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Original Article

Evaluation of Hearing Status in Pre and Post-operative Canal Wall Down Mastoidectomy with Type III Tympanoplasty with or without Cartilage Augmentation

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Abstract:

Objective: *To evaluate Hearing Status in Pre and Post-operative Canal Wall Down Mastoidectomy with Type III Tympanoplasty with or without cartilage augmentation.*

Methods: *This was a prospective study, done in Otolaryngology & Head Neck Surgery department of Sir Salimullah Medical College Mitford Hospital(SSMCMH) and Bangabandhu Sheikh Mujib Medical University(BSMMU) , Dhaka, Bangladesh. 1st July to 31st December, 2012. Forty patients were studied in this series.*

Results: *The results concluded that mean pre and post-operative air bone gap were 38.5 dB and 29.69 dB respectively with a net gain of 8.81 dB in Canal wall down mastoidectomy with cartilage augmented Tympanoplasty type III which is statistically significant. The post-operative PTA-ABG ranged from 25-36 dB , the ABG closure was 11-15 dB in 40% case. Whereas mean pre and post-operative air bone gap were 37.19 dB and 34.19 dB respectively with a net gain of 3 dB in Canal wall down mastoidectomy without cartilage augmented Tympanoplasty type III which is statistically insignificant. The post-operative PTA-ABG ranged from 26.25-41.75 dB, the ABG closure was 0-5 dB in 35% case.*

Conclusion: *Hearing results after cartilage augmentation in type iii Tympanoplasty showed improvement at individual and mean post-operative PTA-ABG and also improvement in ABG closure suggesting thin cartilage disc increased the effective vibrating area of tympanic membrane graft.*

Key Words: *Air-bone Gap, Chronic otitis media, Canal Wall Down Mastoidectomy, Type III Tympanoplasty.*

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Introduction:

Chronic Otitis Media (COM) is a worldwide health problem and is still prevalent in the modern antibiotic era .The disease usually presents with hearing loss and aural discharge[1]. COM affects 0.5-30% of any community and squamous type of COM is 3.5% in Nepal[2,3]. Studies in Bangladesh, India, various countries in Africa and amongst certain ethnic groups have shown that COM may have a prevalence of between 2 & 17%.The prevalence of COM is 8% in rural and 2% in urban population of Bangladesh[4]. COM causes partial or total loss of tympanic membrane and ossicles which leads to conductive hearing loss in severity up-to 60-70 dB[5].

High rates of COM have been attributed to overcrowding, inadequate housing, poor nutrition, passive smoking, high rates of nasopharyngeal colonization with potentially pathogenic bacteria and inadequate or unavailable health care. Poverty is a major risk factor in developing countries and certain neglected populations[6].

More than eighty percent of our people are from rural areas and for practical reasons a small portion of this bulk is within the access of the national health care system. COM in our population is still alarming in our hospital and day-to-day practical experience[4].

COM is the commonest cause of persistent mild to moderate hearing impairment in children and young adults in developing countries[2]. Non-marginal perforation with intact ossicular chain shows hearing loss approx. 10-30 dB; postero-superior marginal perforation with disruption of ossicular chain hearing loss is 40-60 dB and total or subtotal perforation with loss of malleus and incus, the stapes remaining mobile, hearing loss is 60-80 dB[7,8].

The predominant hearing loss in chronic otitis media is conductive in nature. But a few cases of sensorineural hearing loss is also found[9].

The hearing loss arising from COM is a matter of serious concern globally, particularly in children, because of its long-term effects on early communication, language development, educational process and achievement. Hearing disability in adults is a burden to the individual and also to the family & entire society[1].

COM is typically a persistent disease, insidious in onset usually presents with hearing loss and aural discharge[10-12].

Traditionally Chronic Otitis Media has been divided into two types: Safe or tubotympanic disease & Unsafe or atticoantral disease[12-14].

More recently COM has been classified into five types: i) Healed chronic otitis media (COM), ii) Inactive (mucosal) COM, iii) Inactive (squamous) COM, iv)Active (mucosal) COM, v) Active (squamous) COM[15].

Squamous variety of COM most commonly involves the epitympanum & usually associated with cholesteatoma. Cholesteatoma is histologically benign but may be aggressive locally and associated with significant morbidity or mortality if untreated[16].

The choice of treatment for cholesteatoma is surgery for which the goal is total clearance of the disease, to obtain a safe, dry ear, restoration or maintaining the functional capacity if possible[17].

There are different surgical modalities of treatment according to the extent of cholesteatoma and amount of destruction such as suction clearance, intact canal wall

procedures (cortical mastoidectomy, combined approach Tympanoplasty) and canal wall down procedures (atticotomy, atticoantrostomy, Modified radical mastoidectomy and Radical mastoidectomy)[18].

