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Bacteriological Profile and Antibiotic Sensitivity Pattern in Chronic Rhinosinusitis Patients: A Hospital-Based Study

Dr. Sapna. M. [1], Dr. Sahana Raju [2]*, Dr Afshan Fathima[3]

[1]Senior Resident, Department of Otorhinolaryngology, Bangalore Medical College and Research Institute (BMCRI), Bangalore.
[2]Assistant Professor, Department of Otorhinolaryngology, Bangalore Medical College and Research Institute (BMCRI), Bangalore.
[3]Assistant Professor, Department of Otorhinolaryngology, Indira Gandhi Institute of Child Health, Bengaluru.

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Corresponding Author:

Dr. Sahana Raju
sara1993ind@gmail.com

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is a multifactorial inflammatory condition of the nose and paranasal sinuses which affects a large segment of the world population. The persistent bacterial colonization and biofilm formation play a central role in the chronicity of the disease. Growing resistance of common sinonasal pathogens to antimicrobials poses challenge to empirical management that necessitates regional bacteriological analysis.

Methods: A prospective observational study conducted over 12 months in the Department of Otorhinolaryngology, Bangalore Medical College and Research Institute (BMCRI), tertiary care setup. A total of 120 clinically diagnosed CRS patients, who met EPOS criteria, were enrolled. Middle meatal swabs were collected under endoscopic guidance, followed by aerobic culture and antibiotic susceptibility testing by the Kirby-Bauer disc diffusion method.

Results: the 120 patients, 96 (80.0%) were culture positive. The most common isolate was Staphylococcus aureus (28.1%) followed by Pseudomonas aeruginosa (18.8%), coagulase-negative staphylococci (14.6%), Klebsiella pneumoniae (12.5%), Escherichia coli (8.3%), Streptococcus pneumoniae (7.3%) and Proteus mirabilis (6.3%). MRSA made up 22.2% of S. golden strains. 68.3% of cases involved CRS without nasal polyps and 31.7% CRS with nasal polyps Gram-positive isolates showed high sensitivity to vancomycin (97.9%) and linezolid (95.8%). Gram-negative isolates were most sensitive to meropenem (95.8%) and amikacin (87.5%) Resistance to amoxicillin-clavulanate and ciprofloxacin was noted in both groups.

Conclusion: In conclusion, at our center, the major pathogens that continue to cause CRS are staphylococcus aureus and pseudomonas aeruginosa. MRSA was also high in prevalence along with resistance to first-line empirical antibiotics. To achieve a better clinical outcome and reduce further resistance, culture-directed therapy should be strongly recommended over empirical therapy.

Keywords*: Chronic rhinosinusitis; Antibiotic susceptibility; Bacteriological profile; Antimicrobial resistance; Staphylococcus aureus.*

INTRODUCTION

Chronic rhinosinusitis (CRS) refers to inflammation of the nose and paranasal sinuses that persists for 12 weeks or longer. CRS is accompanied by two or more symptoms which include nasal blockage, nasal discharge (anterior and/or posterior), facial pain or pressure, or reduction or loss of smell.[1,2] Objective evidence of disease must only be demonstrated by an endoscopic and or radiological examination. The examination must be undertaken by a suitably qualified practitioner.[3] The two major classifications of CRS are CRS with nasal polyp (CRSwNP) and CRS without nasal polyp (CRSsNP) better still referred to CRS with and without aspiration.

CRS is estimated to affect 5-12% of the general population worldwide. Subsequently, CRS is a substantial cause of decreased quality of life and lost productivity. It is also common cause of expenditure on health care. [4].

Chronic rhinosinusitis is caused by many factor that includes Mucociliary dysfunction, anatomical obstruction, allergic and immunological mechanisms. Notably, persistent bacterial infection often organized as biofilms on the sinonasal mucosa. [5,6]] This ability of the biofilm helps them resist clearance by the host immune system. Moreover, they also fail to respond to systemic antibiotic therapy. This phenomenon is strongly associated with Staphylococcus aureus. Furthermore it is also linked to more severe, and chronic disease and poor surgical outcomes. [7,8].

In the absence of reliable culture data, empirical therapy remains the initial antibiotic of choice for CRS exacerbations in most circumstances, especially in resource-limited tertiary care hospitals.[9] But wide-spread and often indiscriminate use of broad-spectrum antibiotics has prompted a measurable change in the bacteriologic profile of CRS, with increasing isolation of multidrug resistant organisms including methicillin-resistant Staphylococcus aureus (MRSA) and extended-spectrum beta-lactamase (ESBL) producing gram negative bacilli.[10] Antimicrobial stewardship guidance is increasingly recommending that antibiotic selection in upper respiratory tract infections including CRS be made based on local antibiograms and not generalized guidelines owing to significant regional and institutional variation in pattern of drug resistance.[11,12]

Keeping this background in mind, CRS should be evaluated for its bacteriological profile and antibiotic susceptibility pattern on a periodic basis at the local level to ensure rational evidence-based empirical prescribing and limit further emergence of resistance. Thus, the study was conducted with the objective to determine the bacteriological profile and antibiotic sensitivity pattern among patients of chronic rhinosinusitis attending a tertiary care centre and to correlate the findings with clinical subtype and duration of disease.

