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TYMPANOPLASTY WITH MASTOIDECTOMY – THE INITIAL CAPE COAST EXPERIENCE

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ABSTRACT

Objectives: A high prevalence of untreated surgical disease for hearing loss exists in West Africa. The purpose of this pilot study was to review hearing outcomes after initial implementation of a surgical otology program in a teaching hospital in Ghana. **Methods:** A retrospective case series of patients who had surgical intervention for chronic suppurative otitis media (CSOM) in February 2016 at the Cape Coast Teaching Hospital (CCTH) was done. Pre-operative and post-operative audiometric air-bone gap (ABG) testing at frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz were compared. **Results:** The average pure tone audiometry air-bone gap (PTA-ABG) in our study pre-operatively was 27.75 dB and 14.00 dB post-operatively, with a net gain of 13.75 dB. The difference between the pre-operative and post-operative PTA-ABG results was statistically significant ($p<0.05$). **Conclusion:** The results from this study show that hearing thresholds can improve on performing tympanoplasty with mastoidectomy for chronic suppurative otitis media patients.

KEYWORDS: Chronic suppurative otitis media, acute otitis media, secretory otitis media, tympanoplasty, mastoidectomy.

INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is an inflammatory disease or infection of the middle ear which presents with recurrent ear discharges or otorrhea through a permanent tympanic membrane perforation.[1,2] This results in the disruption of the anatomy and physiology of the middle ear and hearing loss. There are two main types of CSOM ie. the mucosal /tubotympanic disease and the bony/attico- antral disease. CSOM usually begins in childhood after a spontaneous tympanic membrane perforation due to an acute infection of the middle ear, known as acute otitis media (AOM), or as a sequel of less severe forms of otitis media (e.g. secretory otitis media). The infection may be recurrent for several months and years mainly due to ineffective medical treatment thus graduating from AOM to CSOM. The long term effect or result is a partial or total loss of the tympanic membrane (which may not heal) and erosion of some parts of the ossicular chain.[3,4] Although healing is often observed over prolonged periods, there are many patients who develop either recurrent bouts of otorrhoea (active CSOM) or a dry but permanent tympanic perforation (inactive CSOM).[1] The consequence thereof is conductive hearing loss that can range in severity from 60–70 decibel (dB).[2,3,5] Chronic otitis media is a common condition affecting 0.5–30 % of any community and the commonest ear disease of acquired hearing loss in many developing countries with a conservative estimate of 20 million people in the world suffering from CSOM.[1,3,4] In a study by Appiah – Korang et al in Ghana, during a period of two years, 351 cases of ear discharges were documented.[6] Treatment of chronic otitis media is of two forms – conservative and surgical. Conservative treatment is with antibiotic/steroid ear drops after aural toileting. This is mainly good for mucosal disease but tends to be characterized by recurrence of disease. Ototoxicity may also be a risk as these ear drops usually contain aminoglycosides. Surgery is thus indicated for recurrent or persistently active chronic otitis media and those with significant hearing loss. In some cases, surgery is done for inactive chronic otitis media for social reasons. Examples are as a pre-employment requirement or in swimmers to avert recurrent infections. Surgical management has remained the ultimate choice for the treatment of CSOM though it remains expensive.[5,7,8] This operation can be combined with either an intact external auditory canal wall or a

canal wall down mastoidectomy to eradicate disease from the mastoid cavity.

In this study, focus was on audiometric evaluation of patients' hearing results preoperatively and postoperatively taking into account their air conduction and bone conduction thresholds. The patients were audiologically assessed preoperatively and postoperatively for their hearing status. The study was designed to evaluate the efficacy of the treatment of chronic suppurative otitis media using tympanoplasty by comparing preoperative and postoperative hearing results of patients.

METHODS

Aims / Objectives

This case series attempts to evaluate the efficacy of the treatment of CSOM using tympanoplasty to improve hearing sensitivity by comparing preoperative and postoperative hearing results of patients. This study is unique because it is the first ever of any form of tympanoplasty procedure carried out at the CCTH.

Design

This case series was performed based on tympanoplasty patients' records at the CCTH. Audiometric assessments were done at the Hearing Aids and Speech Assessment Centre (HASAC). This centre was established by the Lions Club in 2012 on the premises of the Cape Coast School for the Deaf to provide hearing and speech assessment and management services for persons with such disabilities. The facility can boast of state of the art equipment such as calibrated audiometers tympanometer, otoacoustic emission equipment, and acoustically treated room and booth. Both the preoperative and postoperative hearing assessments were conducted at HASAC by visiting audiologists from University of Education, Winneba as the Cape Coast centre did not have a resident audiologist.

The tympanoplasties were conducted at the CCTH by a team made up of ENT surgeons of the CCTH and the University of Utah School of Medicine, United States Of America.

