

A clinical study with changes in microbiological flora in chronic rhinosinusitis



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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is characterized by mucous membrane inflammation that lines the paranasal sinuses and nasal cavity for at least twelve consecutive weeks. Microbes play a major role in pathogenesis. The treatment objectives are to reduce mucosal edema, restore paranasal sinus ventilation, and eliminate infectious pathogens. **Aims and Objectives:** (1) To study the presenting clinical features of chronic sinusitis. (2) To study the changes in microbiological flora. **Materials and Methods:** The study was conducted on 202 patients in the Department of ENT and Microbiology (JNMCH) from December 2020 to 2022. Patients above the age of 10 years were evaluated in this study. Those who received antibiotics in the last week of the presentation and those resistant to medical therapy were excluded. Patients were subjected to a detailed history, the clinical examination, and a radiological examination. Under all aseptic precautions and after the patient's informed consent, the sample was taken from the middle meatus area for culture and sensitivity. **Results:** The study had a male predominance (71.28%), with the maximum number of patients in the age group 21–30 years (38.11%). The most common clinical features were nasal obstruction (96.03%) and mucopurulent discharge (100%). The most common isolate was *Staphylococcus aureus* (45.13%). **Conclusion:** Bacterial infection is a major etiological factor in CRS. Screening for *S. aureus* carriers may be an alternative to decrease the infection of *S. aureus*. There is a statistically significant increasing trend for methicillin-resistant *S. aureus* (19.46%) and fungal sinusitis (13.36%).

Key words: Chronic rhinosinusitis; *Staphylococcus aureus*; Methicillin-resistant *Staphylococcus aureus*; Mucormycosis

INTRODUCTION

Chronic rhinosinusitis (CRS) is defined as a 12-week inflammation of the mucous membranes of the paranasal sinuses and nasal cavities.¹ According to the European Position Paper on Rhinosinusitis and Nasal Polyposis: 2012, rhinosinusitis is defined by at least one or both primary symptoms, namely nasal blockage and nasal discharge, as well as at least one additional symptom, namely facial pain and hyposmia/anosmia.² It is diagnosed by combining the symptoms mentioned by the Rhinosinusitis Task Force with either endoscopic signs of edema/mucosal congestion, mucopurulent discharge, or polyp from the middle meatus, as well as computed tomography changes such as mucosal changes within the osteomeatal complex and/or sinuses.³

The radiological examination may show polypoidal changes in sinuses mucosa or sinuses filled with secretions. The term “microbiota” refers to the entire community of resident commensal, symbiotic, and pathogenic microorganisms that inhabit a specific niche and are organized and function as a single community.⁴ A diverse assemblage of microorganisms inhabits healthy sinuses, and changes in the types and quantities of these microbes may play a role in the pathogenesis of CRS. Pathogenic organisms can be found in a wide range of microbial communities, including many genera of aerobic and anaerobic microorganisms such as *Staphylococcus* species, *Pseudomonas aeruginosa*, and facultative Gram-negative rods. There is no single treatment regimen because of the heterogeneity of CRS. On the other hand, the principles involved in treating the disease

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include identifying and treating the underlying causes. The treatment objectives are to reduce mucosal edema, restore paranasal sinus ventilation, and eliminate infectious pathogens. This frequently necessitates a combination of topical and oral medication. Medical therapies include topical and systemic corticosteroids, antibiotics, hypertonic and isotonic saline irrigations or sprays, antileukotrienes, and others. Surgery is reserved for patients who have not improved despite medical treatment and those with an anatomic obstruction causing CRS.⁵ Endoscopic sinus surgery is the standard surgical option for treating CRS.

Aims and objectives

1. To study the presenting clinical features of chronic sinusitis.
2. To study the changes in microbiological flora.

MATERIALS AND METHODS

From December 2020 to December 2022, the study was carried out in the Department of ENT in collaboration with the Department of Microbiology. 202 patients were chosen based on detailed clinical features. This study looked at patients over the age of 10 years. Those who received antibiotics in the final week of the presentation were excluded.

Patients underwent a detailed history, diagnostic nasal endoscopy, and radiological examination. The diagnostic nasal endoscopy was performed under local anesthesia with topical 4% xylocaine using a rigid nasal endoscope with zero angulation. Under strict aseptic conditions, samples were taken through endoscope from the middle meatus, avoiding any risk of contamination within the nasal cavity. Swabs were immediately labeled, taken to the microbiology laboratory, and tested for culture and sensitivity.

Processing of sample

For aerobic culture, swabs were inoculated in brain heart infusion broth (BHIB), 5% sheep blood agar, or MacConkey's agar for 24 h at 37°C. If no growth is seen after 24 h, the plates, and BHIB are further incubated for another 24 h and examined as above. If still no growth was seen, then the culture was reported as "no growth after 48 h of incubation." Anaerobes were organisms that could not grow aerobically. The sample was inoculated in Robertson-cooked meat media for 24 h at 37°C for anaerobic culture. After 48–72 h of incubation, the results were analyzed.

