

## BACTERIOLOGY OF ANTRUM IN CHRONIC MAXILLARY SINUSITIS<sup>+</sup>

Dr.Fevzi Sefa DEREKÖY \*  
Dr.Davut AKTAŞ \*\*  
Dr.Ahmet BÜYÜKBAŞUSTA \*\*\*  
Dr.Mustafa ÖZYURT \*\*\*

*There have been many investigations about the microbial aetiology of chronic sinusitis with great variations. Because the culture and the antibiogram tests in the management of the patients with sinusitis are impractical in daily life, selection of antibiotic drugs is done empirically. Keeping this fact in mind, the results of these tests should be disclosed more often on a reliable method. In this study, twenty-five sinus cultures were obtained from the patients with chronic maxillary sinusitis with pathological verification. After treating the nares and inferior meatus with povidone iodine solution, intranasal inframeatal antrostomy was performed. Separate transport mediums specially prepared for aerobic and anaerobic collections were used. Following differentiation of the microorganisms, antibiotic sensitivity tests were determined. Biopsy specimens of maxillary sinus mucosa, obtained peroperatively were studied under the light microscope. Aerobic bacteria were recovered in seventeen cases(68%), whereas there were fifteen anaerobes isolated(60%). Mixed infections were seen in seven patients. The most common isolates were anaerobic streptococci, Staphylococcus aureus, Haemophilus influenzae, alpha-haemolytic streptococci and bacteroid species. It was noticed that the aminoglycoside antibiotics were the most effective drugs in tests.*

**Key words:** Chronic maxillary sinusitis, bacteriology, antrum.

\*Afyon Kocatepe Üniversitesi Tıp  
Fakültesi KBB AD  
MALATYA

\*\* İnönü Üniversitesi Tıp Fakültesi  
KBB AD,  
MALATYA

\*\*\* Gülhane Askeri Tıp Akademisi Tıp  
Fakültesi Mikrobiyoloji ve Kll.Mk. AD  
ANKARA

### Yazışma Adresi:

Dr.Fevzi Sefa DEREKÖY  
Afyon Kocatepe Üniversitesi  
Tıp Fakültesi, Rektörlük  
Araştırma ve Uygulama  
Hastanesi, KBB AD  
AFYON  
Tlf: 272 216 6432  
Faks: 272 216 6992

\* Bu çalışma 18-22 Eylül 1999 tarihinde  
25.Ulusal Türk Otorinolarinoloji ve Baş-  
Boyun Cerrahisi Kongre'sinde Türkçe  
olarak sözlü tebliğ halinde sunulmuştur.

### Kronik Maksiller Sinüzitiste Antrum Mikrobiyolojisi

*Kronik sinüzitin mikrobiyal etyolojisi hakkında pek çok araştırma vardır ve bunların arasında da derin farklar göze çarpmaktadır. Günlük hayatta sinüzit tanısı alan hastaların tedavisinin planlanmasında kültür ve antibiyogram testlerinin yapılması pratik değildir. Bu nedenle de antibiyotik seçimi ampirik olarak yapılmaktadır. Bu gerçekten hareketle, bu tür hastaların kültür ve antibiyogramları daha güvenilir metodlarla yapılmalı ve sık olarak ortaya konmalıdır. Bu çalışmada histopatolojik olarak doğrulanmış kronik maksiller sinüzitli hastalardan yirmibeş sinüs kültürü elde edildi. Bu hastalara, nares bölgesi ve nazal kaviteleri povidon iyodür solüsyonuyla silindikten sonra intranasal inframeatal antrostomi uygulandı. Maksiller sinüsten alınan kültür örnekleri aerobik ve anaerobik kültürler için farklı transport besi yerlerine ekildi. Ayrıca patolojik tanı için sinüs mukozasından biyopsi yapıldı. Mikroorganizma türlerinin tespiti sonrasında antibiyogram çalışmalarına geçildi. Olguların onyedisinde aerobik bakteriler bulunurken(%68), onbeşinde de anaeroplara izole edildi(%60). Yirmibeş hastanın yedisinde mikst enfeksiyon söz konusuydu. En sık rastlanılan bakteriler ise anaerobik streptokoklar, Stafilokokkusu aureus, Hemofilus enfluenza, alfa-hemolitik streptokoklar ve bakteroid türleridir. Anibiogramda en etkin grubun aminoglikozidler olması dikkat çekiciydi.*

