

## RESEARCH ARTICLE

# Bacterial Profile and Antibiotic Sensitivity in Patients with Chronic Rhinosinusitis undergoing Functional Endoscopic Sinus Surgery: A Prospective Study

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## ABSTRACT

**Background:** Chronic rhinosinusitis (CRS) is a prevalent disorder affecting up to 2% of the world population with a significant impact on the quality of life. Not only is it common, it is also the type of nasal disease with greater propensity for morbidity. The study was done to identify bacteria causing CRS and to obtain information regarding the antibiotic sensitivity of the organism.

**Materials and methods:** A prospective study was done on 109 patients with CRS, undergoing endoscopic sinus surgery. Swabs were obtained from the maxillary sinuses and sent for bacterial cultures and sensitivity tests.

**Results:** Hundred patients (91.7%) were positive for pathogenic organisms. Among them, Gram-positive cocci were seen in 77%, methicillin-sensitive *Staphylococcus aureus* was found in 49 patients and was the most common organism isolated. This was followed by methicillin-resistant *S. aureus* (MRSA) in 15 patients and coagulase-negative *Staphylococcus* (CoNS) in 13 patients. These organisms were most sensitive to Linezolid (96.1%) and least sensitive to Ampicillin and Clindamycin (54.4%). Gram-negative bacilli included *Pseudomonas* in 11 patients, *Klebsiella* in 5 patients, and *Proteus*, *Enterobacter*, and *Fusobacterium* one in each patient (3 patients). All the Gram-negative organisms were sensitive to Piperacillin-Tazobactam (100%) and showed 86.9% sensitivity to Amikacin, Imipenem, and Ceftazidime.

**Conclusion:** Our study showed there is rise in the number of methicillin-sensitive *S. aureus* (MSSA) cases compared to other studies. All organisms isolated in our study showed resistance to majority of the oral and parenteral antibiotics. We also observed an increase in the number of Gram-negative rods, mainly *Pseudomonas aeruginosa*, and *Klebsiella* spp., and hence, antibiotic prescription should be streamlined to minimize the chances of rising trend in antibiotic resistance.

**Keywords:** Aerobic bacteria, Anaerobic bacteria, Antibiotic sensitivity, Chronic sinusitis.

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## INTRODUCTION

Chronic rhinosinusitis is a prevalent disorder affecting up to 2% of the world population<sup>1</sup> and has significant impact on the quality of life of affected individual. Not only is it common, it is also the type of nasal disease with greater propensity for causing morbidity. This disease accounts for an average of 11.6 million visits to primary care physicians annually. The term "rhinosinusitis" refers to a group of disorders characterized by inflammation of mucosa of nose and paranasal sinuses. Chronic rhinosinusitis occurs when the duration of symptoms is greater than 12 weeks. Any anatomical, physiological, or pathological features that in a way or other obstruct free drainage from the sinuses, permit the stasis of secretion and thus predispose to infection. The etiology of chronic sinusitis continues to be the focus of much debate and research in the field of rhinology.<sup>2</sup> Many factors have been described as playing a role in the development of chronic sinusitis. These factors include allergy, asthma, dental disease, nasal polyps, immunodeficiency, mucociliary disorders, trauma, medications, surgery, noxious chemicals, anatomic abnormalities, and microorganisms (bacterial, fungal, and viral).

In CRS, the etiology and pathogenesis are much less clear and the majority of cases are idiopathic. A small subset, however, occurs in association with known genetic disorders [Kartagener Syndrome, cystic fibrosis (CF)],<sup>3</sup> autoimmune disorders (sarcoidosis, Wegener granulomatosis, systemic lupus erythematosus),<sup>4</sup> or systemic immunodeficiencies (human immunodeficiency virus).<sup>5</sup> In these settings, CRS that occurs is a local manifestation of a systemic disease and will typically exhibit a more specific histology and clinical course. Exogenous agents that trigger or exacerbate the sinonasal inflammation in these cases may be somewhat selective to the underlying systemic disorder as well (e.g., *Staphylococcus* and *Pseudomonas* in CF). Idiopathic CRS, which comprises the vast majority of CRS cases, is a clinical syndrome linked by the unifying presence of sinonasal mucosal inflammation,

however, the etiology and pathogenesis of this inflammation are complex.<sup>6-8</sup> The most widely accepted classification system divides CRS into CRS without nasal polyps and CRS with nasal polyps based on nasal endoscopy.

