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Original Research Article

Correlation of adenoid hypertrophy with impedance audiometry findings in children under twelve

Krishan Jeet Singh, Sajad Majid Qazi, Aamir Yousuf*

Department of Otorhinolaryngology and HNS, GMC, Anantnag, Kashmir, India

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***Correspondence:**
Aamir Yousuf,
E-mail: miraamir83@gmail.com

ABSTRACT

Background: Adenoid hypertrophy is a common cause of nasal obstruction, hearing impairment, and otitis media with effusion (OME) in children. Accurate evaluation of adenoid size and its relationship with middle ear status is essential for appropriate management.
Methods: This cross-sectional observational study included 80 children aged 2–12 years presenting with symptomatic adenoid hypertrophy. Adenoid size was assessed using radiological methods and nasal endoscopy. Endoscopic evaluation was performed using the Adenoid-Choanal-Eustachian (ACE) grading system. Middle ear status was evaluated using impedance audiometry, and tympanogram patterns were correlated with adenoid size and endoscopic findings.
Results: A significant correlation was observed between increasing grades of adenoid hypertrophy and the incidence of OME. Among patients with Grade 2 hypertrophy, 75% had OME, while 90% of those with Grade 3 hypertrophy were affected. Bilateral type B tympanograms, indicative of middle ear effusion, were seen in 33.33% of Grade 2 cases and 55.56% of Grade 3 cases. Nasal endoscopy using the ACE grading system demonstrated a 100% correlation with Type B tympanograms in cases where adenoid tissue abutted the Eustachian tube.
Conclusions: Higher grades of adenoid hypertrophy are strongly associated with OME. The ACE grading system is a reliable tool for predicting Eustachian tube involvement. A combined approach using nasal endoscopy and impedance audiometry improves diagnostic accuracy and supports standardized management in pediatric patients.

Keywords: Adenoid hypertrophy, Otitis media with effusion, Impedance audiometry

INTRODUCTION

Adenoid hypertrophy is a common pediatric condition characterized by enlargement of lymphoid tissue in the nasopharynx, leading to nasal obstruction, mouth breathing, hyponasal speech, hearing impairment, and sleep-disordered breathing. It is most prevalent in children between 2 and 12 years of age due to physiological lymphoid hyperplasia during early childhood.[1] Prolonged upper airway obstruction due to enlarged adenoids may also contribute to craniofacial abnormalities and impaired overall growth if not addressed in a timely manner.[2] One of the most significant complications of adenoid hypertrophy is otitis media with effusion (OME), which represents a major cause of conductive hearing loss in children. OME is characterized by the presence of non-purulent fluid in the middle ear cleft without signs of acute infection.[3] The pathophysiology involves mechanical obstruction of the Eustachian tube by hypertrophied adenoid tissue, along with mucosal inflammation and infection, resulting in impaired middle ear ventilation, negative intratympanic

pressure, and fluid accumulation.[4] Persistent OME can adversely affect speech and language development, cognitive performance, and academic outcomes in children.[5] Accurate assessment of adenoid size and its impact on surrounding structures, particularly the Eustachian tube, is essential for appropriate diagnosis and management. Lateral X-ray of the nasopharynx has traditionally been used as a simple, cost-effective, and widely available imaging modality for assessing adenoid size.[6] However, it provides only a static, two-dimensional view and may not accurately reflect the dynamic relationship between adenoid tissue and the Eustachian tube or choana.[7] Nasal endoscopy has emerged as a superior diagnostic modality, allowing direct visualization of the adenoids, degree of choanal obstruction, and Eustachian tube involvement.[8] Endoscopic grading systems, such as the Adenoid-Choanal-Eustachian (ACE) classification, provide a more comprehensive assessment and have shown better correlation with middle ear pathology.[9]

Impedance audiometry is a reliable and objective method for evaluating middle ear function. Tympanometry, in particular, helps in identifying middle ear effusion, with a Type B tympanogram being highly suggestive of fluid in the middle ear.[10] Correlating endoscopic grading of adenoid hypertrophy with tympanometric findings can improve diagnostic accuracy and facilitate evidence-based clinical decision-making. Despite the known association between adenoid hypertrophy and OME, variability exists in diagnostic approaches and management protocols.

Therefore, this study aims to evaluate the correlation between adenoid hypertrophy size, assessed using radiological and endoscopic methods, and impedance audiometry findings. It also seeks to determine the incidence of OME across different grades of adenoid hypertrophy and contribute toward the development of standardized diagnostic and management strategies in pediatric patients.

