

Evolving Options and Challenges in the Management of Traumatic Perforation of Tympanic Membrane, Pondicherry India, 2016

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Abstract: Background: Damage to the tympanic membrane remains a substantial burden to patients presenting the emergency department. Traumatic perforation of the tympanic membrane though a common injury is mostly under reported. Many perforations are small and heal spontaneously. This study was conducted to analyze the mechanism of injury, treatment outcome of conservative management and when to do surgical management. Methods: We conducted cross sectional study among patients presenting with tympanic membrane perforation. Diagnosis was done using otoscopic and otoendoscopic examination. Patients were screened for hearing loss by Pure Tone Audiometry at the time of presentation. All patients were advised follow up every week for a period of 6 weeks. Systemic and local risk factor estimation was done in a comprehensive examination. Univariate and stepwise regression analyses were done to identify the independent risk factors associated with the presence and severity of trauma. We calculated adjusted odds ratio with 95% CI to identify the factors associated with traumatic perforation. Results: About 121 cases were recruited for the study the mean age group is 31.5±10 years. Nearly 65.29 % of traumatic perforation of tympanic membrane were among females There were 15 cases who presented bilaterally, thus making it 136 affected ears. The predominant symptomatology were impaired hearing 47.93%, earache 19.01% and bleeding from ear 6.61%. In context of conductive hearing loss 60.3% had a range of 26-35dB. The common aetiology for traumatic perforation of tympanic membrane were injury caused due to slap 38.84% and fire cracker burst 25.62%. The left ear was more commonly involved in 65.29%. Majority of patients presented with perforation in a single quadrant (grade I) 56.62 % (77 affected ears). In terms of the margins of perforation 58% had ragged margins of perforations and 33% inverted margins. Majority of the perforations 49.32% were noted in poster inferior quadrant. Nearly 30.14% tympanic membrane perforations underwent myringoplasty. The average time taken for spontaneous healing by the uninfected cases was five weeks. Conclusion: Ear trauma is common phenomena which mostly commonly affects the tympanic membrane. Sudden increase in canal pressure from blows and slaps were the major mechanism of injury. Management outcome was good except for few late presenters with complications. Persistent conductive hearing loss suggests disruption of the ossicular chain, necessitating surgical exploration and repair. Evolving options and challenges in the management of Traumatic Perforation of Tympanic Membrane Pondicherry India, 2016

1. Introduction

The tympanic membrane is a thin wall that separates the outer ear from the middle ear [1]. It is much more traumatized than middle or inner ear structures [2]. The incidence has been estimated to be at 6.8 per 1000 person and the annual incidence rates of traumatic perforation vary between 1.4 to 8.6 per 100.000 [2, 3]. The causes of acute rupture of tympanic membrane include direct trauma by instruments such as cotton swab, pin, and sticks; welding; skull fracture and foreign body. Iatrogenic procedure like syringing, suction, and probing of the ear are the major cause of presentation in emergency department [3]. Pressure changes causing issues include blast injury, open palm trauma (slapping), diving, and flying [4].

Tympanic membrane is a thin structure that measures only 81 mm². It transmits sound from the external ear canal to the ossicles residing in the middle ear [5] A tympanic membrane perforation (TMP) results in hearing loss by diminishing the impedance mismatch and decreasing the pressure differential induced by sounds, leading to decreased ossicular coupling. [6]. There are multiple factors, such as perforation

size, sound frequency tested, middle ear space dimensions, and mastoid volume which determine the degree of hearing loss associated with TMP [7]. When TMP occurs, patients may experience substantial pain, hearing loss, and drainage of fluid (including blood) from the ear.

Closing a tympanic membrane perforation has the advantages like improvement in hearing, patient can tolerate getting water in to the ear while swimming and that recurrent ear discharges is unlikely to occur during upper respiratory tract infections [9, 10]. Sometime perforation occurs by self-cleansing of own ear, scraping by safety pin, match stick, warm oil, caustic or thermal burn, syringing in ENT OPD and also by barotrauma may be challenging and difficult to manage conservatively [11]. Spontaneous healing of Traumatic tympanic membrane perforation is very good but spontaneous healing of perforated TM is controversy [12]

The entire hearing apparatus has a complex temporal bone, in which much vital structure found mainly the cochlea and facial nerve. In road traffic accident there is involvement of all these structure in such type of manner blunt trauma,

laceration, avulsion of pinna, with tympanic membrane perforation (13, 14). Sometimes ossicles and inner ears were affected. Hearing loss depends on the side of trauma and size of perforation but some authors found results to be conflicting and inconclusive (15). Traumatic perforations often occur in the healthy members in the community and the prognosis excellent (13, 15).

