Original Research Article

Study of middle ear pressure in patients of nasal obstruction

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Abstract

Background: The nasopharynx communicates laterally with the middle ears through the eustachian tubes.Intermittent brief dilatation of the eustachiantube is the principal mechanism forequilibration of middle ear pressure with the ambient atmosphere. **Aim:** To find out whether nasal obstruction leads to change in middle ear pressure. **Material and Methods:** Fifty patients with nasal obstruction were included in the study.A thorough ENT examination was done. Middle ear pressure was measured through impedance audiometer AT235 and a tympanogram recorded on thermal paper. Middle ear pressure was measured in mm of water pressure or Deka Pascal units. **Results:** Out of total 100 ears examined in patients with nasal obstruction 41% have middle ear pressure in the normal range and 59% were having negative middle ear pressure. 50% shows either type B or type C tympanograms. **Conclusion:** Nasal obstruction has a significant effect on eustachian tube function and middle ear pressure in the majority of cases in the study population especially in 0-20 years age group.

Key Words: Nasal obstruction, Eustachian tube, middle ear pressure, tympanogram

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INTRODUCTION

Nasal obstruction is defined as discomfort manifested by feeling of insufficient air flow through the nose. The causes of nasal obstruction in humans are numerous and diverse, but the symptoms are essentially similar. Posteriorly both nasal cavities are in direct continuity with nasopharynx. The nasopharynx communicates laterally with the middle ears through the eustachian tubes.[1] The eustachian tube serves to regulate air pressure in the middle ear and mastoid system, clear material from the middle ear, and prevent reflux of material or sound from the nasopharynx.[2] It is believed that intermittent brief dilatation of the tube is the principal mechanism for equilibration of middle ear pressure with the ambient atmosphere. Middle ear and mastoid gas exchange is an ongoing process that continually generates a net absorption of gases resulting in an increasingly negative pressure between tubal dilatations. Failure to dilate for an extended period of time can lead to pathologically severe negative pressure and consequences of tympanic membrane retraction, atelectasis, and otitis media with effusion (OME). Reflux of nasopharyngeal secretions into the middle ear is limited or prevented by the closed position of the resting pharyngeal eustachian tube and by the trapped volume of gas in the middle ear and mastoid bone which creates a “cushion". Reflux of the sounds of breathing and vocalization are also blocked by the closed resting position of the pharyngeal eustachian tube. Thus, it is evident from above knowledge that nasal cavity, nasopharynx and middle ear are closely related to each other and goal of this study was to find out whether nasal obstruction leads to change in middle ear pressure.

MATERIAL AND METHODS

This study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery and

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Pathology, over a period of two years. During this period fifty patients with nasal obstruction were included in the study.

Inclusion criteria

- Patients with complaints of unilateral or bilateral nasal obstruction.
- Patients giving consent for study.
- Patients below age 60 years.
- Patients above the age of 1 year.

Exclusion criteria

- Age >60 years or <1year.
- Patients with ear discharge, otitis externa, acute otitis media, outer ear defects such as complete stenosis or atresia of external auditory canal and excessive wax.
- Patients with perforation of tympanic membrane.
- Patients using nasal drops/spray.
- Patients with previous ear surgery

Methodology

Permission from Institutional Ethical Committee was obtained prior to the commencement of the study. A written informed consent was taken from each participant. Detailed history obtained from study participants regarding nasal obstruction, unilateral or bilateral involvement, duration of nasal obstruction, allergic symptoms, nasal discharge, ear discharge, earache, decreased hearing, headache, tinnitus, mouth breathing at night, congenital hearing loss, previous surgical procedures. Clinical examination of patient was done including general physical examination and systemic examination for assessing the general condition of participants. A thorough ENT examination was done including anterior rhinoscopy, posterior rhinoscopy, ear examination, throat examination. Various nasal patency tests such as cold spatula test, cotton wool test, cottle's test were performed to assess and compare the nasal breathing on bilateral nasal cavities. Middle ear pressure was measured through impedance audiometer AT235 and a tympanogram recorded on thermal paper. Middle ear pressure was measured in mm of water pressure or Deka Pascal units. The pressure at which the tympanogram shows the highest compliance is the pressure of the air in the middle ear cavity. The most accepted range is +50mm of water pressure to -50mm of water pressure was taken as normal.