METHODS

Study design

This cross-sectional observational study was conducted at the Department of Otorhinolaryngology and Head and Neck Surgery, Government Medical College, Anantnag, Kashmir, from March 1, 2024, to February 28, 2025.

Study population

Eighty newly diagnosed patients aged 2–12 years with symptomatic adenoid hypertrophy were included.

Inclusion criteria

Children aged 2–12 years who present with symptomatic adenoid hypertrophy.

Exclusion criteria

A history of adenoidectomy, ear discharge, cleft palate, or congenital ear deformities.

Diagnostic tools

X-ray nasopharynx

Adenoid hypertrophy was graded based on nasopharyngeal air column width as proposed by Fujioka et al: Grade 1 is defined as greater than 6 mm, Grade 2 as 4–6 mm, and Grade 3 as less than 3 mm.

Nasal endoscopy

A 2.2 mm rigid zero-degree endoscope was used to grade adenoid hypertrophy based on choanal obstruction: Grade 1 is defined as adenoid tissue filling one-third of the vertical choanae, Grade 2 as one-third to two-thirds obstruction, and Grade 3 as two-thirds to nearly complete obstruction.

Modified ACE grading system

Assessed adenoid size (A), choanal obstruction (C), and Eustachian tube abutment (E): Grade 1 is defined as up to one-third obstruction with no Eustachian tube abutment, Grade 2 as one-third to two-thirds obstruction with abutment of the Eustachian tube, and Grade 3 as over two-thirds obstruction with abutment of the Eustachian tube.

Impedance audiometry

Performed bilaterally, with Type B tympanograms indicating OME.

Data collection

Patients underwent X-ray nasopharynx, nasal endoscopy, and impedance audiometry. Clinical symptoms (nasal obstruction, ear fullness, hearing loss) were recorded. Data were analyzed to correlate adenoid hypertrophy grades with OME incidence and tympanogram findings.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics were expressed as frequencies and percentages.

The association between adenoid hypertrophy grades and the presence of OME (Type B tympanogram) was assessed using the Chi-square test. A p value of <0.05 was considered statistically significant. Correlation analysis was performed to evaluate the relationship between endoscopic grading (ACE classification) and tympanometric findings.

Ethical considerations

The study was approved by the Scientific Research Committee GMC Anantnag, and informed consent was obtained in the local language. No ethical or financial conflicts were reported.

RESULTS

A total of 80 patients were included in the study. The age distribution showed that 25% of patients were in the 2–4 years age group, 40% were between 5–7 years, and 35% were between 8–12 years (Figure 1). The male-to-female ratio was 2:3 (Figure 2). The most common presenting symptoms were nasal obstruction, snoring, and ear fullness, although detailed symptom-wise frequency distribution is depicted (Figure 3).

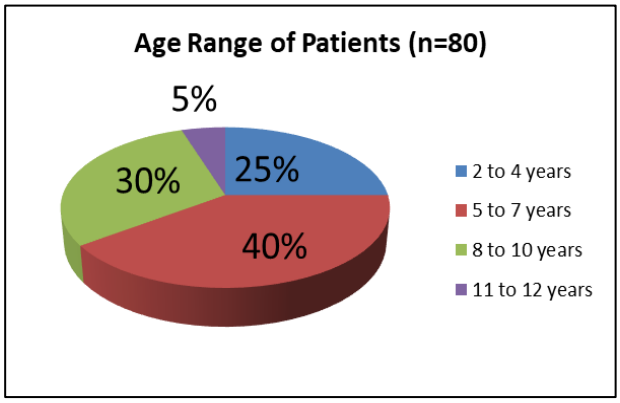

Figure 1: Age distribution of patients.

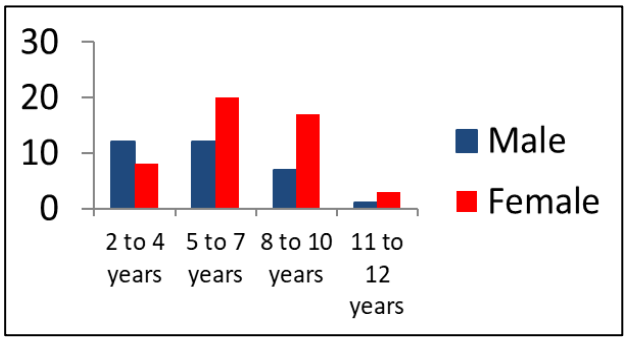

Figure 2: Sex distribution of patients.

