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Endoscopic Eustachian Tube Baloon Dilation:Our Experience At A Tertiary Care Hospital, Salem, India

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Abstract:

Introduction: Eustachian tube dysfunction is a common condition in everyday ENT practice. This study was done to find the effectiveness of transnasal endoscopic balloon dilatation of eustachian tube for treatment of chronic eustachian tube dysfunction.

Materials and methodology: Forty patients who were diagnosed with ET dysfunction were assigned to the study. A balloon catheter was used to dilate the cartilaginous part of eustachian tube using transnasal endoscopy. Pre operatively all the patients underwent a complete clinical examination of ear , nose and throat , pure tone audiometry ,tympanometry and thin layer CT temporal bone .Endoscopy was done for all the patients to rule out any pathology in the nose and nasopharynx. Post operatively, symptomatic improvement , Valsalva maneuver ,tympanometry of the patients were assessed .

Results: Eustachian tube was dilated with balloon catheter under endoscopic vision for all 40 patients. 36 patients showed significant improvement in the functioning of eustachian tube .

Conclusion: After balloon dilatation , majority of the patients showed significant improvement in the eustachian tube function.Eustachian tube balloon dilation constitutes a safe and very promising treatment option for patients with Eustachian tube dysfunction based on early-outcome analysis. ETS and specifically tubomanometry appear promising as assessment tools but await validation for use in the diagnostic workup and outcome analysis after ETBD. The pathophysiologic mechanism of Eustachian tube balloon dilation remains unclear. Long-term analysis and stratification of patients are needed to better evaluate the definite value of Eustachian tube balloon dilation.

Introduction

Eustachian tube is a osseocartilaginous tube that connects nasopharynx and middle ear. Eustachian tube dysfunction results in the inability of eustachian tube to equalize air pressure between atmosphere and middle ear .The primary function of eustachian tube is pressure

equalization and middle ear ventilation. Symptoms associated with eustachian tube dysfunction includes ear ache , ringing sensation in the ear , ear fullness and hard of hearing. ET dysfunction can be treated with antihistamines, autoinsufflation, nasal steroids. Tymapanostomy tube placements can equalize middle ear pressure and shows symptomatic improvement , but carries the risk of tympanic perforation tympanosclerosis. This study was done to assess the surgical technique, complications and effectiveness of endoscopic guided eustachian tube balloon dilation

Materials and methods:

Before initiating the study , informed consent was obtained from all the patients. 40 patients with chronic eustachian tube dysfunction participated in this study . Patients with age more than 18 years and with Eustachian tube dysfunction for more than 4 months were included. Patients with gross septal deviation, patients with nasal polyposis and patients with hypertrophied turbinates were excluded from the study.

Pre operatively all the patients underwent a complete clinical examination of ear, nose and throat, pure tone audiometry ,tympanometry and thin layer CT temporal bone .Endoscopy was done for all the patients to rule out any pathology in the nose and nasopharynx. Postoperatively ,symptomatic improvement,Valsalvamaneuvre and tympanometry of the patients were assessed.

The procedure was carried out under general anaesthesia, nasal cavity decongested with lignocaine and adrenaline soaked cotton pledgets.Under rigid nasal endoscopy a 500 µm diameter balloon catheter was introduced into eustachian tube through a special instrument .After which the catheter was inserted into the nasopharyngeal opening of eustachian tube. By using an inflation pump, the balloon was inflated. The balloon removed after emptying. The aim was to dilate the cartilaginous part of the eustachian tube without any structural damage. The successful technique is always associated with dilatation of cartilaginous part of the ET along with symptomatic improvement of the patient without any intra-operative and post-operative complications. This is a day care procedure. After day of the procedure, all the patients were reviewed at outpatient department for complications and advised to do Valsalva maneuver three times a day for two weeks. Nasal sprays were used after the procedure like nasal decongestants for 7days and corticosteroids for 2 weeks. The nasal spray was given to clear any nasal allergy in post-operative period, so that it will not interfere with positive outcome due to balloon dilatation of ET.(2) All the patients were reviewed at the outpatient department on 1st and 2nd week of procedure.After 2 months of procedure, the patients were reviewed for audiological tests again.

