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MICROBIOLOGICAL PROFILE AND ANTIBIOGRAM OF ISOLATES FROM RHINOSINUSITIS CASES ATTENDING TERTIARY CARE HOSPITAL IN SOUTH INDIA

Microbiology

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ABSTRACT

Introduction: Rhinosinusitis (RS) is a group of disorders characterized by inflammation of the mucosa of nose and paranasal sinuses which is a significant health issue worldwide for which a lot of non recommended medications are being prescribed and clinicians should be aware of current trends of microbiological profile and their antibiogram before initiating treatment to stop the emergence of superbugs in the community. **Objective:** To isolate and identify the microbial pathogens from cases of rhinosinusitis and perform antibiotic susceptibility testing on the isolates using standard protocol. **Results:** Out of 125 samples collected from clinically diagnosed or clinically suspected cases of rhinosinusitis, 60 (48%) were from cases of Acute Rhinosinusitis (ARS) and 65 (52%) were from cases of Chronic Rhinosinusitis (CRS) out of which 110 (88%) were culture positive in which 52 (47.3%) were from ARS and 58 (52.7%) were from CRS. In cases of ARS, Staphylococcus aureus (MSSA) was the predominant isolate (19.3%) followed by Moraxella cattarhalis (17.3%) and Streptococcus pyogenes (15.3%) and from cases of CRS Staphylococcus aureus (MRSA) was predominant isolate (15.5%) followed by Klebsiella pneumoniae (13.8%) and Coagulase Negative Staphylococcus (12%). Out of the Gram positive isolates from ARS majority of them showed highest susceptibility to vancomycin, linezolid, ciprofloxacin, ceftriaxone (100%) and Gram Negative isolates showed highest susceptibility to amoxyclav, ceftriaxone, ciprofloxacin, polymyxin B, tigecycline (100%). Gram positive isolates from cases of CRS showed highest susceptibility to vancomycin, linezolid, clindamycin, tetracycline, ceftriaxone (100%) and Gram negative isolates showed highest susceptibility to polymyxin B, tigecycline, amikacin, meropenem, imipenem, piperacillin tazobactam and cefoperazone sulbactam (100%). **Conclusion:** This study gives an insight about various etiological agents and their antibiogram in cases of ARS and CRS inorder to create awareness in the clinicians and help them to follow evidence based clinical practice guidelines which will help the patients in speedy recovery and also help in reduction of Antimicrobial resistance (AMR).

KEYWORDS

Acute rhinosinusitis (ARS), Chronic rhinosinusitis (CRS), Fungal rhinosinusitis (FRS), Gram positive & Gram negative organisms, Antibiotic susceptibility testing (AST),Vancomycin (Va) linezolid (LZ), ciprofloxacin (CIP), ceftriaxone (CTR), amoxyclav(AMC), polymyxin B (PB), tigecycline (TGC), amikacin(AK), meropenem (MRP), imipenem (IMP), piperacillin tazobactam (PIT) and cefoperazone sulbactam (CFS).

INTRODUCTION

Rhinosinusitis(RS) is a group of disorders characterized by inflammation of the mucosa of the nose and paranasal sinuses which was previously known as 'sinusitis', a common term used for any infection or inflammation involving sinuses where the terminology is now changed to 'Rhinosinusitis' as the nasal cavity is always involved in any kind of inflammation or infection involving the sinuses.[1] Although various definitions are being postulated by different organizations, the widely accepted definition was that given by European Position Paper on Rhinosinusitis & Nasal Polyps (EPOS) based on clinical grounds like nasal blockage/obstruction/congestion, nasal discharge(anterior/posterior) and additional symptoms like facial pain/pressure & olfactory dysfunction (hyposmia/ anosmia) along with clear evidence of mucosal inflammation.[2,3,4]