Traumatic perforation of the tympanic membrane is a common injury that is under-reported in developing countries especially India where there is shortage of resources and trained manpower. There is also the need to educate the allied health staff who man rural health post regarding unskilled removal of foreign body, early identification, evaluation and referral of patients to specialty centres to reduce the morbidity with hearing loss (17). Although traumatic TM perforations may have good prognosis, there is no data to know the true burden of these injuries and any existing protocol for management of traumatic perforation in patients. It is necessary to induce patients with explanations regarding possible complications and advise to visit the out-patient clinic until the wound has healed completely(18). There present study aim to address the above issues with clear objective to understand the true burden of Ear Injuries and suggest guidelines for management and follow up of complication mainly hearing loss.

2. Methods

Study Population

Our study population were patients who presented either to causality, ENT OPD and referral from other e outpatient rural healthcare facilities in the age group between 10 - 65 years for any of their health needs.

Study design

We did a facility based cross-sectional survey at Health centres between January 2014 and March 2016.

Sample size and Sampling Procedure:

The sample size was based on the assumption of 15% prevalence, 5% absolute precision and at 95% confidence interval with 5% non-response [8]. Selections of participants were made on the basis of consecutive sampling of cumulative cases over one week per facility in order to obtain the sample size. The principal investigator and two trained investigators collected the data. Participants were recruited after sharing the information about the purpose of the study in their local language. All patients who indicated willingness to participate in the study and gave written informed consent were included in the study. Subsequently their consent was obtained alongside a witness in case of illiterates. We used a structured questionnaire to collect data regarding sociodemographic details, behavioural risk factors and history of other diseases

Ear Examination

Inspection of the auricle was done for any sign of trauma, palpation for tenderness, careful suctioning of blood, purulent discharge, and debris, from the ear canal if present. Diagnosis was done by otoscopic and otoendoscopic examination. The shape, size and location of the perforation

{posterior, anterior, central (kidney shape) or subtotal} were recorded. Tuning fork tests at the point of care was done by Renne's, Weber's, and Absolute bone conduction test. Patients were subjected for hearing assessment with Pure Tone Audiometry at speciality clinics in tertiary health facility following referral from rural health unit at the time of presentation. Patients included in the study were advised for follow up every week for a period of six weeks in speciality clinic and followed up by the principal investigator and two trained investigators. Patients were advised to keep the ear dry and clean. An antibiotic was used to prevent or treat infection. Oral antibiotics Amoxicillin 500mg, thrice daily for five days and patient allergic to penicillin were provided with alternate antibiotics after consultation with Infectious disease specialist. Cleaning of the external auditory canal were done when indicated. Follow up period was for a period of six weeks. During each follow up the healing of Tympanic Membrane Perforation was assessed with otoscopy and otoendoscopy.

Analysis

Data was expressed in the form of frequencies and percentages. We calculated the prevalence infection and various other co-morbid conditions with 95% CI. We also analysed the various risk factors for Tympanic membrane perforation. To measure the strength of the associations OR was calculated and the 95% confidence interval (CI) tested to ascertain whether the results were statistically significant. We computed unadjusted and adjusted ORs with 95% CI using the logistic regression method. We adjusted each of the risk factors for age in separate models and used Epi-Info version 3.5.3 for data entry and analysis.

Protection of human subjects

We obtained approval from the Institutional Ethics Committee of the Indira Gandhi Govt. General Hospital and Post Graduate Institute, Pondicherry as well as written informed consent from all the participants. We referred head injury patients of road traffic injury with traumatic perforation for further evaluation of Neurosurgery Team. The antibiotic regime was as per Infections disease guidelines.

