Relative Etiological Importance of Adenoid Hypertrophy Versus Sinusitis in Children with Persistent Rhinorrhoea

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Abstract Persistent rhinorrhoea is a common, yet often neglected, problem among Indian children. This study was designed to evaluate the relative etiological importance of adenoid hypertrophy versus sinusitis in children with persistent rhinorrhea. Additionally, the association between *S. pneumoniae* colonization and adenoid hypertrophy was studied. Children aged 1–14 years with persistent rhinorrhea underwent clinical evaluation, rigid nasal endoscopy and xrays of the nasopharynx and paranasal sinuses to ascertain the presence of adenoid hypertrophy and sinusitis using standard criteria. Nasopharyngeal swabbing to ascertain the presence of nasopharyngeal colonization with *S. pneumoniae* was also performed. Adenoid hypertrophy was more consistently associated with persistent rhinorrhea than sinusitis ($p < 0.0001$). Coincident adenoid hypertrophy and sinusitis occurred in 57 %. *S. pneumoniae* was cultured in only 29 % of children. Up to 47 % of patients had features of nasal allergy. There was no association between *S. pneumoniae* colonization and adenoid hypertrophy ($p = 0.1$). Adenoid hypertrophy is an important cause of persistent rhinorrhea in children. Measures to evaluate for and treat adenoid hypertrophy should be instituted early to alleviate the problem of persistent

rhinorrhoea in children. *S. pneumoniae* colonization of the nasopharynx is not a major etiological factor for persistent rhinorrhoea in these children. Nasal allergy may be a cause of adenoid hypertrophy in roughly half the children.

Keywords Persistent rhinorrhoea · Adenoid hypertrophy · Sinusitis · *S. pneumoniae* nasopharyngeal colonization

Introduction

Persistent rhinorrhoea is a common condition among pre-school and school children. In several developing countries, this condition is frequently ignored with the belief that spontaneous resolution occurs with time. A previous epidemiological study among rural Indian children has shown that the prevalence of persistent rhinorrhea is around 22 % in rural children attending daycare [1]. This condition was also shown to be an important risk factor for otitis media in preschool children [2].

The etiology of persistent rhinorrhoea in children includes adenoid hypertrophy and/or adenoiditis and chronic rhinosinusitis. The adenoids are known to cause either mechanical obstruction and stasis of secretions or may be a nidus causing repeated episodes of upper respiratory infection [3]. The etiology of pediatric rhinosinusitis includes recurrent upper respiratory infections, sinonasal allergy, congenital anomalies like choanal atresia, gastroesophageal reflux, passive smoking, mucociliary disease and cystic fibrosis. Hence, the evaluation of children with persistent rhinorrhoea should include an evaluation of both of these conditions. In many children adenoid hypertrophy and rhinosinusitis are known to coexist. The association between the two conditions is variable, with some authors

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finding that an association exists [4] and others showing that there is no such association [3, 5].

The relationship between nasopharyngeal colonization with *S. pneumoniae* and persistent rhinorrhoea has been studied in the past. High rates of recovery of *S. pneumoniae* by nasopharyngeal swabbing have been noted in children with persistent or purulent rhinorrhoea by some authors [1, 6]. The association between adenoid hypertrophy and nasopharyngeal colonization by *S. pneumoniae* is, however, less well studied.

The present study aimed to ascertain the relative role of sinusitis and adenoid enlargement as the cause of persistent rhinorrhoea in Indian children aged 1–14 years. Additionally, the association between nasopharyngeal colonization by *S. pneumoniae* and adenoid hypertrophy was also evaluated.

Methods

This was a prospective study done over a 1 year period, in the Departments of ENT, Radiology and Infectious Diseases Department of Christian Medical College, Vellore. The study was approved by the Institutional Review Board and Ethics Committee. Children aged 1–14 years with persistent rhinorrhoea, who attended the Paediatric ENT outpatient clinic were included in the study. Persistent rhinorrhoea was defined as an episode of rhinorrhoea lasting more than 10 days despite therapy or repeated episodes of rhinorrhea (more than one episode every 2 months) each lasting more than 10 days. Children with cleft palate, submucous cleft, ciliary motility disorders, cystic fibrosis and craniofacial abnormality were excluded from the study.

A detailed history was taken for all children after obtaining informed consent from the parents. Children who fulfilled the inclusion criteria were subjected to a thorough clinical ENT examination. Children with a history suggestive of nasal allergy underwent detailed history to ascertain food and inhalant allergens, skin allergy tests where feasible and IgE levels. After creating a good rapport with the child and administering adequate local anaesthesia and vasoconstriction with nasal sprays, rigid nasal endoscopy was performed using a 2.7 mm zero degree paediatric endoscope. The size of the adenoid mass was graded endoscopically as suggested by Cassano et al. [7].

