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Clinical and Bacteriological Profile in Chronic Adenoiditis – A Cross Sectional Study

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ABSTRACT

Introduction: Diseases of the adenoid are a frequent cause for patients to seek medical attention. Adenoids play a crucial role in the aetiology of otitis media, rhinosinusitis, adenotonsillitis and this may predispose the child to long term functional sequelae including auditory impairment. Treatment of chronic adenoiditis includes both medical and surgical methods. The knowledge of bacterial flora and antibiogram play an important role.

Objectives: The primary objective was to study the clinical and bacteriological profile in patients with chronic adenoiditis and the secondary objective was to compare the bacteriology of adenoid surface swab and adenoid core tissue.

Methodology: The cross sectional study was conducted for a period of 18 months from January 2021 to June 2022 among 100 patients who had chronic adenoiditis attending the department of ENT, Government Medical College Thiruvananthapuram. Data was collected using a pre-designed proforma and entered into Microsoft excel worksheet and was analysed using SPSS software version 25.0.

Results: The majority of the patients were in between 6-10 years of age. Mouth breathing (100%) was the most prevalent symptom, followed by snoring and nasal obstruction. Most of the patients had grade III adenoid. Adenoid surface swab and core tissue culture provided 78% and 68.2% of the bacterial growth respectively. Majority of adenoid surface swab and core tissue showed normal pharyngeal flora. Staphylococcus aureus and Klebsiella were the pathogens that were most frequently isolated from adenoid surface and core tissue. Presence of similar micro organisms on the surface of the adenoid and core was statistically significant.

Conclusion: Isolation of similar bacteria from the adenoid surface swab and core tissue was statistically significant. Hence adenoid surface swab can be used as a reliable indicator for the identification of pathogens and selection of proper antibiotics in chronic adenoiditis.

Keywords: Chronic adenoiditis, Adenoid surface swab, Adenoid core tissue, Clinical profile, Microbial flora, Bacteria

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INTRODUCTION

Adenoids are a group of lymphoid tissue located at the junction of roof and posterior wall of the nasopharynx. They play an important role in the human immune system. Adenoids are present at birth and enlarge throughout childhood, reaching peak size by age seven and regress during puberty.[1] For this reason, adenoiditis is commonly a problem of childhood and adolescence.

The disorders of the adenoids can be classified as acute adenoiditis, adenoid hypertrophy and chronic adenoiditis. Adenoid inflammation with concomitant obstructive hypertrophy is more commonly found in clinical practice.[2] Adenoiditis occurs when there is inflammation of the adenoid tissue resulting mainly from infection and also due to allergy or acid reflex.

The clinical manifestations of acute adenoiditis are similar to acute rhino-sinusitis which include fever, nasal obstruction, nasal discharge and post nasal drip. The manifestations of simple adenoid hypertrophy include mouth breathing, snoring which is more severe in the supine position and can progress to obstructive

sleep apnoea-hypopnea syndrome [OSAHS] in severe cases and adenoid facies.[2] Chronic adenoiditis is defined as symptoms (nasal block, nasal discharge, postnasal drip, snoring, mouth breathing, halitosis etc.) lasting for more than 3 months, and results in the adenoid harbouring bacteria and acting as a reservoir of infection.[3]

Chronic adenoiditis is a common disease that is easily overlooked in children. Also as the adenoids are located behind the nose and cannot be directly observed through the mouth, misdiagnosis and missed diagnosis are relatively common.[4]

Adenoids have many folds or furrows with limited blood flow, and thus bacteria can easily aggregate in them and these infected adenoids may serve as a "bacteria pool" in the upper airway.[5] The infection is polymicrobial in nature. Rajeshwary et al.[4] performed bacterial culture with 100 specimens from resected adenoids and found that 93% showed bacterial growth and most common bacteria included Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus, and Moraxella catarrhalis.