Rhinosinusitis can be classified into various types like Acute Rhinosinusitis (ARS) which is a new infection resulting from predisposing factors like allergic rhinitis, impaired immune status or respiratory viral infections where the duration of symptoms is less than 10 days. Acute Bacterial Rhinosinusitis (ABRS) which is a condition where there will be exacerbation of symptoms after 5 days of infection or persistence of symptoms even after 10 days after infection but are present for only less than 12 weeks duration. Recurrent Acute Rhinosinusitis (RARS) in which there will be symptom-free episodes between the clinical manifestations, Chronic Rhinosinusitis(CRS) where clinical manifestations persist for more than 12weeks, Fungal Rhinosinusitis (FRS) which is classified into two groups where Invasive Fungal Rhinosinusitis includes Acute invasive FRS, granulomatous invasive FRS, Chronic invasive FRS and non invasive FRS includes saprophytic fungal infestation, fungus ball and fungus related eosinophilic FRS (Allergic Fungal Rhinosinusitis- AFRS) [5,6,7,8]

Based on the presence or absence of nasal polyps (NP) in endoscopy or pathophysiology, CRS can be classified as CRS with NP (CRSwNP) and CRS without NP (CRSsNP) and some patients with CRSwNP fall into a separate category having bronchial asthma or aspirin sensitivity and this condition is known as 'Samter's triad' or Aspirin-exacerbated respiratory disease (AERD) in which the symptoms will be severe after ingestion of salicylates.[9,10,11,12,13]

The Pathogenesis of Rhinosinusitis involves three key elements where Narrow ostia is responsible for obstruction of secretion and mucosal swelling leading to infection/inflammation, Dysfunction of Mucociliary apparatus which is mainly seen during viral cord leading to progressive loss of cilia resulting in reduced mucociliary clearance, viscous sinus secretions where the cilia can be protective only in the presence of fluid media and during inflammation there will be formation of viscous secretions leading to loss of ciliary function.[14,15,16,17,18,19] The organisms implied in cases of ARS are *Rhinoviruses*, *Influenza* and *Parainfluenza viruses*, *Respiratory syncitial viruses*, *Entero viruses*, *Streptocoocus pneumoniae*, *Haemophilus influenza*, *Moraxella cattarhalis*, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter cloacae*, *Pseudomonas aeruginosa* and *Proteus mirabilis*.

The relationship between the viruses and development of CRS is not well understood but according to literature latent / chronic viral infections may lead to sinonasal inflammation which may predispose to CRS and the role of bacteria in CRS was debated earlier but it was demonstrated that many microbial communities like *Staphylococcus aureus*, *Streptococcus pyogenes*, *Coagulase Negative Staphylococcus*(CoNS), *Streptocoocus pneumoniae, Escherichia coli*, *Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter* species etc; colonise the nasal mucosa and sinuses leading to infection and inflammation.[20] Many fungi are implicated as causative organisms of CRS like *Aspergillus* species, *Schizophyllum commune*, *Alternaria*, *Bipolaris*, *Curvularia* species and *Zygomycetes*.[21,22]

According to EPOS guidelines, apart from the physical findings of the patient in cases of RS, included endoscopy and radiological findings to confirm the diagnosis of RS, microbiological adjuncts also should be considered to aid in the diagnosis of RS which may give more information about the etiological agents and their antibiotic susceptibility pattern.

This study is undertaken at our institution as it is important to educate physicians about the self limited nature of RS and antibiotics should be prescribed only after utilization of all the diagnostic tools including microbiology as they should be aware of current trends of

microbiological profile and their antibiogram in these cases to initiate proper antibiotic treatment after obtaining the microbiological data in cases of RS to help the patients for speedy recovery and reduce the burden of Antimicrobial Resistance (AMR).

MATERIALS & METHODS

The present study is conducted at the department of Microbiology in collaboration with the department of Otorhinolaryngology care where a total of 125 clinically suspected or clinically and radiologically diagnosed cases of rhinosinusitis were included in the study for a period of 16 months after attaining Institutional Ethics Committee (IEC) approval.

Inclusion criteria:

Patients with signs and symptoms of rhino sinusitis (acute and chronic), including both clinically diagnosed and radiologically diagnosed cases of rhino sinusitis.