KOH wet mount: The specimen was examined and used to detect fungal elements' characteristic presence.

All patients were provided with written informed consent, and the Institutional Research and Ethical Committee approved the study protocol. The information was gathered

and statistically analyzed before being presented as numbers and percentages.

RESULTS

Most of the study population constituted the male gender (71.28%) (Table 1).

The most common age group in the current study was 21–30 years (38.11%), and those over 60 years (3.46%) were the least affected (Table 2).

Aligarh region had the highest number of patients (57.42%), followed by Kasganj and Bulandshahar (9.40%), Hathras (4.95%), and nearby regions (18.81%).

Ninety-six (96.03%) patients presented with nasal obstruction as the main symptom. One hundred and six patients also complained of itching in the eyes and ears. Nose bleed was the presenting complaint in 13 patients (Figure 1).

On clinical examination, all patients had a mucopurulent discharge. One hundred eleven (54.95%) patients had a deviated nasal septum with inferior turbinate hypertrophy; forty-three (21.28%) had a sinonasal polyp; and forty (19.80%) had adenoid hypertrophy (Figure 2).

Non-contrast computed tomography of the nose and paranasal sinus showed sinus opacification in 142 (70.29%) patients. 105 (54.95%) patients had osteomeatal obstruction; concha bullosa was found in 37 (18.31%) patients (Figure 3).

Culture and Sensitivity

Out of 202 samples, 113 were bacterial, followed by 33 that showed no growth. Twenty-seven (13.36%) samples

Table 1: Distribution of patients according to gender

Gender	Number of patients (%)
Male	144 (71.28)
Female	58 (28.71)
Total	202

Table 2: Distribution of patients according to age group

Age group (years)	Number of patients (%)
11–20	57 (28.21)
21–30	77 (38.11)
31–40	30 (14.85)
41–50	11 (5.44)
51–60	20 (9.90)
>60	7 (3.46)
Total	202

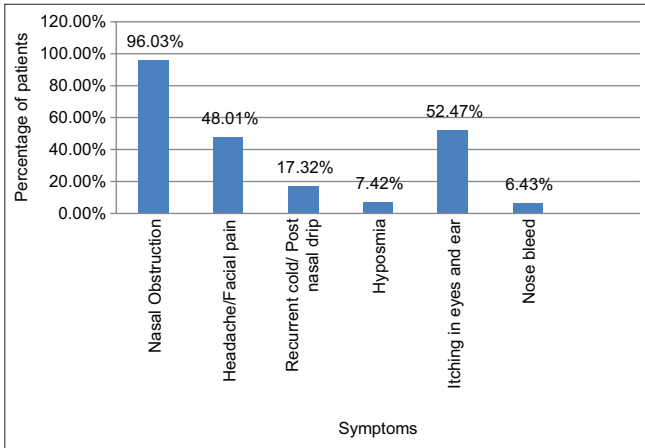


Figure 1: Distribution of patients according to symptoms

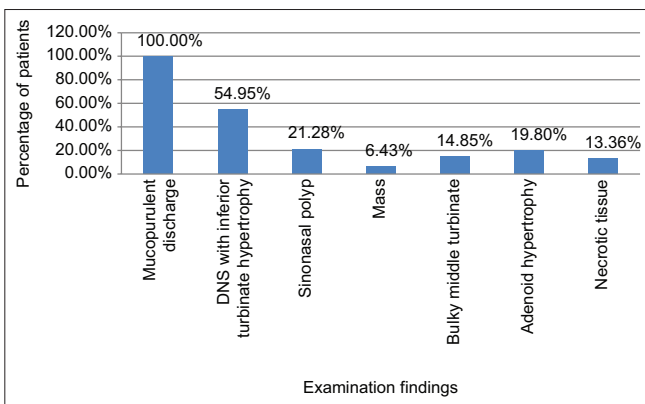


Figure 2: Distribution of patients according to examination findings

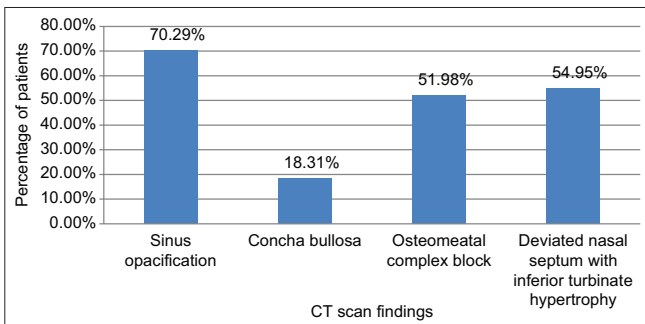


Figure 3: Distribution of patients according to finding in CT scan

isolated fungi, mainly mucor, in which 14 samples only had fungal growth, and 13 had fungal growth along with bacterial growth.