Eustachian tube dyfunctionquestionnaire :

40

Sl.No.	Over the past 1 month, how much has each of the following been a problem for you?	No Problem		Moderate Problem			Severe Problem	
1.	Pressure in the ears?	1	2	3	4	5	6	7
2.	Pain in the ears?	1	2	3	4	5	6	7
3.	A feeling that your ears are clogged or “under water”?	1	2	3	4	5	6	7
4.	Ear symptoms when you have a cold or sinusitis?	1	2	3	4	5	6	7

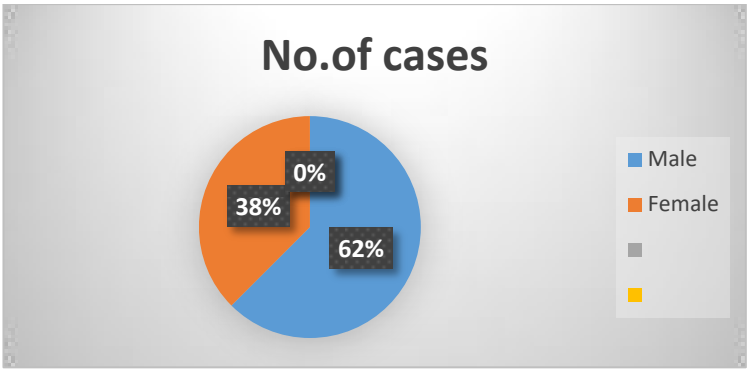
5.	Crackling or popping sounds in the ears?	1	2	3	4	5	6	7
6.	Ringing in the ears?	1	2	3	4	5	6	7
7.	A feeling that your hearing is muffled?	1	2	3	4	5	6	7

All the patients were asked Eustachian tube dyfunction questionnaire after two months of procedure on the basis of overall improvement of symptoms with the procedure. Nasopharyngeal opening of the ET was asessed endoscopically after 2 months of surgery to find out its patency.

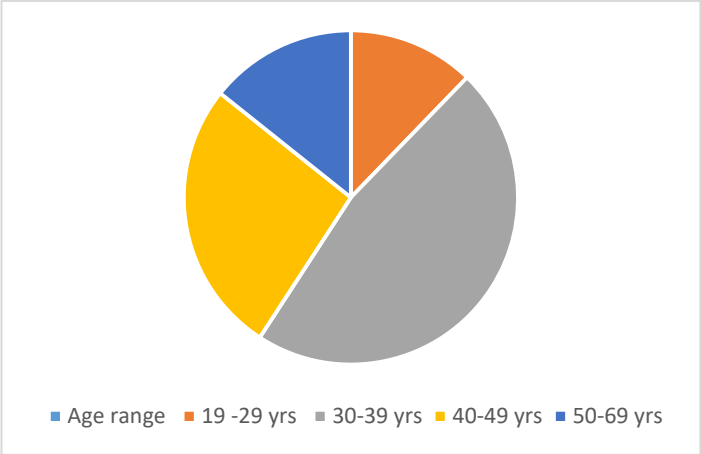
Results:

There were totally 40 patients participated in this study. Out of 40 patients, 25 were males and 15 females. The mean age of the patients was 44.90 years and age ranged from 19 to 64 years.For 8 patients procedures were done in both sides. Out of 40 patients, 24 patients had chronic persistent ET dysfunctions, 11patients had intermittent ET dysfunctions and 5 patients had recurrent glue ear .