Chronic adenoiditis is treated medically with antibiotics, topical steroids and antihistamines. Inappropriate antibiotic therapy is an important cause for treatment failure. Nasopharyngeal biofilm also play a role in chronic inflammation of adenoid. Those children who fail to respond to medical therapy are usually candidates for surgery. But in children younger than 2 years low dose prophylactic antibiotic treatment is preferred to adenoidectomy.[5] Besides the risk of general anaesthesia, the complications of adenoidectomy includes bleeding, dental trauma, atlanto-axial subluxation, velopharyngeal dysfunction, aspiration etc.[5]

METHODOLOGY

i) Study design: Hospital based cross sectional study.

ii) Study setting: Department of ENT and Department of Microbiology, Government Medical College, Thiruvananthapuram, Kerala.

iii) Study Period: 18 months from January 2021 to June 2022

iv) Study subjects

Inclusion criteria: All patients with chronic adenoiditis attending Department of ENT, at Government Medical College, Thiruvananthapuram.

Patients who were not on systemic antibiotic for a minimum of 48 hours prior to sample collection.

Exclusion criteria:

Those who were not willing to be included in the study.

v) Sample size: Calculated by using the formula

'n' = $Z\alpha^2pq / d^2$
= $(1.96)^2$x 14 x 86 / 7^2
= 95

Zα value when α = 0.05 is – 1.96
P = proportion of patients with nasal obstruction in a study by
Rajeshwary et al[(4)] = 14% (symptom in the smallest proportion)
Q = 100-P = 86 %
D = Absolute precision, 7%

vi) Data collection technique: Patients who met the eligibility criteria were enrolled in the study after obtaining written informed consent and assent. Details collected in a pre-designed proforma were used to elicit required information. General and routine Ear, Nose and Throat examination were done. Investigation results recorded. In all the recruited patients in whom adenoidectomy was done, before the commencement of surgery, surface of the adenoid was swabbed using a sterile cotton swab. A sample for core culture was collected from the deeper layers of adenoidectomy specimen and transported in sterile normal saline. Both the specimens were sent to the microbiology department for culture and sensitivity under sterile precautions. Aerobic culture was done on MacConkey agar, blood agar and chocolate agar. Antibiotic sensitivity was performed by Kirby-Bauer disc diffusion method. Results were entered in the proforma and evaluated.

RESULTS

Out of 100 patients who underwent adenoidectomy there were 61 males and 39 females with a male to female ratio 1.56:1. The youngest patient in the study group was 3 years old and eldest was 22 years old. Majority of the patients were in between 6-10 years of age in the study with a mean age of 9.46 and standard deviation of 4.19 (**Figure 1)**. 37 % of patients belongs to Above Poverty Line (APL) category while remaining