Statistical analysis

Data were entered in Microsoft Excel sheet. The continuous variables were presented using mean/ median. For categorical variables proportions were used. Means were tested using student t-test and proportions using Chi-square and Z-test. Level of significance was set at $p<0.05$. The statistical analysis was done using Epi Info v7 software.

RESULTS

The mean age of the study participants with nasal obstruction at presentation was 16.2 years (SD±11.9). Thirty-three (66%) patients were aged 0-20 years. Sixteen patients (32%) were in the age group 21-40 years and 01 (2%) patients were of the age group 41-60 years. Out of overall 50 subjects studied 31/50(62%) males and 19/50(38%) females. The study population comprised of 15/50 (30%) male adults, 7/50 (14%) female adults, 16/50 (32%) male children and 12/50 (24%) female children. Out of 50 subjects studied, 14/50 (28%) subjects were having complaint of unilateral nasal obstruction and rest 36/50 (72%) were having bilateral nasal obstruction.

Table 1: Frequency distribution of the presenting symptoms

Symptom	Frequency	Percentage (%)
Nasal obstruction	50	100%
Mouth breathing	29	58%
Excess sneezing	16	32%
Post nasal discharge	15	30%
Decreased hearing	09	18%
Headache	08	16%
Ear Pain	04	8%
Tinnitus	01	2%

All cases 50/50(100%) presented with nasal obstruction. Among other associated symptoms, mouth breathing at night was commonest in 29 (58%) followed by excess sneezing in 16 (32%) and only 1/50(2%) had associated tinnitus. (Table 1). In our study, 37/50 (74%) were having complaints of nasal obstruction for duration between 0-20 months, 8/50 (16%) for 21-40 months, 4/50 (8%) for 41-60 months and 1/50 (2%) for 61-80 months of duration.

Table 2: Clinical diagnosis in study population

Clinical diagnosis	Frequency	Percentage (%)
Adenotonsillitis	21	42%
Allergic rhinitis / Allergic rhinosinusitis	05	10%
Nose and PNS Polyposis	06	12%
Turbinate hypertrophy	06	12%
DNS / Spur / CSD	02	04%
Nasal Packing	04	08%
Rhinolith	01	02%
Adenoiditis+Turbinate Hypertrophy	02	04%
DNS + ITH + Polyp	01	02%
DNS/ITH/CSD + ITH	02	04%

Table 3: Frequency distribution of the middle ear pressure in 100 ears

Middle ear pressure indaPa	Frequency	Percentage(%)
+100 to +150	01	01%
+50 to +100	01	01%
0 to +50	14	14%
0 to -50	25	25%
-50 to -100	15	15%
-100 to -150	14	14%
-150 to -200	09	9%
-200 to -250	07	7%
-250 to -300	04	4%
-300 to -350	06	06%
-350 to -400	04	04%

Middle ear pressure measured in 50 subjects (total = 100 ears) showed that in right ear 17/50 (34%) had middle ear pressure in the normal range (-50to +50 daPa) and 34/50 (68%) had negative middle ear pressure (<-50daPa). In left ear, 24/50(48%) have middle ear pressure in the normal range (-50to +50 daPa) and 26/50(52%) were having negative middle ear pressure (< -50daPa). Thus, out of total 100 ears examined, 41/100(41%) had middle ear pressure in the normal range (-50 to +50 daPa) and 59/100(59%)were having negative middle ear pressure (<-50 daPa). In our study, right ear tympanometry showed that 23/50(46%) had type A, 02/50 (4%) had type Ad, 07/50 (14%) had type B, 18/50 (36%) had type C tympanograms and left ear tympanometry showed that 22/50 (44%) had type A, 02/50 (4%) had type Ad, 01/50(2%) had type As, 09/50(18%) had type B, 16/50(32%) had type C tympanograms. So, out of total 100 tympanograms, 45% were type A, 4% were type Ad, 1% were type As, 16% were type B and 34% were type C tympanograms.