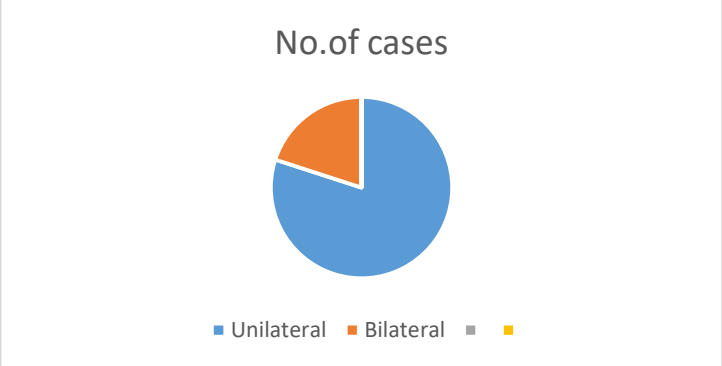
	Male	Female	Total
No.of patients	25	15	40



Age range	No.of cases
19 – 29 yrs	6
30 – 39 yrs	23
40 – 49 yrs	13
50 – 69 yrs	7

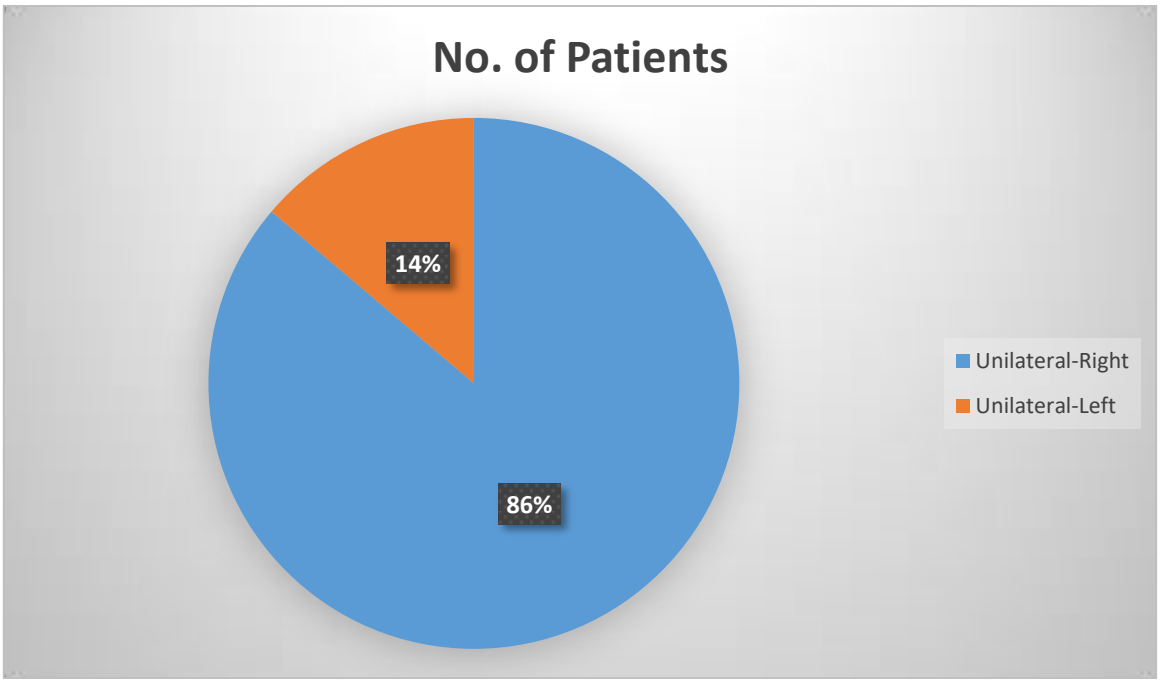


	Unilateral	Bilateral	Total
No.of patients	32	8	40



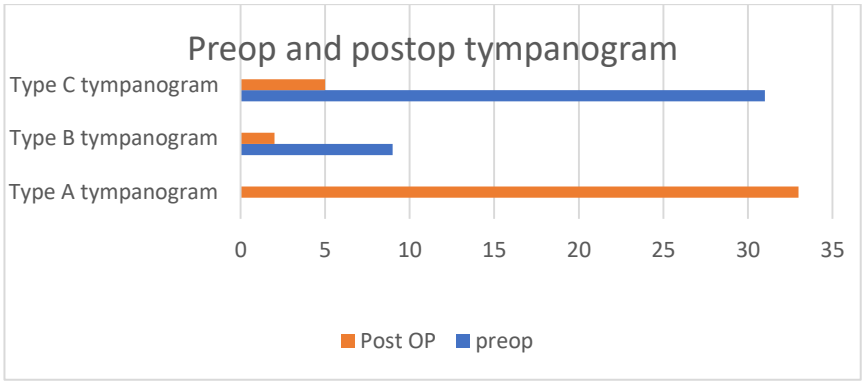
In our study, 32 patients underwent unilateral ET balloon dilation whereas 8 patients underwent bilateral ET balloon dilation. Out of 32 unilateral ET balloon dilations, 20 patients underwent the procedure in right side and 12 patients in left side.

	Unilateral –Right	Unilateral– Left	Total
No.of patients	20	12	32



Out of 40 patients, 31 patients showed type-C tympanogram, 9 had type-B tympanogram before procedure. Among the 40 patients, 3 underwent tympanostomy tube in past but failed to resolve the ET dysfunction.