MATERIAL AND METHODS

Study Design and Setting: This was a prospective, hospital-based observational study conducted in the Department of Otorhinolaryngology at Bangalore Medical College and Research Institute (BMCRI), a tertiary care teaching institute, over a period of 12 months.

Study Population: A total of 120 patients clinically diagnosed with chronic rhinosinusitis, based on EPOS criteria (symptom duration ≥12 weeks with supportive nasal endoscopic and/or computed tomography findings), were enrolled consecutively from the outpatient department after obtaining informed written consent and institutional ethics committee clearance.

Inclusion and Exclusion Criteria: Patients aged above 12 years with a confirmed clinico-radiological diagnosis of CRS were included. Patients who had received systemic antibiotic therapy within the preceding two weeks, those with fungal rhinosinusitis, and immunocompromised patients were excluded to minimize confounding of culture results.

Sample Collection and Processing: Middle meatal swabs were collected under rigid nasal endoscopic guidance using sterile technique prior to any antibiotic instillation, then transported to the microbiology laboratory in Amies transport medium. Samples were processed for aerobic culture on blood agar and MacConkey agar, and organism identification was performed using standard colony morphology, Gram staining, and biochemical test panels.

Antibiotic Susceptibility Testing: Antibiotic susceptibility was assessed using the Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines. MRSA screening was performed using the cefoxitin disc diffusion method.

Variables Analyzed: Data collected included age and sex distribution, duration of symptoms, clinical subtype (CRSwNP versus CRSsNP), culture positivity rate, organism-wise distribution of isolates, and antibiotic sensitivity/resistance patterns for both gram-positive and gram-negative organisms.

Statistical Analysis: Data were entered into a Microsoft Excel spreadsheet and analyzed using descriptive statistics, with results expressed as frequencies and percentages presented in tabular form.

RESULTS

Of the 120 enrolled patients, 68 (56.7%) were male and 52 (43.3%) were female, giving a male-to-female ratio of approximately 1.3:1, with a mean age of 34.6 ± 12.8 years. The majority of patients (42.5%) belonged to the 21 -40 year age group.

Table 1: Age and Sex Distribution of Study Participants (n=120)

Age Group (years)	Male, n (%)	Female, n (%)	Total, n (%)
≤20	10 (8.3)	8 (6.7)	18 (15.0)
21-40	30 (25.0)	21 (17.5)	51 (42.5)
41-60	22 (18.3)	17 (14.2)	39 (32.5)

>60	6 (5.0)	6 (5.0)	12 (10.0)
Total	**68 (56.7)**	**52 (43.3)**	**120 (100)**

Table 2: Clinical Characteristics of Study Population (n=120)

Characteristic	Number of Patients	Percentage (%)
CRS without nasal polyps (CRSsNP)	82	68.3
CRS with nasal polyps (CRSwNP)	38	31.7
Symptom duration 3-6 months	46	38.3
Symptom duration 6-12 months	44	36.7
Symptom duration >12 months	30	25.0
Bilateral sinus involvement	74	61.7
Unilateral sinus involvement	46	38.3

Culture positivity was observed in 96 of 120 patients (80.0%), while 24 samples (20.0%) showed no bacterial growth. Culture positivity was notably higher in CRSwNP patients (86.8%) compared to CRSsNP patients (76.8%).

Table 3: Distribution of Bacterial Isolates (n=96)

Organism	Number of Isolates	Percentage (%)
Staphylococcus aureus	27	28.1
Pseudomonas aeruginosa	18	18.8
Coagulase-negative staphylococci	14	14.6
Klebsiella pneumoniae	12	12.5
Escherichia coli	8	8.3
Streptococcus pneumoniae	7	7.3
Proteus mirabilis	6	6.3
Others (mixed growth)	4	4.1
Total	**96**	**100**

Among the 27 *S. aureus* isolates, 6 (22.2%) were confirmed as MRSA by cefoxitin disc testing, while the remaining 21 (77.8%) were methicillin-sensitive *S. aureus* (MSSA).

