and randomly. In this situation, a single emphatic word may be responsible for most of the bacteria dispersed onto the field.

It is important to note that it is unknown whether bacterial dispersal from speech during an intravitreous injection leads to postinjection endophthalmitis. To definitively prove such a link would be very difficult given the relative rarity of postinjection endophthalmitis. However, there is some evidence to suggest such an association. According to a meta-analysis by McCannel, the rate of postinjection endophthalmitis caused by streptococcal species was approximately 30% and is approximately 3 times greater than what is seen among postoperative endophthalmitis or among cultures of conjunctival swabs of patients about to undergo intravitreous injections. Given that streptococcal species were seen in only 4% to 7% of bacterial colonies grown from conjunctival cultures, oropharyngeal droplet contamination from the procedurist may be an alternate source for the streptococcal organisms causing the disproportionately higher rate of postinjection streptococcal endophthalmitis.

Within our study, speaking without a face mask, speaking with the face turned, and speaking from the reclined position as the patient not only generated a significant amount of bacterial growth compared with the room control, but particularly generated streptococcal organisms as a large fraction of the colonies (66.7%-82.6%). Interestingly, no streptococcal isolates were seen when a face mask was worn and when the volunteer remained silent. As face masks are often a requirement in operating rooms, rates of streptococcal postoperative endophthalmitis may thus be decreased. Within the semisterile clinical setting of most intravitreous injections, the bacterial dispersal associated with speech could theoretically contaminate the patient’s ocular surface with predominantly streptococcal organisms. Furthermore, a needle held within the field could also become contaminated, which could subsequently inoculate the intravitreous space directly with bacteria. Given that there was significant culture plate contamination when the volunteer spoke from the reclined position, further studies could include assessing the efficacy of draping or placing a face mask on the reclined volunteer.

There is evidence within the anesthesia literature supporting an association between oral bacterial dispersal and subsequent meningitis. Iatrogenic meningitis is a rare but serious complication following dural puncture procedures, which, like intravitreous injections, are often performed in semisterile conditions. A review by Baer found that 76% of iatrogenic meningitis cases in which a bacterial isolate was obtained involved an oral commensal. Furthermore, in some of the reported cases of postdural puncture meningitis, the Health Care Infection Control Practices Advisory Committee made the recommendation in 2005 that surgical masks should be worn by spinal procedure operators to prevent infection.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Staphylococcal Species</th>
<th>Streptococcal Species</th>
<th>Neisseria Species</th>
<th>Gram-Negative Rod</th>
<th>Yeast or Mold</th>
<th>Other</th>
<th>Total Growth</th>
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<tr>
<td>No face mask</td>
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<td>9</td>
<td>3</td>
<td>1</td>
<td>2</td>
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<td>12</td>
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<td>Colonies, No.</td>
<td>10</td>
<td>122</td>
<td>8</td>
<td>15</td>
<td>2</td>
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<td>157</td>
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<tr>
<td>%</td>
<td>6.3</td>
<td>77.7</td>
<td>5.1</td>
<td>9.6</td>
<td>1.3</td>
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<tr>
<td>Face turned</td>
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<td>7</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>10</td>
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<td>Colonies, No.</td>
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<td>18</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>%</td>
<td>0</td>
<td>66.7</td>
<td>18.5</td>
<td>3.7</td>
<td>11.1</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Colonies, No.</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>1(^b)</td>
<td>4</td>
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<td>%</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>25.0</td>
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<td>Silence</td>
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<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Colonies, No.</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2(^c)</td>
<td>5</td>
</tr>
<tr>
<td>%</td>
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<td>0</td>
<td>0</td>
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<td>40.0</td>
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<tr>
<td>Reclined</td>
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<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Colonies, No.</td>
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<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>%</td>
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<td>8.7</td>
<td>4.3</td>
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<td>0</td>
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<td>Room control</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Colonies, No.</td>
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<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>%</td>
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<td>20.0</td>
<td>0</td>
<td>0</td>
<td>40.0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) For each bacterial species, the number of positive plates and the total number of bacterial colonies are shown (for each condition, the percentage of total bacterial colonies is represented by each species).

\(^b\) Organism was identified as 1 colony of *Propionibacterium acnes*.

\(^c\) Organisms were identified as 1 colony of gram-positive rod bacteria and 1 colony of Lactobacillus.

Table. Organisms Identified in Each Condition"
In contrast, other studies suggest that there is no significant difference in rates of postoperative wound infection following surgical procedures by masked vs non-masked staff. The surgical procedures studied included gynecologic, obstetric, general, orthopedic, breast, and urologic procedures. However, the most commonly isolated organisms from surgical site infections include Staphylococcus aureus, coagulase-negative staphylococci, enterococci, Escherichia coli, and, less commonly, streptococcal species. Oral streptococcal species such as viridans streptococci, α-hemolytic streptococci, and Streptococcus salivarius are of relatively low virulence in the immunocompetent host, which may explain why they are less frequently associated with surgical wound infections. The vitreous and cerebrospinal fluid, as immune-privileged sites, may be particularly fertile environments for the growth of streptococcal species compared with other surgical sites in the body. The data obtained from studies on prevention of surgical site infection may be less applicable to prevention of post-injection endophthalmitis.

While the risk of endophthalmitis per injection is relatively low, with reports ranging from 0.009% to 0.541%, patients frequently receive multiple monthly injections. To understand the risk of endophthalmitis on a per patient basis, one can look at the best available data from recent prospective studies. In the 1-year publication of the MARINA study, the rate of endophthalmitis was 5 cases in 477 patients (approximately 1 in 95 patients, or 1%). In the 1-year publication of the ANCHOR study, the rate was 2 cases in 277 patients (1 in 138.5 patients, or 0.72%). More recently, in the 1-year publication of the Comparison of Age-Related Macular Degeneration Treatments Trials, the rate of endophthalmitis was 6 cases among 1185 patients (approximately 1 in 200 patients, or 0.5%). On a per patient basis rather than a per injection basis, the rate of endophthalmitis remains concerning, especially since these aforementioned rates occurred during a single year of study and the per patient risk is likely to increase with greater numbers of injections over time.

The number of intravitreal injections is increasing because of both a growing population of patients receiving intravitreal injections and the expanding number of injections each patient receives. More injections will likely increase the number of postinjection endophthalmitis cases, and efforts to further reduce the risk may be worthwhile. Clinicians performing intravitreal injections should consider wearing a face mask or remaining silent for the duration of the procedure, and patients could be advised to remain silent during the injection. These measures may help to further reduce the rate of post-injection endophthalmitis by reducing speech-associated bacterial dispersal and contamination.

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