The most common bacteria isolated were *S. aureus* (45.13%) among Grampositive and *Klebsiella* species (11.50%) among Gramnegative (Figure 4).

All the isolated *S. aureus* were sensitive to vancomycin, followed by levofloxacin 42 (82.35%) and amikacin 38 (74.50%), and least sensitive to azithromycin 4 (7.84%) (Figure 5).

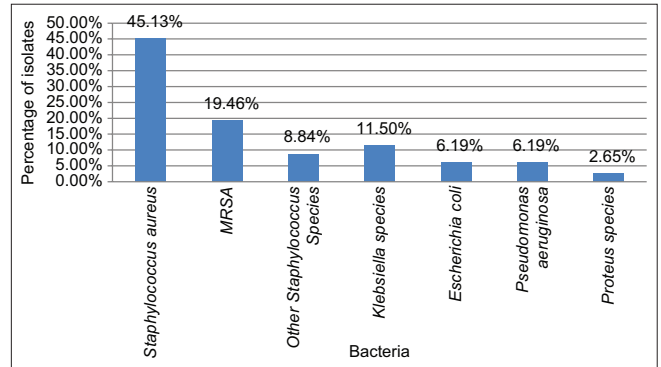


Figure 4: Bacterial profile of patients

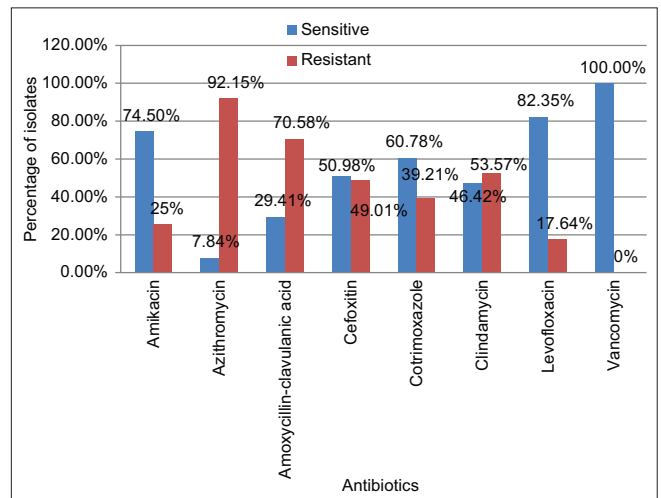


Figure 5: Antibiotics susceptibility pattern in *Staphylococcus aureus*

On comparing the microbiological profile of our study with that of Arun et al.,⁶ Doyle and Woodham,^{6,7} Busaba et al.,^{6,8} and Irfan et al.,⁶ *S. aureus* is still the predominant isolate in CRS. There is an increasing trend in the Methicillin-resistant *S. aureus* (MRSA) population. There is also a drastic increase in fungal isolates in the present research as a result of increasing mucormycosis in the postCOVID era (Table 3).

DISCUSSION

It is a highly prevalent disorder that impacts the quality of life. The prevalence of CRS ranges from 12% in the USA to 7.12% in Korea to 10.9% in Europe.⁹ India is greatly afflicted by sinusitis, with an estimated 134 million Indians.¹⁰ One in eight Indians suffers from chronic sinusitis, caused by long-term inflammation of the nose and paranasal sinuses. Among Indians, this disease is more widespread than diabetes, asthma, or coronary heart disease.¹¹ The most common associated etiopathological factor was anatomical obstruction due to a deviated nasal septum.

Out of 100 patients with CRS, 144 (71.28%) were male and 58 (28.71%) were female. The male-to-female ratio

Table 3: Comparing the microbiological profile of our study with different previous studies

Name of organisms	Present study out of 2022 (%)	Arun et al. (2020) out of 100 (%)	Irfan et al. (2014) out of 100 (%)	Busaba et al. (2004) out of 179 (%)	Doyle and Woodham (1991) out of 94 (%)
<i>Staphylococcus aureus</i>	51 (45.13)	34 (34)	46 (46)	33 (18.4)	31 (33)
MRSA	22 (19.46)	0	0	0	0
Other <i>Staphylococcus</i> species	10 (8.84)	0	0	0	0
<i>Klebsiella</i> species	13 (11.50)	0	9 (9)	4 (2.2)	2 (2.1)
<i>Pseudomonas aeruginosa</i>	7 (6.19)	12 (12)	1 (1)	9 (5)	1 (1.1)
<i>Escherichia coli</i>	7 (6.19)	2 (2)	0	0	4 (4.2)
<i>Proteus</i> species	3 (2.65)	1 (1)	0	0	8 (8.4)
Fungi	27 (13.36)	3 (3)	9 (9)	0	1 (1.1)

was 2.4:1. Erkan et al., (1994) and Madani et al., (2007) also showed a male predominance in their studies. The majority of the survey respondents reported male predominance, which could be attributed to the relatively higher involvement of males in outdoor activities, the higher prevalence of smoking, and the reluctance of females in social settings such as India to seek medical care.