These surgeries were historic as these happened to be the first ever tympanoplasties performed at the CCTH and thus the need to evaluate the efficacy of the procedure on improving the hearing of the patients.

Patient pre-operative preparation

Participants (patients) who were included in the surgeries were made to fill and sign an informed consent form having had the surgical procedure explained to them with the possible side effects.

Surgical Procedure

Tympanoplasty is a surgical procedure during which a graft is placed over a tympanic membrane perforation with or without reconstruction of the osscicular chain. 5 types have been described by Zollner and Wullstein. Type I also called Myringoplasty involves placing a graft over an intact ossicular chain. In Type II graft is placed over the incus in which case the malleus is eroded. Ideally this should result in a minimal hearing loss of only 2.5 dB. In Type III, the graft is placed over a mobile stapes superstructure where the malleus and incus may be eroded. This is also known as myringostapediopexy. In type IV, a graft is placed over a mobile stapes footplate when the superstructure is eroded. In type V, graft is placed over a fenestra/window made in the horizontal semi-circular canal when the stapes footplate is fixed.[7,9] Various materials have been used for grafting. Examples include lobular fat, temporalis fascia, periosteum and perichondrium.

In this study, every patient had tympanoplasty combined with mastoidectomy. This is also called tympanomastoidectomy. The canal wall up approach was used in all cases. Temporalis fascia was used.

Post-operative care and follow up

Patients were provided with antibiotic ear drops and analgesics. After the surgery, the patients were reviewed after 4 weeks, 8 weeks and 12 weeks. The hearing assessment was conducted after the 12th week.

Instrumentation

The instruments used for the study were physiological measures including otoscopic examination, pure tone audiometry and tympanometry. Physiological measures provide bodily measures with precision of data of the instruments.[10] The audiometer and tympanometer provide body measurements with precision of data. Gelfand explains that calibration of test equipment is needed to ensure the equipment is in compliance with standards.[2] The AC 40 clinical audiometer and tympanometer used for the testing of the participants were all well calibrated.

The selected patients had complete ear, nose and throat examination. An initial otoscopic examination was conducted. This was followed by a microscopic examination to establish the pre-operative diagnosis of CSOM.

Additionally, all patients had pre-operative pure-tone audiometric (PTA) air and bone conduction thresholds to measure their hearing status at standard audiometric frequencies (250, 500, 1000, 2000, 4000, 8000 Hz) using the modified Hughson-Westlake method. A calibrated Interacoustics AC 40 clinical audiometer was used with a set of headphones for the testing in a calibrated test booth. The audiometer and headphones were checked for proper functioning before conducting each series of tests biologically.

The Pure Tone Audiometry (PTA) tests were conducted within seven days prior to the operation through air conduction and bone conduction modes. The air

conduction and bone conduction threshold averages were calculated by taking the averages of 500, 1000, 2000 and 4000 Hz frequencies. The air and bone conduction thresholds were recorded both preoperatively and postoperatively. The air-bone gaps were then calculated as the difference between the air conduction and bone conduction thresholds. Patients were followed up regularly with PTA three months postoperatively.

Furthermore, middle ear measurements were taken of all participants using a 226-Hz tympanometer. This was performed to establish the patients' static acoustic admittance and ear canal volumes.

Analysis

The results were computed and analyzed using averages of pre-operative and postoperative PTA-ABGs and comparisons conducted. The data was analyzed using SPSS version 20 software package and p-values were calculated using the independent sample t-test. P value of <0.05 was taken to be significant.

RESULTS

5 patients were included in the study because they had adequate followed up. Patients less than 11 years were 2 (40%), 21-30 years were also 2 (40%) and one was above 40 years (i.e. 20%).

Among the 5 patients included in the study, 3 (60%) were females and 2 (40%) were males.

Table 1: Pre-operative and post-operative ABG.

Group	N	Min	Max	Mean	S.D	S.E	P-Value
Pre-Operative ABG 500Hz	5	10	50	31	15.166	6.782	0.01
Post-Operative ABG 500Hz	5	5	30	16	11.402	5.099	
Pre-Operative ABG 1000Hz	5	15	45	29.00	2.942	5.788	0.007
Post–Operative ABG 1000Hz	5	5	25	16.00	8.216	3.674	
Pre-Operative ABG 2000Hz	5	20	40	26.00	8.944	4.000	0.003
Post–Operative ABG 2000Hz	5	5	15	9.00	5.477	2.449	
Pre-Operative ABG 4000Hz	5	20	45	33.00	10.368	4.637	0.002
Post–Operative ABG 4000Hz	5	5	30	14.00	10.840	4.848	
Pre-Operative ABG Average	5	22	33	27.75	5.132	2.562	0.002
Post-Operative ABG Average	5	9	16	14.00	3.367	1.683	

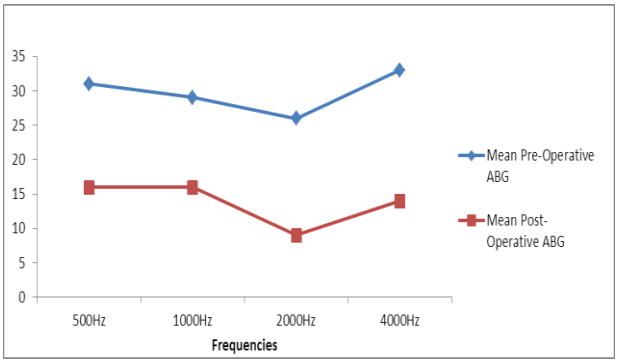

Figure 1: Pre and Post Tympanoplasty PTA-ABG.