Table 4: Antibiotic Sensitivity Pattern of Gram-Positive Isolates (n=48)

Antibiotic	Sensitive, n (%)	Resistant, n (%)
Vancomycin	47 (97.9)	1 (2.1)
Linezolid	46 (95.8)	2 (4.2)
Clindamycin	38 (79.2)	10 (20.8)
Cefoxitin	34 (70.8)	14 (29.2)
Erythromycin	30 (62.5)	18 (37.5)
Amoxicillin-clavulanate	26 (54.2)	22 (45.8)
Penicillin	14 (29.2)	34 (70.8)

Table 5: Antibiotic Sensitivity Pattern of Gram-Negative Isolates (n=48)

Antibiotic	Sensitive, n (%)	Resistant, n (%)
Meropenem	46 (95.8)	2 (4.2)
Amikacin	42 (87.5)	6 (12.5)
Piperacillin-tazobactam	38 (79.2)	10 (20.8)
Gentamicin	34 (70.8)	14 (29.2)
Ceftazidime	30 (62.5)	18 (37.5)
Ciprofloxacin	22 (45.8)	26 (54.2)
Amoxicillin-clavulanate	16 (33.3)	32 (66.7)

Overall, gram-positive organisms showed the highest sensitivity to vancomycin and linezolid, while gram-negative organisms were most susceptible to meropenem and amikacin. Both groups exhibited marked resistance to amoxicillin-clavulanate, a widely used first-line empirical agent, and gram-negative isolates additionally showed high resistance to ciprofloxacin, a commonly prescribed oral fluoroquinolone in outpatient practice.

DISCUSSION

In the current study, Staphylococcus aureus was the predominant organism. Many Indian and international series which studied the CRS bacteriology using middle meatal swab cultures have similar results. The MRSA rate of 22.2% may be comparable to the MRSA rate of 19.35% in a recent prospective study from northern India. Furthermore, the results suggest

a rising methicillin resistance among staphylococcal strains from sinonasal infections in India tertiary care, according to Gupta et al. [2]. The biofilm phenotype of S. was observed as well. The over-representation of Staphylococcus aureus among culture-positive samples results from the greater severity of refractory CRS 30. RSV has been noted in systematic reviews of the CRS biofilm literature by Keir et al 8 and Fastenberg et al [11]. Early samples were from patients with prolonged symptoms and with NP.Pseudomonas aeruginosa was the second most common organism in this study. The significant isolation of this organism has been reported in the literature as potential organism causing gram-negative sinonasal infection due to their intrinsic mechanisms that confer multidrug resistance and strong biofilm forming ability as described by Chaudhary et al. [1]. According to our results, patients with CRSwNP demonstrated greater positivity than patients with CRSsNP. This is consistent with the pathophysiological differences attributed to the two phenotypes; the CRSwNP phenotype is linked to increased eosinophilic and neutrophilic mucosal inflammation, known to favour persistent bacterial colonisation, as seen in recent phenotypic classifications [13, 14].

The resistance of amoxicillin-clavulanate observed in the gram-positive (45.8%) and gram-negative (66.7%) isolates and reduced susceptibility of gram-negative isolates to ciprofloxacin (54.2%) is in line with the global and regional evidence of the more recently diminished efficacy of these drugs, which were widely used for empirical treatment, in accordance with Shrestha [3] and with other recent microbiome studies [5, 6]. The same observations were noted in bacteriological surveillance done pre- and during the COVID-19 pandemic, and the development of resistance in sinonasal pathogens during this phase could be due to high bacterial pressure as per the latest bacteriological surveillance [4]. The observation is also consistent with national recommendations against not using broad-spectrum beta-lactams and fluoroquinolones for upper respiratory tract infections without microbiological confirmation from the Indian Council of Medical Research [15].

Published evidence to date indicates a shift away from empirical antibiotic prescribing, based on them affecting patient outcomes when used alone. According to Fokkens et al. [12] as well as the Indian Council of Medical Research[15], modified culture-guided therapy may be the way forward in the management of CRS in patients with recurrent, recalcitrant, or treatment-refractory disease. According to sensitivity patterns, vancomycin and linezolid continue to remain acceptable for confirmed MRSA infections while meropenem and amikacin represent a reliable approach for resistant gram-negative organisms. On the other hand, amoxicillin-clavulanate should not be considered a first-line empirical drug because of marked resistance in this population. The biofilm-forming potential of the predominant isolates can also indicate the use of adjunctive strategies, including nasal saline irrigation and topical therapies, with systemic antibiotics in selected recalcitrant cases, as recommended by Hale et al. [16].

CONCLUSION

According to this study, Staphylococcus aureus and Pseudomonas aeruginosa are the most common bacterial pathogens isolated from patients of chronic rhinosinusitis at this tertiary care centre. MRSA burden is significant. And it shows a high level of resistance to commonly used empirical antibiotics like Amoxicillin-clavulanate and ciprofloxacin. Meaningful statistical methods an incremental change positivity and organism distribution varied significantly with clinical subtype. The significance of regular culture-guided antimicrobial selection and ongoing local antimicrobial surveillance has been reiterated in order to curb the increasing rates of resistance and improve treatment outcomes and management of chronic rhinosinusitis.

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