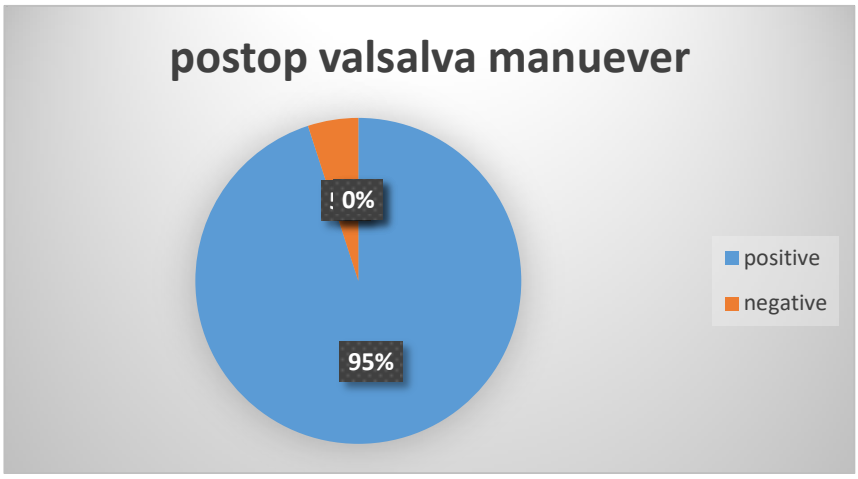
Postoperatively, 33 patients showed type A tympanogram and no change in 7 patients. Otoscopy before and after procedure were compared. In all patients, preoperatively tympanic membranes were not normal before procedure and for 37 cases tympanic membrane became normal post surgery (2 months after procedure) except 3 cases.



Before ET dilatation, CT scan was done in all cases which did not show any significant abnormalities.

Valsalva maneuver was done in all cases before and after procedure. All cases showed positive, normal/patent ET Valsalva postoperatively except 2 cases.

Post op -Valsalva manuever	Positive	Negative
Cases	38	2



Based on Eustachian tube dyfunction questionnaire ,function of eustachian tube was assessed.