**Anahtar kelimeler:** Kronik maksiller sinüzitis, bakteriyoloji, antrum.

Sinusitis is an extremely common medical condition and an important cause of morbidity. Statistics from the Department of Health and Social Security in Great Britain estimated that one half million working days were lost in the country each year from sinusitis.<sup>1</sup>

Although sinusitis is one of the most common infectious problems seen in outpatient practice, its cause is often obscure, leading to empiric use of antibiotics. For this reason, knowledge of bacteriology of the diseased maxillary sinus is obviously important to be successful in treatment. Many microbiological studies of chronic paranasal sinusitis have reported various organisms of doubtful importance because sampling of the sinuses was usually accomplished through the nose and contamination with the bacterial flora of the nasal fossae obscured the results.

*Haemophilus influenzae*, *Streptococcus pneumoniae* and *Staphylococcus aureus* have been the predominant isolates recovered from inflamed sinuses<sup>2</sup>, although it was suggested that anaerobes were common in these patients because poor drainage, local inflammation and vasoconstricting agents act to produce a low oxygen tension within the sinus.<sup>3</sup> However the definition of chronic sinusitis is somewhat arbitrary and it should be based on the histopathological findings.

In this study, the purpose was to establish the bacteriological findings in the maxillary sinus of the patients with chronic maxillary disease whose diagnosis was confirmed by microscopic study.

#### **MATERIALS AND METHODS**

Twenty-five patients who had chronic maxillary sinusitis were the subjects of this study. There were sixteen men and nine women ranging in age from 23 to 65. Preoperatively, patients' histories, physical examinations and computed tomography scans of the paranasal sinuses have been routinely obtained. All of these patients underwent bilateral intranasal antrostomy. Biopsy specimens of maxillary

sinus mucosa, obtained peroperatively were studied by the light microscope to confirm the diagnosis of chronic sinus disease.

No patient had received antimicrobial therapy for at least three weeks prior to sample collection. The areas of the nares and inferior meatus were cleaned by suction and swabbing, and then treated with povidone iodine solution. Under local anesthesia, the inferior turbinate was initially fractured medially and then, by using the perforator, the lateral wall of the nose was pierced at the highest point under the genu of the turbinate. Direct culture from maxillary sinus mucosa through nasal antral window with strict asepsis was done prior to performing inferior meatal antrostomy. The mucosa of the maxillary sinus was swabbed with a sterile applicator during this process.

Thioglycolate broth and Carry-Blair transport medium for aerobic and anaerobic collections were used peroperatively. Aerobic samples, then were inoculated onto blood and EMB agar and were incubated at 37 C . Chocolate agar was incubated in 10% CO<sub>2</sub> in a period of 48 hours for anaerobic culture. For incubations, anaerobic jar (Oxoid AN 25) and gas pack (BBL Gas Pack, USA) were used. Antibigrams were determined by ATP ANA strip system.

#### **RESULTS**

Twenty-five sinus cultures were obtained in this study. As outlined in Table 1, aerobic bacteria were recovered in seventeen cases (68%), whereas there were fifteen anaerobes isolated (60%). Mixed infections were seen in seven patients. The most common isolate was Anaerobic *Streptococcus*, 9 strains (36%), followed by *Staphylococcus aureus*, 7 strains (28%). *Haemophilus influenzae*, alpha-haemolytic *Streptococcus* and *bacteroides* species were the other common pathogens. Four mixed aerobic infections were noted as follows: Alpha-haemolytic *Streptococcus* and *Staphylococcus aureus*; *E.Coli* and *Klebsiella pneumoniae*; Alpha-haemolytic *Streptococcus* and *Klebsiella pneumoniae*; *Pseudomonas*

## Bacteriology of Antrum In Chronic Maxillary Sinusitis

**Table 1.** Bacteria isolated at surgery in cases of chronic sinusitis.

ORGANISMS	% NO. OF SPECIMENS	%
<b>AEROBIC</b>		
Staphylococcus aureus	7	28
Hemophilus influenzae	3	12
Alpha-haemolytic Stretococcus	3	12
Proteus mirabilis	2	8
Escherichia Coli	2	8
Klebsiella pneumoniae	2	8
Morganella morganii	1	4
Pseudomonas aeruginosa	1	4
<b>ANAEROBIC</b>		
Anaerobic Streptococci	9	36
Bacteroides species	3	12
Veilonella parvulla	2	8
Fusobacterium species	1	4