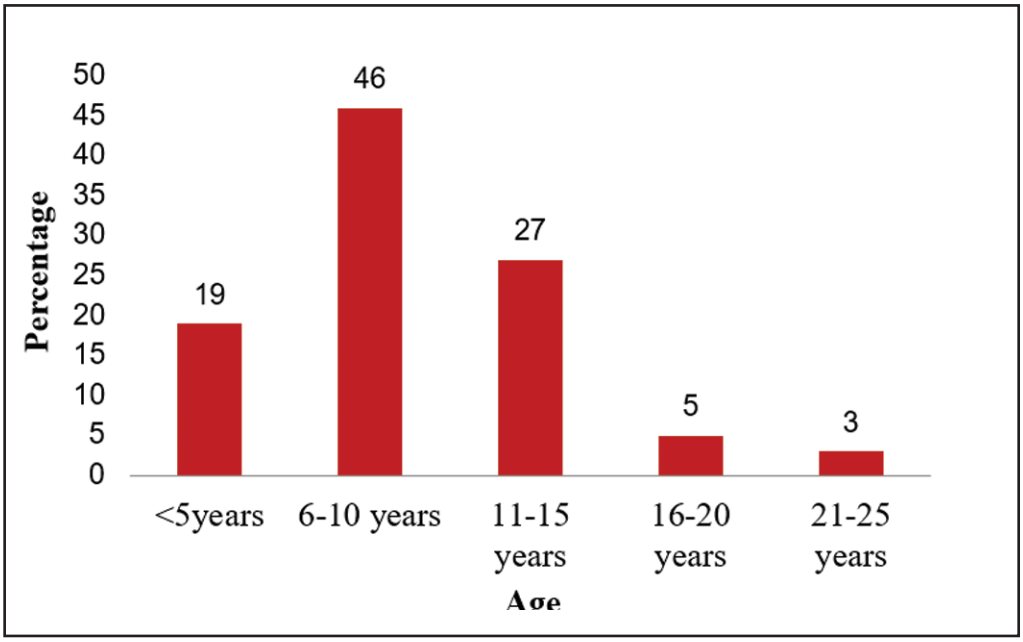

Figure 1: Percentage distribution of sample according to age in years

Table 1. Distribution of sample according to symptoms

Symptoms	Frequency	Percentage
Nasal obstruction	54	54
Nasal discharge	9	9
Sneezing	20	20
Hyponasal voice	27	27
Post nasal drip	11	11.1
Cough	1	1
Epistaxis	8	8
Mouth breathing	100	100
Snoring	91	91
Halitosis	27	27
Sleep disturbance	38	38
Waking spells	20	20
Choking spells	4	4
Attention deficit	9	9
Headache	7	7
Facial pain	1	1
Earache	9	9
Ear block	9	9
Hard of hearing	9	9
Scanty purulent foul smelling ear discharge	1	1
Copious mucoid non foul smelling ear discharge	2	2
Sore throat	22	22
Odynophagia	18	18
Dysphagia	15	15

63% belongs to Below Poverty Line (BPL). Majority of the patient in study group came from panchayath (64%) followed by municipality (26%) and corporation (10%).

The most common symptom was mouth breathing (100 %) which was present in all the study subjects. 91% of patients had snoring, 54% of patients had nasal obstruction. 38% of patients had sleep disturbances followed by sore throat (22%), waking spells (20%) and hyponasal voice (20%). Other complaints were odynophagia (18%), dysphagia (15%), post nasal drip (11%) **(Table 1)**. Less than 10 patients had nasal discharge, cough, epistaxis, choking spells, attention deficit, headache, facial pain, earache, ear block, hard of hearing and ear discharge.

Out of the 54 patients with nasal obstruction, 50 had bilateral nasal obstruction (92.6%). All patients had mouth breathing as presenting complaint, out of which 89% had mouth breathing for a duration of more than or equal to 1 year. For the grading of adenoid size, Clemens and McMurray endoscopic grading was used. Most of the patients had grade III adenoid (75%), this was followed by grade II (10%), grade I (12%) and grade IV (3%) **(Figure 2)**.

Adenoid surface swab was obtained from all 100 subjects, of which majority (78%) showed bacterial growth. No bacterial pathogen isolated from remaining

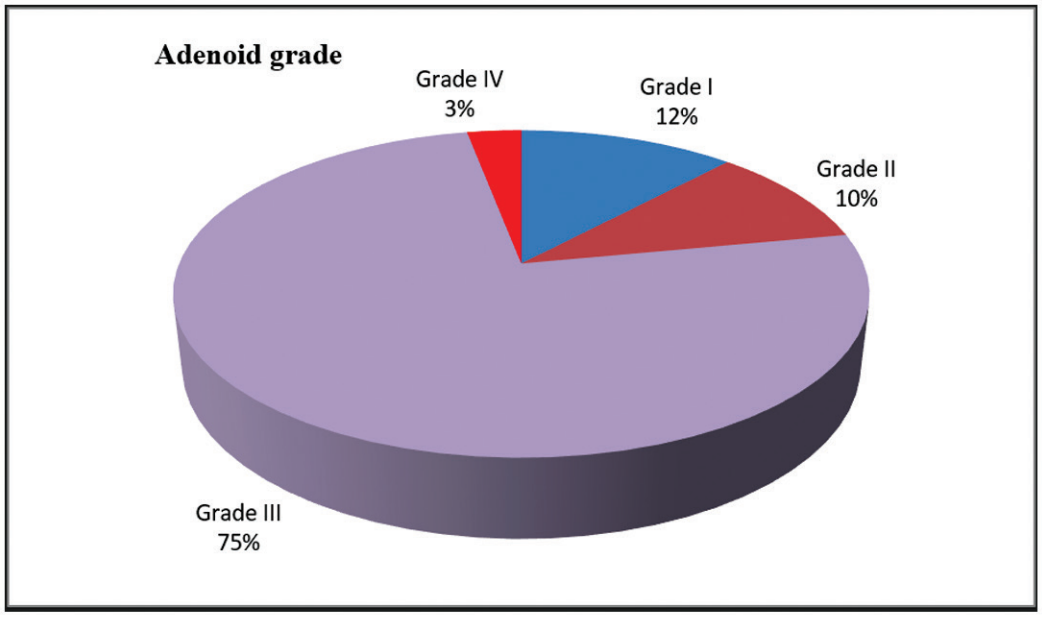

Figure 1: Percentage distribution of the sample according to adenoid grade

22%. Out of the 78 samples, majority showed normal pharyngeal flora (71.4%). Pathogens isolated were Staphylococcus Aureus and Klebsiella (7.8% each) Pseudomonas (6.5%), MRSA (5.2%) and Beta haemolytic streptococci (1.3%) **(Table 2)**.