Exclusion criteria:

- Patients with upper respiratory tract infection but no signs of sinusitis.
- Patients with malignancy of paranasal sinuses
- Patients with known/suspected immunodeficiency's & autoimmune diseases
- Patients on recent antibiotics

Two nasal swabs were collected during nasal endoscopy with two sterile flexible swabs and other samples like sinus washings and allergic mucins were collected during nasal resection and Functional Endoscopic Sinus Surgery (FESS) procedure and also tissue biopsies from sinus mucosa were collected during the procedure are placed in a sterile container containing 0.85% physiological saline and are transported to the microbiology laboratory and were processed within 2 hours of collection for microbiological examination.[23,24,25]

Macroscopically the specimens were inspected for their colour, odour, consistency, purulent or blood stained and they were subjected to Gram's stain and KOH mount (10%) and the findings were noted for the presence of host cells, bacterial and fungal elements for which one swab was used out of the two collected (KOH mount was subjected to only aspirates and biopsy materials). The second swab was put in nutrient broth and incubated at 35-37°C for 6 hours and was used for bacterial culture by inoculating onto a nutrient agar, blood agar, chocolate agar and MacConkey agar and incubated at 35-37°C for 24-48 hours and were checked for growth and the isolates were identified according to standard procedures up to species level.[23,24,25]

For fungal culture, the specimen was inoculated onto Sabaroud dextrose agar(SDA) & SDA with antibiotics (fungibiotic) and were incubated at 25^0C in a BOD incubator and were regularly examined for 7-10 days period and if culture positive, the isolates were identified by colony morphology, Lacto phenol Cotton Blue (LCB) and finally using slide culture technique.[23,24,25]

Antibiotic sensitivity testing was done by the Kirby-Bauer disc diffusion technique on bacterial isolates on Mueller Hinton agar (MHA) and interpreted as Sensitive (S), Intermediate (I), and Resistant (R) as per CLSI guidelines.[26]

The ATCC strains used for Quality control were *Staphylococcus aureus* (25923), *Enterococcus faecalis (*29212), *Streptococcus pneumoniae* (49619), *Escherichia coli* (25922), *Klebsiella pneumoniae* (27736) and *Pseudomonas aeruginosa* (27853).

RESULTS

Table 1- Showing gender distribution of collected samples:

Total	Male	Female
125	71(56.8%)	54(43.2%)

Out of 125 samples collected, the majority of them were from males 71(56.8%), followed by females 54(43.2%)

Table 2- Showing the distribution of rhinosinusitis cases:

Total	Acute rhinosinusitis(ARS)	Chronic rhinosinusitis(CRS)
125	60(48%)	65(52%)

Out of 125 samples majority were from cases with CRS 65(52%) followed by ARS 60(48%).

Table 3- Showing culture results of processed samples:

Total	Culture positive	Culture negative
125	110 (88%)	15(12%)

Out of 125 samples collected from cases of ARS &CRS,110 (88%) were culture positive &15(12%) were culture negative.

Table 4- Showing the distribution of culture positivity from cases of rhinosinusitis:

Total	ARS	CRS
110	52(47.3%)	58(52.7%)

Out of 110 culture positive samples, 58(52.7%) were from cases of CRS and 52(47.3%) were from cases of ARS.

Table 5- Showing various bacterial isolates from cases of ARS:

Organism	Number	Percentage (%)
Methicillin Sensitive Staphylococcus aureus (MSSA)	10	19.3%
Moraxella catarrhalis	9	17.3%
Streptococcus pyogenes	8	15.3%
Hemophilus influenzae	5	9.6%
Streptococcus pneumoniae	4	7.7%
Methicillin-Resistant Staphylococcus aureus (MRSA)	4	7.7%
Klebsiella pneumoniae	4	7.7%
Pseudomonas aeruginosa	3	5.8%
Escherichia coli	3	5.8%
Enterobacter cloacae	2	3.8%
Total	52	100%

Out of 52 isolates from cases of ARS, *Staphylococcus aureus* (MSSA) was the predominant isolate 10(19.3%) followed by *Moraxella catarrhalis* 9(17.3%) and *Streptococcus pyogenes* 8 (15.3%).

Table 6- Showing various bacterial isolates from cases of CRS:

Organism	Number	Percentage(%)
Methicillin-Resistant Staphylococcus aureus(MRSA)	9	15.5%
Klebsiella pneumoniae	8	13.8%
Coagulase-negative Staphylococcus	7	12%
Streptococcus pyogenes	5	8.6%
Pseudomonas aeruginosa	4	6.9%
Acinetobacter baumannii	4	6.9%
Moraxella catarrhalis	3	5.1%
Escherichia coli	3	5.1%
Proteus mirabilis	3	5.1%
Methicillin-sensitive Staphylococcus aureus (MSSA)	2	3.5%
Enterococcus faecalis	2	3.5%
Streptococcus pneumoniae	2	3.5%
Haemophilus influenzae	2	3.5%
Citrobacter freundii	2	3.5%
Enterobacter cloacae	2	3.5%
Total	58	100%

Out of 58 isolates from cases of CRS, *Staphylococcus aureus* (MRSA) was the predominant isolate 9(15.5%) followed by *Klebsiella pneumoniae* 8(13.8%) and CoNS 7(12%).

