



Analysis Of Microbial Flora In Patients With Chronic Sinusitis Under Going Functional Endoscopic Sinus Surgery (FESS): A Cross-Sectional Study

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Abstract

BACKGROUND & OBJECTIVE : The purpose of this study is to analyze microbial flora of paranasal sinuses of patients with chronic sinusitis undergoing functional endoscopic sinus surgery (FESS). **METHODOLOGY:** This cross sectional study includes 60 patients who were diagnosed as chronic sinusitis (male:female ratio is 1:1 mean age: 41 yrs). Computed tomography (CT) imaging of the paranasal sinuses and nasal endoscopic examinations were performed for each patient. Patients were sampled during FESS for microbiological analysis and culture. **RESULTS:** 56 (93.3%) out of 60 patients were positive for pathogenic organisms. *Staphylococcus aureus* and members of the family *Enterobacteriaceae* were the most frequent classical pathogens isolated. Out of the total, 50 patients are positive for aerobic organisms where *Staphylococcus aureus* was present in 30 (60%), MRSA (Methicillin resistant *Staphylococcus aureus*) was positive in 8 (16%), followed by *Streptococcus* isolated in 6 (12%) samples. Other organisms found were *Enterobacter* 2 (4%), *Actinomyces* 2 (4%), *Acinobacter* 2 (4%), *Pseudomonas* 2 (4%) and *Klebsiella* 2 (4%). Co-infections with multiple organisms were found in few patients. **CONCLUSION:** The study supports the hypothesis that bacterial infection is the predominant etiology, but not the only cause of chronic sinusitis. Fungal and allergic etiology was found in few patients in the study. *Staphylococcus aureus* is most commonly isolated organism in patients with chronic sinusitis.

Keywords: Chronic sinusitis, FESS, *Staphylococcus aureus*, MRSA.

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1. Introduction

Chronic paranasal sinusitis is generally a mild disease. It's a common disorder that causes major physical, emotional, and economical effects, and is associated with poor quality of life. Chronic sinusitis is infection of the sinuses lasting for more than 3 months. However, it is important to realize that it afflicts a significant percentage of the population and causes considerable long term morbidity. The etiology of chronic sinusitis isn't well known, while bacterial infection is believed to be a major causative factor in the development of disease. Despite the tremendous advances in medicine over the last few decades, there have been relatively few improvements in the diagnosis and treatment of the disease. Many patients with the chronic sinus disease are subjected to multiple courses of antibiotics and surgeries, with little or no improvement in their condition. Long-term results of medical and surgical therapies have resulted in cure rates that vary between 29 and 80%¹⁻³. Knowledge of the normal microbial flora can help in assessment of the significance of organisms isolated from the sinuses of patients. No studies have examined the normal flora of the chronic sinuses. Bjorkwal⁴ in this study found normal healthy maxillary antra to be sterile in 54 cases; however, other studies have shown conflicting results⁴⁻⁷. It is difficult to extrapolate these results to the chronic sinuses.

The diagnostic criteria for acute maxillary sinusitis are well-established, but the definition of chronic maxillary sinusitis is controversial with respect to the importance of bacteria in the initiation and progression of the disease. Aspirates from community-acquired acute rhinosinusitis usually harbour bacterial species such as *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella*

catarrhalis. In contrast, microbiological cultures from chronically inflamed sinuses that fail to respond to antibiotic therapy are often found to be sterile or harbour a limited number of bacterial species, such as coagulase-negative *Staphylococci*, *Prevotella spp.* or *Fusobacterium nucleatum*. Chronic sinusitis has thus been considered to be a chronic inflammatory condition rather than a microbial infection. The role of bacteria in the chronicity of inflammation is unknown⁸. Ventilatory obstruction of the sinus ostium plays the key role in its pathogenesis. Acute infection destroys the normal ciliated epithelium impairing drainage from the sinus. Pooling and stagnation of secretions in the sinuses invites infections. Factors such as virulence of organism causing sinusitis, condition of sinus mucosa, decrease in mucociliary clearance, and immunity of host are effective in the pathogenesis of sinusitis⁹. Persistence of infection causes mucosal changes, such as loss of cilia, edema and polyp formation, thus continuing the vicious cycle¹⁰.

The diagnosis of this disease is commonly confirmed by computed tomography (CT) scanning of the paranasal sinuses. However, the severity of patients' symptoms does not always correlate well with CT stage of the disease^{11,12}. Hence, all symptoms of sinusitis cannot be solely attributed to the objective findings obtained by radiological examinations. The use of endoscopes expanded our knowledge about sinus infections by enabling the detailed examination of the intranasal cavity. Taking collections to determine the microbiology of each sinus with a lower probability of contamination has been possible by endoscopy¹⁰.

Lack of progress, paucity of knowledge on microbiology and histopathology of the chronic sinus disease available to us, was the impetus of our study to evaluate the microbiology of chronic sinusitis in patients undergoing FESS. We undertook this study to examine the microbiology of sinuses of patients with chronic sinusitis.