Radiological assessment using X-ray nasopharynx demonstrated that 36 patients (45%) had Grade 2 adenoid hypertrophy, while 44 patients (55%) had Grade 3 hypertrophy. No patient was found to have Grade 1 hypertrophy. On nasal endoscopy, 32 patients (40%) were classified as Grade 2, and 48 patients (60%) as Grade 3, with no cases in Grade 1. The endoscopic grading is illustrated in Figure 4. Impedance audiometry was performed on a total of 160 ears. Type A tympanograms, indicating normal middle ear function, were observed in 36 ears (22.5%), with 20 cases being bilateral and 16 unilateral. Type B tympanograms, suggestive of otitis media with effusion, were seen in 48 ears (30%), including 40 bilateral and 8 unilateral cases. Type C tympanograms were observed in 16 ears (10%), with equal distribution between bilateral and unilateral presentations.

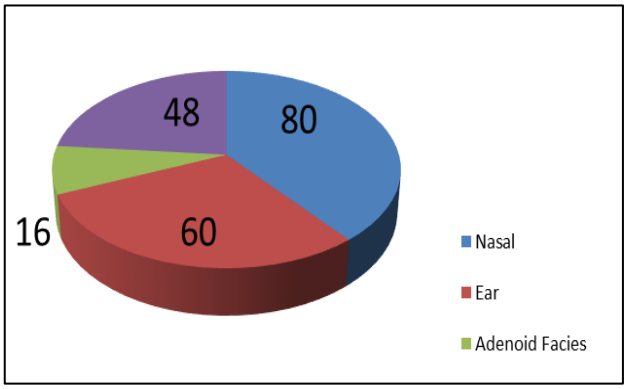

Figure 3: Symptom distribution of patients.

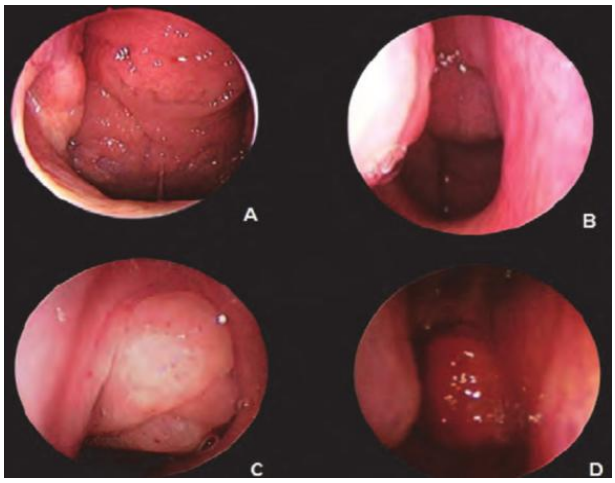

Figure 4: Nasal endoscopic grading of adenoid.

The incidence of OME increased with higher grades of adenoid hypertrophy. Among patients with Grade 2 adenoid hypertrophy (n=32), OME was present in 24 patients (75%). Of these, 8 patients (33.33%) had bilateral Type B tympanograms, while 16 patients (66.67%) had unilateral involvement. In patients with Grade 3 hypertrophy (n=48), OME was observed in 36 patients (90%). Among these, 20 patients (55.56%) demonstrated bilateral Type B tympanograms, while 16 patients (44.44%) had unilateral Type B tympanograms. In unilateral cases, the contralateral ear showed Type C tympanogram in 12 patients and Type A in 4 patients.

Evaluation using the Modified Adenoid-Choanal-Eustachian (ACE) grading system revealed that in Grade 2 hypertrophy, bilateral Eustachian tube abutment was present in 8 patients (25%), while unilateral abutment was observed in 16 patients (50%). In Grade 3 hypertrophy, bilateral Eustachian tube abutment was seen in 20 patients (41.67%) and unilateral abutment in 16

patients (33.33%). Notably, Eustachian tube abutment on nasal endoscopy showed a 100% correlation with Type B tympanograms.

Adenoid hypertrophy grading

X-ray findings

Grade 2 was observed in 36 patients (45%), Grade 3 in 44 patients (55%), and no patients (0%) were classified as Grade 1.

Nasal endoscopy (DNE)

Grade 2 was observed in 32 patients (40%), Grade 3 in 48 patients (60%), and no patients (0%) were classified as Grade 1.

Impedance audiometry

Of the 160 ears examined, type A (normal) was observed in 36 ears (22.5%), including 20 bilateral and 16 unilateral cases; type B (indicative of OME) in 48 ears (30%), including 40 bilateral and 8 unilateral cases; and type C in 16 ears (10%), including 8 bilateral and 8 unilateral cases.