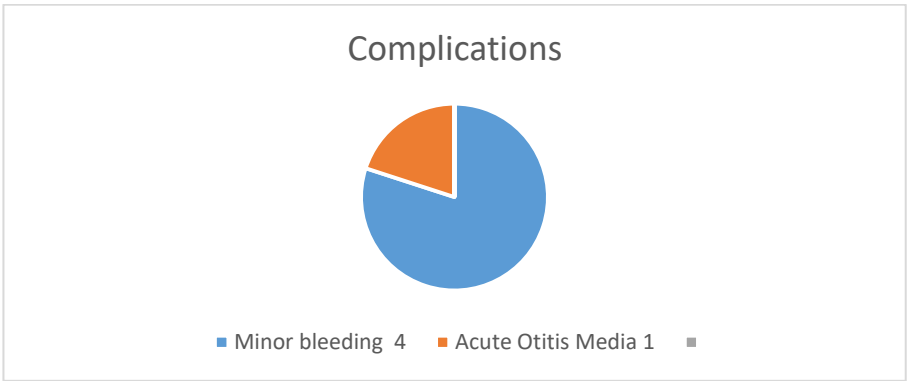
Variable	Mean	Std.deviation	Mean difference	p-value
ETDQ Preop	31.6	4.50577		
ETDQ Postop	12.40	4.95518	19.2	0.001

The mean ETDQ score was 31.6 preoperatively and 12.40 at 1 month postoperatively .[P < 0.01], indicating the efficacy of treatment.

The mean ETDQ score was 2.91 preoperatively and 1.42 at 1 month postoperatively .[P < 0.05], indicating the efficacy of treatment.

There was no evidence of carotid artery aneurysm, tumors or malformations in the course of eustachian tube. Postoperative CT scan were also done in all cases which showed no change in bony lumen of the eustachian tube. There were no fractures seen in bony part of the eustachian tube. During the procedure, four patients had minor bleeding from eustachian opening whereas to the rest of the patients ,the procedure was uneventful. (4) One patient developed acute otitis media after 48 hours of the procedure for which the patient was treated with medications like antibiotics, antihistamines and nasal decongestants. According to the eustachian tube dysfunction questionnaire , all patients improved symptomatically except four cases.

Complications	Minor bleeding	Acute Otitis Media
No. of patients	4	1



Discussion:

The length of eustachian tube in adults is 37.5mm long and has bony and cartilaginous parts, extending from nasopharynx to the middle ear. The physiological functions of the eustachian tube are pressure regulation of the middle ear, ventilation, drainage of the middle ear secretions. The current researches focuses on utilizing video endoscopy to help us improve the understanding of eustachian tube functions and its role in middle ear pathology.

Allergic rhinitis, laryngopharyngeal reflux, mechanical obstruction by nasopharyngeal growth, primary ciliary dyskinesia and neuromuscular dysfunction are the common causes of eustachian tube dysfunction. The technique of rigid nasal endoscopy for dilating eustachian tube was developed by Yamashita in 1983 by the use of the flexible fiberscope with an instrument channel to insufflate air for expanding the lumen of the eustachian tube (15). Eustachian dysfunction is a disorder where there is inadequate middle ear ventilation, resulting in aural fullness, hearing loss and tinnitus. It may complicate into serous otitis media, retraction of tympanic membrane and cholesteatoma formation (9).ET dysfunction affects approximately 1 per 100 adults. Eustachian tube dysfunction is a physiological disorder which may be temporary and spontaneously resolving. Eustachian tube dysfunction lasting for a period of 3 months is usually called as chronic eustachian dysfunction.

The symptoms often affect the quality of life due to persistent sensation of fullness in the ear, otalgia and uncomfortable air travel or scuba diving. Prolonged ET dysfunction may cause conductive hearing loss and cholesteatoma formation. On examination, there may be serous otitis media or negative middle ear pressure (in tympanometry). Sequel of eustachian tube dysfunctions are retraction pockets, perforation, chronic otorrhea and cholesteatoma. Pure tone audiometry, tympanometry and CT scan of the bilateral temporal bone are the tests performed in cases undergoing balloon dilation of eustachian tube. Functional MRI is useful in differentiating mucosal obstruction from structural obstruction.