The most common age group in the present study was 21–30 years, and more than 60 years was the least affected age group. Garg et al., (2009) showed the maximum number of patients in the age group of 18–27 years, while the minimum was in the age group of 57–66 years.¹² Our study showed different results compared to Madani et al., (2007), where the most common age group was 40 years.

The maximum number of patients in the present study were from Aligarh, the only tertiary care hospital in this region. It is pioneering work done in this region.

In our study, nasal obstruction (96.03%) was the most common symptom, followed by headache or facial pain (48.01%). Rekhade et al., (2021) documented nasal obstruction as the primary complaint, followed by nasal discharge. Garg et al., (2019) documented nasal discharge as the most common symptom in 100% of patients.

In the present study, mucopurulent discharge (100%) was seen in all patients. Similar results were obtained by Rekhade et al., (2021), where nasal discharge was the most common sign (72%), followed by nasal mucosa congestion (42%). Ferguson et al., (2012) reported that 56% of patients with nasal discharge.¹³

Adenoid hypertrophy was present in around 20% of patients. Although there is no proven link between adenoid size and maxillary sinus bacterial or fungal culture positivity, adenoidectomy alleviates symptoms in children with CRS and adenoid hypertrophy.¹⁴

Fifty-one patients (45.13%) were found to be affected by *S. aureus* out of 113 bacterial isolates. It was similar to the

findings of Irfan et al., (2014), who reported 46%, and Ologe et al., (2003), who reported 48.1%. MRSA was the most prevalent organism in Singh et al., (2017), at 58.33%. Similarly, Brook et al., (2008) isolated MRSA in 60% of cases of chronic sinusitis.

In the current study, around 12% of culture isolates tested positive for *Klebsiella* species. In contrast, Busaba et al., (2004) and Finegold et al., (2002) showed *Pseudomonas aeruginosa* as the most common gram-negative isolates, at 5% and 11%, respectively. Seven cultures (6.19%) showed *Escherichia coli* in the present study. Finegold et al., (2002) showed 1.1%, and Rombaux et al., (2002) reported around 9.5%. In our study, *Proteus mirabilis* was isolated in three patients (2.65 %), while Finegold et al., (2002) reported 1.4%.

Fungal isolates were positive in 27 out of 202 patients (13.36%). However, the observations stated by Doyle and Woodham (1991) were 1.1%. Busaba et al., (2004) found no fungi and concluded that fungi play no role in CRS. Mucormycosis is becoming more common in patients with uncontrolled diabetes, particularly in India and China. The estimated prevalence in India is approximately 70 times higher than in global data, and it is one of the pioneer studies on mucormycosis.

The sensitivity pattern of *S. aureus* varies greatly. Vancomycin had the highest sensitivity (100%), followed by levofloxacin (82.35%), amikacin (74.50%), cotrimoxazole (60.78%), and cefoxitin (50.98%). Singh et al., (2017) also showed maximum sensitivity to vancomycin. However, Davoudi et al., (2016) reported resistance to vancomycin in one isolated *S. aureus*. It showed low sensitivity to amoxicillin-clavulanic acid (28.75%) and azithromycin (7.15%). Pol et al., (2020) also reported low sensitivity (3.03%).

Thus, the current study shows bacterial infection is a major etiological factor in CRS. The sensitivity profile of these bacteria varies greatly and is influenced by the emergence of drug resistance. Proper antibiotic stewardship is urgently

required. Antibiotics should be used more wisely in treating CRS patients to achieve the best results.

Limitations of the study

It is a short term study with limited sample size. For more significant results, a bigger sample size should be used.

CONCLUSION

CRS is a clinical condition that primarily affects men. The majority of patients are between the ages of 21 and 30. A common symptom is a nasal obstruction. Mucopurulent discharge is a common sign. Opacification of the sinuses is the most common radiological finding. The most common cause is bacterial. *S. aureus* is the most common organism responsible for CRS. Vancomycin and levofloxacin were the most sensitive antibiotics in CRS. Antibiotics that are commonly used, such as amoxicillin-clavulanic acid, are losing effectiveness due to the emergence of drug-resistant bacterial strains.

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NG- Concept and design the study, prepared first draft of manuscript; **AR**- Concept, coordination, and interpretation, preparation of manuscript and revision of the manuscript; and **KC**- Drafting, literature review, and final version and **RG**- reviewed the literature and manuscript preparation.

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