3. Results

About 121 cases recruited for study period. The mean age group is 31.5±10 years. About 50.41% cases reported were between 21-30 years of age. Nearly 65.29 % of traumatic perforation of tympanic membrane among females Fig [6]. There were 15 cases who presented bilaterally thus making a total of 136 affected ears Fig [1-5]. The predominant symptomatology were impaired hearing 47.93%, ear ache 19.01% and bleeding from ear 6.61%. In context of conductive hearing loss 60.3% had a range of 26-35dB, 23.97% with ≤ 25dB and 15.7% with ≥ 36dB hearing loss Fig [7]. The common aetiology for traumatic perforation of tympanic membrane was injury caused due to slap 38.84% and fire cracker burst 25.62%. The left ear was more commonly involved in 65.29% and 12.40 % presented with bilateral perforations Table [1]. Majority of patients presented with perforation in a single quadrant (grade I) 56.62 % Fig [8]. In terms of the margins of perforation 58% had ragged margins of perforations, 33% inverted margins in

45 affected ears (33.09%) Fig [9].The overall quadrants involved was 221 which Included grade 1, grade 2 and grade 3 Fig [10].Majority of the perforations 49.32% were noted in poster inferior quadrant, 22.17% in posterosuperior quadrant and 14.1% IN anteroinferior quadrant and least involved was 14.03% anterosuperior quadrant Fig [10].

All the patients were treated conservatively and followed up every week till six weeks.69.8% of tympanic membrane perforations healed spontaneously at the end of six weeks duration. Nearly 30.14% tympanic membrane perforations underwent myringoplasty. The average time taken for spontaneous healing by the uninfected cases was five weeks in 78 perforated tympanic membrane and the remaining 17 perforated tympanic membrane healed spontaneously at 6 weeks.

4. Discussion

Traumatic perforation of the tympanic membrane is a common injury that is under reported in rural population. There is a need to educate the allied health services regarding unskilled removal of foreign body, early identification, evaluation and referral of patients so as to reduce the morbidity. Trauma generally is blight on our society and it is a major cause of morbidity and mortality (19). Traumatic Tympanic membrane perforation most commonly seen in Otorhinolaryngology OPD. The tympanic membrane forms the pathway for conduction of sound via its character of vibration (16). The increase in number of cases may be due to increased domestic violence and following road traffic accident (RTA)(17).

Although traumatic TM perforations have good prognosis, it is necessary to provide patients with explanations for possible complications and to regularly visit the out-patient clinic until the wound has healed completely. The population mainly effected with traumatic perforation are the younger age group considering work activity and injury risk. As reported in studies by Lindeman e tal (1987), Kirstenson et al (1992), and Berger et al (1994) [19, 20]. The reported mean age were between 21.7 -24.1 years as reported in their case series. Studies done by Lindeman et al (1987) who reported a greater incidence among females[20]. But Camnitz et al (1985), reported prevalence among males. The females form the majority in our outpatient attendance, the most common reason being domestic violence by their family members [20, 21]. Traumatic perforations among females were mainly caused by slap injury. However, a higher male predominance was reported by Gacek et al and Gacek et al and da Lilly-Tariah and Somefun et al [22, 23]. The higher prevalence among males their study can also be explained by the fact that study was undertaken in a conflict zone.

A large series by Lou et al reported that, in a Chinese population, the overwhelming cause of traumatic TMP was slap injuries (78.4%), while instrumentation was responsible for only 5.0% of injuries [24]. A recent study from Germany demonstrated that an open-handed slap led to 37.4% of injuries, while cotton-tipped applicators represented 19.3% and barotrauma from high diving represented 13.0% of injuries[25]. A study from Nigeria demonstrated that the

most common causes of traumatic TMP were slaps to the head (35.9%) and road traffic injuries (23.5%) [23]. Differences in the cause of traumatic TMPs may reflect cultural and behavior differences among populations. In various other studies in western literature 45.3% of foreign body instrumentation causing traumatic TMP was from cotton tipped applicators [25].