Table7-Showing antibiotic susceptibility pattern of Gram positive isolates from cases of Acute rhinosinusitis:

Antibiotics	Methicillin-Resistant Staphylococcus aureus(MRSA)-4	Methicillin-Sensitive Staphylococcus aureus(MSSA)-10	Streptococcus pyogenes-8	Streptococcus pneumoniae-4
CX	0	10(100%)	_	_
AMC	0	10(100%)	7(87.5%)	_
P	0	0	8(100%)	1(25%)
AZT	1(25%)	8 (80%)	4 (50%)	1(25%)
CD	3(75%)	9 (90%)	8(100%)	0
COT	2(50%)	10(100%)	5(62.5%)	1(25%)
VA	4(100%)	10(100%)	8(100%)	4(100%)

LZ	4(100%)	10(100%)	8(100%)	4(100%)
G	2(50%)	10(100%)	7(87.5%)	0
CTR	0	10(100%)	8(100%)	4(100%)
TE	2(50%)	8 (80%)	4 (50%)	1(25%)
CIP	1(25%)	10(100%)	6 (75%)	4(100%)
AMP	1(25%)	6(60%)	_	0

Out of the Gram-positive isolates of ARS, *Staphylococcus aureus* (MRSA) showed the highest susceptibility to VA & LZ (100%), *Staphylococcus aureus* (MSSA) showed the highest susceptibility to VA, LZ, CX, AMC, COT, G, CIP & CTR (100%), *Streptococcus pyogenes* showed the highest susceptibility to P, CD, VA, LZ, CTR (100%) and *Streptococcus pneumoniae* showed the highest susceptibility to VA, LZ,CTR & CIP(100%).6

Table 8- Showing antibiotic susceptibility pattern of Gram negative isolates from cases of Acute rhinosinusitis:

Antibiotics	Moraxella catarrhalis-9	Haemophilus influenzae - 5	Escherichia coli-3	Klebsiellapneumoniae-4	Pseudomonasaeruginosa-3	Enterobacter cloacae-2
PB	_	_	3(100 %)	4(100%)	3(100%)	2(100%)
TGC	_	0	3(100 %)	4(100%)	_	2(100%)
MRP	_	0	3(100 %)	4(100%)	3(100%)	1 (50%)
IPM	_	0	3(100 %)	1(25%)	3(100%)	1 (50%)
AK	_	_	3(100 %)	1(25%)	2(66.6%)	2(100%)
G	8(88.8%)	_	3(100 %)	4(100%)	1(33.3%)	2(100%)
COT	8(88.8%)	2(40%)	3(100 %)	4(100%)	_	2(100%)
AMP	4(44.4%)	2(40%)	1(33.3 %)	_	_	_
AMC	9(100%)	5(100%)	3(100 %)	3(75%)	_	_
CTR	9(100%)	4(80%)	3(100 %)	4(100%)	_	2(100%)
CIP	9(100%)	5(100%)	3(100 %)	4(100%)	1(33.3%)	2(100%)
CAZ	0	0	3(100 %)	4(100%)	0	2(100%)
PT	_	_	2(66.6 %)	4(100%)	2(66.6%)	2(100%)
CFS	_	_	3(100 %)	3(75%)	2(66.6%)	_
CPM	7(77.7%)	3 (60%)	_	_	_	_

Out of the Gram-negative isolates from cases of ARS, *Moraxella catarrhalis* showed highest susceptibility to AMC, CTR, CIP (100%), *Haemophilus influenzae* showed highest susceptibility to AMC & CIP (100%), *Escherichia coli* showed highest susceptibility to PB, TGC, MRP, AK, G, COT, AMC, CTR, CIP, CFS, IPM, CAZ (100%), *Klebsiella pneumoniae* showed highest susceptibility to PB, TGC, MRP, G, COT, CTR, CIP, CAZ, PT (100%), *Pseudomonas aeruginosa* showed highest susceptibility to PB, MRP, IPM (100%) and *Enterobacter cloacae* showed highest susceptibility to PB, TGC, AK,G, COT,CIP,CTR,CAZ & PT (100%).