Table 4: Frequency distribution of the compliance in 100 ears

Middle ear compliance	Right ear	Left ear	Total	Percentage
0ml to 0.35ml	16	16	32	32%
0.36ml to 1.40ml	29	30	59	59%
>1.40ml	05	04	09	09%

Acoustic compliance is an expression of elastic movement or springiness of the middle ear system and is reciprocal of stiffness. It is measured in millilitres. In our study subjects, middle ear compliance in right ear was low(0 to 0.35 ml) in 16/50(32%), normal (0.36ml to 1.40 ml) in 29/50(58%) and high (>1.40 ml) in 5/50(10%). Middle ear compliance in left ear was low(0 to 0.35 ml) in 16/50(32%), normal (0.36ml to 1.40 ml) in 30/50(60%) and high (>1.40 ml) in 4/50(8%). So, in all the 100 ears examined, middle ear compliance in right ear was low(0 to 0.35 ml) in 32/100(32%), normal (0.36ml to 1.40 ml) in 59/100(59%) and high (> 1.40 ml) in 9/100(9%).

DISCUSSION

Eustachian tube maintains middle ear pressure equal to that of atmospheric pressure and allows normal respiratory secretions to pass to nasopharynx. Its functions is deranged due to various nasal, nasopharyngeal and palatal causes. Eustachian tube function may also get deranged transiently during nasal packing and introduction of nasogastric tube and nasopharyngeal intubation. Most of the above conditions present with subjective sensation of nasal obstruction.