In the early days of chronic ear surgery radical mastoidectomy was the operation of choice but poor hearing and high incidence of chronic or intermittent discharge were the limitations of this procedure. To overcome this disadvantage Modified radical mastoidectomy was proposed and most commonly performed [14,18].

In intact canal wall procedure there is good preservation of hearing but more chance of incomplete clearance or recurrence of disease. Canal wall down procedure causes disease clearance properly but the disadvantage of poor preservation of hearing which can be overcome by reconstructive surgery such as type III Tympanoplasty under magnification is a modern advancement in otology [14,19].

In canal wall down mastoidectomy without reconstruction there is loss of ossicles and/or tympanic membrane for complete clearance of disease. The postoperative audiometric evaluation shows further hearing loss. On the other hand canal wall down mastoidectomy with reconstruction i.e. type iii Tympanoplasty, cartilage augmentation, ossiculoplasty, improves hearing in variable amount. In the study of MU Ahmed (2005) and Ajalloueyan (2006) shows that significant number of patients receiving such procedure has improved their hearing status [20].

As there is chance of improvement of hearing status and quality of life by doing reconstruction of hearing mechanism during Canal Wall Down Mastoidectomy, this procedure is gaining popularity worldwide. Observing the outcome of this procedure I have been also encouraged to do study work on this procedure.

Methods:

This Prospective, comparative study was done in Otolaryngology & Head Neck Surgery department of Sir Salimullah Medical College Mitford Hospital (SSMCMH) and Bangabandhu Sheikh Mujib Medical University (BSMMU) from 1st July to 31st December , 2012 to find out hearing status before and after canal wall down mastoidectomy with Type III Tympanoplasty with or without cartilage augmentation and observe the reliability of tragal or conchal cartilage graft with perichondrium as a material of augmentation. Forty patients of both sexes having Squamous COM admitted in the Otolaryngology & Head-Neck Surgery department of the above mentioned hospital for canal wall down mastoidectomy with Tympanoplasty type III were included and divided into two groups. 20 Patients of canal wall down mastoidectomy with augmented Tympanoplasty type III were in group-I and 20 Patients of canal wall down mastoidectomy without augmented Tympanoplasty type III were in group-II. Only indoor patients having COM (squamous type) got canal wall down mastoidectomy with Tympanoplasty type III by temporalis fascia with or without cartilage augmentation to be included in this study irrespective of age and sex. Patients, who will refuse, have COM with intra-cranial complications, recurrence of cholesteatoma after operation, sensorineural hearing loss, absent or fixed stapes were excluded from study. Data were collected by well prescribed data sheet and

statistically analyzed by SPSS method. Ethical review committee of Sir Salimullah Medical College has given permission to perform the study.

Results:

Table I :
Age distribution of the patients (n=40).

Age group (Years)	No. of Patients	Percentage (%)
0-10	02	05
11-20	17	42.5
21-30	16	40
31-40	03	7.5
41-50	01	2.5
>50	01	2.5

The youngest patient was 8 years and the eldest was 55 years old. The highest number of patients was in the 11-20 years age group (42.5%).The average age being 22.64.

Table II :
Ear involved of the patients (n=40).

Ear	No of patients	Percentage
Right	14	35
Left	21	52.50
Both	05	12.5
Total	40	100

Right ear was involved in 35%, Left ear in 52.5% and both ear only 12.5% cases

Table III :
Clinical presentations of the patients before operation (n=40).

Symptoms	Number of patients	Parentage (%)
Aural discharge	40	100
Hearing impairment	40	100
Headache	O4	10
Vertigo	02	05
Tinnitus	02	05
Pain in the ear	04	10
Post auricular abscess	01	2.5
Post auricular sinus	02	05
Facial weakness	01	2.5

Table IV :
Findings of the physical examination of the patients (n=40)

Auraldischarge	Odor		Amount of discharge		Nature of discharge			
	Odorless	Mal-odorous	Scanty	Profuse	Mucoid	Muco Purulent	Purulent	Blood Stained
	04(10%)	36(90%)	33(82.5%)	07(17.5%)	00(00%)	06(15%)	32(80%)	02(05%)

TM perforation	Attic	32 (80%)
	Posterior marginal	07(17.5%)
	Central	01(2.5%)
Cholesteatoma	30(75%)	
Aural polyp	02(05%)	
Granulation tissue		08(20%)
Epithelial in growth	01(2.5%)	
Ossicles	Intact	04(10%)
	Eroded	36(90%)

Here found that aural discharge is mostly malodorous, purulent and scanty in amount. Attic perforation, cholesteatoma and ossicular erosion were found in majority of the cases.