Table 9- Showing the antibiotic susceptibility pattern of Gram-positive isolates from cases of Chronic rhinosinusitis:

Antibiotics	Methicillin-Resistant Staphylococcus aureus(MRSA)-9	Methicillin Sensitive Staphylococcus aureus(MSSA)-2	Coagulase-negative staphylococcus-7	Enterococcus faecalis-2	Streptococcus pyogenes-5	Streptococcus pneumoniae -2
CX	0	2(100%)	4(57.1%)	0	_	2(100%)
AMC	0	2(100%)	7(100%)	-	5(100 %)	2(100%)
P	0	2(100%)	0	0	5(100%)	2(100%)
AZT	3(33.3%)	1 (50%)	3(42.8%)	1(50%)	2(40%)	2(100%)
CD	4(44.4%)	2(100%)	5(71%)	0	5(100 %)	2(100%)
COT	6(66.6%)	1 (50%)	7(100%)	0	_	2(100%)
VA	9(100%)	2(100%)	7(100%)	2(100%)	3(60%)	2(100%)
LZ	9(100%)	2(100%)	7(100%)	2(100%)	5(100%)	2(100%)
G	5(5.5%)	1 (50%)	5(71%)	0	5(100%)	1 (50%)
CTR	8(88.8%)	2(100%)	7(10 0%)	0	2(40%)	2(100%)
TE	3(33.3%)	2(100%)	5(71%)	0	0	2(100%)
CIP	5(55.5%)	1 (50%)	7(100%)	1(50%)	2(40%)	0
AMP	8(88.8%)	1(50%)	6(85.6%)	1(50%)	_	2(100%)

Out of the Gram-positive isolates from cases of CRS *Staphylococcus aureus* (MRSA) showed highest susceptibility to VA& LZ (100%), *S aureus* (MSSA) showed highest susceptibility to VA, LZ, CX, AMC, P, CD, CTR, TE (100%), CoNS showed highest susceptibility to VA, LZ, AMC, COT, CTR, CIP (100%), *Enterococcus faecalis* showed highest susceptibility to VA, LZ (100%), *Streptococcus pyogenes* showed highest susceptibility to LZ, AMC,P,CD,G (100%), *Streptococcus pneumoniae* showed highest susceptibility to VA, LZ, CX, AMC, P, AZT, CD, COT, CTR, TE, AMP(100%).

Table 10- Showing the antibiotic susceptibility pattern of Gram-negative isolates from cases of Chronic rhinosinusitis:

Antibiotics	Escherichia coli-3	Klebsiella pneumoniae-8	Proteus mirabilis-3	Pseudomonas aeruginosa-4	Acinetobacter baumannii-4	Citrobacter freundi i-2	Enterobacter cloacae -2	Moraxella catarrhalis-3	Haemophilus influenzae-2
PB	3(100 %)	8(100%)	_	4(100%)	4(100%)	2(100 %)	2(100%)	_	_
TGC	3(100 %)	8(100%)	_	_	-	2(100%)	2(100%)	_	2(100%)
MRP	3(100%)	7(87.5%)	3(100%)	2(50%)	4(100%)	2(100%)	2(100%)	_	0
IPM	3(100%)	5(62.5%)	3(100%)	4(100%)	3(75%)	2(100%)	2(100%)	_	0
AK	3(100%)	6(75%)	2(66.6%)	3(75%)	3(75%)	2(100%)	2(100%)	3(100%)	_
G	2(66.6%)	5(62.5%)	2(66.6%)	3(75%)	0	2(100%)	2(100%)	3(100%)	_
COT	2(66.6%)	5(62.5%)	3(100%)	_	2(50%)	1(50%)	2(100%)	1(33.3%)	1(50%)
AMP	2(66.6%)	_	2(66.6%)	_	_	_	_	0	0
AMC	2(66.6%)	6(75%)	2(66.6%)	_	_	_	_	3(100%)	1(50%)
CTR	2(66.6%)	7(87.5%)	3(100%)	_	3(75%)	_	_	3(100%)	2(100%)
CIP	3(100%)	8(100%)	3(100%)	4(100%)	2(50%)	2(100%)	2(100%)	2(66.6%)	2(100%)
CFS	3(100%)	6(75%)	_	3(75%)	_	2(100%)	_	_	_
CPM	_	_	_	_	_	_	_	2(66.6%)	1(50%)
PT	3(100%)	7(87.5%)	2(66.6%)	3(75%)	2(50%)	1(50%)	2(100%)	_	0
CAZ	3(100%)	8(100%)	3(100%)	4(100%)	3(75%)	1(50%)	2(100%)	0	0

