

"EFFECT OF ANTERIOR NASAL PACKING ON MIDDLE EAR FUNCTION AND HEARING: A PROSPECTIVE STUDY"

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Abstract

Introduction- The Eustachian tube provides an anatomic communication between the middle ear and nasopharynx, and maintains pressure equality across the tympanic membrane.

Objective- To see the effect of anterior nasal packing on Otological symptoms, middle ear pressure and hearing

Materials and method- This prospective study was carried out during period of September 2018 till August 2019. 100 ears were taken in the study. Middle ear pressure and hearing threshold were evaluated by Tympanometry and Audiometry respectively.

Results- Postoperatively two days after anterior nasal packing, there was increase in no. of patient ears with ear fullness, ear ache, tinnitus, hearing threshold and abnormal negative middle ear pressure. After removal of nasal packing up to twelve weeks, improvement in middle ear pressure and hearing threshold was seen.

Conclusion- Anterior nasal packing causes decrease in middle ear pressure and increase in hearing threshold.

Key words- Eustachian tube, Middle ear pressure, Hearing threshold

Introduction-

The Eustachian tube provides an anatomic communication between the nasopharynx and the middle ear and is in a unique position to cause changes in the middle ear secondary to reactions

in the nose. The Eustachian tube serves, several functions, including protection from nasopharyngeal secretions, drainage of middle ear secretion into the nasopharynx and ventilation of the middle ear to equilibrate air pressure with atmospheric pressure and to replenish oxygen that has been absorbed. In normal tubal function, the intermittent opening of the Eustachian tube maintains near ambient pressure in the middle ear cavity^[1]. Its dysfunction causes negative middle ear pressure, the tympanic membrane gets sucked in resulting in impaired sound conduction and hearing loss. Nasal packing causes complete nasal obstruction and induces edema of nose, nasopharynx and paranasal sinuses that may overload regional lymphatics at the level of peritubal plexus and retropharyngeal nodes. Thus, if eustachian tube is affected by nasal obstruction or lymphatic stasis patients subjected to nasal packing would be expected to demonstrate abnormalities in tubal function. An early symptom of an insufficient eustachian tube is the presence of negative middle ear pressure. Tympanometry can reliably demonstrate the variation in middle ear pressure at a very early stage^[2]. The Eustachian tube dysfunction consequently causes hypoventilation of middle ear are among the most frequent causes of failure of middle ear surgery. Thus, a complete evaluation of the nasopharyngeal tubal unit and nasal airflow is mandatory before middle ear surgery to increase

the success rate. Impedance Audiometry should be performed in all patients who are subjected to middle ear surgery to evaluate the opportunity of improving nasal breathing before surgery thereby improving the success rates of surgery^[3].

This study is planned to see the effect of anterior nasal packing on otological symptoms (ear fullness, pain in ears and tinnitus) middle ear pressure and hearing.

Materials and method- This prospective randomized comparative study which was conducted during period of September 2018 till August 2019 in Department of ENT and Head and Neck Surgery, Swaroop Rani Nehru Hospital, Moti Lal Nehru Medical College, Prayagraj (Allahabad), Uttar Pradesh. Fifty patient (100ears) were taken in study. This study was conducted after due clearance from the Institution Ethics Committee. Patients of age groups 15-50 years irrespective of gender were included in the study. Patients having history of co-morbidity like Bronchial Asthma, Tuberculosis (TB), Diabetes Mellitus (DM), Allergic rhinitis, and patients having external and middle ear infection/disease, history of ototoxic drug intake, history of trauma to ear, oral maxillofacial injuries, past history of ear or nasal surgeries, history of sudden weight loss and pregnant women were excluded from the study. Nasal packing was done bilateral in all the cases. Screening of ear symptom (fullness of ears, pain in ears and tinnitus), middle ear pressure, hearing threshold were evaluated, prior to nasal packing, two days after pack, one, four and twelve week after removal of anterior nasal pack. Anterior nasal packing of ribbon gauze impregnated with Bismuth iodoform paraffin paste (BIPP) was used and anterior nasal pack was removed within 48-72 hours.

Otological symptoms were evaluated by taking history and middle ear pressure was evaluated by Impedance Audiometer GSI Tympanostar Pro. Middle ear pressure between -100daPa to +100daPa was considered as normal middle ear pressure. The tympanograms were classified in

standard manner according to Jerger^[4]. Hearing was evaluated by Pure Tone Audiometer GSI Pello respectively in both ears. Normal hearing defined on Pure Tone Audiometry (PTA) as average pure tone within 25 decibel^[5].