Out of 66 samples of core tissue, 68.2% showed bacterial growth, remaining 31.8% was sterile. Out of the 45 samples showing bacterial growth majority were normal pharyngeal flora (46.7%). Pathogens isolated from adenoid core tissue were Staphylococcus Aureus and Klebsiella (13.3% each) followed by Pseudomonas (11.1%). MRSA, Beta haemolytic streptococci and Escherichia coli were isolated from 4.4% of samples each **(Table 3)**. Acinetobacter found in one sample (2.2%), which was sensitive to ciprofloxacin, gentamicin, amikacin, piperacillin+tazobactum, cefoperazone+sulbactum.

Among the 66 patients that underwent adenoidectomy, bacteria could be isolated from 45 core samples and the remaining 21 samples were sterile. Out of those patients having 45 culture positive core tissue samples, 41 adenoid surface swab cultures were also positive. Same organisms were cultured from 32 samples of adenoid surface swab and core tissue and this finding was statistically significant with a p value of 0.013 **(Table 4)**. In the remaining 9 samples of culture positive core tissue, the surface yielded different organisms. In the 21 patients whom the core tissue was sterile, 14 showed positive culture on the adenoid surface and remaining 7 were sterile.

Table 2. Distribution of sample according to bacteriological profile from adenoid surface swab culture (n = 78)

Bacteria isolated from adenoid surface swab	Frequency	Percentage
Normal pharyngeal flora	56	71.8
Staphylococcus Aureus	6	7.7
MRSA	4	5.1
Klebsiella	6	7.7
Pseudomonas	5	6.4
Beta hemolytic streptococci	1	1.2
Total	78	100
Total	78	100

Table 3. Distribution of sample according to bacteriological profile from adenoid core tissue cultre (n = 45)u

Bacteria isolated from adenoid core tissue	Frequency	Percentage
Normal pharyngeal flora	21	46.7
Staphylococcus Aureus	6	13.3
MRSA	2	4.4
Klebsiella	6	13.3
Pseudomonas	5	11.1
Beta hemolytic streptococci	2	4.4
Acinetobacter	1	2.2
Escherichia coli	2	4.4
Total	45	100

Table 4. Association between adenoid surface swab and adenoid core tissue

Adenoid surface swab result	Adenoid core tissue result				Total	
	No bacterial pathogen		Bacteria isolated			
	n	%	n	%	n	
No bacterial pathogen	7	33.3	4	8.9	11	16.7
Bacteria isolated	14	66.7	41	91.1	55	83.3
Total	21	100	45	100	66	100

	χ^2	df	p
Chi-Square test	6.160	1	0.013

Culture was positive in 45 adenoid core tissue samples. Among that majority (91%) were also positive from adenoid surface swab. Cultures were positive in both adenoid core tissue and adenoid surface swab from 41 patients. Out of these 41 samples, majority (78%) were same organisms **(Figure 3) (Figure 4)**. 32 culture samples obtained same organisms from both adenoid core tissue and adenoid surface swab. They were normal pharyngeal flora (60%), *Klebsiella* (13%), *staphylococcus aureus* and *Pseudomonas* (9% each), *MRSA* (6%) and *Beta hemolytic streptococci* (3%).

In 9 samples, we got different organisms from cultures of adenoid core tissue and adenoid surface swab. Out of this, two samples showing normal pharyngeal flora in core tissue showed *Staphylococcus aureus* and *MRSA* in adenoid surface swab. Two core tissue samples revealed *Staphylococcus aureus*, in contrast to normal pharyngeal flora in their surface swab. One sample had *Klebsiella* in the core tissue, but the surface had normal pharyngeal flora. Two samples showed *Pseudomonas* in the core tissue culture, showing normal pharyngeal flora and *Klebsiella* respectively surface swab. *Escherichia coli* were isolated from adenoid core tissue of 2 samples, whereas adenoid surface swab showed normal pharyngeal flora.

