Bacteriology of Acute and Chronic Ethmoid Sinusitis
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Aspirates from 26 acutely and 17 chronically infected ethmoid sinuses were studied. Thirty-seven aerobes and 10 anaerobes were recovered from isolates from patients with acute sinusitis. Streptococcus pneumoniae and Haemophilus influenzae were predominant. Twenty-seven aerobes and 41 anaerobes were found in isolates from patients with chronic sinusitis. The predominant isolates were anaerobic gram-negative bacilli and Peptostreptococcus spp.

Acute ethmoid sinusitis. Forty-seven isolates were recovered from 26 cases (an average of 1.8 isolates/specimen), 37 aerobic and facultative (1.4 isolates/specimen), and 10 anaerobes (0.4 isolate/specimen). The number of isolates/specimen varied from one to three. Aerobes alone were recovered from 18 specimens (69%), anaerobes only from 2 specimens (8%), and mixed aerobes and anaerobes from 6 specimens (23%). The predominant aerobes were Streptococcus pneumoniae and Haemophilus influenzae (Table 1). The predominant anaerobes were Peptostreptococcus spp. and Propionibacterium acnes. Nine beta-lactamase-producing bacteria (BLPB) were recovered from eight specimens (31%).

Chronic ethmoid sinusitis. Sixty-eight isolates were recovered from 17 patients (an average of 4.0 isolates/patient); these included 27 aerobic and facultative isolates (1.6 isolates/specimen) and 41 anaerobic isolates (2.4 isolates/specimen). The number of isolates varied from two to five. Aerobes only were recovered in two instances (12%), anaerobes only in seven instances (41%), and mixed aerobes and anaerobes in eight instances (47%). The predominant aerobes were gram-negative bacilli and Staphylococcus aureus (Table 1). The predominant anaerobes were gram-negative bacilli (including pigmented Prevotella and Porphyromonas and Bacteroides spp.), Peptostreptococcus spp., and Fusobacterium spp. Twenty-nine BLPB were recovered from 20 patients (47%). BLPB were recovered from 11 of the 16 individuals (69%) who received beta-lactam antibiotics, compared to 9 of the 27 (33%) who received other antibiotics or no therapy (P < 0.001).

A foul smell was noted with 16 isolates, including those from 12 patients with chronic sinusitis (6 were mucopurulent and 4 were opaque) and 4 patients with acute sinusitis (2 were mucopurulent and 2 were opaque). Anaerobes were recovered from 11 of the 12 specimens obtained from chronically infected sinuses and 2 of the 4 from acutely infected sinuses that produced a foul smell.

Concomitant medical problems included hypertension (7 cases), asthma (5 cases), diabetes (4 cases), oral steroid (4 cases), malignancy (3 cases), and skull trauma (2 cases). No correlation was found between these conditions and the microbiological findings.

Organisms similar to those recovered in the sinuses were found in the blood in six instances. These included S. aureus (two in cases of acute sinusitis) and Klebsiella pneumoniae (one in a case of acute sinusitis) and microaerophilic streptococci,
Fusobacterium nucleatum, and Prevotella intermedia (one each in cases of chronic sinusitis).

This study demonstrates the microbiological features of acute and chronic ethmoid sinusitis. S. pneumoniae and H. influenzae predominate in acute ethmoid sinusitis, as with acute maxillary sinusitis. As was described in three previous studies (1, 9, 13) and unlike another report (6), this study illustrated that S. aureus does not predominate in cases of chronic ethmoid sinusitis. We have confirmed previous observations (1, 6, 9, 13) that aerobic gram-negative bacilli can be recovered in isolates from patients with chronic ethmoid sinusitis. Fungal cultures were not obtained, however, in this study.

We found that chronic ethmoid sinusitis involves more organisms per specimen than does acute infection and that the most common isolates in chronic infection were oropharyngeal anaerobes. The high recovery rate of anaerobes with chronic ethmoid sinusitis is similar to that seen with chronic maxillary sinusitis (3, 8, 11). The failure to recover anaerobes in other studies (6, 9, 13) may be due to the lack of utilization of adequate methods of specimen collection and transportation.

The frequent involvement of anaerobes in chronic sinusitis may be related to the poor drainage and increased intranasal pressure that develops during inflammation (7). This can decrease the mucosal blood flow (2) and depress ciliary action (5), thus reducing the intrasinus oxygen tension (4). The low-erating of the oxygen content and pH supports the growth of anaerobes (5).

BLPB were isolated in 20 of 43 patients (47%). These organisms were recovered more often from individuals who received beta-lactam antibiotics than from those who received other antibiotics or no therapy.

The management of ethmoid sinusitis involves the use of adequate antimicrobials. Amoxicillin is often used for sinusitis therapy. The addition of a beta-lactamase inhibitor to amoxicillin or the use of antimicrobials resistant to beta-lactamase is effective against aerobic and anaerobic BLPB. The heightened resistance of S. pneumoniae to penicillin requires an increase in the amount of administered amoxicillin (90 mg/kg of body weight/day for children and 4.0 g/day for adults).

Agents effective against the pathogens recovered in acute ethmoid sinusitis include several of the cephalosporins (cefuroxime axetil, cefprozil, cefdinir, and cefpodoxime) that are active against penicillin-resistant Haemophilus and Moraxella spp. and intermediately penicillin-resistant S. pneumoniae. The “newer” quinolones (e.g., gatifloxacin and moxifloxacin) and telithromycin (a ketolide) are effective against penicillin and macrolide-resistant S. pneumoniae as well as Haemophilus and Moraxella spp.

Antimicrobials used for chronic ethmoid sinusitis should be effective against aerobic and anaerobic BLPB. These include clindamycin, metronidazole plus a macrolide, a penicillin plus a beta-lactamase inhibitor, and some of the “newer” quinolones (e.g., moxifloxacin). If aerobic gram-negative organisms are involved, an aminoglycoside, an expanded spectrum cephalosporin (cefepeime or cefazidime), or a fluoroquinolone (only for postpubertal patients) is also used. Cefoxitin, cefotetan, and the carbapenems provide coverage for both aerobes and anaerobes.

Prospective studies are warranted to elucidate the roles of aerobic and anaerobic bacteria, fungi, and atypical mycobacteria in acute and chronic ethmoid sinusitis. It is, however, recommended that specimens be routinely cultured for these organisms so that appropriate antimicrobial therapy can be initiated.

### REFERENCES