Traumatic tympanic membrane perforations: an overview in tertiary care hospital

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This hospital-based prospective study was conducted in the Department of Ear Nose Throat, Head and Neck Surgery, Government Medical College Srinagar, Jammu and Kashmir, for a period of 1 year from June 2013 to June 2014, with the aim of studying the aetiological factors, clinical presentation and management options for traumatic tympanic membrane perforations. A total of 50 patients with traumatic perforations of the tympanic membrane were enrolled in the study, comprising of 34 males and 16 females patients. Age of the patients ranged from 12 to 56 years, with a mean age of 32 years. The results showed that the most common mode of trauma was slaps (56%); sudden hearing loss and tinnitus were the two most common presentations (92%). Audiometry shows that the larger the tympanic membrane perforation, the larger the air–bone gap. Hearing loss was highest at the lowest frequencies and generally decreased as the frequency increased. The differences in air–bone gaps between small and large perforations were significant at all frequencies ($P<0.05$, Student's t-test). Overall, 72% of patients responded to conservative management, whereas 28% needed fat myringoplasty and/or chemical cauterization.

Keywords:
Hearing loss, pure-tone audiometery, fat myringoplasty, traumatic tympanic membrane perforation

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Introduction

The tympanic membrane (TM) is an important component of sound conduction, as its vibratory characteristic is necessary for sound transmission in human beings [1]. Trauma patients consume more healthcare resources compared with heart and cancer patients combined. Whereas mortality from heart disease and cancer is declining, the incidence of trauma is increasing [2,3]. Traumatic TM perforations (TMPs) may result from various causes (e.g. slap against the ear, barotrauma or instrumental injury) [4–6]. A perforated TM results in loss of hearing due to decreased drum area and liability to recurrent infection of the middle-ear mucosa. These problems limit the patients' participation in water sports and their recruitment for jobs in military services and as motor vehicle drivers [7]. TM perforation leads to an increase in acoustic coupling by 10–20 db, caused by a loss of the shielding effect of an intact TM. The increase in acoustic coupling allows one to predict the maximum conductive hearing loss following a perforation to be about 40–50 db [8]. The volume of middle-ear space also affects hearing. A smaller volume results in a larger air–bone gap. For a given sound pressure in the ear canal and a given perforation, the resulting sound pressure within the middle-ear cavity is inversely proportional to the middle ear volume. Thus, the transtympanic sound pressure difference will be smaller with smaller middle-ear volumes. Identical perforations in two different ears have conductive losses that can differ by up to 20–30 db if the volumes of the middle-ear space differ [8].

Materials and methods

The current study was conducted at the Department of Ear Nose Throat, Head and Neck Surgery, Government Medical College Srinagar, Jammu and Kashmir, for a period of 1 year from June 2013 to June 2014. A total of 50 patients with a history of trauma to the ear(s) who presented to our department with otoscopy-confirmed TMP were enrolled in the study.

Written informed consent was obtained from all patients after explaining to them the study and the risks associated with it. They were evaluated in detail for the type of trauma, mode of trauma and presenting symptoms. Full ENT examination was carried out, including audiological tests (e.g. pure-tone audiometery and impedance audiometery as and

Table 1 Sex distribution of patients

Sex	No. of patients (%)
Male patients	34 (68)
Female patients	16 (32)
Total	50 (100)

when required). Ethical committee clearance from the college was sought.

Results

Out of 50 enrolled subjects 34 were males and 16 were females with the age ranging from 12 to 56 years (Table 1). The most common mode of trauma was slaps (56%), followed by pricks with needles, barotrauma, trauma cause by instruments (syringing or mopping of wax) and road traffic accidents (Table 2).

Among men, the majority of slaps received were from security personnel (68%), whereas among women, they were from their husbands (70%).

Sudden hearing loss and tinnitus were the two most common presentations (92%). Other symptoms were discharge and otalgia as shown in Table 3.

Otoscopic examination of subjects showed that only pars tensa was involved, none had perforation of pars flacida, the most common location of TM perforation was the posterosuperior quadrant. The size of the perforations was variable as depicted in Table 4:

(1) Central
(2) Subtotal
(3) Near total
(4) Total

Audiometric results showed that the larger the TMP, the larger the air–bone gap (ABG; conductive hearing loss). Hearing loss was the highest at the lowest frequencies and generally decreased as the frequency increased. The differences in ABGs between small and large perforations were significant at all frequencies

Table 2 Aetiological profile of patients with tympanic membrane perforation

Aetiology	No. of patients (%)
Slaps	35 (70)
RTA	5 (9)
Instruments and syringing	3 (7)
Foreign body	3 (6)
Barotrauma	2 (4)
Others	2 (4)

RTA, road traffic accident.

($P<0.05$, Student's t-test). The differences between small and medium perforations and between medium and large perforations were significant ($P<0.05$) at 1000, 2000 and 4000 Hz. Although there was a trend for the anterior perforations to show a slightly smaller mean ABG (1–8 dB at lower frequencies), no statistically significant differences in ABGs were found at any frequency between anterior and posterior TMPs ($P=0.09$ at 250 Hz, $P=0.40$ at 500 Hz, $P=0.07$ at 1000 Hz, $P=0.70$ at 2000 Hz, and $P=0.83$ at 4000 Hz).

