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# Recovery of Aerobic and Anaerobic Bacteria in Sinus Fungal Ball

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## Abstract

This case study with chart review describes the aerobic and anaerobic microbiology of specimens obtained from 47 patients with *Aspergillus* spp fungus ball. Bacteria were recovered from 32 of the 47 (68%) patients. Eighty-six isolates, 29 aerobic and facultatives and 57 anaerobic, were recovered. Aerobic and facultatives only were recovered in 6 instances (19% of culture-positive specimens), anaerobes only in 11 (34%), and mixed aerobes and anaerobes in 15 (47%). The predominant aerobes were *Staphylococcus aureus* (6 isolates),  $\alpha$ -hemolytic streptococci (5 isolates), *Enterobacteriaceae* (4 isolates), and microaerophilic streptococci (4 isolates). The predominant anaerobes were Gram-negative bacilli (26), *Peptostreptococcus* spp (14), and *Fusobacterium* spp. (10). Twenty-two  $\beta$ -lactamase-producing bacteria were recovered from 15 patients. These included all 6 *S aureus* and 2 *Bacteroides fragilis* group isolates, 4 of 10 of *Fusobacteria*, and 7 of 19 *Prevotella* and *Porphyromonas*. This study demonstrates the recovery of polymicrobial aerobic-anaerobic flora in the sinuses of patients with fungus ball.

## Keywords

fungal sinusitis, fungus ball, anaerobic bacteria, *Staphylococcus aureus*

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Fungus ball expands within the confines of a single sinus and does not invade or penetrate the sinus mucosa. *Aspergillus* is the main causative organism, and the ball generally involves the maxillary sinus.<sup>1</sup> Complete excision of the fungus ball is the treatment of choice. The presence of coinfection with bacteria is rarely considered.<sup>1</sup>

This report describes the aerobic and anaerobic microbiology of specimens obtained from patients with fungus ball caused by *Aspergillus* spp.

## Patients and Methods

Forty-seven consecutive patients who had fungus ball due to *Aspergillus* spp (44 *Aspergillus fumigatus* and 3 *Aspergillus flavus*) were studied between 1974 and 2007. Patients with

allergic fungal sinusitis were not included. They were seen in hospitals in the Los Angeles, California, area between 1974 and 1977 and in the greater Washington, DC, area between 1978 and 2007. The study was approved by the institution's institutional review board.

Patients' ages ranged from 20 to 82 years (mean, 52 years 3 months), and 27 were men. All patients were clinically immunocompetent. The maxillary sinuses were involved in all instances.

Fungus ball was diagnosed by radiological and histological criteria as described by deShazo et al.<sup>2</sup>

Maxillary surgery was performed by an external approach in 20 patients or by an intranasal endoscopy in 27 patients. Strict asepsis was employed to avoid any contamination, and specimens of sinus aspirates of purulent secretions were transported to the laboratory in a syringe sealed with a rubber stopper after evacuation of the air or in an anaerobic transport tube (Port-A-Cul, Baltimore Biological Laboratories, Cockeysville, MD). The time between the collection of materials and inoculation of the specimen was less than 30 minutes for syringes and less than 3 hours for the anaerobic transport tube. Microbiological methods of cultivation, identification, and determination of  $\beta$ -lactamase activity were performed as previously described.<sup>3</sup>

## Results

Bacteria were recovered from 32 of the 47 (68%) patients. A total of 86 isolates were recovered from these 32 patients (2.7/culture-positive specimen), 29 aerobic and facultatives (0.9/culture-positive specimen), and 57 anaerobic (1.8/culture-positive specimen). The number of isolates varied from 1 to 5. Antimicrobial therapy was administered to 20 patients (62.5%) in the month prior to sample collection. No difference in the recovery of organisms was observed in those treated with antimicrobials as compared with those not treated.

Aerobic and facultative organisms only were recovered in 6 instances (19% of culture-positive specimens), anaerobes only in 11 (34%), and mixed aerobic and anaerobic bacteria were recovered in 15 (47%). The predominant aerobic bacteria were *Staphylococcus aureus* (6 isolates),  $\alpha$ -hemolytic

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**Table 1.** Bacteriology of 32 Patients with *Aspergillus* Maxillary Sinusitis Fungus Ball<sup>a</sup>