**Table 2.** Results of antibiotic tests in 25 patients.

ANTIBIOTIC	SENSITIVE ORGANISMS		RESISTANT ORGANISMS	
	NO	%	NO	%
Amikacin	22	88	3	12
Tobramycin	22	88	3	12
Netilmicin	21	84	4	16
Gentamicin	21	84	4	16
Ofloxacin	21	84	4	16
Cefuroxime	18	72	7	28
Ceftazidim	18	72	7	28
Piperacillin	13	52	12	48
Trim-Sulpha	13	52	12	48
Chloramphenicol	12	48	13	52
Penicillin-G	10	40	15	60
Tetracycline	9	36	16	64
Erythromycin	9	36	16	64
Ampicillin	5	20	20	80

aeruginosa and Staphylococcus aureus. But no consistent patterns of bacterial combinations were noted.

Anaerobes included nine anaerobic streptococci, three bacteriodes species, two Veilonella parvullas and one Fusobacterium. They were the sole bacterial isolates in eight cases (32%).

Gram-positive bacteria involved in ten aerobic isolates (47.6%), as gram-negative bacilli involved in eleven aerobic isolates (52.4%) in this study. Eleven of anaerobic isolates were gram-positive cocci (73.3%), while four of

them were gram-negative bacilli (26.7%).

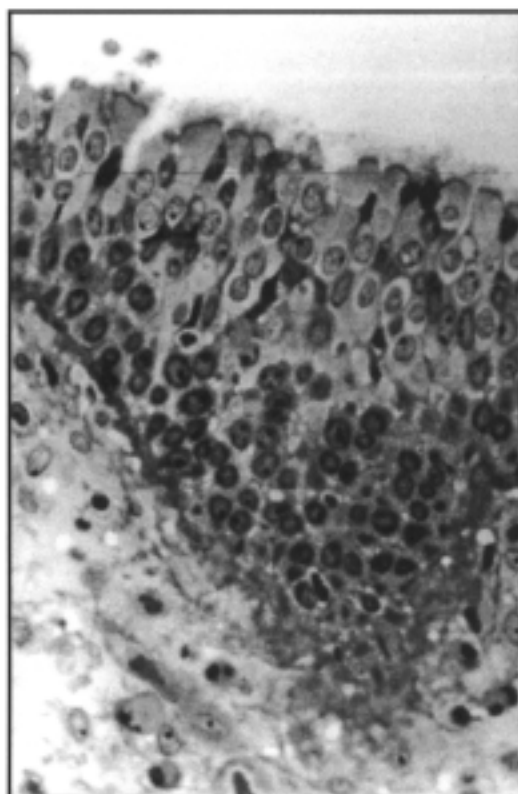
Results of antibiotic sensitivity tests were shown in Table 2. The most effective drugs were amikacin and tobramycin with the percentage of 88. Netilmicin, gentamicin and ofloxacin were amongst the effective drugs (84%), whereas trimethoprim / sulphamethoxazole, chloramphenicol, penicillin-G, tetracycline and erythromycin had little effect against the isolates.

Mucosal thickening, polypoid mass, air-fluid level and opacification were detected on the CT scans of the patients.

The histopathological examination of the biopsy specimens revealed epithelial thickening, increase in number of the goblet cells, fibrosis, edema, infiltration of the inflammatory cells in all patients (Figure 1).

## DISCUSSION

The bacteriology of chronic maxillary sinusitis has been studied in medical centers reporting various kinds of microorganisms. Palva et al. suggested that these different results were due to sampling methods like antral washings or nasal puncture prone to contamination with residential nasal flora.<sup>2</sup> Indeed the paranasal sinuses were considered previously to be sterile cavities.<sup>4</sup> In a study, it was reported that there was no growth on culture in almost 25 per cent of all sinus infections.<sup>5</sup> But, in 1981, Brook published the presence of aerobic and anaerobic organisms in the non-inflamed sinus demonstrating the non-sterility of the sinus cavity.<sup>6</sup> Anaerobic bacteria were recovered in all his twelve cases, whereas sixteen of the isolates were aerobes which included five beta haemolytic *Streptococci*, three alpha haemolytic *Streptococci* and two each of *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Haemophilus parainfluenzae*. However, Almadori et al. found only aerobic organisms in the aspirates of the patients with traumatic fractures of the maxillary sinuses.<sup>7</sup> It is important that these results at least suggest that the normal paranasal sinuses are not sterile. In that case, following closure of the sinus ostium, these bacteria may become pathogenic.<sup>6</sup> The most common organisms in chronic maxillary sinusitis were *Streptococcus viridans* and *Haemophilus influenzae* in a study<sup>8</sup>, while the predominant aerobes were *Streptococcus* species and *Staphylococcus aureus* in another.<sup>9</sup> In the present investigation, anaerobic *Streptococci*, *S.aureus* and *H.influenzae* were frequent isolates, as cultures from patients grow out predominantly aerobic organisms (68%). This result was in agreement with the investigation of Carefelt et al. who reported seventy per cent of microorganisms were aerobes.<sup>10</sup> However, *Strep. Pneumoniae* was not discovered in any



