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ASSESSMENT OF EUSTACHIAN TUBE FUNCTION IN MIDDLE EAR DISEASES

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ABSTRACT **Objective -** Purposes of the current study evaluate the function of eustachian tube and compare the outcome of surgery with normal and abnormal eustachian tube functions.

Research Design- The present study was using the purposive observational clinical research design.

Method-This prospective clinical study was conducted at the department of otorhinolaryngology- Head and Neck surgery, command hospital (eastern command), Kolkata, for a period of eighteen months from Jan 2013 to Jun 2014. The study group comprised of 52 patients who were diagnosed to have Chronic Otitis Media (mucosal disease). The details of history with special emphasis on ear discharge, duration, character and period of dryness were noted.

Statistical Analyses- Purpose of the current study descriptive analyses was done with the help of SPSS.

Result- The present study shown the age group of 41-60 years (40.38%), mean of age is 39.35 years and standard deviation 17.61 was higher than other age group. Male patients were 28 (53.84%) higher than female patients 24 (46.16%). Methylene blue dye test, otologic instillation test and toynbee's test, were performed, the toynbee's test was statistical significant in other test.

Conclusion- Eustachian tube function tests (Toynbee test) correlated well with severity of disease. The outcome of the middle ear surgery would be a success in normal eustachian tube function, while in dysfunction the outcome need necessarily not be a failure. Tympanometry is a safe easy and effective method to assess the tube function. Gross dysfunction of eustachian tube function predicts poor result.

KEYWORDS : Eustachian Tube Function, Methylene Blue Dye Test, Otologic Drop Instillation, Toynbee's Test

INTRODUCTION

Chronic otitis media (COM) is the result of an initial episode of acute otitis media and is characterized by a persistent discharge from the middle ear through a tympanic perforation (WHO, 2004). Its incidence in India is 7.8 %. Healing is often observed over prolonged periods, but patients require surgery (tympanoplasty) in certain cases (WHO, 2004).

The Eustachian tube function (ETF) has been the center of focus as a prognostic factor because of its presumed primary role in the pathogenesis of otitis media and in clearance of middle ear cavity (Priya, Karthikeyan, Coumare, & Sambandan, 2012). A functioning Eustachian tube (ET) is an integral part of a normal middle ear and is thus an essential requirement for optimum results in tympanoplasty operations (Prasad, Hegde, Prasad, & Meyappan, 2009). In our study we will study eustachian tube function by methylene blue dye, otologic drop instillation test.

In 1927, kolmer et al. was the first to detect ciliated cells in the tympanic cavity. Some year later, it was noted that foreign particles were rapidly cleared from middle ear through the Eustachian tube into nasopharynx. Sade was the first to study the middle ear mucosa systematically in autopsy material.

A year later, in 1967 his middle ear clearance studies with visible foreign charcoal particle or glass beads disclosed the mucous pathway from middle ear cavity to Eustachian tube. Since then, the middle ear mucosa has been accepted to be an active part of the upper respiratory tract mucosa. Lafaye et al (1974) and Gaillard de Collogny et al (1974) were the first to employ radioisotopic techniques, which were improved due to the contributions of Valles et al. (1981) and Nuutinen et al. (1983). The requirement of complicated apparatus led to the evaluation of alternative, simpler techniques with to study eustachian tube function.

Aims And Objectives-

Purposes of the current study evaluate the function of eustachian tube and compare the outcome of surgery with normal and abnormal eustachian tube functions.

Research Design-

The present study was using the purposive observational clinical research design.

METHOD-

This prospective clinical study was conducted at the department of otorhinolaryngology- Head and Neck surgery, command hospital (eastern command), Kolkata, for a period of eighteen months from Jan 2013 to Jun 2014. The study group comprised of 52 patients who were diagnosed to have Chronic Otitis Media (mucosal disease). The details of history with special emphasis on ear discharge, duration, character and period of dryness were noted.