Results were statistically analyzed using SPSS (statistical package for social sciences). Results of ear symptom (fullness of ears, pain in ears and tinnitus), audiometry and tympanometry were compared and analyzed utilizing Chi square test. Paired T-test was utilized to compare and analysis of middle ear pressure. Statistical significance was accepted as $p < 0.05$.

Result:- A total of 58 patients underwent nasal surgery and anterior nasal packing was studied. Out of these, two patients with epistaxis had Diabetes mellitus (Type II), four patients had sensorineural hearing loss, and 2 patients did not turn up in the follow-up period. Hence, they were excluded from the study.

Table 1- Age and sex distribution of patients (n=50 patients)

Age group(yrs)	Male	Female	Number of patients	Percentage
15-19	10	2	12	24%
20-24	7	4	11	22%
25-29	3	7	10	20%
30-34	2	4	6	12%
35-39	5	0	5	10%
40-44	1	2	3	6%
45-50	0	3	3	6%
Total	28	22	50	100%

Finally 50 patients between the age group 15 to 50years (male to female ratio was 7:6.5) who underwent anterior nasal packing after nasal surgery, were included in this study. The mean age of patients was 26.98 ± 7.19 years (mean \pm SD) (Table 1).

Out of 50 patients, 29 patients were diagnosed as a case of Deviated Nasal Septum who underwent Septal correction (submucous resection and septoplasty), and 16 patients were diagnosed as bilateral ethmoidal polyp and 5 patients were diagnosed as a case of bilateral Allergic Fungal Rhinosinusitis who underwent Functional Endoscopic Sinus Surgery.

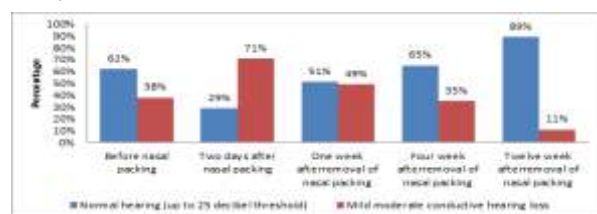
Table 2- Otological symptoms of patient ears

S.N.	Otological symptom	Before nasal packing	Two days after nasal packing	After removal of nasal packing		
				After one week	After four weeks	After twelve weeks
1-	Ear fullness	58 (58%)	98 (98%)	62 (62%)	21 (21%)	10 (10%)
2-	Earache	16 (16%)	34 (34%)	30 (30%)	20 (20%)	18 (18%)
3-	Tinnitus	24 (24%)	36 (36%)	28 (28%)	18 (18%)	14 (14%)

At initial visit (preoperatively) 58% ears had ear fullness, 16% ears had an earache and 24% ears had tinnitus. There was an increase in symptoms of ear fullness (98%), earache (34%) and tinnitus (36%) at initial post-operative evaluation after 2 days of nasal packing (Table 2).

Table 3- Pure Tone Audiometry finding of patient ears (n=100ears)

S.N.	Hearing (in decibel)	Before nasal packing	Two days after nasal packing	After removal of nasal packing		
				After one week	After four weeks	After twelve weeks
1-	Normal hearing	62(62%)	29 (29%)	51 (51%)	65(65%)	89 (89%)
2-	Mild-moderate hearing loss	38 (38%)	71 (71%)	49 (49%)	35 (35%)	11 (11%)
3-	p value		p<0.0001 (significant)	p>0.05(not significant)	p>0.05(not significant)	p<0.0001 (significant)

Figure 1- Pure Tone Audiometry findings (n=100 ears)

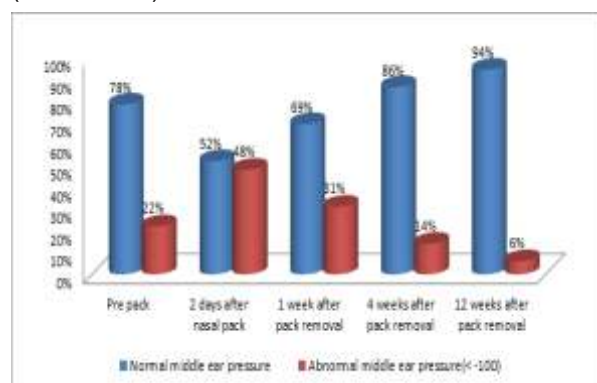
Preoperatively 62% ears had a normal hearing threshold (up to 25 decibels) and 38% ears had mild-moderate conductive hearing loss. Postoperatively there was an increase in mild to moderate (up to 26-55 decibel threshold) conductive hearing loss in 71% ears at initial post-operative evaluation that is two days of nasal packing. There was improvement in at normal hearing at one week (51%), four weeks (65%) and twelve-weeks (89%) after removal of nasal packing (Table 3, Figure 1).