**Figure 1.** Sinus mucosa from a patient with chronic sinusitis. A marked goblet cell hyperplasia, thickening of the basement membrane, infiltration of the inflammatory cells and oedema are seen (T.Blue,X 420).

specimens in our study. Frederich and Braude found that *Staphylococci* and alpha haemolytic *Streptococci* predominated among aerobic bacteria somewhat resembling the present study.<sup>3</sup> Also results of culture of antral contents in an investigation of a surgical technique by Lund were similar to our study except anaerobes.<sup>11</sup> In another study, about the microbiology of chronic sinusitis in fifty adult patients, *S.aureus* and *Propionibacterium* sp. were found to be the most common pathogens.<sup>12</sup> But on the contrary, it was proposed that the importance of *S.aureus* in sinusitis had been exaggerated since it was part of the normal nasal flora in 28 and to 35 per cent of healthy individuals.<sup>13</sup>

Because anaerobic cultures were not done in most of the previous studies, anaerobic aetiology of chronic maxillary sinusitis has not

## Bacteriology of Antrum In Chronic Maxillary Sinusitis

been widely disseminated among physicians. High frequency of anaerobic organisms in this study should not be surprising since many features of the diseased sinus tend to encourage anaerobic growth.<sup>3</sup>

Bacterial infection of the sinus occurs when the self-cleansing mechanism becomes impaired.<sup>1</sup> Brook said that the mechanism by which the pathogenic bacteria reach the sinus was not clear.<sup>14</sup> One possibility is that these organisms reside in the sinus cavity as normal flora; while another hypothesis is that they may reach the sinus following sealing of the ostium through the lymphatic or venous systems. Also poor drainage of the sinus in chronic disease reduces oxygen tensions in the cavity, which causes the growth of anaerobic bacteria. Anaerobic bacteria were isolated in 100 of 113 culture-positive specimens (88%) in a study<sup>9</sup>, while the same percentage was found by Brook.<sup>15</sup> In the present study, anaerobic bacteria accounted for sixty per cent of infections in accordance with data obtained by Frederich and Braude<sup>3</sup> Karma et al. encountered anaerobes in about 18% of their cases<sup>8</sup>, while Greval et al. did in ten per cent of their patients.<sup>16</sup> The causes of this great variation may be the differences in sampling techniques, patient selection, site of culture, transport method and media as well as culturing techniques.<sup>17</sup>

On the basis of the clinical picture and the results of Gram staining, which can be completed within five minutes, the physician can prescribe early effective antimicrobial.<sup>13</sup> Slavin suggested that gram-negative organisms were extremely uncommon.<sup>1</sup> However gram-negative bacilli were encountered in 52.4% of aerobic isolates as in 26.7% of anaerobes. When a Gram smear is positive, penicillin would be ineffective in the treatment because of penicillinase producers.<sup>13</sup> When gram-negative organisms are seen on smear, the laboratory can usually differentiate *H.influenzae* from other gram-negative bacilli. When therapy must be instituted without culture, ampicillin is suggested as antibiotic of choice for children and penicillin is suggested

for adults.<sup>13</sup> But as seen in the present study, infections due negative bacilli such as *E.coli*, *Klebsiella* or *Pseudomonas* are not uncommon. Inefficiency of ampicillin in the majority of our cases is the evidence for this fact. Indeed the concentration of ampicillin in the sinus fluid is reported to be low, but mucosal levels are higher.<sup>18, 19</sup>

Antibiotic sensitivity tests showed that aminoglycoside antibiotics were very active against the isolates recovered from inflamed sinuses. It is well known that these antibacterial compounds are effective against gram-negative bacilli like *P.aeruginosa*, *E.Coli*. Koltai et al. concluded that when the maxillary sinus was chronically infected with *P.aeruginosa*, postoperative intravenous aminoglycosides should be used.<sup>20</sup>

On the basis of this present trial, anaerobic bacteria appear to be a very important cause of chronic sinusitis. *S.aureus* was the most common aerobic isolate in our cases, as gram-negative bacilli account for about half of aerobic sinus infections. Results of antibiotic sensitivity tests showed that ampicillin was not effective in most of the cases while aminoglycoside antibiotics were found more active.