Table V :
Distribution of types of surgery (n=40)

Groups	Types of surgery	Number of patients	Percentage
Group-I	Canal wall down mastoidectomy with augmented Tympanoplasty type III.	20	50
Group-II	Canal wall down mastoidectomy without augmented Tympanoplasty type III.	20	50

Table VI :
Post-operative follow-up of the patients(n=40)

Findings	2nd week	4th week	10th week
Dry ear	04(10%)	20(50%)	35(87.5%)
Aural discharge	15(37.5%)	09(22.5%)	04(10%)
Vertigo	03(7.5%)	Nil	Nil
Vomiting	04(10%)	Nil	Nil
Facial weakness	01(2.5%)	01(2.5%)	01(2.5%)
Graft taken	18(45%)	32(80%)	36(90%)
Graft failure	03(7.5%)	04(10%)	04(10%)
Dead ear	Nil	Nil	Nil
Recurrence	01(2.5%)	01(2.5%)	01(2.5%)

Table-X shows dry ear after 10th week of operation was 87.5%,vertigo (7.5%) & vomiting (10%) within first two week, facial weakness in one patient and Graft taken in 90% patient at 10th week.

Table VII:
Evaluation of the pre and post-operative PTA–ABG(dB) in Group-I (n=20)

Parameter	Group	Mean	Std Deviation	Min.	Max.	P Value
Canal wall down mastoidectomy with augmented Tympanoplasty type III.	Pre-operative ABG 500Hz	45.75	18.16	20	70	< .01
	Post-operative ABG 500Hz	36	15.61	15	60	
	Pre-operative ABG 1000Hz	43.50	13.48	20	65	< .01
	Post-operative ABG 1000Hz	34.25	14.80	10	65	
	Pre-operative ABG 2000Hz	32	12.71	15	60	<.001
	Post-operative ABG 2000Hz	23.50	16.15	05	60	
	Pre-operative ABG 4000Hz	32.75	16.50	00	70	.05
	Post-operative ABG 4000Hz	30	12.03	15	60	
	Pre-operative ABG Average	38.5	6.95	32	45.75	< .01
	Post-operative ABG Average	30.94	6.35	25	36	

The four frequency average pre-operative ABG was 38.5 dB which was reduced to 30.94 dB post- operatively with a net gain of 7.56 db. It was observed that the ABG was the smallest at 2000 Hz as compared with other frequencies in both pre and post operative audiogram.

Table VIII :

Evaluation of the pre and post-operative PTA–ABG(dB) in Group-II (n=20)

Parameter	Group	Mean	Std Deviation	Min.	Max.	P Value
Canal wall down mastoidectomy without augmented Tympanoplasty type III.	Pre-operative ABG 500Hz	42.5	11.64	25	70	> .1
	Post-operative ABG 500Hz	41.75	12.17	15	60	
	Pre-operative ABG 1000Hz	44.75	13.48	25	70	> .1
	Post-operative ABG 1000Hz	39.75	14.80	70	25	
	Pre-operative ABG 2000Hz	32.25	12.71	15	55	.1
	Post-operative ABG 2000Hz	28	16.15	10	50	
	Pre-operative ABG 4000Hz	35.25	17.54	20	50	> .1
	Post-operative ABG 4000Hz	33.75	12.03	05	60	
	Pre-operative ABG Average	38.69	7.56	29.50	44.75	>.1
	Post-operative ABG Average	35.81	7.17	26.25	41.75	

The four frequency average pre-operative ABG was 38.69 db which was reduced to 35.81 dB post-operatively with a net gain of 2.88 db. It was observed that the ABG was the smallest at 2000 Hz as compared with other frequencies in both pre and post-operative audiogram.

Table –IX :

ABG closure in different bins

Groups	0-5 db	6-10 db	11-15 db	>15 db	ABG Increase
Group-I(Canal wall down mastoidectomy with cartilage augmented Tympanoplasty type III.)	02(10%)	05(25%)	08(40%)	03(15%)	02(10%)
Group-II(Canal wall down mastoidectomy without cartilage augmented Tympanoplasty type III.)	07 (35%)	05 (25%)	02 (10%)	01 (5%)	05 (25%)

Table XIV shows in group I hearing improved 90% cases and most cases (40%) gain ABG closure of 11-15 db. In group II hearing improved 75% cases and most cases (35%) gain ABG closure of 0-5 db.

