

## Original Article

---

# Effects of Enlarged Adenoids on Middle Ear Pressure and Hearing

Md. Noor Kutubul Alam<sup>1</sup>, S M Nazmul Huque<sup>2</sup>, A B M Delowar Hossain<sup>3</sup>, Kazi Atikuzzaman<sup>4</sup>, Mohammad Jamal Hussain<sup>5</sup>, Mostafa Kamal Arefin<sup>6</sup>

### Abstract:

**Background:** Adenoids are common childhood upper respiratory tract problem which frequently obstruct the nasopharyngeal opening with tubal occlusion causes reduction in middle ear pressure with conductive hearing loss.

**Objective:** To observe middle ear pressure and level of hearing in children with enlarged adenoids.

**Methods:** This cross sectional observational study conducted among 72 children of enlarged adenoids admitted or attended in Dhaka Medical College Hospital and Bangabandhu Sheikh Mujib Medical University Dhaka.

**Results:** 72 children of enlarged adenoids of age ranges between 5-12 years with male female ratio was 1.25:1. Mouth breathing (65.27%), hearing impairment (59.72%), nasal obstruction (55.55%) and snoring (56.94%) were the presenting symptoms of the patients. Majority of the patients of this study came from middle class (52.77%). Most of the patients with enlarged adenoids were grossly enlarged (51.38%). 43.05% grossly enlarged adenoids had significant hearing loss. In this series 65 ears (45.13%) had type A Tympanogram. 58 ears (40.27%) has Type B Tympanogram and 21 ears (14.58%) has Type C Tympanogram.

**Conclusion:** This study revealed significant association between enlarged adenoids and conductive hearing loss of variable degree and negative middle ear pressure.

**Keywords:** Adenoids, Middle ear pressure, Hearing

- 
1. Assistant Professor, Department of Otolaryngology and Head-neck Surgery, Jashore Medical College, Jashore Assistant Professor, Department of Otolaryngology and Head-neck Surgery, Jashore Medical College, Jashore
  2. Assistant Professor, Department of Otolaryngology and Head-neck Surgery, Jashore Medical College Jashore
  3. Associate Professor, Department of Otolaryngology and Head-neck Surgery, Enam Medical College, Savar, Dhaka
  4. Assistant Professor, Department of Otolaryngology and Head-neck Surgery, Rangamati Medical College, Rangamati, Chittagong
  5. Indoor Medical officer, Department of Otolaryngology and Head-neck Surgery, Dhaka Medical College, Dhaka

**Address for Correspondence:** Md. Noor Kutubul Alam, Assistant Professor, Department of Otolaryngology and Head-neck Surgery, Jashore Medical College, Jashore, Cell No : 01710808409. E-mail:kutubrumy@gmail.com

**Introduction:**

Adenoids hypertrophy are frequent health problem for young children. Adenoids are component of Waldeyer's ring and because of their anatomic position can be relevant in the pathogenesis of otitis media when they are inflamed and/or enlarged. Adenoids can create mechanical eustachian tube obstruction. Adenoids are very small at birth and progressively enlarge as a result of increased immunologic activity. The Adenoids appear to be at it's largest in the seven-year-old age group<sup>1</sup>. Involution of the adenoids begin after puberty. Regression of the adenoids occur rapidly after 15 years of age in most children<sup>1</sup>. Hypertrophied and chronically infected adenoids had increased load of pathogenic bacteria, especially beta-lactamase producers, as compared with nondiseased adenoids. An equilibrium exists between the normal flora of the adenoid tissue and their local immunologic response and this equilibrium can become disrupted with recurrent acute viral or bacterial infections or colonization with pathogenic bacteria, resulting in hypertrophied lymphoid tissue<sup>2</sup>.

Evaluation of adenoids are much more difficult because it is not easily accessible on physical examination. Lateral neck radiography may be helpful to assess adenoids hypertrophy. Historically, the adenoids has been associated with upper airway obstruction, and more recently with the persistence of otitis media with effusion. Clinical symptoms are more common in a younger age group, due to the relative small volume of the nasopharynx and the increased frequency of upper respiratory tract infections<sup>3</sup>.