## REFERENCES

1. Slavin RG. Sinusitis. *J.Allergy Clin.Immunol* 1984; 712-6.
2. Palva T, Grönroos JA, Palva A. Bacteriology and Pathology of Chronic Maxillary Sinusitis. *Acta Otolaryngol* 1962; 54:159-75.
3. Frederich J, Braude AI. Anaerobic Infection of the Paranasal Sinuses. *N.Engl.Med* 1974; 290:135-7.
4. Evans FO Jr, Sydnor JB, Moore WEC et al. Sinusitis of Maxillary Antrum. *N Eng J Med* 1975; 293:735-9.
5. Kinnman J, Won LC, Hahm P. Bacterial Flora in Chronic Purulent Maxillary Sinusitis. *Acta Otolaryngol* 1967; 64:37-44.
6. Brook I. Aerobic and Anaerobic Bacterial Flora of Normal Maxillary Sinuses. *Laryngoscope* 1981;91:372-6.
7. Almadori G, Bastianini L, Bistoni F et al. Microbial Flora of Nose and Paranasal Sinuses in Chronic Maxillary Sinusitis. *Rhinology* 1986; 24:254-64.
8. Karma P, Jokipii L, Sipilä P et al. Bacteria in Chronic Maxillary Sinusitis. *Arch. Otolaryngol* 1979; 105:386-90.
9. Erkan M, Aslan T, Özcan M, Koç N. Bacteriology of Antrum in Adults with Chronic Maxillary Sinusitis. *Laryngoscope* 1994; 104:321-4.
10. Carenfelt C, Lunberg C, Nord CE, Wretling B. Bacteriology of Maxillary Sinusitis in Relation to Quality of the Retained Secretion. *Acta Otolaryngol* 1978; 86:298-302.
11. Lund VJ. Inferior Meatal Antrostomy: Fundamental Considerations of Design and Function. *J.Laryngol.Otol.Suppl* 1988;9:30-3.

## Dereköy et al

12. Maisel RH, Kimberley BP. Treatment of Chronic Sinusitis with Open Drainage and Cefaclor. *Am J Otolaryngol* 1988;15:1-18.
13. Chapnik JS, Bavh MC. Bacterial and Fungal Infections of the Maxillary Sinus. *Otolaryngol Clin N Amer* 1976;9:43-54.
14. Brook I, Conroni G, Rodriguez WJ. Aerobic and Anaerobic Bacteriology of Sinusitis in Children. *Curr Chemother Infect Dis* 1980;11:882-5.
15. Brook I. Bacteriology of Chronic Maxillary Sinusitis in Adults. *Ann Otol Rhinol Laryngol* 1989;98:426-8.
16. Greval RS, Khurana S, Shobha R, Sharma SK. Anaerobic Infection in Chronic Maxillary Sinusitis. *Indian J Med Sci* 1993;47:201-3.
17. Cauwenberg PB, Mijnsbrugge AMV, Ingels KJAO. The Microbiology of Acute and Chronic Sinusitis and Otitis Media: A review. *Eur Arch Otorhinolaryngol* 1993; 250: S3-S6.
18. Jeppesen F, Illum P. Concentration of Ampicillin in Antral Mucosa Following Administration of Ampicillin Sodium and Pivampicillin. *Acta Otolaryngol* 1972;73:428-32.
19. Axelsson A, Brorson JE. The Concentration of Antibiotics in Sinus Secretions: Ampicillin, Cephadrine and Erythromycin cinesolate. *Ann Otol Rhinol Laryngol* 1974; 83:323-331.
20. Koltai PJ, Maisel BO, Goldstein JC. *Pseudomonas Aeruginosa* in Chronic Maxillary Sinusitis. *Laryngoscope* 1985;95:34-7.