Viruses, fungi, bacteria, allergens, and other foreign materials interact with the sinonasal epithelium. In patients with CRS, this interaction results in persistent mucosal inflammation and the resultant symptom complex associated with the disorder.

## AIMS AND OBJECTIVES

To study the bacterial profile and antibiotic sensitivity in CRS patients undergoing functional endoscopic sinus surgery.

## MATERIALS AND METHODS

The study was conducted on 109 patients who presented with the symptoms of CRS in Department of ENT, Head & Neck Surgery, Bangalore Medical College & Research Institute, Bengaluru, India, from November 2014 to December 2016.

The patients of either sex aged between 18 and 60 years presenting with symptoms of chronic maxillary sinusitis for a minimum of 12 weeks duration according to TFR (Rhinosinusitis Task Force) criteria and willing to give written and informed consent were included in the study. The patients who had contraindication for functional endoscopic sinus surgery and did not give their consent were excluded from the study.

Detailed clinical history of the patient was taken along with complete general and ear, nose, and throat examination. Diagnostic nasal endoscopy, computed tomography (CT) scan of nose and paranasal sinuses, preoperative blood investigations were done and patients were taken up for surgery.

During the endoscopic surgery, middle meatal antrostomy was performed and discharge from the maxillary sinus if present was taken on sterile culture swab with great care so as not to touch the adjacent mucosa or skin. The culture swab was then immediately sent to laboratory for the culture. For each specimen, aerobic cultures were performed on blood agar, McConkey's agar, and chocolate agar plates.<sup>11</sup> The anaerobic cultures were placed in Robertson's cooked meat media. All specimens were cultured for 48 hours. Bacterial isolation was conducted through microscopic examination and biochemical testing of each colony. If a colony was not observed after 48 hours, the specimen was determined culture negative. The antibiotic sensitivity was done according to the Clinical and Laboratory Standards Institute guidelines separately for Gram-positive and Gram-negative bacteria. The Gram-positive bacteria were tested for eight antibiotics

Ampicillin, Erythromycin, Co-trimoxazole, Tetracycline, Doxycycline, Cefoxitin, Clindamycin, and Linezolid. The Gram-negative bacteria were tested for six antibiotics Ciprofloxacin, Imipenem, Amikacin, Levofloxacin, Ceftazidime, and Piperacillin-Tazobactam.

## RESULTS

We studied 109 patients who underwent endoscopic sinus surgery for chronic maxillary sinusitis at our hospital. The youngest patient in our study was 22 years and the oldest was 57 years; maximum patients were in the age group of 18 to 28 years. The mean age was 36.9 years. In our study, 55 patients were males and 54 were females. The average duration of symptoms was 10 months, ranged from less than 4 months to more than 24 months. In the present study, the most common symptom was nasal obstruction seen in 96 patients (88.07%) followed by headache, which was seen in 82 patients (75.22%), facial pain was seen in 75 (68.8%), nasal discharge in 32 (29.35%), postnasal discharge in 25 (22.93%), cough and hyposmia in 19 (17.53%) and 11 (10.09%) respectively, as depicted in Table 1. On examination, 80% of the patients had deviated nasal septum. On CT scan, almost all the patients had mucosal thickening in one or more of the sinuses.

