

Bacteriology of the adult middle meatus

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Abstract

The aim of this work was to assess the commensal flora in the adult middle meatus. Thus, 139 samples were taken from subjects of both sexes, over 16 years of age, seen in the community or hospitalized for less than 72 hours for non-rhinological conditions. They had had no nasal or sinus conditions in the previous three months. One hundred and thirteen samples contained at least one aerobic or anaerobic bacterium. Fifty-nine samples yielded a single organism in culture. A maximum of five organisms were isolated from a given patient. These results show that the adult middle meatus contains a mixed commensal flora and should prove useful in interpreting endonasal swab cultures during acute and chronic sinus infection.

Key words: Middle meatus, microbiology

Introduction

The commensal nasosinus flora are poorly documented (Brook, 1981; Savolainen *et al.*, 1986; Jousimies-Sommer *et al.*, 1989; Ylikoski *et al.*, 1989), especially in the region of the middle meatus (Axelson and Brorson, 1973). The key role of the middle meatus in the onset and persistence of infections in the maxillary and/or ethmoid sinuses has been known for many years (Aust and Drettner, 1974; Carenfelt, 1979).

The maxillary, frontal and anterior ethmoid cavities drain to this area. Sinus secretions are then actively pushed into the rhinopharynx along the back of the inferior nasal concha (Stammberger, 1986).

The aim of this work was to identify the commensal bacteria present in the middle meatus of subjects free of sinus disease, by using middle meatus swabs in the area close to the maxillary ostium. Samples were obtained by using an endoscope (Hopkins system 0°, 25°, 30°), providing directed samples of secretions at the medial part of the ostial maxillary canal.

Materials and methods

One hundred and thirty-nine patients were included in the study. The sampling method was explained and patient's consent was obtained. The mean age was 42.3 years (range 17 to 82 years). There were 74 men and 65 women.

Inclusion criteria were the absence of chronic rhinosinusitis or rhinological infections in the pre-

vious three months. None of the patients had received systemic or local antimicrobial chemotherapy in the two weeks preceding the study.

Samples were taken under endoscopic guidance (0° or 30° lens, 4 or 2.7 mm diameter). Three swabs (Calgiswab* type 1, Spectrum Laboratories, INC) were taken under direct visual control near the maxillary ostium (lower part of the unciform process), thus avoiding any risk of contamination within the nasal cavity. Two swabs were immediately placed in transport medium (TGV Anaer®, Diagnostics Pasteur) and rapidly taken to the laboratory. A smear was prepared from the third sample for direct examination.

At the laboratory, samples were inspected for purulence and the white cell count was determined by a semi-quantitative technique (three classes: none, few, abundant) and the smear was then Gram-stained. Colombia-blood agar and chocolate agar were used for aerobes and non-selective Colombia-blood agar for all anaerobes. Nalidixicolistin-nystatin agar or neomycin-vancomycin agar were used to isolate Gram-negative anaerobes.

Aerobic cultures were incubated at 37° in five per cent CO₂ and examined at 24 and 48 hours. Anaerobic cultures were incubated at 35 °C in an anaerobic atmosphere or in anaerobic chambers for five days and were examined every 48 hours and at the end of the culture. Nitrocefin disks (Cefinase® Biomerieux®) were used to detect any β-lactamase production.

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TABLE I
SPECIES ISOLATED FROM THE ADULT MIDDLE MEATUS

Total number of samples	n = 139
Number of samples with aerobes only	n = 91
Number of samples with anaerobes only	n = 4
Number of samples with mixed populations	n = 18

Results

Of the 139 aspirates, 81.3 per cent of the cultures were positive (Table I). Isolates are described in Table II. The most common bacterial species were: coagulase negative staphylococci (50 per cent), corynebacteria (20 per cent), *Staphylococcus aureus* (12.6 per cent), Enterobacteriaceae (5.3 per cent) (Table II). Anaerobes were found in 18 mixed cultures and four pure cultures (Table III). *Propionibacterium* spp., *Peptostreptococcus* spp., and skin commensals were predominant in 27 out of 29 samples. More than 95 per cent of samples contained few or no white cells confirming the normality of the population. Seasonal variations in samples are shown in Table IV. A difference ($p = 0.07$) was found between the two groups.

Discussion

Sterile samples

The large number of non-sterile samples in this study (>80 per cent) may be due to the precision of the sampling method (under direct endoscopic control) and the short time between sampling and analysis.

The leukocyte counts showed the absence of latent infections in this healthy population. The absence or paucity of leukocytes in 129 samples confirmed the normality of our population. Savolainen *et al.* (1986), in their study of a control population, reported finding 171 leukocyte-poor samples out of 194. In the other six patients in our study, the presence of numerous leukocytes was not always associated with the presence of a pathogen. Similar results have been reported by Savolainen *et al.* (1986), who found a combination of pathogen with numerous leukocytes in only two cases. In his control series of 98 subjects, Holopainen (1967) found five per cent of samples containing numerous leukocytes, but did not correlate these data with the presence of pathogens. These reports confirm that our subjects represented a good control population in agreement with the study of Sobin *et al.* (1992), who selected his patients