Discussion:

The objectives of surgical management of cholesteatoma include the eradication of disease, restoration of hearing and normal anatomical configuration[21]. Conventionally Squamous type of COM (Cholesteotoma) was being managed by Radical Mastoid surgery or Modified Radical Mastoid surgery where eradication of disease is the main aim. As a result disease clearance was done at the expense of hearing. Due to advancement of micro surgical techniques of ear, repair of hearing mechanism is gaining popularity. Ensuring total clearance of the disease if

repair is done properly, satisfactory hearing gain can be achieved. This study was performed to compare the pre and post-operative hearing results in terms of average ABG and ABG closure.

In the present study the average age of the patients was 22.64 years, the range being 8 to 55 years. The highest number of patients (42.5%) was in 11-20 years age group. The younger age groups suffer more as because of cellular mastoid ,horizontal position of Eustachian tube and enlarged adenoids and recurrent upper respiratory tract infections which is supported by other studies[11,22].

There were total 24 (60%) males and 16 (40%) females with a male female ratio of 1.5:1. Gender wise distribution of patients of our study compare favorably with other studies published in the literature[22-24].

Rural people (70%) were affected more than urban (30%) people and it is well explained by inadequate health care facilities, lake of awareness[22].

The majority of the patients (67.5%) were having poor socio-economic condition. This is because of overcrowding, poor hygiene,poor sanitation ,malnutrition ,upper respiratory tract infection etc. This study is similar to other study[14,22,25].

Higher incidence of COM in illiterate (35%) and primary educated (30%) group were also reported in many studies[22,14]. This reflects that people , lake of health education and awareness about their problem were more affected.

The study population revealed that major group (67.5%) had the habit of bathing in pond and river which was a factor of reactivation of ear infection and complication, these findings had also supported by others[20].

Among the study group right ear involvement was 35%, left ear 52.5% and both ear 12.5%.

The commonest presentation of the patients was otorrhoea (100%) and hearing impairment (100%) which was also supported by other studies[26].

Study showed cholesteatoma was present in 75%, granulation tissue in 20%and aural polyp in 2.5% patients , that is also similar to other study[20].

In this study 80% had attic perforation, 17.5 % had posterosuperior marginal perforation and 2.5% had central perforation. This findings are more or less similar to other series where attic perforation were more[27,28].

Present study shows vertigo (7.5%) & vomiting (10%) within first two week, facial weakness in one patient which did not return after 10th week .Graft taken in 90% and dry ear was 87.5% of patient after 10th week of operation which is similar to other study[16].

In our study group-I patients average PTA-ABG was 38.5 dB pre-operatively and 30.94 dB post-operatively with a net gain of 7.56 dB. The post-operative PTA-ABG ranged from 25-36 dB. The difference between the pre and post-operative PTA-ABG results was statistically significant (<.o1)[29]. Hearing improved in 90% cases and most cases (40%) gain ABG closure of 11-15 dB.

In group-II patients average PTA-ABG was 38.69 dB pre-operatively and 35.81 dB post-operatively with a net gain of 2.88 dB. The post-operative PTA-ABG ranged from 26.25-41.75dB. The difference between the pre and post-operative PTA-ABG results was statistically insignificant (>.1)[29]. Hearing improved in 75% cases and most cases (35%) gain ABG closure of 0-5 dB

In both groups, during MRM, partially diseased ossicles and incus were removed resulting in discontinuity of ossicular chain

and deterioration of hearing. In some cases, the gap between the disrupted ossicular chains was bridged by cholesteatoma and thus hearing was maintained. But after removal of disease, continuity of ossicular chain was lost and resulting in deterioration of hearing[15]. In addition, in case of CWD mastoidectomy with Tympanoplasty, sometimes medialization of graft and dislodgement of cartilage occurs, for which middle ear cavity was not maintained and possibly Eustachian tube function is not established properly. As a result deterioration of hearing occurs.

Conclusion:

The results concluded that mean pre and post-operative air bone gap were 38.5 dB and 30.94 dB respectively with a net gain of 7.56 dB in Canal wall down mastoidectomy with cartilage augmented Tympanoplasty type III which is statistically significant. The post-operative PTA-ABG ranged from 25-36 dB, the ABG closure was 11-15 dB in 40% case. Whereas mean pre and post-operative air bone gap were 38.69 dB and 35.81 dB respectively with a net gain of 2.88 dB in Canal wall down mastoidectomy without cartilage augmented Tympanoplasty type III which is statistically insignificant. The post-operative PTA-ABG ranged from 26.25-41.75 dB, the ABG closure was 0-5 dB in 35% case. Thus, hearing results after cartilage augmentation type iii Tympanoplasty showed improvement at individual and mean post-operative PTA-ABG and also improvement in ABG closure suggesting thin cartilage disc increased the effective vibrating area of tympanic membrane graft.

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