Sample Inclusion Criteria-

Purpose of the current study sample were included with same criterion has followed such as Chronic otitis media (COM) mucosal type, No any other history of previous middle ear surgery.

Sample Exclusion Criteria-

Purpose of the current study sample was excluded in their criterion as eg. otomycosis squamous disease, systemic diseases.

Methods Of Assessment Of Eustachian Tube

A complete otorhinolaryngological examination was performed to rule out any associated pathologies and focus of infection which could influence the result of tympanoplasty. Each patient was followed eustachian tube function test (methylene blue test, otologic drop instillation, Toynbee test William test).

Preoperatively the eustachian tube function was assessed in all the patients by the following methods and their results were tabulated.

Otologic Drop Instillation Test-

The procedure and its implications were explained to the patients. With the patient seated, under direct visualization otologic drops was placed in the middle ear through the tympanic membrane defect. The time required for the patient to taste the drops, was measured. If the patient did not taste the drops for over 45 minutes, his/her taste sense was tested by directly placing the sweet and salt solution on tongue. If this too was negative the result was noted as no response. The results of this test were classified into three groups as follows:

Eustachian tube dysfunction	Time
Normal	< 10 min
Partial dysfunction	10 - 20 min
Gross Dysfunction	> 20 min

Methylene Blue Dye Test-

2-3 drops of sterile methylene blue dye was placed using operating

microscope on the middle ear mucosa through the tympanic membrane defect. Using sinoscope the nasopharygeal end of eustachian tube was focused to look for the dye and the interval noted. The results of this test were classified into three groups as follows-

Eustachian tube dysfunction	Time
Normal	< 10 min
Partial dysfunction	10 - 20 min
Gross Dysfunction	> 20 min

Toynbee's Test-

Toybee's test was done in patients with some basic criterion e.g. perforated ear drum, impedance audiometer is programmed to artificially increase or decrease the air pressure at the middle ear and then record the change of air pressure in the middle ear each time when the patient swallows, the patient is asked to swallow repeatedly and recorded graphically by impedance audiometer. Change of pressure during swallowing is recorded as step ladder type of graph, that is, normal. If some residual pressure persists even after five swallows, the tubal function is considered to be partially impaired.

Procedure Of Treatment-

Within a week of evaluation of eustachian tubal function, patients were taken up for surgery. Patients with normal ETF were taken up for tymapnoplasty; Patients with impaired ETF irrespective of middle ear mucosal status (dry or wet) were taken up for cortical mastoidectomy with tympanoplasty. It was done through a post auricular approach by underlay grafting technique using temporalis fascia as the graft material under local anaesthesia. After grafting the ear canal was packed with gel foam and medicated gauze externally. The external pack and sutures were removed on the seventh postoperative day. Inner pack removed on 21 day. Systemic antibiotic and antihistamines were advised in all cases. Patients were reviewed after 8 weeks, for inspection of the operated ear. The second and third postoperative reviews were done at 4 months, and 6 months respectively.

Patients were evaluated post operatively using otoscopy, tympanometry and audiometry. However, hearing results were not used as an outcome measure. On the basis of middle ear status following tympanoplasty, patients were divided into three outcome groups a) successful outcome, defined as healed graft with good middle ear aeration b) retraction or atelectasis (healed graft with persistent high negative pressure c) graft failure, initial failure or perforation secondary to otitis media during the follow up period. The latter two outcomes were considered as failures.

Statistical Analyses-

Purpose of the current study descriptive analyses was done with the help of SPSS.

RESULT-

The study conducted at the department of Otorhinolaryngology & Head and Neck surgery, Command Hospital (Eastern Command), Kolkata, for a period of one & half years from Jan 2013 to Jun 2014.The study group comprised of 52 patients who were diagnosed to have Chronic Otitis Media of mucosal type.

Following parameters were taken in demographics age, sex, site of perforation and its age wise distribution, size of perforation in age wise distribution.