Middle ear pressure between -100 dapa to

100dapa has been considered to be normal middle ear pressure. Out of 100 ears only 22% ears shows abnormal middle ear pressure preoperatively and ranged between -101dapa to -200dapa. Two days after anterior nasal packing (pack in situ), abnormal middle ear pressure was seen in 48% ears. Middle ear pressure was found abnormal in 31%, 14% and 6% ears at one, four and twelve-week after removal of nasal packing respectively (Table 4, Figure 2).

Table 4- Middle Ear Pressure of the patient ears (n=100 ears)

S.N.	Middle ear pressure (daPa)	Before nasal packing	Two days after nasal packing	After removal of nasal packing		
				After one week	After four weeks	After twelve weeks
1-	< -100	22 (22%)	48 (48%)	31 (31%)	14 (14%)	6(6%)
2-	-100 to 0	30 (30%)	48 (48%)	19 (19%)	14 (14%)	14 (14%)
3-	1 to 100	48 (48%)	4 (4%)	50 (50%)	72 (72%)	80 (80%)

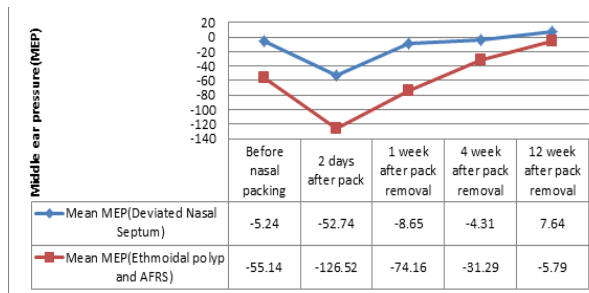
Figure 2- Middle Ear Pressure of the patients ears (n=100 ears)**Table no 5-** Statics of Middle Ear Pressure (n=100 ears)

Statics	Before nasal packing	Two days after nasal packing	After removal of nasal packing		
			After one week	After four weeks	After twelve weeks
Mean MEP (daPa)	-26.2	-83.73	-36.17	-10.64	2.00
S.D.	±61.14	±71.19	±57.10	±42.34	±28.88
p-value		p< 0.0001 (significant)	p < 0.05 (significant)	p <0.001 (significant)	p< 0.0001 (significant)

The change in mean middle ear pressure and the standard deviation was significant two days after anterior nasal packing, one, four and twelve-

weeks after removal of anterior nasal packing (Table 5).

Figure 3- Showing comparison between Mean Middle Ear Pressure in patients with Deviated Nasal Septum and patients with bilateral ethmoidal polyp and allergic fungal rhinosinusitis



Mean middle ear pressure in patients with Ethmoidal Polyp and Allergic Fungal Rhinosinusitis were more negative than patients with Deviated Nasal Septum, at two days after nasal pack (in situ), one, four and twelve-weeks after removal of nasal packing. It was persistently negative in patients with Ethmoidal Polyp and Allergic Fungal Rhinosinusitis even twelve weeks after removal of nasal packing (Figure 3).

Discussion- Normal Eustachian tube function is mandatory to prevent and treat middle ear inflammatory diseases. Chronic nasal obstruction is a frequent cause of eustachian tube dysfunction which can lead to middle ear hypoventilation and suffering. During nasal packing, the incidence of eustachian tube dysfunction is very high as a consequence of the absence of nasal airflow and inflammatory mediator release^[31].

Fifty patients (100 ears) having nasal obstruction were included in our study. Out of which 28 (56%) were male and 22(44%) patients were female and male to female ratio was 7:6.5 (Table 1). Similar to study by Mohan C et al (2016)⁶ who had taken fifty patients (100 ears)(male to female ratio was 3:2) and Bhuiyan MR et al (2017)⁷ who took 30 patients

in his study and male to female ratio was 2:1

The patients included in our study were suffering from deviated nasal septum (29%), bilateral ethmoidal polyp (16%), allergic fungal rhinosinusitis (5%). Similar study was done by Bhuiyan MR et al (2017)⁷, which included deviated nasal septum with turbinate hypertrophy (36.66%), deviated nasal septum (30%), ethmoidal polyp (16.66%), antrochoanal polyp (10%) and deviated nasal septum with nasal deformity(6.66%).