Closing a perforation has the following advantages like improvement in hearing, patient can tolerate getting water in to the ear like swimming, taking shower etc. and recurrent ear discharges is unlikely to occur during upper respiratory tract infections[26]. Ali Juboori A.N. et al (2014) studied that rate of healing was reported faster in young adults people because of higher protease turn over in these age group[26]. Traumatic perforations often occur in community and generally the prognosis is excellent [23, 24, 25]. The two main factors that predispose to failure of perforation to heal area, loss of tissue, and secondary infection. The average time taken for healing by the uninfected cases was five weeks. Korkis et al (1946) reported 29.4 days and 38 days as the mean time taken for healing in the case of uninfected and infected perforations respectively. The overall healing rate achieved in the study group was 69.86%. Berger et al (1994) case series reported 94.8% spontaneous healing.[27]

Outpatient follow-up with an otolaryngologist evaluation of the TMP is mandatory to pick up early signs of Deafness. Instructions provided at discharge should include from parent department must include strict precautions to keep the ear canal dry and to prevent water from entering the ear canal. Swimming should be avoided and a cotton ball coated with petroleum jelly can be placed in the ear canal during bathing. If there is otorrhea, topical antibiotic ear drops can be prescribed. It is required that an audiogram be performed three months after the injury to confirm the normalcy of the patient's hearing and no ossicular chain discontinuity

5. Limitation

The limitations of this study include self-selection bias as the participants were selected from the health facilities. Low levels of education/awareness and higher median age could have contributed to high levels of error in recall. Information bias could possibly have crept in while collection of information on smoking, alcohol, health facility resources and providers attitudes from the patients. To reduce these biases we trained the field workers to appropriately prompt the patients and elicit information. Identified risk factors were based on just point estimation; therefore, a causal relationship with Tympanic perforation could not be proved. In addition, a considerable limitation of this study pertains to the relatively small sample size

6. Conclusion

A ruptured eardrum often heals without any invasive treatment. Most people with ruptured eardrums experience only temporary hearing loss. Even without treatment, your eardrum should heal in a few weeks. Eardrum ruptures can be easily prevented by protecting hearing and avoid injury or putting objects in the ear. Sudden increase in canal pressure

from blows/slaps was the major mechanism of injury. The rate of healing was reported faster in young adults.

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Figure 1: Traumatic Perforation due to Slap Injury



Figure 4: Traumatic Perforation due to Self Cleaning of Ear Using Hair Pin

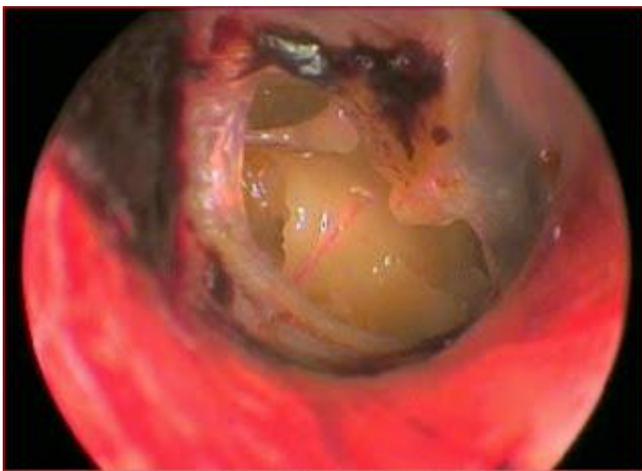


Figure 2: Traumatic Perforation due to Iatrogenic Injury (Unskilled removal of Foreign Body)