The function of middle ear is to transmit sound wave from external ear to inner ear by its transformer mechanism. The normal middle ear pressure is -100mm of H<sub>2</sub>O to +50mm of H<sub>2</sub>O and normal middle ear compliance is

0.39 ml to 1.30ml<sup>4</sup>. Middle ear pressure (MEP) is believed to influence sound transmission primarily by increasing the stiffness and damping of tympanic membrane.

Due to mechanical obstruction of eustachian tube by enlarged adenoids, negative pressure is being created within the middle ear<sup>5</sup>. Resulting in vascular engorgement with increased capillary permeability leading to pouring of fluid in the middle ear<sup>6</sup>. Negative pressure is also responsible for retraction of tympanic membrane, together with accumulated fluid influence the middle ear mass effects producing reduced middle ear compliance and conductive type of hearing loss<sup>7</sup>.

The risk of otitis media with effusion was more than seven times as more among adenoidal group than among the non-adenoidal control. Gross nasopharyngeal obstruction is significantly associated with type B tympanogram. The diagnosis of otitis media with effusion correlated significantly with the degree of nasopharyngeal obstruction<sup>8</sup>. In otitis media with effusion middle ear pressure reduces below -100mm H<sub>2</sub>O<sup>9</sup>. In otitis media with effusion usually mild to moderate degree of hearing loss develops<sup>7</sup>.

**Methods:**

This study was done in the department of Otolaryngology and Head-Neck surgery in the Bangabandhu Sheikh Mujib Medical University, Dhaka and Dhaka Medical College Hospital, Dhaka from February 2012 to August 2012. Inclusion criteria were all patients with enlarged adenoids of both sex from 5 to 12 years of age. Exclusion criteria were Patients or their guardian who refused to include this study, Patient with hearing loss due to chronic suppurative otitis media or other causes than adenoids, child with profound hearing loss, congenital deafness, cleft palate.

With proper ethical consideration after taking an informed consent from the guardian of all selected patients were interviewed, examined and investigated. Total 72 patients were included in this study. Diagnosis of enlarged adenoids was based on the symptoms and clinical presentation of the patient, clinical examination and radiological investigation (e.g. X-ray nasopharynx lateral view). Middle ear condition was assessed by clinical examination, otoscopy, microscopic examination of ears and tympanometry. Hearing threshold was assessed by audiometry (pure tone audiometry) along with

clinical assessment. All the information and data was recorded and compiled in a structured data sheet. All the data was analyzed by a standard statistical methods and computer software (SPSS-16, Sigma Stat-3.2)

#### Results:

Maximum numbers of patients presented with enlarged adenoids belonged to 5 – 8 years (77.78%). In this study among the patients with enlarged adenoids 55.55% were male and 44.44% were female. Thus male to female ratio was 1.25:1.

**Table-I :**  
*Age and Sex distributions of patients of adenoids (n=72)*

Age in years	Sex		Number of patients
	Male	Female	
>5-8	31	25	56 (77.78%)
>8-12	9	7	16 (22.22%)
Total	40(55.55%)	32 (44.44%)	72(100.0%)

**Table-II :**  
*Presenting symptoms of adenoids (n=72)*

Symptoms	Number of Patients	Percentage
Mouth breathing	47	65.27
Hearing impairment	43	59.72
Snoring	41	56.94
Nasal obstruction	40	55.55
Dribbling of saliva	33	45.83
Sleep disturbance	27	37.5
Earache	13	18.05
Voice change	14	19.44
Epistaxis	2	2.77
Headache	7	9.72

Majority of the patients of this study were suffering from mouth breathing (65.27%) hearing impairment (59.72%). Nasal obstruction (55.55%) and snoring (56.94%).