TABLE II
BACTERIOLOGICAL FINDINGS IN 139 SAMPLES TAKEN FROM THE MIDDLE MEATUS

Facultative aerobes: n = 160	
<i>Streptococcus viridans</i>	6
<i>Streptococcus pneumoniae</i>	2
Coagulase negative staphylococci	74
<i>Staphylococcus aureus</i>	19
Corynebacteria	34
Enterobacteriaceae	8
<i>Haemophilus influenzae</i>	2
Miscellaneous	15

TABLE III
ANAEROBIC ISOLATES IN 139 SAMPLES TAKEN FROM THE MIDDLE MEATUS

Obligate anaerobes n = 29	
<i>Peptostreptococcus</i> sp	7
<i>Propionibacterium acnes</i>	18
<i>Propionibacterium granulosum</i>	2
<i>Clostridium perfringens</i>	1
<i>Prevotella melanogenica</i>	1

on clinical criteria alone, whereas some authors have used radiological examination to confirm the normality of the maxillary sinus.

The presence of bacteria in more than 80 per cent of the samples confirms the existence of a commensal flora in the middle meatus. Axelson and Brorson (1973) obtained bilateral samples from the maxillary and inferior meatus in 100 patients and also found a culture-positivity rate of 85 per cent. This proportion was lower than values published by Savolainen *et al.* (1986) for the nasal cavity (100 per cent positivity in 97 samples from the posterior nasal cavity).

Isolates

Only one species was isolated in almost half the cases (59/139), while 16 per cent of subjects had a mixed flora. Savolainen *et al.* (1986) studied 572 samples and identified a mixed flora in more than two-thirds of cases. The precise origin of these organisms was not determined. They may have originated from the nasal flora in the vicinity of the ostium, or from the sinus flora draining actively from the sinus cavities to the nasal cavity. Su *et al.* (1983) found that *Staphylococcus epidermidis* and corynebacteria were the most frequent isolates from the nasal cavity of healthy subjects. On the other hand Savolainen *et al.* (1986) isolated 79 per cent *Staphylococcus epidermidis*, 41 per cent corynebacteria and 34 per cent *Staphylococcus aureus*. Brook (1981) studied healthy adult sinus secretions and isolated, not only the above three species, but also α - and β -haemolytic streptococci, untypable *Haemophilus influenzae* and anaerobic species. Our results confirm the presence in the middle meatus of an aerobic flora (coagulase-negative staphylococci, corynebacteria, *Staphylococcus aureus*), and reveal the presence of anaerobic species as well.

The combined (n = 18) or sole (n = 4) presence of anaerobes strongly suggests the presence of an anaerobic commensal flora in the middle meatus; *Propionibacterium acnes* and *Peptostreptococcus* spp.

TABLE IV
BACTERIOLOGICAL FINDINGS ACCORDING TO SEASON

Bacteria	Summer	Winter
Sterils	11/39	15/100
Corynebacteria	6	28
Enterobacteria	3	5
<i>Staphylococcus aureus</i>	4	15
Coagulase negative <i>Staph.</i>	18	56
<i>Peptostreptococcus</i> sp.	2	5
<i>Propionibacterium</i>	8	12
Others	7	20

were the two main anaerobes isolated in our study. This is in keeping with the findings of Brook (1981) and Su *et al.* (1983), who also reported the presence of anaerobes in sinus and nasal secretions of healthy subjects. Jousimies-Sommer *et al.* (1989) isolated about 60 per cent of anaerobes from 286 patients, including strains of *Propionibacterium acnes* and *Peptostreptococcus* sp. The presence of anaerobes suggests that the flora in the middle meatus is derived from the sinus or the nasal fossa. Brook (1981) demonstrated the presence of anaerobic species in the maxillary sinus which are continuously removed by the mucociliary system from the sinus to the nasal fossa. Bacteria isolated from the middle meatus may thus be considered as the commensal flora of the maxillary sinus. We sampled an area at the edge of the ostial canal as did Sobin *et al.* (1992) and deduced that the flora of the middle meatus may correspond to the normal flora of the nasal cavity and that the maxillary sinus can either be sterile or harbour a small number of bacteria. Combined sampling of the nasal and sinus cavities from patients suffering from chronic sinusitis is being undertaken to confirm these possibilities (data not published).

As this study lasted several months, we investigated whether the sampling period influenced the results. We found a significantly higher incidence of culture negativity during the summer than in the winter ($p = 0.07$). This may be due to a proliferation of the bacterial population in healthy subjects during winter, or an increase in the overall number of bacteria in the environment. Again, these preliminary results must be confirmed by longer studies. The presence of a commensal flora raises its possible protective role against invasion by pathogens of the nasosinus cavities. Several authors have raised the possibility that aerobes and anaerobes might be responsible for the persistence of chronic sinusitis with nasal obstruction.

Conclusion

This 18-months prospective study suggests the existence of a commensal flora within the middle meatus. Its potential role remains unknown.

These data will help to interpret cultures of maxillary sinus secretions, and to distinguish the normal flora from pathogenic organisms. While the sinus puncture remains the reference sampling method for sinus secretions (Savolainen *et al.*, 1989; Wald, 1991; Gwaltney, 1995) the method used requires additional studies especially including comparative analysis of specimens from both sides (nasal and maxillary sinus) to confirm its accuracy.

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