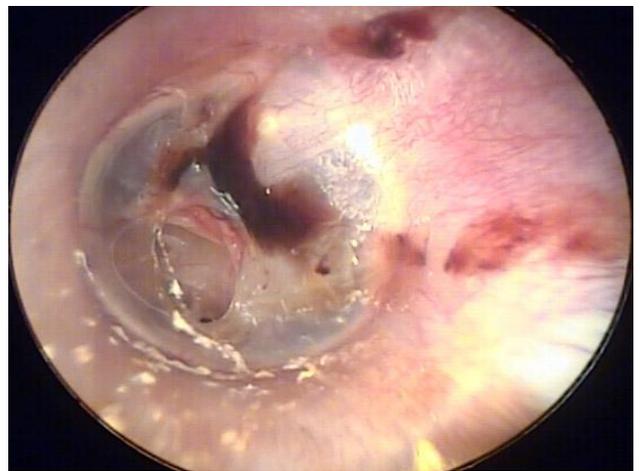


Figure 5: Traumatic Perforation due to Road Traffic Injury

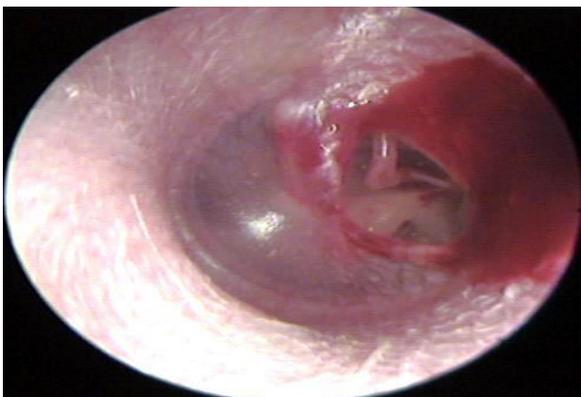


Figure 3: Traumatic Perforation of a Child (Left Ear)

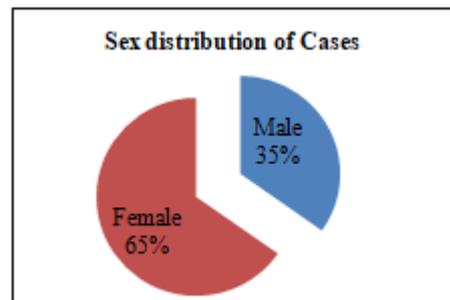


Figure 6: Gender Distribution of patients presenting with traumatic rupture of tympanic membrane

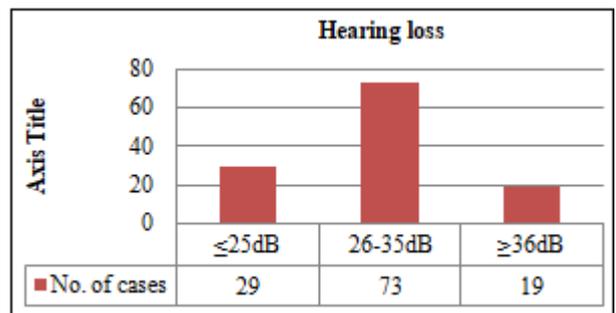


Figure 7: Hearing loss at the time of presentation the pure tone audiometry in dB (@ 500 Hz, 1 & 2 KHz)

Table 1: Mode of injury causing rupture of Tympanic membrane

Percentage %	No of cases	Mode
38.84	47	Slap
25.62	31	Fire crackers
6.61	8	Water diving
14.05	17	Ear budding/safety pin
9.92	12	RTA
4.96	6	Iatrogenic

Table 2: Grades of Tympanic membrane perforation

	No. of affected ear	Percentage %
Involving one quadrant (Grade I)	77	56.62
Involving two quadrants (Grade II)	33	24.26
Involving more than two quadrants (Grade III)	26	19.12

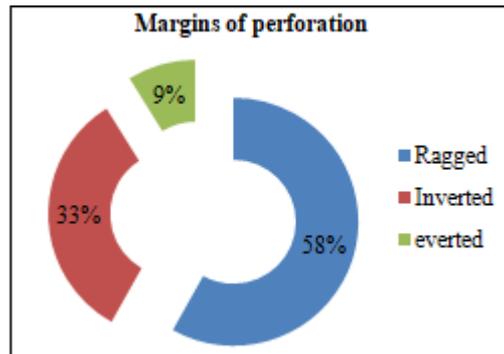


Figure 8: Margins of Perforation

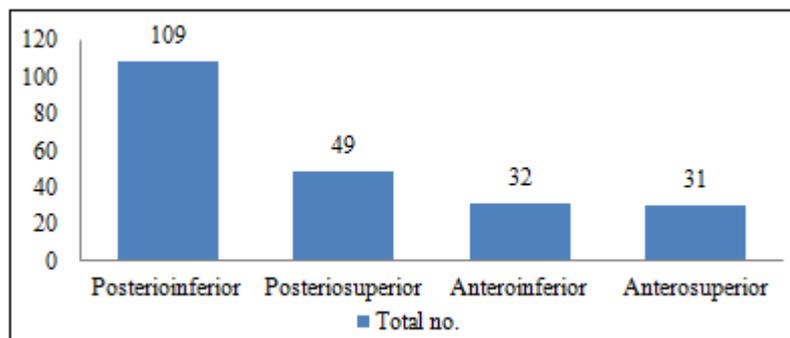


Figure 9: Quadrants Involved in Perforation