During a prospective study Satish *et al*[3] while studying the role of adenoidectomy in otitis media with effusion in 50 patients in the age group 5-15 years observed that majority of patients 40/50(80%) were in the age group of 5-10 years and rest 10/50(20%) were in the age group of 10-15 years and the mean age of study participants was 7.48 years. Almost similar findings observed in our study as the mean age of the study participants with nasal obstruction at presentation was 16.2 years (SD±11.9).33/50 (66%) patients were aged 0-20 years suggesting that nasal obstruction was more common in the age group of 0-20 years. Out of the total 50 subjects studied, all cases 50/50 (100%) presented with nasal obstruction,9/50 (18%) have decreased hearing, 29/50(58%) complain of mouth breathing at night. Adenoidits/ tonsillitis/ adenotonsillitis 21/50 (42%) is observed as thelargest cause of nasal obstruction in my study. Out of total 100 tympanograms of Group A subjects 45% were type A, 4% were type Ad, 1% were type As,16% were type B and 34% were type C tympanograms. All these findings well correlate with the observation made by Satish *et al*.[3] Nasal obstruction was more common in patients 0-20 years of age and frequency decreases with increasing age. These findings can be attributed to higher frequency of tonsillar enlargement, adenoid hypertrophy and adeno-tonsillar hypertrophy in children. Since, polyps and allergic rhinitis are common in age group 21-40 years which can be attributed to frequency of nasal obstruction in this age group. Shrivastva *et al*[4] while studying the effect of antrochoanal polyp on middle ear pressure in 39 subjects found that 24 cases(61.5%) were in the age group of 21-40 years, followed by 8 cases(20.5%) in 0-20 years age group followed by 6cases(15.4%) in 41-60 years and only 1 case(2.6 %) was found to be in more than 60 years of age. They concluded that age group most affected with antrochoanal polyp was of 21-40 years (61.5 %). No gender preponderance was observed in their study with 53.8 % of males and 46.2 % of females. In our study gender distribution was more inclined toward males 31/50 (62%) versus 19/50 (38%) females, which was slightly different from observations of Shrivastva *et al*.[4] During measurement of middle ear pressure we observed that out of total 100 ears examined, 41/100(41%)have middle ear pressure in the normal range (-50 to +50 daPa) and 59/100(59%) were having negative middle ear pressure (< -50 daPa). So, most of the findings observed by Shrivastva *et al*[4] were congruent with our study. During a prospective study Murthy A *et al*[5] while analysing the role of allergic rhinitis and its effect on the middle ear pressure in two groups of patients, who had not taken any medication Group A (n=68) and patients who were on anti-allergy medications Group B (n=60) observed that patients already on anti-allergy medications (Group B) were having normal middle pressure on their first and subsequent visits also. Whereas patients in Group A had Type C curvein 30% of the patients on their first visit and subsequently on six to eight weeks of anti-allergy medications the impedance tympanometry showed normal middle ear pressure. These findings correlate with our study as out of total 100 tympanograms, 50% were type A, 16% were type B and34% were type C tympanograms in our study. Salaheldin AH[6] studied the effect of deviated nasal septum and hypertrophy of inferior turbinate on middle ear pressure on 34 patients observed that type c tympanogram<-100daPa was found in only 5 patients (14.71%) and rest of the patients 29 85.29%)had MEP within the normal range. Similar findings observed in our study and observed that out of total 100 ears examined in Group A subjects 41/100(41%)have middle ear pressure in the normal range (-50 to +50 daPa) and 59/100(59%) were having negative middle ear pressure (<-50 daPa). During a studyon effect of nasal obstruction surgery on middle ear ventilation Nawad OGA etal[7] observed that out of 60 ears examined preoperatively, 47 (78.3%) ears were type A, 24 ears of them had poor ETF and 23 ears had good ETF. Thirteen(21.6%) ears were type C, all of them had poor ETF. The postoperative results of ETF tests were significantly better than preoperative results (P <0.002). Significant improvement in tympanometeric values was also found (P <0.05).Preoperatively, 28 patients (93.3%) had sensation of ear fullness. At 30 days after removal of nasal packs, 20 patients (66.7%) still had sensation of ear fullness, with significant improvement (P < 0.001). Similar findings observed in our study as out of total 100 tympanograms, 45% were type A, 4% were type Ad, 1% were type As, 16% were type B and 34% were typeC tympanograms. Out of the total 50 subjects studied, all cases 50/50(100%) presented with nasal obstruction. Chronic rhinosinusutis is associated with inflammatory changes ranging from polypoid mucosa to gross nasal polypi. Nasal polypi cause post nasal drip which is considered to cause eustachian tube dysfunction. The tube is frequently involved in different pathological conditions of the nasal, paranasal and nasopharyngeal cavities. Therefore, nasal obstruction can alter eustachian tube function. Most inflammatory disorders of the middle ear are thought to be due to inadequate ventilation through the eustachian tube. The lymphatics of the middle ear and eustachian tube course along the posterior-inferior aspect of the eustachian tube, getting afferent from nasal cavity, paranasal sinuses, nasopharynx and adenoids. Efferent from plexus terminate in retropharyngeallymph nodes. Inflammation and oedema in these areas cause obstruction to the flow, resulting in retrograde obstruction

of tympanic and tubal lymphatics producing tubal dysfunction and middle ear effusion. Although tubaldysfunction and middle ear effusion may occur simultaneously, but effusion can occur in absence of frank obstruction of eustachian tube lumen and development of middle ear vacuum. As evident from above literature nasal obstruction can result from various causes in nose, paranasal sinuses, and nasopharynx. This study has taken wide range of patients with subjective complaint of nasal obstruction such as recurrent rhino-sinusitis, deviated nasal septum, nasal polyps, nasal masses, enlarged adenoids, nasopharyngeal angiofibroma, nasopharyngeal carcinoma, nasal packing and rhinolith. All the above and various other causes directly or indirectly interfere with normal eustchian tube function and cause blockage of eustachian tube which leads to formation of aclosed chamber in middle ear cleft. During course of time, air entrapped in middle ear cleft gets absorbed by mucosal lining of middle ear cleft and generation of negative pressure in middle ear cleft. Due to negative pressure in middle ear cleft various aural symptoms arise in patients such as aural fullness, decreased hearing. Due to intimate relation between nose, nasopharynx and middle ear through eustachian tube any condition leading to nasal obstruction and simultaneous obstruction of eustachian tube can have negative impact on proper functioning of middle ear.

CONCLUSION

Nasal obstruction has a significant effect on eustachian tube function and middle ear pressure in the majority of cases in the study population especially in 0-20 years age group.

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