Incidence of OME

Among patients with Grade 2 adenoid hypertrophy (n=32), OME was present in 24 patients (75%), with 8 patients (33.33%) showing bilateral type B and 16 patients (66.67%) showing unilateral type B. Among those with Grade 3 adenoid hypertrophy (n=48), OME was present in 36 patients (90%), with 20 patients (55.56%) showing bilateral type B and 16 patients (44.44%) showing unilateral type B, of whom 12 had type C and 4 had type A findings in the contralateral ear.

ACE grading and eustachian tube abutment

In Grade 2, bilateral Eustachian tube abutment was observed in 8 patients (25%) and unilateral abutment in 16 patients (50%), while in Grade 3, bilateral abutment was seen in 20 patients (41.67%) and unilateral abutment in 16 patients (33.33%); Eustachian tube abutment on nasal endoscopy showed a 100% correlation with Type B tympanograms.

DISCUSSION

The present study demonstrates a strong association between the severity of adenoid hypertrophy and the incidence of otitis media with effusion (OME). The majority of patients in our study belonged to the 5–7 years age group (40%), which is consistent with the findings of Paradise et al, who reported a peak incidence of adenoid-related morbidity in early childhood.[1] The observed female predominance (male:female=2:3) differs from some earlier studies, such as Bitar et al, which reported a slight male predominance, indicating possible regional or sample variations.[2]

In the present study, nasal obstruction and snoring were the most common presenting symptoms, similar to observations by Maw et al, who identified upper airway obstruction as the predominant clinical feature in children with adenoid hypertrophy.[3] These symptoms are often associated with Eustachian tube dysfunction and middle ear disease. Radiological assessment using X-ray nasopharynx showed that 55% of patients had Grade 3 hypertrophy, while nasal endoscopy demonstrated 60% in Grade 3. This slight variation highlights the limitation of radiography as a two-dimensional modality. Similar observations were made by Wang et al, who emphasized that X-ray may underestimate the actual adenoid size and its relation to surrounding structures.[4] In contrast, nasal endoscopy provides a dynamic and direct visualization, as supported by Clemens et al, who reported superior diagnostic accuracy with endoscopic evaluation.[5] In terms of middle ear status, Type B tympanograms were observed in 30% of ears in our study. This finding is comparable to Kumar and Verma, who reported Type B tympanograms in 58% of ears, and Khadgi et al, who observed Type B curves in 49.81% of cases.[6,7] Variations may be attributed to differences in sample size and inclusion criteria.

A key finding of this study is the increasing incidence of OME with higher grades of adenoid hypertrophy, with 75% in Grade 2 and 90% in Grade 3. This trend is consistent with the study by Fujioka et al, which demonstrated a positive correlation between adenoid size and middle ear disease.[8] Similar dose-response relationships have also been reported by Parikh et al, emphasizing the role of mechanical obstruction and inflammation in Eustachian tube dysfunction.[9] The Modified ACE grading system used in this study showed a strong correlation with tympanometric findings. Notably, Eustachian tube abutment on nasal endoscopy demonstrated a 100% correlation with Type B tympanograms. This finding is in agreement with Peedikakaa et al (2023), who reported that direct visualization of Eustachian tube obstruction is a reliable predictor of middle ear effusion.[10] This highlights the clinical utility of endoscopic grading systems in guiding management decisions. Overall, the findings of this study reinforce that nasal endoscopy, particularly with ACE grading, is superior to radiological assessment in evaluating adenoid hypertrophy and predicting its impact on middle ear status. The strong correlation between higher grades of hypertrophy and OME supports early diagnosis and intervention to prevent long-term complications such as hearing loss and speech delay.

Limitations

The study's sample size (n=80) limits generalizability. Long-term follow-up data were not collected, and the

impact of treatment (e.g. adenoidectomy) was not assessed.

CONCLUSION

Nasal endoscopy is a reliable and safe method for assessing adenoid hypertrophy, with the ACE grading system offering precise evaluation of Eustachian tube involvement. The strong correlation between adenoid size, Eustachian tube abutment, and Type B tympanograms supports a standardized approach to managing adenoid hypertrophy and OME. These findings advocate for routine endoscopic evaluation in children with suspected adenoid-related hearing loss.

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Ethical approval: The study was approved by the Scientific Research Committee GMC Anantnag, Kashmir, India

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