Table 1 Shown The Socio-demographic Variables (Age And Gender)

S.N.	VARIABLES			MEAN	SD
1		10-20 years	12	39.35	17.61
		21-40 years	12		
	Age group	41-60 years	22		
		>60 years	06		
2		male	28		
	Gender	female	24		

Observation of the table no.1 age of the patients ranged from 12 to 70 years. Majority of them age group of 41 - 60 years (40.38%), with a mean age of 39.353 yrs, standard deviation 17.6123. In present study 28 (53.84%) patients were male & 24(46.15%) patients were female.

Observation of the table no. 2 age group of 41 to 60 years patients were found in inferior site of perforation (14) than other site and age group. In age group 10 - 20 yrs out of 13 patients 6 had (11.54%) small perforations, 5 (9.61%) had medium sized & 2 (3.85%) had large sized perforations. In age group 21 – 40 yrs 9 (17.31%) patients had medium sized perforations 1 (1.92%) had small sized; 2 (3.85%) had large sized perforations. In age group 41 - 60 yrs 16 (30.77%) patients had medium sized perforations, 2 (3.85%) had small sized perforations & 3 (5.76%) had large sized perforations. 6 (11.53%) patients were of more than 60 yrs age all had medium sized perforations. Above table depicts that there is no relation between site of perforation and age (p value 0.16).

Table 2 Shown The Age Wise Distribution Of Perforation Size And Site

Name of variables		Age group			
		10-20 yr	21-40yr	41-60yr	>60yr
site	anterior	3	3	3	0
	inferior	3	2	14	3
	posterior	3	6	3	2
	large	3	1	2	1
	total	12	12	22	6
size	small	6	1	2	0
	medium	5	9	16	6
	large	2	2	3	0

Table 3 Shown Eustachian Tube Function In Different Parameters

Name of parameters	Impairment Of Eustachian Tube Function		
	Good	Partial impairment	Grass impairment
Methyline blue dye test	32	16	4
Otologic drop instillation test	32	16	4
Toynbee's test	29	15	8

Reveal the table no.3 methylene blue dye test 32 patients (61.53%) had good function, 16 patients (30.76%) had partially impaired & 4 patients (7.69%) had gross dysfunction of eustachian tube. Otologic drop instillation test 32 patients (61.53%) had good function, 16 patients (30.76%) had partially impaired & 4 patients (7.69) had gross dysfunction of eustachian tube. In this study according to Toynbee's test 29 patients (55.76%) had good eustachian tube function, 15 patients (28.84%) had partially impaired eustachian tube function & 8 patients (15.38) had gross eustachian tube dysfunction.

Table 4 Shown The Assessment Of ET Site Of Perforation With Different Parameters

Name of assessment Technique	Dysfunction of Eustachian tube	Eustachian tube perforation site			
		Anterior	Inferior	Posterior	Sub-total
Methylene blue dye test	Normal	5	13	11	3
	Partial	4	7	3	2
	Gross	0	2	0	2
	Total	9	22	14	7
Otologic drop instillation test	Normal	5	11	11	3
	Partial	4	3	3	2
	Gross	0	0	0	2
	Total	9	14	14	7
Toynbee's test	Normal	5	12	10	2
	Partial	4	5	4	2
	Gross	0	5	0	3
	Total	9	22	14	7

Observation of table no. 4 had shown 9 patients (17.3%) were anterior perforations of which 5 patients (9.61%) had normal & 4 patients (7.69%) had partial ET dysfunction. 22 patients (42.3%) had inferior perforations out of which 13 patients (25%) had normal ET function, 7 patients (13.46%) had partial ET dysfunction & 2 patients (3.84%) had gross ET dysfunction. 14 patients (26.92%) had posterior perforations out of which 11 patients (21.15%) had normal ET function & 3 patients (5.76%) had partial ET dysfunction. 7 patients (13.46%) had subtotal perforations out of which 3 patients (5.76%) had gross ET dysfunction, 2 patients (3.84%) had partial ET dysfunction & 2 patients (3.84%) had normal ET function. Above table depicts that there is no relation between site of perforation and methylene blue test (p value 0.25).