2. Experimentations

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This study was performed in Kasturba Medical College and Allied Hospital, Manglore during the period of two months (July–August’ 2010) which include 60 patients, diagnosed as chronic rhinosinusitis (30 women and 30 men, mean age: 41± 9.97).

2.1 Patient selection

Patients presenting with a history of chronic sinusitis of more than 6 weeks duration, which was supported by X-ray and/or CT scan findings and confirmed by office endoscopies to be consistent with chronic sinusitis, were included in the study. Specifically, the diagnosis had to include the following: (i) symptoms of nasal obstruction or purulent nasal discharge, discomfort or fullness over the sinuses, episodes of recurrent acute sinusitis, and/or disturbances in olfaction; (ii) radiological evidence of thickening and/or opacification of the chronic sinus, and (iii) signs of inflamed nasal mucosa; purulent exudate in the middle meatus, nasal cavity, or nasopharynx; and/or polyposis, (iv) with allergic rhinitis. It should be noted that these criteria do not differentiate infectious from allergic chronic sinus disease.

2.2 Collection of specimens

Endoscopic examination of the nasal cavity and the sinuses was done on all the patients. Surgery was performed under local anesthesia. A nasal swab specimen was then taken from the area of the middle meatus, which was not disinfected, and this culture was considered representative of the background nasal flora. The endoscopes were sterilized in a glutaraldehyde solution for 10 min and washed prior to use. In order to decrease the risk of contamination, swab specimens were taken from within the sinus air cells upon entering the sinus. Swab specimens for microbiological analysis were inserted immediately and aseptically into a modified anaerobic transport medium, transported immediately to the laboratory.

2.3 Microbiological analysis

Swab samples are inoculated into the culture media within 1 to 4 hrs of collection. Swab specimens were mixed with little amount of culture broth in order to provide aeration to the tissue. They were immediately inoculated, onto agar media (including MacConkey agar and chocolate agar) incubated at 35°C for checking growth of aerobic microorganisms present in the sample. The plates will be evaluated daily for atleast two days¹³. The swab was inoculated via thioglycollate broth in anaerobic plate medium (Schaeidler agar) and incubated anaerobically at 35°C. Anaerobic plates were placed into an anaerobic atmosphere immediately after plating and were examined at 48 h. The swab sample was further tested for fungal analysis by culturing the swab on to Sabouraud Chloroamphenicol agar.

Statistical analysis of data: Data were recorded and analyzed using SPSS version 11.5. and study was evaluated using Chi-Square test.

3. Results and Discussion

During the period of study, 60 patients with chronic sinusitis were included in the study. Microbiological data and clinical data were available for all 60 patients.

3.1 Clinical findings

The clinical diagnosis of chronic sinusitis was confirmed for all 60 patients. Extensive data for all the patients were available for clinical evaluation. The average age of the patients was 41 years (range, 10 to 70 years). The male to female ratio was 1:1. The average duration of symptoms was 1.5 years (ranged from less than 1 year to 15 years). History of allergy was present in 22(36.7%) of 60 patients. Out of these 22 patients, 16(73%) were on antihistaminic treatment. DNS was present in 52(87%) of 60 patients. In 8(15.3%) of these 52 patients spur was present. Turbinate hypertrophy was present in 20(33.3%) patients. Paranasal sinus tenderness was present in 20(33.3%) patients, frontal sinus most commonly involved.

3.2 CT Scan and Intra-op findings

In 20 (33.3%) of 60 patients, concha bullosa was present. 4 (2.4%) patients had pansinusitis. In 24 (40%) of 60 patients, polypoidal mucosa was found. Mucopurulent discharge in sinuses was present in 10 (16.7%) out 60 patients.

3.3 Microbiology results

Data were available for microbiological analysis for 60 swab specimens from the patients. 56 (93.3%) out of 60 patients results were positive for pathogenic organisms. Out of 60 patients, 50 samples were positive for aerobic organisms, none were positive for anaerobes, fungal growth was reported in 6 samples and in 4 samples no growth was found (Table I).

Out of 50 samples positive for aerobic organisms, *Staphylococcus aureus* was present in 30 (60%), MRSA was positive in 8 (16%), followed by *Streptococcus* 6 (12%). Other organisms found were *Enterobacter* 2 (4%), *Actinomyces* 2 (4%), *Acinetobacter* 2 (4%), *Pseudomonas* 2 (4%), *Klebsiella* 2 (4%) (Figure I). More than one organisms were found in a patient. 6 out of 56 patients were positive for fungal organisms. *Aspergillus niger* 2 (35.7%), *Candida albicans* 2 (35.7%), *Candida kruzei* 2 (35.7%) (Table II).

Table I: Microbiological analysis of swab samples

Organisms	No. of patients	Percentage
Aerobic organisms	50	83.33%
Anaerobic organisms	0	0.0%
Fungus	6	10.0%
No organism found	4	6.7%

5. Discussion

To compare the microbiology results of the study with ones in the literature, those studies were selected which used modern aerobic and anaerobic techniques. Bacterial etiology, pathophysiology and management of chronic rhinosinusitis have been most controversial. As stated, literature is sparse and difficult to interpret¹⁴.