Out of the Gram negative isolates from cases of CRS, *Escherichia coli* showed highest susceptibility to PB, TGC, MRP, IPM, AK, CAZ, CIP, PT & CFS(100%), *Klebsiella pneumoniae* showed highest susceptibility to PB, CIP, TGC, & CAZ (100%), *Proteus mirabilis* showed highest susceptibility to IPM, MRP, COT, CTR, CIP, CAZ (100%), *Pseudomonas aeruginosa* showed highest susceptibility to PB, IPM, CIP, CAZ(100%), *Acinetobacter baumannii* showed highest susceptibility to PB & MRP (100%), *Citrobacter freundii* showed highest susceptibility to PB, TGC, IPM, MRP, AK, G, CIP, CFS (100%), *Enterobacter cloacae* showed highest susceptibility to PB, TGC, IPM, MRP, AK, G, COT, CIP, PT,CAZ (100%), *Moraxella catarrhalis* showed highest susceptibility to AK, G, AMC, CTR (100%) & *Haemophilus influenzae* showed highest susceptibility to TGC,CTR, CIP(100%).

Table 11-Showing various fungal isolates from cases of CRS

Organism	No of isolates	Percentage (%)
Aspergillus flavus	6	40%
Mucor spp	5	33.3%
Aspergillus niger	3	20%
Aspergillus fumigatus	1	6.7%
Total	15	100%

Out of 58 samples from cases of CRS, 15 samples were fungal culture positive in which *Aspergillus flavus* (40%) was the predominant isolate followed by *Mucor* spp (33.3%), *Aspergillus niger* (20%) and *Aspergillus fumigatus* (6.7%).

DISCUSSION

Rhinosinusitis is a disorder which is characterized by inflammation or infection of the mucosa of the nose and paranasal sinuses which can be classified into ARS & CRS based on the persistence of clinical manifestations and is one of the common reasons for patients to attend primary care physicians.

In this study, a total of 125 samples from clinically suspected, clinically & radiologically diagnosed cases of rhinosinusitis were collected and processed at the department of Microbiology in collaboration with the department of Otorhinolaryngology at our institution.

Out of the samples collected majority were from males 71 (56.8%) followed by females 54 (43.2%) and majority of them were from cases of CRS 65 (52%) followed by ARS 60 (48%) in which 110 (88%) were culture positive and 15 (12%) were culture negative after 48 hours of aerobic incubation correlating with findings of Udayasri B et al, [27] who reported culture positivity rate of 92%. Among the culture positive samples 58 (52.7%) were from cases of CRS and 52 (47.3%) were from cases of ARS correlating with the findings of Sabaru et al, [28] showing 64% and 36% respectively.

Out of the culture positive samples from cases of ARS the predominant isolate was *S.aureus* in which Methicillin Sensitive *Staphylococcus aureus* (MSSA) strains were 19.3% and Methicillin Resistant *Staphylococcus aureus* (MRSA) were 7.7% correlating with findings of Sabaru et al [28] and Mulvey CL et al,[29] who showed 15.49% followed by *Moraxella catarrhalis* (17.3%) correlating with findings of Makinen et al [30] (10.5%). *S.pyogenes* was isolated in 15.3% cases correlating with findings of Brook I et al, [31] (12%) followed by *H.influenzae* (9.6%) correlating with Sabaru et al, [28] (11.2%), *S.pneumoniae* (7.7%) and *K.pneumoniae* (7.7%) correlating with Keles E et al, [32] (10%, 4.4%) *P.aeruginosa* (5.8%) correlating with Sabaru et al [28] (2.8%), *E.coli* (5.8%) correlating with Makinen et al [30] (2.2%) and *E.cloacae* (3.8%) correlating with Makinen et al [30] (2.1%).

