Original Article

Comparative Study of Middle Meatal Flora in the Era of Antibiotic Resistance

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Abstract

Background: Microbiota of the nasal cavity plays a crucial role in determining the reaction patterns of the mucosal and systemic immune system. It is important to study bacterial and fungal flora from the middle meatus of a healthy population. It will determine micro-organisms colonizing the paranasal sinuses and check their antibiotic resistance. This study aims at identifying and comparing the microbial and fungal flora present in the middle meatus of patients of the nasal surgery group (NSG) and non-nasal surgery group (NNSG). **Material and Methods:** This is a cross-sectional observational study. The endoscopic middle meatal swab was taken from NSG and NNSG (Control) groups for aerobic and fungal cultures. **Results:** Aerobic growths were seen in 43.28% of NSG and 50% of NNSG. The difference was statistically insignificant ($p< 0.44$). In the majority of patients in both groups, *Staphylococcus epidermidis* were isolated, 34.49% in NSG and 34.37% in NNSG. In both groups, the majority of organisms show 100% sensitivity to linezolid, daptomycin, teicoplanin, and vancomycin. Good sensitivity was also shown to tetracycline, trimethoprim, and sulfamethaxaoxazole. There was complete resistance to Benzylpenicillin (100%). Comparison of sensitivity showed data was statistically insignificant. No fungal growth was detected in both groups. **Conclusion:** The present study concludes that there is no difference in the aerobic growths and sensitivity of both groups. No fungal growth was detected in both groups. The culture sensitivity pattern is an indicator of antibiotic selection in this era of antibiotic resistance. Also, the study concludes, oral drugs like Erythromycin, Tetracyclines, and Trimethomprim-Sulfamethaxazole can be considered for medical management.

Keywords: middle meatal aerobic culture, nasal surgery, antibiotic susceptibility, antibiotic resistance

Introduction

The nasal cavity is a large air-filled space mainly responsible for filtering out the entry of foreign or unwanted particles into the lungs cavity. The Nasal flora is associated with a wide variety of microbes[1,2]. The flora of the nose harbors a wide variety of microbes such as Diptheroids, *Staphylococcus*, *Streptococcus, Haemophilus*, and *Moraxella lacunata*. Microbiota of the nasal cavity plays a crucial role in determining the reaction patterns of the mucosal and systemic immune system[1]. Bacterial flora plays important roles in the health of their hosts, including roles in immune system development, nutrition, and resistance to infection. Some of these healthy adults are Carriers of nasal methicillin-resistant *Staphylococcus aureus* (MRSA)[3]. The patients with infected nasal mucosa such as Chronic Rhinosinusitis, polyp[4], etc., are subjected to a very long course of antibiotics, leading to the development of resistant strains. The role of fungal etiology has been proven in chronic Rhinosinusitis[5]. Early diagnosis, and accurate classification of fungal rhinosinusitis[6] may help in deciding the treatment

protocol, preventing multiple surgical procedures, and leading to effective treatment. The infection is substantiated by demonstration of fungal elements in debris material aspirated from affected sinuses as well as in culture[6].

It is important to study bacterial and fungal flora from the middle meatus of a healthy population. It will determine micro-organisms colonizing the paranasal sinuses and check their antibiotic resistance[6]. This study aims at identifying and comparing the microbial and fungal flora present in the middle meatus of patients of the nasal surgery group (NSG) and the control group, i.e., non-nasal surgery group (NNSG).

Material and methods

This cross-sectional observational study included the patients from September 2018 to August 2020 of the ENT department, Medical College, Bharati Vidyapeeth (Deemed to be University), Pune. Study approval was taken from the institutional ethical committee.

After taking written informed consent, a total of 131 patients undergoing various surgeries were divided into two groups - 67 patients in NSG and 64 in NNSG. NSG included patients with infected nasal pathologies undergoing surgeries (Ex: Chronic Rhinosinusitis, Polyp, Tonsillo-Adenoid Resection, etc.) and patients with non-infected nasal pathologies undergoing surgeries (Ex: Septoplasty, Septorhinoplasty, etc.). NNSG included patients undergoing surgery other than nasal surgery (Ex: Tonsillectomy, Tympanoplasty, Thyroidectomy). Exclusion criteria of the study were patients with anatomical obstruction where middle meatus was not accessible (Ex: Nasal mass, Congenital malformations) and patients undergoing nasal intubation.