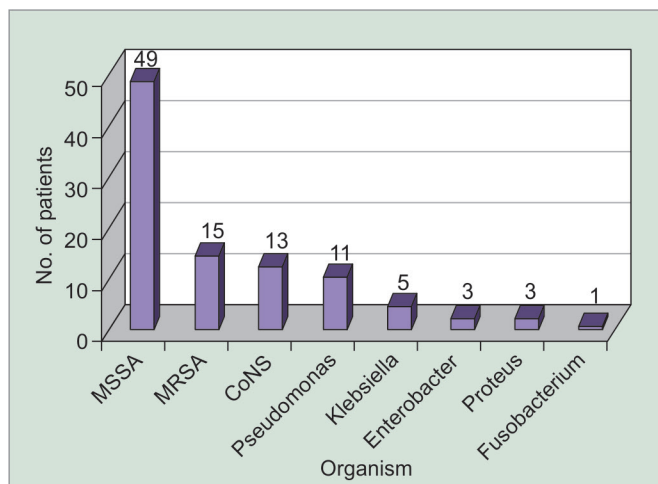
Organisms were isolated in 100 patients in which MSSA was isolated in 49%, MRSA in 15%, CoNS in 13%, *Pseudomonas aeruginosa* in 11%, *Klebsiella* species in 5%, *Enterobacter* species in 3%, *Proteus mirabilis* in 3%, and *Fusobacterium nucleatum* in 1%, and 9 patients showed no growth as shown in Graph 1.

## Antibiotic Sensitivity

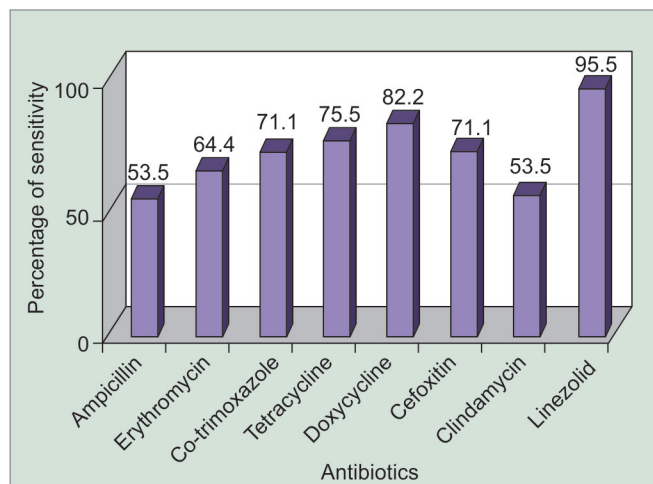
Gram-positive cocci were 95.5% sensitive to Linezolid, 82.2% sensitive to Doxycycline, 75.5% sensitive to Tetracycline, 71.1% sensitive to Cefoxitin and Co-trimoxazole, 64.4% sensitive to Erythromycin, and 53.5% sensitive to Ampicillin and Clindamycin respectively, as depicted in Graph 2.

**Table 1:** Symptom profile of study population

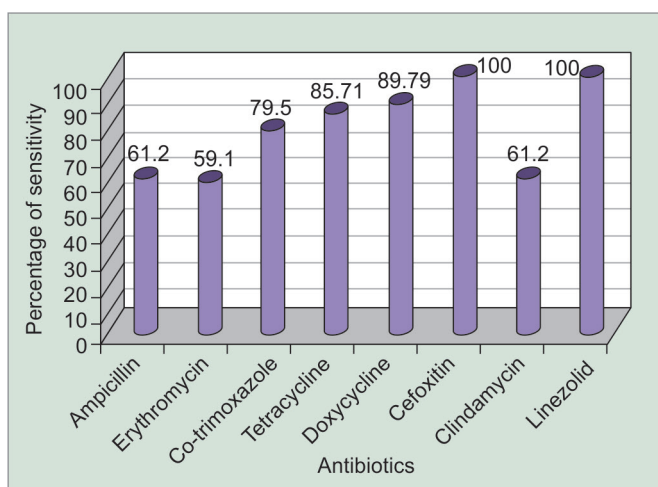
Symptoms	No. of patients	Percentage
Nasal obstruction	96	88.07
Headache	82	75.22
Facial pain	75	68.8
Nasal discharge	32	29.35
Postnasal discharge	25	22.93
Cough	19	17.43
Hyposmia/anosmia	11	10.09
Halitosis	9	8.25
Facial congestion	6	5.50
Ear pain	5	4.58
Fatigue	3	2.75