Out of the culture-positive samples from cases of CRS the predominant isolate was *S. aureus* in which MRSA strains were 15.5% and MSSA strains were 3.5% correlating with findings of Farahani F et al,[33] (19.1%) followed by *K.pneumoniae* (13.8%), CONS (12%), *A.baumannii* (6.9%), *P.aeruginosa* (6.9%), *E.coli* (5.1%), *H.influenzae* (3.5%) correlating with findings of Farahani F et al [33] whose isolation rates were 16.4%,12.6%, 9.1%,4.5%,4.5%, 2.6% respectively.

In our study, the isolation rate of *P.mirabilis* was 5.1%, *S.pneumoniae* (3.5%) and *Citrobacter freundii* (3.5%) correlating with the findings of Vipula VA et al.[34] who reported 3.68%, 2.76%, 3.68% respectively.

The isolation rate of *S.pyogenes* was 8.6% correlating with Keles E et al [32] (5.5%), *M.catarrhalis* (5.1%) correlating with Sabaru et al [28] (6.41%), *E. faecalis* and *E.cloacae* (3.5%) correlating with Arun KT et al [35] (3%) & Jasif Nisar et al [36](2.1%).

In the antibiotic susceptibility testing done against Gram-positive isolates from cases of ARS, MRSA strains showed highest susceptibility to VA (100%), LZ (100%) correlating with the findings of Jasif Nisar et al [36] & O.A Marglani et al [37](100%). MSSA strains also showed highest susceptibility to VA (100%), LZ (100%), CX (100%), COT (100%), AMC (100%), G (100%), CTR (100%) and CIP (100%) correlating with findings of O.A Marglani et al,[37] who showed sensitivity as 100%, 100%, 100%, 100%, 78.8%, 97%, 100%, 87.9% respectively for the above mentioned drugs.

S.pyogenes showed highest susceptibility to VA (100%), LZ (100%), CTR (100%), P (100%) and CD (100%) correlating with findings of Keles E et al,[32] who reported 100% sensitivity to all above drugs. *S.pneumoniae* showed highest susceptibility to VA (100%), LZ (100%), CTR (100%) and CIP (100%) correlating with findings of Keles E et al,[32] who reported sensitivity of 100%, 100%, 91.6% and 100% respectively for the above mentioned drugs.

In the antibiotic susceptibility testing done for Gram-Negative isolates from cases of ARS, *M.catarrhalis* showed highest susceptibility to AMC (100%), CTR (100%), CIP (100%) correlating with Farahani F et al,[33] who reported sensivity rates of 90%, 92.4%, 85%, 75% respectively. *H.influenzae* showed highest susceptibility to AMC (100%) & CIP (100%) correlating with Farahani F et al [33] (100%). *E.coli* showed highest susceptibility to PB (100%), TGC(100%), MRP(100%), IPM(100%), AK(100%), G(100%), COT(100%) , AMC(100%), CTR(100%), CIP(100%), CFS(100%) correlating with O.A. Marglani et al,[37] who reported 100% susceptibility to all the above drugs except for COT(87.5%). *K.pneumoniae* showed highest susceptibility to PB (100%), TGC (100%), MRP(100%), G(100%), COT(100%), CTR(100%), CIP(100%), CAZ (100%), PT (100%) correlating with findings of O.A. Marglani et al,[37] who reported 100% susceptibility to all the above drugs except PT(60%). *P.aeruginosa* showed highest susceptibility to PB (100%), MRP(100%) and IPM (100%) correlating with findings of Udayasri B et al.[27] (100%). *E.cloacae* showed highest susceptibility to PB (100%), TGC(100%), AK(100%), G(100%), COT(100%), CTR(100%), CIP(100%), CAZ (100%), PT (100%) correlating with findings of O.A. Marglani et al,[37] (100%).