DISCUSSION

The present study was done to find out the clinical and bacteriological profile in patients with chronic adenoiditis. This study was done in 100 patients with chronic adenoiditis, in the Department of ENT, Govt. Medical College Thiruvananthapuram for a period of 18 months from January 2021 to June 2022.The results were compared with the studies conducted by other researchers.

In our study, majority of the patients were in between 6-10 years of age with a mean age of 9.46 and standard deviation of 4.19. This was comparable to a study by Rajashekharan R P et al[8] where majority were in the age group of 5-10 years. In a study by Karataş et al,[9] 230 children were selected to determine and to compare the core and the surface bacteriologies of the adenoids of the pediatric patients, their age ranged from 2 to 13 years (mean: 6.68±2.36).

There were 61 males accounting for 61% and 39 females

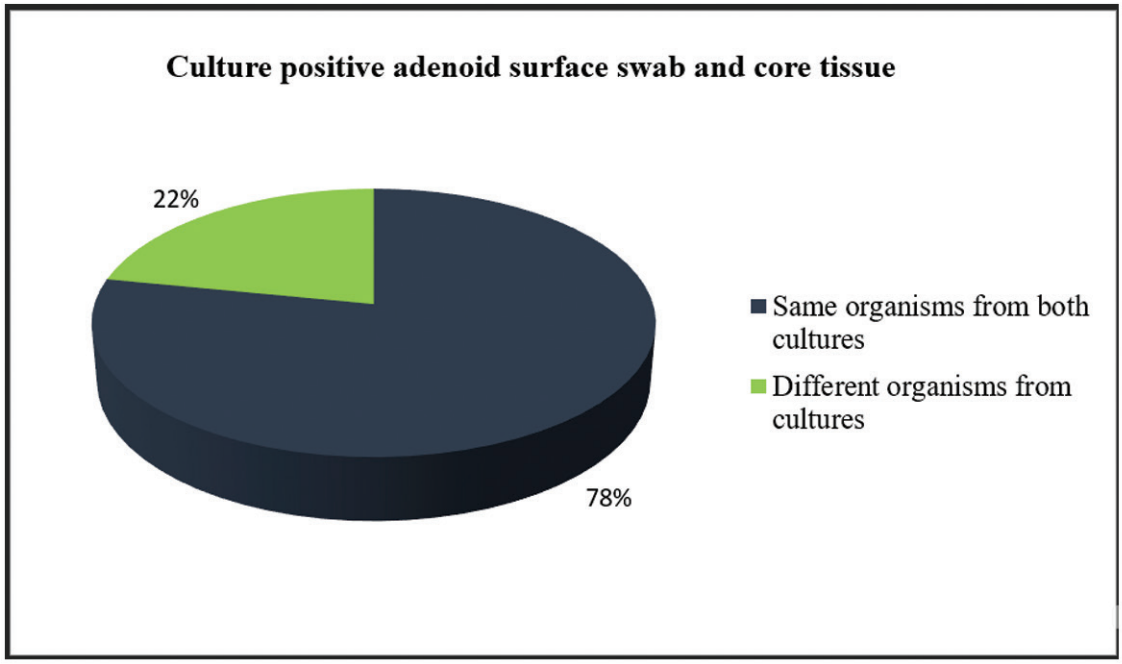

Figure 3: Percentage distribution of samples according to isolation of organisms from culture positive adenoid core tissue and surface swab