The majority of our patients (i.e.58 ears) at pre-operative assessment had complaints of ear fullness. 4th week after removal of the nasal pack, 21ears complained of ear fullness but there was a significant improvement in 12th week. In Abdel-Naby Awad OG et al (2014)⁸ study ear fullness was the most common pre-operative symptom. The study included 30 patients, in which 28 patients had sensation of ear fullness and 30 days after removal of the nasal pack, 20 patients still had a sensation of ear fullness.

In postoperative first assessment done just before the removal of the nasal pack i.e. 2 days after surgery there was an increase in symptoms of ear fullness, earache, and tinnitus. Not much improvement was achieved for earache and tinnitus though it recovered later as compared to the assessment done at 2days after anterior nasal packing (Table 2). A similar study on 40 patients was done by Manpreet S Nanda et al (2018)⁹ they found no improvement in earache and tinnitus before and after removal of nasal packing. Similar to our study where 16(earache) and 24(tinnitus) had no significant improvement even after twelve-week of removal of anterior nasal packing.

The hearing thresholds were measured in all the 50 patients (100 ears), before, two days after anterior nasal pack in situ and one, four and twelve weeks after removal of anterior nasal packing. In this study, the normal hearing threshold was taken as hearing less than 25 dB, and above this threshold (26-55 dB) was

considered as mild-moderate loss. In pre-pack pure tone audiometry there was normal hearing in 62 ears and mild-moderate conductive hearing loss was seen in 38 ears, two days after anterior nasal packing 29 ears had normal hearing threshold, there was also increase in percentage of patients with conductive hearing loss (table 3, Figure1). This could be attributed to mucosal edema and inflammation as a result of surgery. Similar results were obtained by Manpreet S Nanda et al (2018)⁹ after two days of surgery.

One week after removal of nasal packing, 51 ears had normal hearing threshold, and 49 ears (49%) had mild-moderate conductive hearing loss. 12 weeks after removal of nasal packing, 89 ears had normal hearing threshold, and 11 ears had mild-moderate conductive hearing loss (Table 3 and figure 1). A similar study was done by Mohan C et al (2016)⁶.

In our study the negative middle ear pressure came to normal range one week after removal of nasal packing in 69 ears and remained negative (< -101 dapa) in 31 ears which improved up to 86 ears and 94 ears, four week and twelve-week after removal of nasal packing respectively (Table 4). A similar study was done by Bhuiyan MR et al (2017)⁷ on 30 patients, they found a similar result to our study.

In a similar study, Jasser et al (2009)¹⁰ measured middle ear pressure in 40 ears before surgery, after 48 hours of nasal pack, and 7 days after removal of nasal pack. They found that, preoperatively, there was normal middle ear pressure in all the ears; none of the ears had abnormal middle ear pressure. After 48 hours of nasal packing, 14 ears had got abnormal middle ear pressure, while 26 ears were normal. Seven days after the removal of the nasal pack, there was marked improvement in middle ear pressure. These findings are similar to our study.

Four weeks after the removal of nasal packing, there was not much different from the pre-operative findings regarding hearing or middle

ear pressure (Table no-10 and Table no-. 12). Similar results were obtained by Salvinelli et al (2005)¹¹ who found tympanometry results almost the same after one month as compared to preoperative results.

In our study Figure 3- shows that patients with Ethmoidal Polyp and Allergic Fungal Rhinosinusitis have more negative middle ear pressure than patients with Deviated Nasal Septum, and 6 ears (6%) remained in abnormal negative middle ear pressure (< -100 dapa) (Table 4), twelve-week after removal of nasal packing. Chronic nasal obstruction seems to have a detrimental effect on middle ear pressure, which may not return to normal even after the removal of chronic obstruction.

Conclusion- Eustachian tube play key role in success of middle ear surgery by maintaining pressure equality across tympanic membrane and drainage of secretion. Assessment of otological symptoms, middle ear pressure and hearing threshold was done before nasal packing, two days after nasal packing (in situ), and after removal of nasal pack at the end of one, four and twelve weeks.

Postoperatively two days after anterior nasal packing, there was increase in number of patients with ear fullness, ear ache and tinnitus. There was also increase in patient ears with conductive hearing loss which improved after twelve weeks.

After removal of anterior nasal packing up to twelve weeks, significant improvement in middle ear pressure was seen. In chronic nasal obstruction cases, such as nasal polyps, there was persistent negative middle ear pressure, probably due to long standing inflammation and edema causes irreversible changes in Eustachian tube function. Thus corrective surgery for middle ear pathology should be considered at least twelve weeks after surgery of nasal obstruction for improvement of success rates of middle ear surgery.

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