From Table 1 and Figure 1, the average preoperative air-bone gaps (ABGs) at frequencies 500Hz, 1000Hz, 2000Hz and 4000Hz were found to be 31dB, 29dB, 26dB and 33dB respectively compared to the average postoperative ABGs of 16dB, 16dB, 9dB and 14dB respectively. These show that the hearing of participants significantly improved with reduced ABGs postoperatively. These differences as observed were statistically significant. It can be seen that the four frequencies average pre-operative ABG which was 27.75dB reduced significantly to 14.00dB post-operatively with a net gain of 13.75dB. This gain in the ABG postoperatively was found to be statistically significant with p-value of less than 0.05.

DISCUSSION

The aim of this study was to compare the pre-operative and post-operative audiometric hearing results of patients who had had tympanoplasty using their ABG averages. Being the first ever of such surgeries at the CCTH, the study sought to monitor the improvement of hearing sensitivity of participants as well as set tone and basis for future studies in the area of tympanoplasty as a corrective surgery for hearing pathology. The study focused on 5 patients who followed through with clinical review procedures after the surgery. This is in sharp contrast with other studies which had larger numbers of participants and gender distribution.[4,11] The study took into account short term hearing results since according to Shrestha et al, long term success results of any ossicular chain repair is largely dependent on factors outside the control of the surgeon such as patient follow-up rates, eustachian tube function, middle ear stability and the condition of the mucosa. In effect, short-term results are therefore a more accurate reflection of the actual reconstructive procedures.[4] Thus the short-term results were focused on in this study. Accordingly, the pre-operative air-bone gaps were computed using the pre-operative air conduction and pre-operative bone conduction thresholds at 500, 1000, 2000 and 4000 Hz. Similarly, the post-operative air-bone gaps were also computed using the post-operative air conduction and post-operative bone conduction thresholds at 500, 1000,

2000 and 4000 Hz. From the results, it was observed that none of the participants had a worsening air and / or bone conduction threshold post-operatively therefore resulting in an improved or better post-operative air-bone gap.

The average PTA-ABG in our study pre-operatively was 27.75 dB and 14.00 dB post-operatively with a net gain of 13.75 dB. The difference between the pre-operative and post-operative PTA-ABG results were statistically significant ($p<0.05$). These findings were consistent with the findings of other studies where there had been improvement of the PTA-ABG in the post-operative results. In two studies where patients had tympanoplasty, the first study reported that the PTA-ABG decreased from 47.5dB in the pre-operative assessment to 15 dB in the post-operative assessment whilst in the second study, the PTA-ABG decreased from 35.41dB in the pre-operative testing to 24.33 dB in the post-operative assessment.[4,12]

The clients in this study testify to an improved livelihood as recurrent ear discharges have stopped and hearing has improved. A university student who was part of the study was very grateful that she could now receive phone calls on the operated ear. A trader from the Brong Ahafo region was thankful that her clients were not coming to find her with ear discharges any more.

CONCLUSION

In conclusion, we report that post-operative hearing thresholds i.e. PTA-ABGs were much better than those of the pre-operative PTA-ABG i.e. from 27.75 dB to 14.00 dB with a gain of 13.75 dB. These differences were found to be statistically significant. The study therefore reports of improved hearing thresholds of patients after tympanoplasty. A gain of up to 13 dB is very significant in the hearing life of any individual for effective oral and aural communication.

RECOMMENDATION

Tympanoplasty should be made easily available to the CSOM patients in Ghana as hearing and recurrent ear discharges can be improved.

AUTHOR CONTRIBUTIONS

PAT, RM, JM, NVB and JC formed the operating team for the tympanoplasties. CSA and CMHM were the audiologists who tested the patients. All authors contributed to the design and write-up of the manuscript. ENT Nurses of the Cape Coast Teaching Hospital including Mrs Paulina Adomako, Sis Esther Nketia, Sis Adisa Omar, Sis Bernice Baah and Sis Tabitha Simons-Dadzie were very helpful in taking care of the study subjects.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Ethical Review Committee of the Cape Coast Teaching Hospital. A copy of the letter of approval is available for review by the editor.

CONFLICT OF INTEREST

No conflict of interest declared.

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