Table no. 4 shown the otologic drop instillation test 9 patients (17.3%)

had anterior perforations of which 5 patients (9.61%) had normal & 4 patients (7.69%) had partial ET dysfunction. 22 patients (42.3%) had inferior perforations out of which 13 patients (25%) had normal ET function, 7 patients (13.46%) had partial ET dysfunction & 2 patients (3.84%) had gross ET dysfunction. 14 patients (26.92) had posterior perforations out of which 11 patients (21.15) had normal ET function & 3 patients (5.76%) had partial ET dysfunction. 7 patients (13.46%) had subtotal perforations out of which 3 patients (5.76%) had gross ET dysfunction, 2 patients (3.84%) had partial ET dysfunction & 2 patients (3.84%) had normal ET function. Above table depicts that there is no relation between site of perforation and otologic drop instillation test (p value 0.25).

In this study 9 patients (17.3%) had anterior perforations of which 5 patients (9.61%) had normal & 4 patients (7.69%) had partial ET dysfunction. 22 patients (42.3%) had inferior perforations out of which 12 patients (23.07%) had normal ET function, 5 patients (9.61%) had partial ET dysfunction & 5 patients (9.61%) had gross ET dysfunction. 14 patients (26.92%) had posterior perforations out of which 10 patients (19.23%) had normal ET function & 4 patients (7.69%) had partial ET dysfunction. 7 patients (13.46%) had subtotal perforations out of which 3 patients (5.76%) had gross ET dysfunction, 2 patients (3.84%) had partial ET dysfunction & 2 patients (3.84%) had normal ET function. Above table depicts that there is no relation between site of perforation and toynbee's test (p value 0.11).

Table 5 Shown The ETF, Size Of Perforation With Different Parameters

Name Of Assessment	Dysfunction of Eustachian tube	Eustachian tube perforation size		
Technique		Small	Medium	Large
Methylene blue dye test	Normal	7	24	1
	Partial	2	10	4
	Gross	0	2	2
	Total	9	36	7
Otologic drop instillation test	Normal	7	24	1
	Partial	2	10	4
	Gross	0	2	2
	Total	9	36	7
Toynbee's test	Normal	7	21	1
	Partial	2	9	4
	Gross	0	6	2
	Total	9	36	7

Observation of table no. 5 shown the Dysfunction of Eustachian tube in methylene dye test, 9 patients had small perforations out of which 7 patients (77.77%) had normal ET function, 2 patients (22.22%) had partial ET dysfunction. 36 patients had medium sized perforations, out of which 24 patients (66.66%) had normal ET function, 10 patients (27.77%) had partial ET dysfunction & 2 patients (5.55%) had gross ET dysfunction. 7 patients had large perforations, out of which 4 patients (57.14%) had partial ET dysfunction, 2 patients (28.57%) had gross ET dysfunction and only 1 patient (14.28%) had normal ET dysfunction.

In otologic drop instillation test 9 patients (17.3%) had small perforation out of which 7 patients (13.46) had normal ET function, 2 patients (3.84%) had partial ET dysfunction. 36 patients (69.23%) had medium sized perforation, out of which 24 patients (46.15%) had normal ET function, 10 patients (19.23%) had partial ET dysfunction & 2 patients (3.84%) had gross ET dysfunction. 7 patients (13.46%) had large perforation, out of which 4 patients (7.69%) had partial ET dysfunction, 2 patients (3.84%) had gross ET dysfunction and only 1 patient (1.92%) had normal ET dysfunction. The toynbee's test 9 patients had small perforation out of which 7 patients (77.77%) had normal ET function, 2 patients (22.22%) had partial ET dysfunction.