A thorough ENT examination was carried out for patients who were posted for surgery in either group. Half an hour prior to intubation, nasal decongestion was done with Xylometazoline drops during the pre-operative period, under aseptic precautions. Adult drops correspond to 0.1% concentration and pediatric drops to 0.05% concentration, respectively.

A standard General Anesthesia technique was employed with oral intubation. Prior to swab collection, special precautions were taken not to violate the nasal cavity with any nasal suctioning.

Under aseptic conditions, the middle meatal swab was collected with endoscopic guidance for both groups. For NSG, if polyp/mass was present, initial debulking was done to visualize middle meatus, then the sample was taken. Nasal endoscopy through 0-degree endoscope Storz (Germany) 4 mm diameter, rigid nasal endoscope attached to a fiberoptic light source was used for visualizing middle meatus. one for aerobic staining culture and one for fungal staining culture. All samples were collected in a sterile container and then inoculated into the culture media within 4 hours of collection.

For aerobic culture, the sample was inoculated in Blood agar, MacConkey agar, and Chocolate agar. The specimens were incubated at 35° C in a 5% carbon dioxide environment. The plates were evaluated daily for at least two days for any microbial growth.

Fungal analysis was done through inoculation on Sabourads Dextrose agar. The specimen was incubated at 37° C for 14 days. Then the plate was evaluated for Fungal growth.

Data was tabulated in Microsoft-Excel 2017 Software. Data was analyzed using SPSS software version 25.0. Statistical tools used were mean percentages and statistical tests of significance (p-value).

Results

A total of 131 patients that fulfilled the selection criteria were selected in two groups, NSG (67) and NNSG (64). In NSG patients, the majority of the cases were in the age group 21-30 years (25.37%), with a mean age of 28.75 ±10.22 years. In patients of the NNSG group, the majority of the cases were in the age group 11-20 years (25%), with the mean age 31.13 ±6.88 years. Comparison of age distribution between NSG and NNSG showed no statistical difference ($p<0.32$) (Refer Table No 1).

In NSG, the majority of patients were male (59.70%), while in NNSG, the majority was female (64.06%), showing no statistical difference ($p<0.32$).

Comparison of co-morbidities among both groups showed that hypertension was more among NSG with a statistical difference. ($p<0.05$)

Table 1: Comparison of age among NSG (n=67) and NNSG (n=64)

Age Group	NSG (n=67)	NSG (%)	NNSG (n=64)	NNSG (%)	Total
⩽10	14	20.89	1	1.56	15
11-20	13	19.40	14	21.88	27
21-30	17	25.37	16	25	33
31-40	11	16.41	13	20.32	24
41-50	01	1.49	11	17.18	12
51-60	07	10.45	6	9.37	13
61-70	02	2.98	3	4.69	05
>70	02	2.98	0	0	02

In NSG, the majority of patients were operated for septoplasty (37.31%), followed by TAR (26.87%) and FESS (14.92%) (Refer Table No 2a), whereas in NNSG, the majority of patients were operated for Type I Tympanoplasty (62.5%), followed by MRM with type III Tympanoplasty (21.87%)(Refer Table No 2b).

Table 2(a): Distribution according to Surgeries performed in NSG (n=67)

Surgery	No. of Patients (n=67)	Percentage (%)
FESS	10	14.92
TAR	18	26.87
DCR	5	7.46
Septoplasty	25	37.31
Polypectomy	2	2.98
Fracture Nasal Bone Reduction	1	1.49
Nasal Mass Excision	2	2.98
Excision of Inverted Papilloma	1	1.49
JNA Excision	1	1.49
Benign Bony tumour excision	1	1.49
Medial Maxillectomy with Nasal mass excision	1	1.49