Pure tone audiometry assesses the hearing loss whereas tympanometry will assess the middle ear status. CT scan will assess the status of bony part of ET and canal for internal carotid artery. There was little evidence of effectiveness for present medical and surgical interventions for EDT like nasal decongestants, systemic and topical corticosteroids, antihistamines, mechanical devices and nasal/ septal surgery (8).The surgical treatment for ET dysfunction is myringotomy and grommet placement in the tympanic membrane which helps to equalize the middle ear pressure and drainage of the middle ear fluid via grommet. It effectively bypasses the ET and relieves the symptoms but does not cure the Eustachian tube dysfunction. Grommet or tympanostomy tubes often require frequent replacement several times if ET dysfunction persists for longer period. Tympanostomy tubes can damage the tympanic membrane, persistent perforation, infection and extrusion.

The target for balloon dilatation of ET is 8 to 12 mm cartilaginous segment of ET which acts as a valve within cartilaginous part of the ET where physiological deficiency seen in chronic ET dysfunction (12).

This is done under nasal endoscopy. Balloon eustachian tuboplasty is less invasive in comparison to microdebrider Eustachian tuboplasty. The mechanisms for eustachian tube balloon dilation include both widening of the cartilaginous part of the ET and histopathological changes.

A study on histopathological changes after balloon dilatation of ET revealed the crushing effect of balloon on inflammatory cells on the mucosal lining of the ET lumen with sparing of the basal layer and rapidly replacing the inflamed mucosal lining with a fibrous scar (14). Histopathological analysis showed decreased inflammation in the epithelial surface and submucous tissues. So, there

is net reduction of the inflammation in the lumen of ET and improvement in clinical functions of the eustachian tube after surgery (10)

There are certain theoretical complications like internal carotid artery rupture, permanent conductive hearing loss, damage to the ET, scarring, stenosis, middle ear infections and pain (5).

Eustachian tubal dilatation is usually avoided in pediatric age group. One study reported minor epistaxis in balloon dilatation. Acute otitis media was also a reported complication of this procedure for which post-operative prophylactic antibiotics are advised. Since the internal carotid artery is in close relationship with the ET it carries clinical significance and require avoiding catastrophic injuries to the ICA.

There is theoretical risk for injury to a dehiscent carotid artery which runs adjacent to the bony part of the ET . Hence CT scan of the petrous temporal bone is done pre-operatively. One study conducted a retrospective analysis of petrous temporal bone CT scan those underwent ET dilatation where authors found 24 balloon dilatations were done in 17 patients with carotid artery canal dehiscence with no complications or any difficulties .Balloon eustachian tubal dilatation is a minimal invasive technique with minimum risks.The inflatable balloon help to deliver maximum pressure of 19.88 mmHg pressure mm^2 surface area in the lumen of the ET which may give pressure over the mucosal capillaries in this area. This may result in localized and temporary edema .

In our study, endoscopic guided transnasal balloon dilation of ET has found be a safe procedure which significantly improves the functions of ET (4)

The outcomes of this surgery are observed on the basis of four factors: Tympanometry profile (Normal-Type-A, Abnormal-Type-B and Type-C), Otoscopic pictures (Normal or abnormal) (retracted tympanic membrane), Patient symptoms (Improved, not improved or worsened) based on Eustachian tube dysfunction questionnaire and Valsalva (Always positive, occasional positive or negative) (5)

Outcomes of endoscopic guided transnasal balloon dilation of ET are divided into short term ($\leq$ 6months) and long term($\geq$ 6months). Long-term studies are needed to properly evaluate the longlasting benefits and safety of balloon ET dilatation in the treatment of the chronic eustachian tube dysfunction. ET balloon dilation has emerged as a surgical option for Eustachian tube dysfunction.

Conclusion:

Endoscopy guided balloon dilatation of eustachian tube is a novel technique to perform minimal invasive eustachian tube dilation for improvement of the ET dysfunction. The objective of the balloon eustachiantuboplasty is to dilate the cartilaginous part of the eustachian tube and to enhance the physiological functions with minimal or no complications. This minimally invasive procedure for ET dysfunction is proved to be feasible and safe in the treatment of the ET dysfunction. Baloon dilation of ET is a low risk surgical procedure with a minimal postsurgical pain,hence patients can resume their daily routine sooner .

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