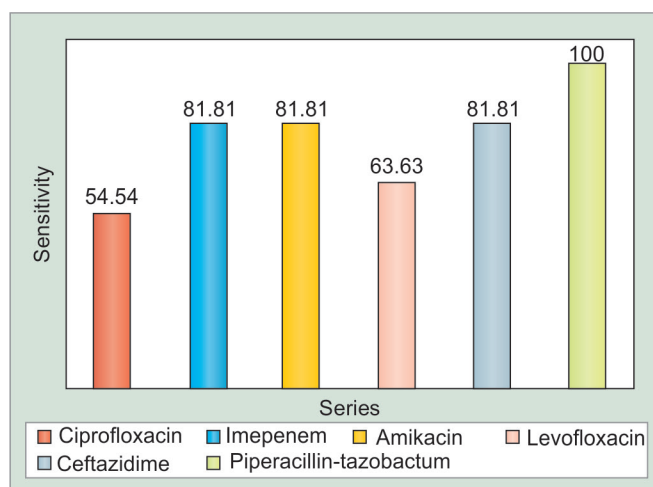
Graph 1: Bacterial profile of study population



Graph 2: Antibiotic sensitivity pattern of study population



Graph 3: Antibiotic sensitivity pattern of MSSA



Graph 4: Antibiotic sensitivity pattern of gram-negative bacteria

Out of the 45 Gram-positive organisms, the most common was MSSA, which was least sensitive to erythromycin (53.5%) and 100% sensitive to Cefoxitin and Linezolid as depicted in Graph 3.

Most Gram-negative bacilli showed resistance to Ciprofloxacin and Levofloxacin, but were sensitive to Imipenem, Ceftazidime, and Piperacillin-Tazobactam (Graph 4).

**DISCUSSION**

Bacterial etiology, pathophysiology, and management of CRS has been one of the most contentious topics of debate in otorhinolaryngology. The literature is sparse and difficult to interpret.<sup>2</sup> Many earlier studies dealing with the bacterial etiology of sinusitis were compromised by technical issues, beginning from specimen collection to final step of identification of organisms. So we in our study, took special care to collect the specimen directly from the sinus, after middle meatal antrostomy and hence, avoiding the common contaminants present

in the nasal cavity. The collected sample was sent immediately to the microbiology department for culture and sensitivity.

In our present study, the main organism isolated was MSSA, which was 49%. In few studies conducted on the microbiological aspect of chronic sinusitis, it was reported to be present in 15 to 60% of the isolates. The second most common isolate was MRSA, which has been reported in few studies in the past. The other organisms isolated were CoNS, *Pseudomonas*, *Klebsiella*, *Proteus*, *Enterobacter*, and *Fusobacterium* in our study, which were in coherence with the previous studies done as depicted in Tables 2 and 3.

Table 2: Comparison of bacterial profile with similar studies

Organism	Jindal and Kamath <sup>9</sup>	Kamath et al <sup>10</sup>	Jee et al <sup>11</sup>	Our study
Aerobes	50 (89%)	112 (92.56%)	72 (96.6%)	99%
Anaerobes	-	-	2 (2.66%)	1%
Mixed	-	-	1 (1.33%)	-
Fungus	6 (10.71%)	9 (7.4%)	-	-