Results from our study indicate that the frequencies of organism isolation were different from those in the other studies with respect to pathogen found in microbiological analysis (Table III).

In particular, we found a predominance of *S. aureus* and members of the family *Enterobacteriaceae* compared with the predominance found in other studies of chronic sinus disease. Our study shows that aerobes were the leading cause of chronic rhinosinusitis. *Staphylococcus aureus* is a highly virulent bacteria and can cause various infections. In most of studies investigating the microbiology of chronic sinusitis,

Table II: Fungal organisms isolated from samples

S. No.	Fungal organisms	No. of patients	Percentage (%)
1	<i>Aspergillus niger</i>	2	35.7
2	<i>Candida albicans</i>	2	35.7
3	<i>Candida kruzei</i>	2	35.7

Staphylococcus aureus was present in 15% to 40% of sinuses, had been reported as most frequent isolate. In our study *Staphylococcus aureus* is present in 60% of results. In our study, second most common was MRSA (16%), which may not have been reported in most of the past literatures¹⁵. Other organisms isolated were *Streptococci*, *Pseudomonas*, and *Enterobacter* which were similar to other recent studies.

Bacterial pathogens in chronic rhinosinusitis are

distinct from those found in acute rhinosinusitis, as is evident from our data. *Streptococcus pneumoniae* and *Haemophilus influenzae* are the predominant pathogens in acute sinusitis.

However both organisms were not found in our study. This difference can impact the choice of antibiotics. We

Reference

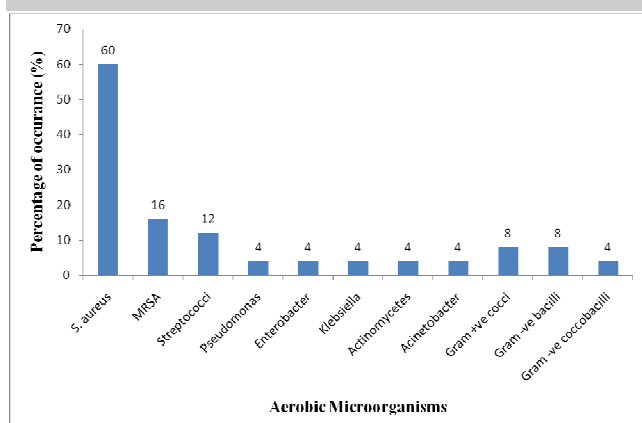
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Table III: Comparison between studies with respect to pathogen found

S. No.	Pathogens	Out of 94(%) ¹⁵	out of 179(%) ¹³	Present study Out of 56(%)
1	<i>Staphylococcus aureus</i>	31(33)	33(18.4)	30(54.5)
2	MRSA	0(0.0)	0(0.0)	8(14.2)
3	<i>Streptococci</i>	5(5.3)	2(1.1)	6(10.7)
4	<i>Pseudomonas</i>	1(1.1)	9(5.0)	2(3.5)
5	<i>Enterobacter spp.</i>	3(3.2)	6(3.4)	2(3.5)
6	<i>Klebsiella</i>	2(2.1)	4(2.2)	2(3.5)
7	<i>Actinomycetes</i>	0(0.0)	0(0.0)	2(3.5)
8	<i>Haemophilus influenza</i>	4(4.3)	8(4.5)	0(0.0)
9	<i>Corynebacterium diphtheria</i>	2(2.1)	0(0.0)	0(0.0)
10	<i>Chlamydia trachomatis</i>	0(0.0)	0(0.0)	0(0.0)
11	Fungus	1(1.1)	0(0.0)	6(10.7)
12	Anaerobes	0(0.0)	11(6.1)	0(0.0)
13	Virus	0(0.0)	0(0.0)	0(0.0)

did not found any anaerobes in our study, in contrast to other studies. It is possible that technical factors or improper processing could have decreased the number of fastidious anaerobic organisms in our study. We detected fungal pathogens in 6 patients. *Candida spp.* was found in 4 of them.

Figure I: Comparison of different aerobic microorganisms isolated



The study has several important limitations that require discussion. The small sample size and patient population at a regional referral center may not be representative of community at large. We attempted to follow a consistent and reproducible technique for harvesting specimens during FESS. In 4 of 60 patients, no pathogenic organism was reported.

In this cross sectional we examined the microbiology of chronic sinusitis. We found *S. aureus* to be the most frequent classical pathogenic bacteria isolated, followed by MRSA. Results also indicated that, in this select group of 60 patients, anaerobes do not play a prominent role in causing the disease. But the results do not imply that anaerobes cannot be involved in other patients with chronic sinus disease. Our study supports the hypothesis that bacterial etiology is predominantly, but not the only cause of chronic sinusitis. Fungal and allergic etiology was also found in few patients in the study. The pathogenesis of chronic sinusitis is likely multifactorial with allergy, mucosal inflammation, the hosts' local immune system, viral infection, and fungus-based eosinophilic inflammation playing a role¹³.

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