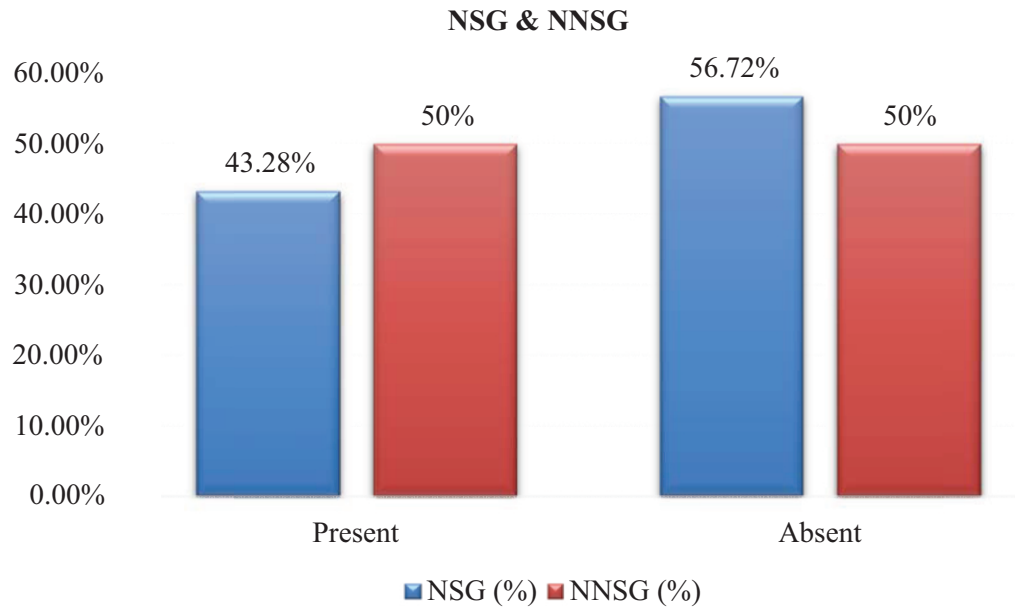
Table 2(b): Distribution according to Surgeries in NNSG (n=64)

Surgery	No. of Patients (n=64)	Percentage (%)
Type I Tympanoplasty	40	62.50
MRM with type III Tympanoplasty	14	21.87
Thyroidectomy	6	9.37
TR	3	4.69
MLS	1	1.56

Aerobic growth was seen in 43.28% of NSG patients and 50% of NNSG patients. Comparison of aerobic growth shows data is statistically insignificant. (p< 0.44) (Refer Graph No 1).

In NSG, the predominant pattern of aerobic growth was as follows - *Staphylococcus epidermidis* in 34.49%, *Staphylococcus* aureus in 24.14%, Coagulase Negative Staphylococcus in 20.69%, and Methicillin-Resistant Coagulase Negative *Staphylococcus* in 3.45%.

Distribution of patients in NNSG according to organisms isolated in aerobic growth showed that majority of patients had growth of *Staphylococcus*



Graph 1: Comparison of Aerobic growth among NSG (n=67) and NNSG (n=64)

epidermidis 34.37% while (18.75%) patients showed growth of Coagulase Negative *Staphylococcus*. (Refer Table No. 3)

was 84% in NSG and 68.97% in NNSG and sensitivity to trimethoprim and sulfamethaxaoxazole was 76.92% in NSG and 93.10% in NNSG. It was observed that the

Table 3: Distribution according to Organisms isolated in NSG and NNSG

Aerobic Bacteria isolated	No of patients in NSG (n=29)	No of patients in NNSG (n=32)
Staphylococcus epidermidis	10 (34.49%)	11 (34.37%)
Staphylococcus aureus	7 (24.14%)	2 (6.25%)
Viridans Grp of Streptococci	1 (3.45%)	0
Diptheroids	3 (10.34%)	3 (9.37%)
Staphylococcus haemolyticus	1 (3.45%)	5 (15.62%)
Coagulase Negative *Staphylococcus*	6 (20.69%)	6 (18.75%)
Methicillin Resistant Coagulase Negative *Staphylococcus*	1 (3.45%)	3 (9.37%)
Staphylococcus wernerii	02	(6.25%)

Aerobic culture sensitivity showed the following pattern in NSG - 100% sensitivity to linezolid, daptomycin, teicoplanin, vancomycin, and rifampicin. These are all higher antibiotics and may not be used as the first-line of antibiotics for chronic nasal pathologies. There was complete resistance to Benzylpenicillin and Oxacillin (100%). In NNSG, it was observed that the majority of organisms showed 100% sensitivity to linezolid, daptomycin, and teicoplanin. There was complete resistance to Benzylpenicillin (100%). Sensitivity to tetracycline

comparison of sensitivity among NSG and NNSG was statistically insignificant. (Refer Table No 4).