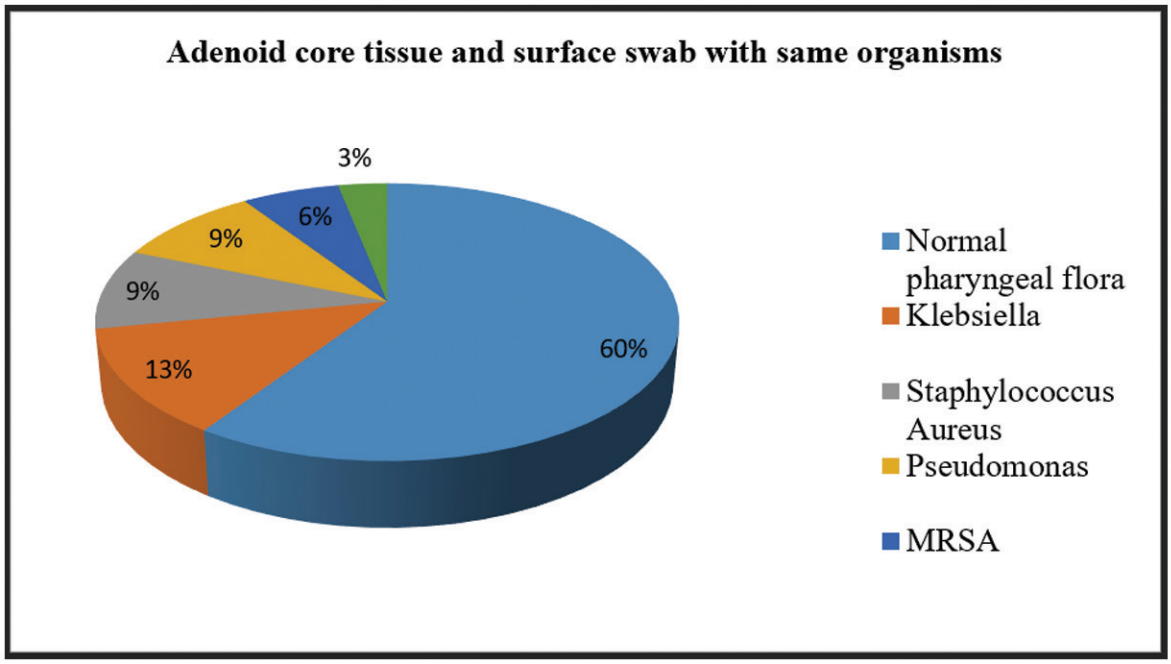

Figure 4: Percentage distribution of sample according to adenoid core tissue and surface swab having same organisms

accounting for 39% with a male to female ratio 1.56:1 in our study. Male preponderance was also noted in studies by Rajeshwary et al,[4] Karataş et al,[9] Taylan et al.[10] This was in contrast to a study by Brook et al[6] where there was female preponderance.

63% of patient in our study belonged to BPL while remaining 37% belonged to APL category. In a study by Chinawa et al,[11] where they studied the clinical profile and pattern of adenoid hypertrophy among children attending a private hospital, majority of patients with adenoid hypertrophy belong to lower social class. Eziyi et al[12] also noted similar finding in his study where most of patients with adenoids belong to a low socioeconomic status. This could be because children with adenoids who belong to low socioeconomic status are more likely to experience recurrent viral and bacterial infections, which could aggravate their condition.

Majority of the patient in study group comes from panchayath (64%) followed by municipality (26%) and corporation (10%). No significant association obtained between place of residence and adenoid surface swab or place of residence and adenoid core result. In a study by Zuo et al[13] there was no significant difference between living environment (rural vs. urban) and colonization of adenoid opportunistic pathogens in children with adenoid hypertrophy. In a study by Glowniak et al,[14] data suggest that place of residence of the child is a significant factor for microbial colonization, especially *S. pneumoniae* and *S. aureus* in the nasopharynx. Living in a rural area has been reported to be associated with less nasopharyngeal carriage of *S. pneumoniae* and *H. influenzae*, in children aged less than 5 years but this was not supported by Boken *et al*.[15] who found no difference in the carriage rate of *S. pneumoniae* between rural and urban-dwelling children.

Mouth breathing was present in all our patients (100%) similar to the study by Rajeshwary et al.[4] In our study, 91% of patients had snoring and 54% of patients had nasal obstruction. 38% of patients had sleep disturbances followed by sore throat (22%), waking spells (20%) and hyponasal voice (20%). In a study by Ungkanont et al[16] the most common symptom was snoring (97%) followed by mouth breathing (63.6%). Another study by Chinawa et al[11] shows that the commonest symptoms presented by almost all their patients were cough, catarrh, snoring and mouth breathing especially at night. This was also similar to the study by Satish et al.[17] Nasal complaints were more than aural complaints, which might be due to the delayed identification of aural symptoms by parents as compared to nasal symptoms. Among all patients with mouth breathing as presenting complaint, 89% of

patients had mouth breathing for a duration of more than or equal to 1 year, similar to the study by Fan et al.[18]