In the antibiotic susceptibility testing done against Gram-positive isolates from cases of CRS, MRSA strains showed highest susceptibility to VA(100%), LZ(100%) and MSSA strains showed highest susceptibility to VA(100%), LZ (100%) CX (100%), AMC(100%), P (100%), CD (100%), TE (100%) correlating with findings of Singh NK et al,[38] (100%). CoNS showed highest susceptibility to VA (100%), LZ (100%),AMC (100%), COT (100%), CTR (100%), and CIP (100%) correlating with findings of Jasif Nisar et al,[36] who reported 100% sensitivity to all above drugs except for COT(71.1%). *E.faecalis* showed highest susceptibility to VA (100%) & LZ (100%) correlating with findings of Shreya Dodeja et al.[39] who reported 100% and 95.5% respectively. *S.pyogenes* showed highest susceptibility to P (100%), AMC (100%), CD (100%), VA (60%), and LZ (100%) correlating with findings of Udayasri B et al, [27] (100%) and *S.pneumoniae* showed highest susceptibility to VA (100%), LZ(100%), P(100%), CX(100%), AMC(100%), COT(100%), TE(100%), CTR(100%) & AMP(100%) correlating with the findings of VipulaVA et al [34](100%).

Out of the Gram-negative isolates from cases of CRS, *E.coli* showed highest susceptibility to PB (100%), TGC (100%), MRP (100%), IPM (100%), AK (100%), CFS (100%), PT (100%), CIP (100%) correlating with findings of Vipula VA et al, [34] (100%). *K.pneumoniae* showed highest susceptibility to PB (100%), TGC(100%), CIP(100%) correlating with findings of Vipula VA et al, [34] (100%). *P.mirabilis* showed highest susceptibility to MRP (100%), IPM (100%), COT (100%), CTR (100%), and CIP (100%) correlating with findings of Vipula VA et al,[34] except for COT(87.5%). *P.aeruginosa* showed highest susceptibility to PB (100%) and CIP (100%) correlating with findings of Vipula VA et al,[34] who reported 90%, 87.5% respectively. *A.baumannii* showed 100% susceptibility to PB & MRP correlating with findings of Jasif Nisar et al.[36] (100%). *C.freundii* showed 100% susceptibility to PB, TGC, MRP, IPM, AK,G correlating with findings of Vipula VA et al, [34] (100%).

E.cloacae showed 100% susceptibility to PB, TGC, IPM, MRP, AK, G, COT correlating with findings of Shreya Dodeja et al,[39] who reported 81.81% to 100% sensivity to above drugs. *M.catarrhalis* showed 100% susceptibility to AK, G, AMC, CTR correlating with findings of Shreya Dodeja et al,[39] who reported sensitivity ranging from 75.5% to 100% to above drugs. *H.influenzae* showed highest susceptibility to TGC (100%), CTR(100%), CIP (100%) correlating with findings of Farahani F et al,[33] (100%).

Fungal culture was performed on FESS samples in which 15 samples were culture positive, where the predominant isolate was *Aspergillus flavus* (40%) followed by *Mucor spp* (33.33%), *Aspergillus niger* (20%) and *Aspergillus fumigatus* (6.66%) correlating with findings of Ajay kumar singh et al [21] and Ravindra et al, [41] who reported that the predominant fungal isolate from cases of CRS was *Aspergillus* species.

CONCLUSION

Rhinosinusitis is a significant health issue worldwide which may be initiated as a viral infection of the upper respiratory tract and may lead to bacterial or fungal super infection leading to inflammation of the mucosa of the nose and paranasal sinuses seeking the advice of primary healthcare physician and may also affect the quality of life, health expenditure and cognitive function of the patient.

Although guidelines for the diagnosis and management of rhinosinusitis cases were established decades ago, a lot of non-recommended medications are being prescribed worldwide which is one of the leading cause of the emergence of superbugs in the community. It is important to educate physicians about the self-limited nature of rhinosinusitis and antibiotics should be prescribed only after the utilization of diagnostic tools which is advised only in cases of bacterial rhinosinusitis. Clinicians also should be aware of current trends of microbiological profile in cases of rhinosinusitis and their antibiogram and proper antibiotic treatment should be initiated after applying their knowledge about the microbiology of rhinosinusitis and follow evidence-based clinical practice guidelines and recommendations which will help the patients in a speedy recovery and also help in reducing the antibiotic prescriptions which will help in the reduction of Antimicrobial Resistance (AMR).

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