36 patients had medium sized perforation, out of which 21 patients (58.33%) had normal ET function, 9 patients (25.00%) had partial ET dysfunction. 6 patients (16.66%) had gross ET dysfunction. 7 patients had large perforation, out which 4 patients (57.14%) had partial ET dysfunction, 2 patients (28.56%) had gross ET dysfunction and only 1 patient (14.28%) had normal ET function.

Table 6 Shown The Success Rate In Middle Ear Aeration, Methylene Blue Dye Test, Otologic Drop Instillation Test And Toynbee's Test

Name of technique	Duration of treatment	Small size disfunction	Medium size disfunction	Large size disfunction
Aeration	2 month	8	21	1
	4 month	1	14	3
	6 month	0	1	3
	Total	9	36	7
		Normal	Partial	Gross
Methylene blue dye test	2 month	32	0	0
	4 month	1	12	0
	6 month	0	4	4
	Total	33	16	4
Otologic drop instillation test	2 month	32	0	0
	4 month	1	12	0
	6 month	0	4	4
	Total	33	16	4
Toynbee's test	2 month	29	3	0
	4 month	0	12	5
	6 month	0	0	3
	Total	29	15	8

Observation of table no. 6 duration of treatment and success rate of estachian tube function was seen that in patients with aeration small perforations 8 patients had middle ear was restored in 2 months, while 22 patient had restored in medium perforation, in this duration large perforation 1had restored, overall medium perforation had maximum number were restored in 2month. 4 month duration medium perforation had 14 patients meddle ear restored it is higher number of restoration than the small and large perforation.

In methylene blue dye test shown that patients with normal ET functions 32 patients with middle ear restored in 2 months in all cases. In patients with partial ET dysfunction {16} middle ear aeration restored in 4 months in 12 (75.00%) patients and in 2 months in 3 (25.00%) patients. Patients with gross ET dysfunction {4} middle ear aeration restoration occurred in six months.

In otologic drop instillation test was seen that in patients with normal ET function {32} middle ear aeration restored in 2 months in all cases. In patients with partial ET dysfunction {16} middle ear aeration restored in 4 months in 12 (75.00%) patients and in 2 months in 3 (25.00%) patients. Patients with gross ET dysfunction {4} middle ear aeration restoration occurred in six months. This table depicts that as the ET dysfunction increases post-operative middle ear aeration increases (p value 0.02).

In toynbee's test seen that in patients with normal ET function {29} middle ear aeration restored in 2 months in all cases. In patients with partial ET dysfunction {15} middle ear aeration restored in 4 months in 12 patients (80%) and in 2 months in 3 patients(20%). In patients with gross ET dysfunction {8} middle ear aeration restored in 4 months in 5 patients (62.5%) and in months in 6 months in 3 (37.5%) patients. This table depicts that as the ET dysfunction increases post-operative middle ear aeration increases (p value 0.001).

DISCUSSION-

A functioning of Eustachian tube (ET) is an integral part of a normal middle ear and is thus an essential requirement for optimum results in tympanoplasty operations. A preoperative test of tubal function is therefore of the greatest interest, especially if such a test provides a possibility of estimating the chances of achieving a satisfactory result of tympanoplasty.

Flisberg et al. in 1963 worked out quantitative methods for measuring preoperative tubal function in patients with perforation of the drum. These methods have subsequently been used by a number of authors. They are based upon the capability of the eustachian tube to equilibrate an induced negative or positive pressure in the middle ear by deglutition.