**Table-III :**  
*Socio-economic status of the patients (n=72)*

Socio-economic status	Adenoids with Normal ear & Hearing	Adenoids with conductive hearing loss	Total (Percentage)
Affluent class	5 (6.94%)	5 (6.94%)	10 (13.88%)
Middle class	15 (20.83%)	23 (31.94%)	38 (52.77%)
Poor class	9 (12.5%)	15 (20.83%)	24 (33.33%)
Total	29 (40.27%)	43 (59.72%)	72 (100%)

Majority of the patients of this study came from Middle class 38(52.77%).

**Table- IV :**  
*Different sizes of enlarged adenoids with hearing status (n=72)*

Sizes of adenoids	Adenoids with Normal ear & Hearing	Adenoids with conductive hearing loss	Total (Percentage)
Mildly enlarged	11 ( 15.27%)	1 (1.38%)	12 (16.66%)
Moderately enlarged	12 (16.66%)	11 (15.27%)	23 (31.94%)
Grossly enlarged	6 (8.33%)	31 (43.05%)	37 (51.38%)
Total	29 (40.27%)	43 (59.72%)	72 (100%)

Most of the patients with enlarged adenoids were grossly enlarged 51.38%. Mildly enlarged adenoids has 16.66%. Moderately enlarged adenoids has (31.94%) . Adenoids with conductive hearing loss has (59.72%).

**Table-V :**  
*Severity of hearing loss in ears with adenoids (144 ear)*

Hearing threshold AC	No of ears	Percentage
Normal (<25dB)	65	45.13%
Mild (26-40dB)	21	14.58%
Moderate (41-55dB)	52	36.11%
Moderately severe (>55dB)	6	4.16%

Among the 144 ears mild (26-40dB) hearing loss was in 14.58% of ears, moderate(41-55 dB) hearing loss was 36.11% of ears and moderately severe (>55dB) hearing loss was 4.16% of ears.

**Table-VI :**  
Severity of conductive hearing loss based on air bone Gap (dB) among the Ears with Enlarged Adenoids (n=79)

AB Gap in PTA	Adenoids enlargement		Total
	Mild to Moderate enlarged	Grossly enlarged	
<15dB	10(12.65%)	11(13.92%)	21(26.58%)
20-30 dB	7(8.86%)	42(53.16%)	49(62.02%)
>30dB	0	9(11.39%)	9(11.39%)
Total	17(21.51%)	62(78.48%)	79(100%)

Among the patients with grossly enlarged adenoids air bone Gap <15dB was in 11 Ears(13.92%), air bone Gap range 20dB-30 dB was in 42 Ears(53.16%) and air bone Gap >30dB was in 9 Ears (11.39%).The severity of conductive (AC) loss had found significantly related with the size of adenoids enlargement. (P = 0.001).

**Table -VII :**  
Types of Tympanometry in both ear (n=144)

Tympanometry	Right ear (%) (n-72)	Left ear (%) (n-72)	Total (%) (n-144)
Type A	32 (44.44%)	33 (45.83%)	65 (45.13%)
Type B	28 (38.88%)	30 (41.66%)	58 (40.27%)
Type C	12(16.66%)	9 (12.5%)	21 (14.58%)

In this series 65 ears 45.13% had type A Tympanogram. Type B Tympanogram and Type C Tympanogram had 58 ears 40.27% and 21 ears 14.58% respectively. There was no significant relation between the right and left ears in middle ear pressure and compliance in tympanometry (P = 0.774).

#### Discussion:

Enlarged adenoids are common among the children. Adenoids hypertrophy has been identified as an aetiological factor in recurrent or persistent otitis media with effusion. To determining adenoidal hyperplasia, the physician typically relies on ent examinations , lateral neck radiograms, and history. Only physical examination gives little information

about size of adenoids. On the other hand, the lateral neck radiograph provides an excellent view of the adenoids. Radiologically adenoids mildly enlarged when nasopharyngeal airway obstruction  $<1/3$  ,moderately enlarged when nasopharyngeal airway obstruction  $>1/3$  but  $<2/3$  and grossly enlarged when nasopharyngeal airway obstruction  $>2/3$ .