Overall, 12% of patients (6) with near-total/total TMP showed sensorineural and/or mixed loss, with an average loss of 10–15 db. Closure of the ABG following healing was significant ($P<0.05$), whereas recovery of the bone conduction abnormality was less favourable.

Patients were allotted into two groups on the basis of TMP size for management purposes. Group A included 36 patients, all with a small central perforation, whereas group B included 16 patients with larger TMPs (subtotal, near-total and total perforation), and it was seen that 91.66% of patients (33/36) with central TMPs recovered with conservative management, as against only 20% of patients with larger TMPs. Only 9% of central TMP patients needed chemical cauterization or fat myringoplasty, whereas 81.25% of those with larger TMPs (11/14; subtotal, near-total and total perforation) required the same.

Thus, majority of the patients(72%) responded to conservative management, which included treatment

Table 3 Clinical presentation

Clinical symptoms	No. of patients (%)
Sudden hearing loss	45 (90)
Tinnitus	26 (52)
Otalgia	19 (37)
Discharge	5 (10)
CSF leak	1 (2)
Others	6 (12)

CSF, cerebrospinal fluid.

Table 4 Classification based on the size of the tympanic membrane perforation

Size of perforation	No. of patients (%)
Central	36 (72)
Subtotal perforation	8 (16)
Near-total perforation	3 (6)
Total perforation	3 (6)
Total no of cases	50 (100)

Table 5 Conservative management

Type of perforation	No. of cases	Conservative management	Percentage
Central TMP (group A)	36	33	91.66
Larger TMP (group B)	16	3	18.75
Total	50	36	72.00

TMP, tympanic membrane perforation.

Table 6 Chemical cauterization/fat myringoplasty

Type of perforation	No. of cases	Chemical cauterization/ fat myringoplasty	Percentage
Central TMP (group A)	36	3	8.33
Larger TMP (group B)	14	11	81.25
Total	50	14	28.00

TMP, tympanic membrane perforation.

of any associated sinonasal allergy/upper respiratory tract infection and water precautions.

Overall, 8% of patients, none with central TMPs, developed full-fledged chronic suppurative otitis media and underwent tympanoplasty (Tables 5 and 6).

Discussion

Trauma to the ear could be a simple blunt trauma to the pinna, laceration of the pinna, avulsion of a part of the pinna or the whole pinna, uncomplicated TMP, dislocation of the ossicles and longitudinal and transverse fractures of the petrous temporal bone with associated loss of inner ear and facial nerve function [9–15]. Trauma to the TM can be caused by overpressure (slap, fight, assault from security personnel and road traffic injury), thermal or caustic burns and blunt or penetrating injuries, such as trauma caused by instruments and barotraumas [16,17]. The current study observed that slaps (overpressure) were the most common aetiological factor, with a frequency of 70% for traumatic perforation of the TM. This is in agreement with the study by da Lilly-Tariah *et al*. [17], who in his study found that overpressure is by far the most common mechanism of trauma to the TM. Various other studies have reported that attempts to remove foreign body, self-ear-cleaning with a variety of objects like cotton buds, and wax removal in an unskilled manner, either by parents or primary-care physicians as important causes of TMPs as seen in the current study [9,10,14,15]. Thus, there is a need for primary-care physicians to identify their limitations and make appropriate referrals.

Perforation causes hearing loss, which depends on frequency, perforation size and middle-ear space. Our study confirmed that with the increase in perforation size hearing loss also increases, with the lowest frequencies being affected more often; this is consistent with other studies in the literature and the study by Santhi and Rajan [18], who in their study found that perforation-induced losses are greatest at the lowest frequencies and that larger perforations result in larger hearing losses.

In the present study, 72% of patients were managed with conservative/medical treatment; this is in agreement with the findings of Toner *et al.* [10] and Ijaduola [12], who stated that traumatic perforations often occur in healthy members of the community and that, generally, the prognosis is excellent with conservative management only. The two main factors that lead to failure of the perforation to heal are loss of tissue and secondary infection. The current study reported that 8% of the ears developed secondary suppurative otitis media, which is similar to that reported in the study by Rehman *et al*. [19]. Because of the risk of introducing infection, the ear should not be cleaned out with a syringe. The ear must be kept dry by preventing water from entering the ear canal [10,12]. This was our observation as well. Those patients who were recommended water syringing for wax in the ear or accidental entry of water during bath came with discharge in their ears. If the perforation fails to close spontaneously within 3–6 months (in the absence of secondary infection), surgical closure is indicated [10,12]. TMP leads to an increase in acoustic coupling by 10–20 db, caused by loss of the shielding effect of intact TMs [18]. Fat myringoplasty and/or chemical cauterization was performed in 28% of patients who did not respond to conservative management for at least 3 months. Same guidelines were followed by Moustafa Hegazy [20] who in his study, performed fat myringoplasty in all those cases who did not respond to conservative treatment for a period of 3 months.

Conclusion

Traumatic TMP is a common injury in our society because of military conflict in the region. Men are the main sufferers; most of the patients recover with conservative measures, but 10–15% suffer from bone conduction loss and 8–10% develop suppurative otitis media. Thus, there is a need to educate security agents on alternative punitive measures, as there is a predisposition to conductive hearing loss or imminent chronic

suppurative otitis media if TMPs are not properly managed. Unskilled removal of foreign bodies should be strictly avoided. Early identification and evaluation of TMP patients and their referral to ENT clinics to reduce morbidity and complications are indispensable.

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Conflicts of interest

There are no conflicts of interest.

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