Distribution according to KOH stain and Fungal Culture and growth showed no fungal growth in all patients in NSG and NNSG.

Discussion

In this modern era, a common trait in all nasal infective pathologies like CRS patients is the antibiotic resistance and decreased sensitivity. Nowadays, antibiotic resistance is seen in healthy individuals also.

Table 4: Comparison of antibiotic sensitivity in NSG and NNSG

Drug	Sensitivity among NSG (%)	Sensitivity among NNSG (%)	p value
Benzylpenicillin	0	0	0.0 (NS)
Oxacillin	0	17.19	0.21 (NS)
Gentamicin	69.23	75.86	0.34 (NS)
Ciprofloxacin	34.6	237.93	0.53 (NS)
Levofloxacin	43.30	41.37	0.42 (NS)
Erythromycin	61.54	51.72	0.63 (NS)
Clindamycin	73.07	61.52	0.78 (NS)
Linezolid	100	100	0.33 (NS)
Daptomycin	100	100	0.33 (NS)
Teicoplanin	100	100	0.33 (NS)
Vancomycin	100	100	0.33 (NS)
Tetracycline	84.62	68.97	0.51 (NS)
Tigecycline	100	96.5	0.49 (NS)
Rifampicin	100	86.20	0.57 (NS)
Trimethoprim Sulfamethaxaoxazole	76.92	93.10	0.13 (NS)

It may be due to treating disease without knowing etiology. Also, the role of improper usage of antibiotics should be taken care of as it might be a cause of altering susceptibility.

Diabetic and immunocompromised patients will usually have a more vigorous disease pattern than healthy individuals. So, it is very important to have early diagnosis and proper treatment to reduce mortality.

The present study includes 131 cases, divided into 67 NSG and 64 NNSG, which is comparable to previous studies. The study conducted by Musa et al.[7] had 135 patients with CRS and 104 healthy individuals. Rajasekaran V et al.[8] had 50 patients with Allergic Rhinitis and 50 in the control group for their study. The study by Elisabeth Araujo et al.[9] had 134 in the case group, mainly comprised of chronic Rhinosinusitis and 50 as the control group.

In the study conducted by Musa et al.[7], the mean age was 31.87 ±8.60 years in the CRS group and 33± 7.35 years in the control group. Similar findings were noted in the present study.

Rajasekaran V et al.[8] consisted of 60% females and 40% males. The study from Musa et al.[7] had 51.5% males and 48.5% females. Similarly, a study by Kamble et al.[10] had 52.1% males while 47.8% were female. All three are comparable with the present study.

In the present study, it was observed that of patients with NSG, 43.28% of patients had aerobic growth, and all were gram-positive. While patients in NNSG had aerobic growth in 50%, and all were gram-positive growth (100%).

In the present study, it was observed that 43.28% of NSG patients had positive aerobic growth, while Musa et al. observed 24.6% pure aerobic growth in CRS, and Kamath et al.[11] observed 41.32% in 100 chronic sinusitis patients.

The distribution of patients in NSG showed that the majority of patients had growth of *Staphylococcus epidermidis* (34.49%), while 24.14% of patients showed growth of *Staphylococcus aureus*. Methicillin-Resistant Coagulase Negative *Staphylococcus* was grown in one (3.45%) patient.

A study by Rajasekaran V et al.[8] had 50 patients with allergic rhinitis as cases, the most common organism seen was *Staphylococcus epidermidis* in 80%.

In a study by Elisabeth Araujo et al.[9] *Staphylococcus aureus* was found in 31% of cases, coagulase-negative *Staphylococcus* in 23%, and *Streptococcus pneumoniae* in 13%.

While Study by Varalakshmi et al.[12] consisted of both Gram-positive and Gram-Negative organisms such Coagulase Negative *Staphyloccocus* 40.50%, followed by Coagulase positive *Staphylococcus* 27.84%, Pneumococci 12.65%, Beta hemolytic Streptococci 6.32%, *Klebsiella pneumoniae* 5.06%, Diphtheroid 3.79%, *Pseudomonas aeruginosa* 2.53%, and Micrococci 1.26%.