This study was conducted to finds out the correlation of hearing and middle ear pressure in children with enlarged adenoids. This study also finds out the different demographic factors related to the enlarged adenoids. Finally, this study finds out the different degree of conductive hearing loss among the children with enlarged adenoids

In this study the patients age range between 5-12 years<sup>10</sup>. Male female ratio was 1.25:1.<sup>11</sup> Majority of the patients presented with more than one symptoms. The common symptoms of the patients of adenoids were mouth breathing (65.27%) hearing impairment (59.72%). These findings of this series are consistent with the findings of a reported series. A study showed mouth breathing and hearing impairment in 77.00% and 83.00% cases respectively<sup>12</sup>. Nasal obstruction (55.55%) and snoring (56.94%) in this series are consistent with the findings of a previous study. A study reported nasal obstruction and snoring is 40.79% and 40.79% cases respectively. Sleep disturbance, dribbling of saliva, earache, voice change, epistaxis, headache were found 37.5%, 45.83%, 18.05%, 19.44%, 2.77%, and 9.72% respectively.<sup>13</sup>

Most of the patient with enlarged adenoids came from middle class 52.77% (38 patient), the next highest incidence 33.33% (24 patient) in the poor class. The relative lower incidence in poor class is possibly due to lack of knowledge, ignorance about the health problems and failure to pay attention to health problems over the other daily requirements and hence failing to attend the hospital.

In the present study patients with enlarged adenoids has the incidence of conductive hearing loss is 59.72% (43 patient). Grossly enlarged adenoids has significant hearing loss 43.05% (31 patients). The child with adenoids with normal ear & hearing and adenoid with conductive hearing loss have significant relation with the different sizes of adenoids. More the size of adenoids more the effect on middle ear pressure and hearing. A study shown large adenoids have an influence on the hearing level of children, but probably via the negative middle ear pressure.<sup>14</sup>

In our study the hearing loss found in the patients with enlarged adenoids range from

26dB to 55dB among 54.86% of ears. Hearing loss between 26dB to 40dB was 14.58%, 41dB-55dB was 36.11% & >55dB was 4.16%. Hearing threshold depends upon the severity of otitis media with effusion<sup>15</sup>.

This study showed 29 patients (40.27%) of enlarged adenoids has normal hearing. Among 37 patients (51.38%) of grossly enlarged adenoids 6 patient (8.33%) has normal hearing. A study carried out in Nepal shown that air-bone gap did not correlate with the increasing grade of adenoids hypertrophy<sup>16</sup>. A study in Canada among 273 children shown only laterally hypertrophied adenoids tissue encroaching upon the eustachian tube orifice significantly causing conductive hearing loss<sup>17</sup>.

In this study 37 patients (51.38%) has grossly enlarged adenoids. Among the patients with grossly enlarged adenoids air bone gap <15dB was in 11 ears (13.92%), air bone gap range 20dB-30 dB was in 42 ears (53.16%) and air bone gap >30dB was in 9 ears (11.39%). The severity of conductive (AC) loss had found significantly related with the size of adenoids enlargement. A study shown that the adenoids hypertrophy in children may lift the hearing threshold level<sup>18</sup>.

In this series 65 ears (45.13%) has type A Tympanogram. Type B Tympanogram and Type C Tympanogram has 58 ears (40.27%) and 21 ears (14.58%) respectively. The reduced middle ear pressure is due to blockage of the eustachian tube by enlarged adenoids, absorption of middle ear air and presence of fluid in middle ear<sup>9</sup>.

In this study it is seen that middle ear pressure change and hearing impairment mostly affecting bilaterally. This bilateral ear involvement was due to enlargement of adenoid tissue from midline interfering the tubal function<sup>10</sup>.