Out of 100 study subjects, 19% of patients had history of atopy, 7% had history of exanthematous fever, 6% had history of asthma and 9% patients had other comorbidities. 28% patients had family history of atopy. 7% patients had passive smoking and 4% patients had congenital anomalies. In study by Modrzynski et al[19] it was noted that in children with allergic rhinitis and hyper sensitivity to dust mites, adenoid hypertrophy occurred significantly (chi square test; $p < 0.00000$) more frequently than in children with other allergic diseases or with no allergies. In our study, no such association was present between atopy and adenoid surface swab culture or core tissue culture result. Passive smoking is associated with upper and lower tract infections, and also increases colonization by pathogens in children but the impact of tobacco exposure and carriage of pathogens is a matter of debate. A study by Murphy et al[20] showed no difference in colonization rates for *H. influenzae* between children with smoking parents and those with non-smoking parents. Principi *et al*.[21] concluded that tobacco smoke exposure of healthy children aged <5 years did not influence pathogen carriage in the upper respiratory tract but a more recent study did show increased *S.pneumoniae* carriage rates in children exposed to tobacco smoke.[22] In contrast, Bakhshaee *et al*.[23] found a significant difference in carriage rates between children living in smoking families, compared to those in non-smoking families for *M. catarrhalis*, but not for *S. pneumoniae* and *H. influenzae*. In the study by Kosikowska *et al*.[14] passive smoking was a risk factor for increased nasopharyngeal colonization of *H. influenzae*. In our study, no association was found between passive smoking and adenoid surface swab or core tissue culture results.

Among the 9 patients with comorbidities, 4 had seizure (45%), 2 had migraine and remaining children had hypothyroidism, rickets and intellectual disability (11% each). Sleep related respiratory events can trigger seizures and interictal epileptiform discharges in patients with epilepsy, and epilepsy has been shown to improve significantly with the resolution of Sleep Breathing Disorder (SBD)[24] and the most common site of narrowing in pediatric patients is at the level of the Waldeyer ring, which may ultimately lead to SBD.

In our study, Clemens and McMurray endoscopic grading was employed to grade adenoid size. Grade III adenoid was the most prevalent in the patients (75%), followed by grade II (10%), grade I (12%), and grade IV (3%).

In our study, adenoid surface swab was taken from 100 children, of which 78% showed bacterial growth. Out of the 78 samples, majority showed normal pharyngeal flora (71.4%). Pathogens isolated were Staphylococcus Aureus and Klebsiella (7.8% each) followed by Pseudomonas (6.5%), MRSA (5.2%) and Beta haemolytic streptococci (1.3%).

Adenoid core was taken for culture from 66 children and out of which, 45 (68.2%) showed bacterial growth, remaining 21 (31.8%) was sterile. Majority were normal pharyngeal flora (46.7%). Pathogens isolated from adenoid core tissue were Staphylococcus Aureus and Klebsiella (13.3% each) followed by Pseudomonas (11.1%). 4.4% of samples showed MRSA, Beta haemolytic streptococci and Escherichia coli. Acinetobacter found in one sample (2.2%), which was sensitive to Ciprofloxacin, Gentamicin, Amikacin, Piperacillin+Tazobactum, Cefoperazone+ Sulbactum.

In a study conducted by Rajeshwary et al[4] adenoidectomy specimen along with the swab from the adenoid surface of 100 patients were sent for microbiological examination. Aerobic organisms grew in 93% of the specimens and 7% had no growth. The surface was predominated by commensals and the pathogens were mainly found in the core. The predominant pathogens were *Staphylococcus aureus* (34%) which is similar to our study. The organisms were resistant to penicillin but showed sensitivity to co-amoxiclav and ciprofloxacin. In our study, all *Staphylococcus aureus* organisms were resistant to penicillin and 75% showed ciprofloxacin sensitivity.

A prospective observational study by Subtil et al,[7] nasal swab, adenoid surface swab and adenoid core tissue were taken from 62 children undergoing adenoidectomy which they categorised as infectious and non-infectious group according to symptoms. 33 bacterial genera were identified including potential pathogenic bacteria such as *Streptococcus pneumoniae, Haemophilus influenzae, Beta-hemolytic streptococci* and *Staphylococcus aureus*. A significant statistical

association was found for *Haemophilus*, *Neisseria*, *Staphylococcus* and *Streptococcus* genera on adenoid surface and core in infectious group, whereas no significant association was found between adenoid surface and core in non-infectious group.