The distribution of patients in NNSG according to organisms isolated in aerobic growth showed that the majority of patients had growth of *Staphylococcus epidermidis* (34.37%), while 18.75% patients showed growth of Coagulase Negative *Staphylococcus.*

Rajasekaran V et al.[9], in a study on microbes in the middle meatus, showed S*taphylococcus epidermidis* 96% in their control. Musa et al.[7] observed coagulase-negative staphylococci in 92 % of their control.

In Shivani et al.[13] study, the Antibiotic sensitivity pattern showed that Linezolid and Vancomycin were the most effective drugs, followed by Cefoxitin and Amikacin in gram-positive isolates. Maximum resistance was seen to Gentamicin, Cefalexin, and Ampicillin in most of the isolated gram-positive strains.

Conclusion

The present study concludes that there is no difference in culture and sensitivity of aerobic growth in NSG and NNSG. Both groups, aerobic organisms, showed sensitivity to higher antibiotics. Oral drugs like Erythromycin, Clindamycin, Tetracyclines, Trimethomprim-Sulafamethaxaozole have shown good sensitivity in both groups and so can be considered for medical management.

100% resistance to Benzylpenicillin was seen in both groups. No fungal growth was seen in both groups. Thus Endoscopic middle meatal culture plays an important role in this era of antibiotic resistance.

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References

1. Rasmussen T, Kirkeby L P ,Poulsen K, Reinholdt J and Kilian M, Resident aerobic microbiota of the adult human nasal cavity, APMIS. US National Library of Medicine National Institutes of Health, 2008 108(10):663- 75.
2. Baron S , Medical Microbiology. 4th edition. Chapter 6 (Normal Flora Bookshelf ID: NBK7617 PMID: 21413249, 1996.
3. Erturk-Hasdemir D, Kasper DL: Resident commensals shaping immunity. Curr Opin Immunol 2013, 25:450–455.
4. Ramakrishnan VR, Feazel LM, Gitomer SA, Ir D, Robertson CE, Frank DN: The microbiome of the middle meatus in healthy adults. PLoS One 2013, 8: e85507.0.
5. Ponikau JU, Sherris DA, Kern EB, et al. The diagnosis and incidence of allergic fungal sinusitis. Mayo Clinic Proc 1999; 74: 877–884.
6. Fokkens WJ, Lund VJ, Mullol J, Bachert C, Alobid I, Baroody F, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2012. Rhinol Suppl. 2012 Mar (23):1- 298.
7. Musa E, Kodiya AM, Kirfi AM, Nwaorgu OG. Antibiotic sensitivity pattern of bacterial

isolates in patients with chronic rhinosinusitis in Kaduna, Nigeria. International archives of otorhinolaryngology. 2019 Jun;23(2):152-6.

8. Rajasekaran V, Kumar S, Sriraman G. Nasal flora in allergic rhinitis. Int J Otorhinolaryngol Head Neck Surg. 2017 Oct; 3:904-7.

9. Araujo E, Palombini BC, Cantarelli V, Pereira A, Mariante A. Microbiology of middle meatus in chronic rhinosinusitis. American journal of rhinology. 2003 Jan;17(1):9-15.

10. Kamble A, Puttewar M. Demographic and clinical profile of chronic rhinosinusitis patients in a rural based tertiary hospital. Int J Otorhinolaryngol Head Neck Surg 2019; 5:1172-8.

11. Kamath MP, Shenoy V, Mittal N, Sharma N. Microbiological analysis of paranasal sinuses in chronic sinusitis–A south Indian coastal study. Egyptian Journal of Ear, Nose, Throat and Allied Sciences. 2013 Nov 1;14(3):185-9.

12. Varalakshmi YU, Sarada D. Microbiological Study of Paranasal Sinusitis Int J Curr Microbiol App Sci. 2016;5(2):309-16.

13. Devi S, Sharma K, Devi P. Bacteriology of Chronic Rhinosinusitis. Journal of Advanced Medical and Dental Sciences Research. 2016 Mar 1;4(2):7.