Grade 1 less than or equal to 25 %

Grade 2 more than 25 % but less than or equal to 50 %

Grade 3 more than 50 % but less than or equal to 75 %

Grade 4 more than 75 % but less than or equal to 100 %

Soon after, a pernasal nasopharyngeal swab was taken using a calcium alginate swab with a flexible aluminium shaft. Culture of the specimen was done primarily to detect

S. pneumoniae. However, the presence of any organism grown on culture was noted. The swabs were transported on the WHO recommended skim milk tryptone-glucose-glycerin (STGG) transport medium to the study laboratory and inoculated onto the primary culture media, trypticase soy blood agar (TSBA) and gentamicin blood agar (5 µg/ml of gentamicin). The swabs were cultured and *S. pneumoniae* identified using standard microbiological protocol. X rays of the nasopharynx and paranasal sinuses were taken. If the patient had allergic symptoms, IgE estimation was also done. Radiological measurement of adenoid size and sinusitis grading were done using standard criteria by a radiologist who was blinded to the clinical findings.

X ray of the paranasal sinuses was graded as follows:

Grade 0 No abnormal findings in the maxillary sinuses bilaterally

Grade 1 Mucosal thickening in the maxillary sinuses bilaterally

Grade 2 Mucosal thickening on one side and total haziness on the other side

Grade 3 Total haziness on the maxillary sinuses bilaterally

On lateral x-ray of the nasopharynx (Fig. 1), the distance from pharyngeal tubercle to maximum convexity of adenoid size was measured (a). The distance from pharyngeal tubercle to posterior end of hard palate was also measured (b).

Fig. 1 X-ray lateral of the nasopharynx showing Grade 3 adenoid hypertrophy; measurements (a pharyngeal tubercle to maximum adenoid convexity and b pharyngeal tubercle to edge of hard palate) are shown by arrows

The adenoid/nasopharyngeal ratio was calculated as a/b. Adenoid size was graded as follows (based on adenoid-nasopharyngeal ratio) [3]

Grade 1 a/b < 1/3

Grade 2 a/b is between 1/3 and 2/3

Grade 3 a/b > 2/3

Statistical Analysis

The results were evaluated and categorical variables are presented using frequencies and percentages. Association between categorical variables was assessed using Chi square test and Fisher's exact test. A p value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS 16.0.

Results

Demography

There were 66 boys and 34 girls (100 children). Their ages ranged from 3–14 years with a mean of 6.8 years (S.D = 3.4). The majority of children (58 %) were >5 years old.

Associated Symptoms

Bilateral nasal obstruction was seen in 99 % of children; mouth breathing (96 %), snoring (78 %) and headache (59 %) were also seen. Additionally, earache and hearing loss were seen in 17 % and sore throat in 37 %. Nasal allergy was present in 47 %.

Adenoid Hypertrophy Grade by Endoscopy

Based on fiberoptic nasal endoscopy findings, 97 % of the children with persistent rhinorrhoea had Grade 2, 3 or 4 adenoid enlargement. Twelve children had adenoids totally obstructing the choanae (Grade 4). Only 3 % of the children had grade 1 adenoid enlargement.

Sinusitis and Adenoid Hypertrophy Grade on Radiology

Most children (93 %) with persistent rhinorrhoea had grade 2 or 3 adenoid hypertrophy (Fig. 1) whereas significant sinusitis (grades 2 or 3) was only seen in 21 % of children (Tables 1, 2). Therefore, adenoid hypertrophy was more significantly associated with persistent rhinorrhea ($p < 0.0001$).

Correlation Between Radiology and Endoscopy in Assessment of Adenoid Hypertrophy

There was a significant correlation between grading of adenoid size by Xraynasopharynx and clinical findings by rigid nasal endoscopy ($p < 0.001$). Ninety seven percent of children had enlarged adenoids as seen on fiberoptic endoscopy while 93 % had significantly enlarged adenoids as measured on the Xraynasopharynx. The correlation between assessment of adenoid size by x ray and by rigid nasal endoscopy was high (Kendall tau correlation coefficient = 0.48; $p < 0.001$).

Adenoid Hypertrophy and Allergy

A total of 47 (47 %) children had features of nasal allergy with frequent sneezing, epiphora and, occasionally, pruritus. IgE levels were raised in all the children evaluated.

Nasopharyngeal Swab Culture Results and Association with Adenoid Hypertrophy

Overall 86 % swabs were positive for 1 or more organisms and *S. pneumoniae* was cultured in 29 % of children. Positive nasopharyngeal swabs for *S. pneumoniae* were seen only in patients with Grade 2 or greater adenoid hypertrophy by rigid nasal endoscopy. However, no definite association was found between *S. pneumoniae* colonization and adenoid hypertrophy ($p = 0.1$). Although only 14 patients showed no growth on nasopharyngeal swab culture, the association between a positive swab (whether due to *S. pneumoniae* or other organism) and adenoid hypertrophy was also not significant ($p = 0.25$).