Similar results were found in current study, that eustachian tube functions are related to size and site of perforation. In current study 9 patients (17.3%) had anterior perforations of which 5 patients (9.61%) had normal & 4 patients (7.69%) had partial ET dysfunction. 22

patients(42.3%) had inferior perforations out of which 12 patients (23.07%) had normal ET function, 5 patients (9.61%) had partial ET dysfunction & 5 patients (9.61%) had gross ET dysfunction. 14 patients (26.92%) had posterior perforations out of which 10 patients (19.23%) had normal ET function & 4 patients (7.69%) had partial ET dysfunction. 7 patients(13.46%) had subtotal perforations out of which 3 patients (5.76%) had gross ET dysfunction, 2 patients(3.84%) had partial ET dysfunction & 2patients(3.84%) had normal ET function.

Prasad et al. 2009 in their study on 86 patients of mucosal chronic otitis media found outcome of middle ear surgery would be success in patients with normal eustachian tube function. In present study had similar findings, it was seen that patients with normal eustachian tube function had good outcome. It was seen that in patients with small perforations {9 patients} middle ear aeration was restored in 2 months in 8 patients (88.88%), 4 months in 1 patient (11.11%). In patients with medium sized perforations {36} middle ear aeration was restored in 2 months in 21 patients (58.33%), in 4 months in 14 patients (38.88%) and in 6 months in 1 patient (2.77%). In patients with large perforation {7} middle ear aeration was restored in 2 months in 1 patient (14.28%), in 4 month in 3 patients (42.85%) and in 6 months in 3 patients (42.85%).

Srivastav et al. in 1993 studied 35 patients with perforated and 15 cases with intact ear drums and eustachian tube function was assessed by Saccharin test, Bortnick - Miller test and manual impedance audiometry. The merits and demerits of one over the other were evaluated, it was observed that more than one test when employed provides better information as every test has its own advantages and limitations.

Megerian in 2000 did a study on paediatric tympanoplasty and the role of preoperative eustachian tube evaluation. He concluded that for the otic drop test to be used successfully, the pediatric patient must be mature enough to reliably report the taste of an ear drop. In current study found that otologic drop instillation is easy and reliable method to assess tubal patency in adults.

Biswas in 1999 did study on 575 ears which had a central perforation in the tympanic membrane found persistence of discharge in safe type of CSOM is related to tubal dysfunction (67.94%). In failed tympanoplasties (83pts.) impaired tubal function was associated in very high percentage (83.12%). Similarly we found large perforations had tubal dysfunction. 7 patients had large perforation, out which 6 patients (85.70%) had ET dysfunction, and only 1 patient (14.28%) had normal ET function. In failed tympanoplasties (2 patients) impaired tubal function was seen in both cases.

Xiao et al. in 2006 in their study of evaluation of eustachian tube function with impedence audiometery in chronic suppurative otitis media found that eustachian tube function was related location of tympanic perforation in chronic suppurative otitis media. It is a simple non-invasive method to evaluate the eustachian tube function of chronic suppurative otitis media with impedence audiometery. Similar results had shown the present study that eustachian tube functions are related to size and site of perforation. In this study 9 patients (17.3%) had anterior perforations of which 5 patients (9.61%) had normal & 4 patients (7.69%) had partial ET dysfunction. 22 patients(42.3%) had inferior perforations out of which 12 patients (23.07%) had normal ET function, 5 patients (9.61%) had partial ET dysfunction & 5 patients (9.61%) had gross ET dysfunction. 14 patients (26.92%) had posterior perforations out of which 10 patients (19.23%) had normal ET function & 4 patients (7.69%) had partial ET dysfunction. 7 patients(13.46%) had subtotal perforations out of which 3 patients (5.76%) had gross ET dysfunction, 2 patients(3.84%) had partial ET dysfunction & 2patients(3.84%) had normal ET function.

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CONCLUSION-

Eustachian tube function was found deranged in only 23 patients 44.23% of COM mucosal type. Eustachian tube function tests (Toynbee test) correlated well with severity of disease. The outcome of the middle ear surgery would be a success in normal eustachian tube function, while in dysfunction the outcome need necessarily not be a failure.

Tympanometry is a safe easy and effective method to assess the tube function. Gross dysfunction of eustachian tube function predicts poor result.

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