Bacteria	Number of Isolates
<b>Aerobic bacteria</b>	
$\alpha$ -Hemolytic streptococci	5
Microaerophilic streptococci	4
Group F streptococcus	1
<i>Streptococcus pyogenes</i>	2
<i>Staphylococcus aureus</i>	6 (4) <sup>b</sup>
<i>Staphylococcus epidermidis</i>	2 (1)
<i>Haemophilus influenzae</i>	2 (1)
<i>Klebsiella pneumoniae</i>	1
<i>Pseudomonas aeruginosa</i>	1
<i>Proteus mirabilis</i>	2
<i>Escherichia coli</i>	3
Subtotal aerobes	29 (6)
<b>Anaerobic bacteria</b>	
<i>Peptostreptococcus</i> species	14
<i>Veillonella parvula</i>	2
<i>Eubacterium</i> species	1
<i>Propionibacterium acne</i>	4
<i>Fusobacterium</i> species	2 (1)
<i>Fusobacterium nucleatum</i>	8 (3)
<i>Bacteroides</i> species	2 (1)
<i>Bacteroides fragilis</i> group	2 (2)
<i>Prevotella melaninogenica</i>	5 (3)
<i>Prevotella oralis</i>	2 (1)
<i>Prevotella oris-buccae</i>	4 (1)
<i>Prevotella intermedia</i>	8 (2)
<i>Porphyromonas asaccharolytica</i>	3
Subtotal anaerobes	57 (14)
<b>Total</b>	<b>86 (20)</b>

<sup>a</sup>Number within parentheses indicates  $\beta$ -lactamase producers.

<sup>b</sup>Two isolates were methicillin-resistant *S aureus*.

streptococci (5 isolates), *Enterobacteriaceae* (4 isolates), and microaerophilic streptococci (4 isolates; **Table 1**).

The predominant anaerobes were Gram-negative bacilli (26 isolates, including pigmented 19 *Prevotella* and 3 *Porphyromonas* spp and 2 *Bacteroides fragilis* group), *Peptostreptococcus* spp (14, including 4 *Peptostreptococcus prevotii*, 3 *Parvimonas micra* [previously *Peptostreptococcus micros*]), 2 *Peptostreptococcus anaerobius*, and *Fusobacterium* spp (10).

Twenty-two  $\beta$ -lactamase-producing bacteria (BLPB) were recovered from 15 patients (47%). These included all 6 *S aureus* and 2 *B fragilis* group isolates, 4 of 10 (40%) *Fusobacteria* spp, and 7 of 19 (37%) *Prevotella* and *Porphyromonas* spp.

Two of the 6 (33%) *S aureus* isolates were methicillin resistant.

## Discussion

This study demonstrates the recovery of polymicrobial aerobic-anaerobic flora in the sinuses of 68% of patients with fungus ball due to *Aspergillus* spp. Similar flora was previously recovered from chronically infected sinuses and included *S aureus*, *Enterobacteriaceae*, anaerobic Gram-negative bacilli, and *Peptostreptococcus* spp.<sup>3</sup>

These findings are similar to the recently presented study by Wang et al,<sup>4</sup> who reported the co-isolation of aerobic and anaerobic bacteria in about three-fourths of patients with fungus ball. However, only 0.15 anaerobes/specimen were recovered by Wang et al<sup>4</sup> compared with 1.7/specimen in this study. Methodological differences in specimen handling and processing for anaerobic bacteria may account for this discrepancy. Regional differences may account for the absence of Enterobacter in this report.

Wang et al<sup>4</sup> found greater frequency of discolored postnasal drainage, nasal obstruction, and purulent discharge in patients who also had bacteria isolated from their infected sinuses. However, these differences were not statistically significant.

The presence of aerobic and anaerobic bacteria in sinuses mixed with *Aspergillus* in patients with a fungus ball suggests that the infection may be fungal-bacterial in nature. These aerobic and anaerobic bacteria are known pathogens in many respiratory tract infections, including sinusitis.<sup>5</sup>

Almost half of the culture-positive sinuses in this report harbored BLPB. These included *S aureus* and anaerobic Gram-negative bacilli. A growing number of anaerobic Gram-negative bacilli (ie, pigmented *Prevotella* and *Fusobacterium* spp) have acquired resistance to penicillin through the production of the enzyme  $\beta$ -lactamase.<sup>3</sup> BLPB can be involved directly in the infection, protecting not only themselves from the activity of penicillins but also penicillin-susceptible organisms.

Prospective studies are warranted that would evaluate the predisposing conditions and unique presentation of fungal sinusitis that also harbors bacteria. The pathogenic role of bacterial co-isolates in fungus ball infection should also be evaluated. This can be accomplished by prospective studies that would compare the recovery and recurrence rate in patients treated also with antimicrobial effective against bacterial co-isolates.

## Author Contributions

**Itzhak Brook**, corresponding author, wrote all of the article.

## Disclosures

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