Discussion

Persistent rhinorrhoea, a condition which is commonly seen in many parts of rural India, is often thought of by parents of such children as being a normal phenomenon not requiring treatment. This is despite the fact that it is the prime risk factor for otitis media among preschool children [2]. Two previous epidemiological studies performed from the same district in South India have shown that the prevalence of persistent rhinorrhoea among preschool, rural Indian children with otitis media to range from 76.8 to 100 % [1]. When children without otitis media were considered, the prevalence was still high at 34.8 % [2]. Expectedly, therefore, parents of such children seek a medical opinion only if complications like acute otitis media or acute purulent sinusitis develop. Hence, the present study originated from a need to identify common causes of persistent rhinorrhoea in young children.

Table 1 Grading of sinusitis based on X ray of the paranasal sinuses

Grade	Number of patients (%)
0	43
1	36
2	13
3	8

Table 2 Grading of adenoid size based on Xray of the nasopharynx

Grade	Number of patients (%)
1	7
2	43
3	50

The present study lends credence to the theory that adenoid hypertrophy is the commonest cause of persistent rhinorrhoea among children. Some authors feel that it is obstruction at the level of the choanae and nasopharynx rather than local infection that is the cause for persistent rhinorrhoea [8, 9]. Tuncer et al. [9] separately cultured maxillary sinus aspirates and adenoid tissue in children undergoing adenoidectomy. They found that there was no similarity between cultures obtained from both specimens. They concluded that the adenoids act as a mechanical barrier rather than a nidus of infection in these symptomatic children. However, others feel that the size of the adenoids is not critical to the development of rhinosinusitis [3–5]. In these patients it is probably the presence of pathogenic bacteria within the adenoids that serves as a reservoir causing persistent rhinorrhoea [4].

As the symptoms of adenoid hypertrophy and chronic rhinosinusitis mimic each other and one may follow another, clinical and radiological evaluation of these children is an essential part of further management. In the present study 57 % of children had coincident adenoid hypertrophy and rhinosinusitis suggesting that routine evaluation for both conditions is essential. However, only 21 % of patients had Grade 2 or 3 sinusitis based on X ray grading, suggesting that a mild form of sinusitis secondary to stasis of secretions in the nose and nasopharynx is an expected consequence of adenoid hypertrophy, with a minority of patients having moderate or severe sinusitis.

Assessment of children with persistent rhinorrhoea for sinusitis involves clinical, endoscopic and radiological assessment. Although CT scan is the investigation of choice for assessing paranasal sinus disease, the limitations of cost and necessity to minimize the amount of radiation exposure, prompted us to order xrayparanasal sinus (Water's view) to assess sinusitis in this population.

Paediatric rigid nasal endoscopy using a 2.7 mm rigid telescope offers a dual benefit of enabling assessment of adenoid size and sinusitis, making it a useful procedure in children with persistent rhinorrhoea. Additionally, radiation exposure to the child is avoided. In uncooperative children, however, radiological investigation may be more useful.

The role of nasopharyngeal colonization in the causation of persistent rhinorrhoea was studied by Cherian et al. [1] who reported that the prevalence of colonization of the nasopharynx by *S. pneumoniae* in preschool children attending daycare with persistent rhinorrhoea to be as high as 85.7 %. In our study, nasopharyngeal swab was positive for *S. pneumoniae* in only 29 % of the children. Of these, twenty six children (89.7 %) were under the age of ten. Seventy one percent of the children had other organisms in the nasopharynx. There was also no statistically significant correlation between a positive culture for *S. pneumoniae* and adenoid enlargement as assessed by both rigid nasal endoscopy ($p = 0.1049$) and xraynasopharynx ($p = 0.7852$). This suggests that adenoid hypertrophy causing mechanical obstruction rather than infective adenoiditis is a more likely cause for persistent rhinorrhoea in the children studied. Although the prevalence of nasopharyngeal colonization with *S. pneumoniae* increased with the severity of sinusitis, the association was not found to be statistically significant. ($p = 0.1227$).

Nasal allergy is another important cause of persistent rhinorrhoea. In the present study, a little less than half the children had allergic symptoms like sneezing (47 %) and pruritus (21 %). Detailed evaluation of allergy using IgE estimation, absolute eosinophil count and cutaneous hypersensitivity testing are useful in these patients. Medical management of adenoid hypertrophy in these children with steroid nasal sprays would clearly be an effective way to manage these children.

Conclusion

In conclusion, adenoid hypertrophy is the prime cause for persistent rhinorrhoea, a common problem among Indian children. While rhinosinusitis may coexist in a little more than half the affected children, it is usually minimal and its presence may be secondary to mechanical obstruction of the nasopharynx rather than direct spread of infection from the adenoids.

Assessment of children with persistent rhinorrhoea is best done by either fiberoptic endoscopy or X ray of the nasopharynx and sinuses. Additionally, tests to exclude allergy and nasopharyngeal swabbing provide information on coexistent allergy and infection. Adoption of this protocol (Fig. 2) is recommended for assessment of all

Fig. 2 Protocol for management of persistent rhinorrhoea in a child

children aged >2 years who present to the otolaryngologist with persistent rhinorrhoea.

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