**Conclusion:**

To observe the middle ear pressure and the level of hearing in children with enlarged adenoids this cross sectional study shows enlarged adenoids had significant effects on middle ear pressure and conductive type of hearing impairment. Early diagnosis and intervention should be encouraged to control the, morbidity and complications of middle ear diseases with hearing impairment in childhood with enlarged adenoids

**References:**

1. Robb PJ. The adenoid and adenoidectomy; Scott-Browns Otorhinolaryngology, Head and Neck surgery, ed. Gleeson M 7th edition, Hodder Arnold 2008, vol 1;84:1094-1101. 14
2. Brodsky L, Koch RJ, Bacteriology and immunology of normal and diseased adenoids in children. *Arch Otolaryngol Head Neck Surg* Aug 1993;119(8):821-829. doi:10.1001/archotol.1993.01880200021003
3. Wysocka J, Hassmann E, Lipska A, Musaitowicz M. Naive and memory T cells in hypertrophied adenoids in children according to age. *International journal of pediatric Otorhinolaryngology*. April 2003;67:237-241
4. Connor A.F. Examination of the ear. Booth J.B, ed. Scott Browns Otolaryngology; Otology ,Oxford, Butterworth-Heinemann, 1997; PP: 3/1/1-3/1/29.
5. Pau HW, Sievert U, Just T, Sadé J. Pressure changes in the human middle ear without opening the eustachian tube. *Acta Otolaryngol*Nov; 2009 ; 129(11):1182-6.
6. Buchman C.A. Functional-anatomical correlation of Eustachian tube obstruction related to the adenoids in a patient with otitis media with effusion: A case report .*Ear –Nose-Throat –J*. 1994,NOV:73(11);835-838.
7. Paradise J.L, Smith C.G, Bluestone C.D. Tympanometric detection of middle ear effusion in infants and young children.*Paediatrics*.1975;58:198-210.
8. Orji FT, Okolugbo NE, Ezeanolue BC. The role of adenoidal obstruction in the pathogenesis of otitis media with effusion in Nigerian children. *Niger J Med*. 2010 ; Jan-Mar;19(1):62-8.
9. Cantekin EI, Berry QC, Bluestone C.D. Tympanometric patterns found in middle ear effusion. *Ann Otol Rhinol Laryngol*, 1977; 86(suppl .41)16-20
10. Hibbert J. and White House G.H.The assessment of adenoidal size by radiological means. *Clinical Otolaryngology*. 1978;vol 3(1):43-47.
11. Maw. A.R, Jeans.W.D. & Fernando. D.C.J. Interobserver variability in the clinical and radiological assessment of adenoid size, and correlation with adenoid volume. *Clin.Otolaryngol*. 1981 October ;Volume 6,317-322
12. Pruzanski S. Roentgencephalometric studies of tonsils and adenoids in normal and pathologic states. *Ann Otolaryngol*, 1995;84 Suppl.19:55.
13. Deweese D.D .& Saunders W.H. Text book of Otolaryngology. Sixth edition .The C.V Mosbey Company. 1982 ;67.386.
14. Haapaniemi JJ. Adenoids in school-aged children. *J Laryngol Otol*. 1995; Mar; 109(3): 196-202.
15. Hibbert J. and White House G.H. The assessment of adenoidal size by radiological means. *Clinical Otolaryngology*. 1978;vol 3:43-47.

16. Acharya K, Bhusal CL, Guragain RP. Endoscopic grading of adenoid in otitis media with effusion. *JNMA J Nepal Med Assoc.* 2010; Jan-Mar;49(177):47-51.
17. Erin D Wright, Alden J Pearl John J Manoukian. Laterally hypertrophic adenoids as a contributing factor in otitis media. *International Journal of Pediatric Otorhinolaryngology.* 1998;Volume 45, Issue 3, 15 October, Pages 207–214
18. Furmann A, Goińska A, Hojan E, Perz P. Effect of middle ear impedance on hearing threshold level in children with adenoid hypertrophy. *Otolaryngol Pol.* 2002; 56(1):77-81