Microbiology of Intracranial Abscesses and Their Associated Sinusitis

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Objective: To evaluate the organisms recovered from infected sinuses and associated intracranial abscesses (IAs).

Design: Retrospective review of findings from aspirate of pus from 10 infected sinuses and their corresponding IAs.

Setting: Academic medical center.

Patients: Ten patients diagnosed as having sinusitis (age range, 7-58 years).

Main Outcome Measure: Aerobic and anaerobic bacteria findings from infected sinuses and IAs.

Results: Polymicrobial flora was found in 9 sinuses and 8 IAs. Anaerobes were isolated from all sinuses and 9 IAs. A total of 26 isolates (2.6 isolates per specimen) were recovered from the sinuses: 19 anaerobic, 6 aerobic or facultative, and 1 microaerophilic; 17 isolates were found in the IAs (1.7 isolates per site): 13 anaerobic, 2 aerobic or facultative, and 2 microaerophilic. The predominant anaerobes were Fusobacterium species (in 5 corresponding sinuses and abscesses, 1 in a sinus only, and 1 in an IA only), Prevotella species (in 3 corresponding sinuses and abscesses), Peptostreptococcus species (in 2 corresponding sinuses and abscesses, and 4 in a sinus only), Staphylococcus aureus, Haemophilus influenzae type b, microaerophilic streptococci, and Bacteroides ureolyticus (in 1 corresponding sinus and abscess each). Streptococcus pneumoniae was recovered 2 times, only from a sinus. α-Hemolytic streptococci and β-hemolytic streptococci group F were each isolated once from the sinus. Concordance in the microbiological findings between the sinus and the IA was found in all instances. However, certain organisms were present at only one or the other site.

Conclusion: These data illustrate the concordance in the recovery of organisms from infected sinuses and their associated IA and confirm the importance of anaerobic bacteria in sinusitis and IA.


METHODS

The 10 patients included in the present report were observed between June 1977 and June 2003. Their ages ranged from 7 to 58 years, and 6 were male (Table). Antimicrobial agents were given to 3 patients prior to drainage: amoxicillin to patients 2 and 14, erythromycin to patient 9.

Cultures of sinuses and IAs were obtained during surgery using aseptically performed puncture and aspiration prior to surgical drainage. The material was collected either by syringe that was immediately sealed and transported to the laboratory within 30 minutes or by a swab that was dipped into the pus and introduced into an anaerobic transport system (Port-A-Cul; BBL Microbiology Systems, Cockeysville, Md) and generally transported to the laboratory within 2 hours.

Anaerobic bacteria material was plated onto 1 of the following: (1) prereduced Brucella blood agar enriched with phytodiolone (vitamin K₃); (2) anaerobic blood agar containing colistin and nalidixic acid; or (3) enriched thioglycolate broth (containing hemin and vitamin K₃). It was then incubated inside GasPak jars (BBL Microbiology Systems) and exam-
Polymicrobial flora was found in 9 sinuses and 8 IAs, and the number of isolates ranged from 1 to 4. Anaerobic bacteria were isolated from all sinuses and 9 IAs (Table). These anaerobes (including microaerophilic streptococci) were the sole bacterial isolates in 5 sinuses (patients 2, 6, 7, 8, and 9) and 7 IAs (patients 1, 2, 4, 6, 7, 8, and 9). Concordance in the microbiological findings between the sinus and the IA was found in all instances. However, certain organisms were present only at one site and not at the other sites.

A total of 26 isolates (2.6 isolates per specimen) were recovered from the sinuses: 19 anaerobic, 6 aerobic or facultative, and 1 microaerophilic; 17 isolates were found in the IAs (1.7 isolates per site): 13 anaerobic, 2 aerobic or facultative, and 2 microaerophilic. The predominant anaerobic isolates were *Fusobacterium* species (in 5 corresponding sinuses and abscesses, 1 in a sinus only, and 1 in an IA only); *Prevotella* species (in 3 corresponding sinuses and abscesses); *Peptostreptococcus* species (in 2 corresponding sinuses and abscesses and 4 in a sinus only); and *Streptococcus pneumoniae* was recovered 2 times from a sinus only. Anaerobes and facultative were each isolated once from a sinus.

Twelve β-lactamase–producing organisms were present in 6 sinuses and 6 IAs. These were *Fusobacterium nucleatum* (4 isolates), *Prevotella* species (2), *S aureus* (2), and *H influenzae* type b (2).

### RESULTS

This study illustrates the importance of anaerobic bacteria in IAs and their predominance in the associated sinusitis-affected sinus. Our findings confirm the observation of Herrmann and Forsen, who recovered aerobic and anaerobic polymicrobial flora from 2 infected sinuses and their associated intracranial complication sites. Anaerobic bacteria were previously recovered from chronically infected sinuses. Although several aerobic bacteria such as *Streptococcus* species, *S aureus*, and *H influ-
enzae were isolated in several instances, the recovery of mainly anaerobic bacteria from all of our patients suggests the chronic nature of their infection.

Anaerobic and microaerophilic cocci and gram-negative and gram-positive anaerobic bacilli are the most important isolates recovered from brain abscesses. These include Bacteroides, Prevotella, Fusobacterium, and Clostridium species.\textsuperscript{1,3,5,13-16} The variations in collection techniques, culturing for strict anaerobes, and improper specimen handling to prevent contamination may account for differences between studies in the final organism identification.

Certain organisms such as S pneumoniae and Peptostreptococcus species were only or mainly present at the sinus and not the IA. The lower number of organisms per specimen recovered from IAs than from sinuses (1.7 vs 2.6 isolates per specimen) suggests that not all the bacteria present in the sinus cavity are able to reach the intracranial space or participate in the IA.

Past studies have not found significant correlation between sinus cultures and IAs.\textsuperscript{9,11} However, most of the sinus cultures were done using an endoscopic method, which can lead to contamination of specimens, and methods adequate for the recovery of anaerobic bacteria were not used.

Although surgical drainage is of primary importance, administration of antimicrobial therapy is an essential part of the treatment of patients with sinusitis and IA and other related complications. A growing number of anaerobic gram-negative bacilli (eg, pigmented Prevotella and Fusobacterium species) have acquired resistance to penicillin through the production of the enzyme \(\beta\)-lactamase.\textsuperscript{17} This has also been observed in the present report, where 6 each of the sinuses and IAs contained such organisms.

The isolation of polymicrobial aerobic and anaerobic flora in most of our patients suggests their important role in sinusitis and the associated IA. However, further prospective studies are warranted that include larger numbers of patients to evaluate the concurrent prevalence of these organisms in sinusitis and the associated IAs.

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\textbf{REFERENCES}