**Table 3:** Comparison of bacterial profile with similar studies

Organism	Jindal and Kamath <sup>9</sup> (n = 56)	Kamath et al <sup>10</sup> (n = 100)	Jee et al <sup>11</sup> (n = 75) <sup>11</sup>	Doyle and Woodham <sup>12</sup> (n = 94)	Our study (n = 100)
MSSA	30 (60%)	43 (38.39%)	6 (8%)	31 (33%)	49%
MRSA	8 (16%)	3 (2.6%)	–	–	15%
CoNS	–	–	36 (48%)	–	13%
<i>Klebsiella</i>	2 (4%)	9 (8.03%)	2 (2.6%)	2 (2.1%)	5%
<i>Pseudomonas</i>	2 (4%)	1 (0.8%)	–	1 (1.1%)	11%
<i>Streptococci</i>	6 (10.7%)	2 (2%)	5 (6.6%)	5 (5.3%)	–
<i>Proteus</i>	–	–	–	–	3%
<i>Enterobacter</i>	2 (3.5%)	1 (1%)	13 (17.3%)	3 (3.2)	3%
<i>Fusobacterium</i>	–	–	–	–	1%
<i>Corynebacterium diphtheria</i>	–	–	–	2 (2.1%)	–
<i>Citrobacter</i>	–	1 (1%)	1 (1.3%)	–	–

## CULTURE SENSITIVITY

The present study showed that Gram-positive cocci formed the major organism isolated and these were subjected to antibiotic sensitivity. We found out that the Gram-positive organisms isolates were 96.1% sensitive to Linezolid, 84.4% sensitive to Doxycycline, 76.6% sensitive to Tetracycline, 72.2% sensitive to Cefoxitin, and 70.1% Co-trimoxazole. They were least sensitive to Clindamycin (54.4%) and Erythromycin (58.4%).

The study conducted by Jee et al<sup>11</sup> isolated Gram-positive cocci showed 60% sensitivity to Gentamicin, 66% to Erythromycin, 93% Ciprofloxacin, 70% to Co-trimoxazole, and 100% sensitivity to Vancomycin and Teicoplanin.

In our study, MSSA was the most common organism found. It showed 100% sensitivity to Linezolid, followed by Doxycycline which was 89.79% and Co-trimoxazole which was sensitive to 79.5%. It was least sensitive (59.1%) to Erythromycin. Our study showed that Gram-negative bacilli were found to be most sensitive to Piperacillin-Tazobactam (100%), followed by Amikacin, Ceftazidime, and Imipenem, which showed sensitivity of 86.9%. The isolated organisms were least sensitive (60.81%) to Ciprofloxacin.

In the study done by Jee et al,<sup>11</sup> Gram-negative bacilli were 90, 95, 95, and 100% sensitive to Ciprofloxacin, Amikacin, Co-trimoxazole, and Imipenem respectively, hence, showing increase in resistance of commonly used oral antibiotics.

## CONCLUSION

Chronic rhinosinusitis is one of the most common rhinological problem encountered worldwide, which has greater propensity to cause morbidity.

The present study revealed that nasal obstruction and headache are the two most common symptoms of

CRS. Out of all the organisms isolated, we found out that Gram-positive aerobes are the most commonly isolated organism in patients suffering from chronic maxillary sinusitis. Among these Gram-positive aerobes, the most commonly isolated was MSSA, with rising number of isolates for CoNS, which is a commensal in the nasal cavity.

This study showed that there are a rising number of cases which show emergence of MRSA that were resistant to majority of the oral and parenteral antibiotics. We also observed that there is increase in the number of Gram-negative rods, mainly *P. aeruginosa* and *Klebsiella* spp. In the study, we also isolated one anaerobic bacteria (*F. nucleatum*). The study was aimed to prove that bacterial infection is also one of the important causes of chronic inflammation of the mucosa of nose and paranasal sinus and that there is increase in the resistance of the organism against commonly used antibiotics. This study highlighted the various bacteria which are implicated in causation of chronic sinusitis and their antibiotic sensitivity, which will influence the treatment decisions and also reduce the morbidity caused by the disease, and will be helpful in the management and postoperative prophylaxis of chronic sinusitis.

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