Another study was conducted by Glowniak et al[14] where nasopharyngeal swab and adenoids core swab were collected from 103 children undergoing adenoidectomy. The overall carriage rates were *S. pneumoniae* (64·1%), *H. influenzae* (70·9%), *M.catarrhalis* (30·1%) and *S. aureus* (36·9%). Correspondingly, adenoid colonization was found to be significantly associated with age (p= 0·004) and decreased by cephalosporin therapy for the most recent infection episode (p= 0·027)

Among the 66 patients who underwent adenoidectomy, bacteria could be isolated from 45 core samples. Out of those patients having 45 culture positive core tissue samples, 41 adenoid surface swab cultures were also positive. When microorganisms from adenoid surface swab and core were compared, similar organism was isolated from 32 samples of adenoid core tissue and surface. This finding was found to be statistically significant with a p value of 0.013 in our study. Same observation was obtained in the study by Taylan et al.[10]

Out of the 41 samples where bacteria could be isolated from both adenoid surface swab and adenoid core tissue, 32 culture samples obtained same organisms from both adenoid core tissue and adenoid surface swab. They were normal pharyngeal flora (60%), *Klebsiella* (13%), *staphylococcus aureus* and *Pseudomonas* (9% each), *MRSA* (6%) and *Beta hemolytic streptococci* (3%). In the remaining 9 samples, we got different organisms from cultures of adenoid core tissue and adenoid surface swab. Out of this, two samples showing normal pharyngeal flora in core tissue showed *Staphylococcus aureus* and *MRSA* in adenoid surface swab. Two core tissue samples revealed *Staphylococcus aureus*, in contrast to normal pharyngeal flora in their surface swab. One sample had *Klebsiella* in the core tissue, but the surface had normal pharyngeal flora. Two samples showing *Pseudomonas* in the core tissue culture, revealed normal pharyngeal flora and *Klebsiella* respectively in their surface swab. *Escherichia coli* were isolated from adenoid core tissue of 2 samples, whereas adenoid surface swab showed normal pharyngeal flora.

4 samples were culture positive for adenoid core tissue but surface swab was sterile. They were one sample each of *Staphylococcus aureus, Klebsiella, Beta hemolytic streptococcus* and *Acinetobacter*.

When we look into the bacteriological profile, *Staphylococcus aureus, MRSA, Klebsiella, Pseudomonas* and *Beta hemolytic streptococci* were isolated from both adenoid surface swab and core tissue but *Escherichia coli and Acinetobacter* were obtained from adenoid core tissue alone.

CONCLUSION

100 cases of chronic adenoiditis were studied and the following conclusions were made:

- Majority of the patients were in between 6-10 years of age, with a male preponderance.
- Most common symptom was mouth breathing (100%) followed by snoring (91%) and nasal obstruction (54%).
- Most of the patients had grade III adenoid (75%) by Clemens and McMurray endoscopic grading.
- 78% of adenoid surface swab culture showed bacterial growth.
- Majority of adenoid surface swab culture showed normal pharyngeal flora (71.4%).
- Most common pathogens isolated from adenoid surface swab were Staphylococcus Aureus and Klebsiella (7.8% each) followed by Pseudomonas (6.5%), MRSA (5.2%) and Beta haemolytic streptococci (1.3%).
- The bacterial growth rate in adenoid core tissue was 68.2%.
- Staphylococcus aureus and Klebsiella were the pathogens that were most frequently isolated from adenoid core tissue (13.3% each), followed by Pseudomonas (11.1%). In 4.4% of samples, MRSA, Beta haemolytic streptococci and Escherichia coli were isolated. One sample (2.2%) contained Acinetobacter.
- When microorganisms from adenoid surface swab and core were compared, out of 41 samples, identical bacteriological profiles were obtained in

32 samples (78.1%). This relation was found to be statistically significant with a p value of .013.

- Surface swab will help to predict the bacteriology of core in majority of cases. Knowing the bacterial pathogen and the antibiogram will aid in selecting the proper antibiotics thus preventing antibiotic resistance.

END NOTE

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