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A Clinical Study on Traumatic Perforation of Tympanic Membrane

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ABSTRACT

Background: Tympanic Membrane is the only true closing membrane remaining in the fully developed fetus that is vital for transmission of sound and an important structure in impedance matching for sound waves traveling from air to fluid .The increasing incidence of trauma is a blot on our society and is a major cause of morbidity and mortality. Traumatic tympanic membrane perforation is a fairly common event and is very much on the rise.

Methods: It was a cross sectional study carried out in 60 patients who came to outpatient department of ENT and casualty with traumatic TM perforation. After taking informed consent, detailed history and complete examination of ear was performed and characteristics of perforation were noted. Pure tone audiometry (PTA) was conducted in all cases and data was statistically analyzed on presentation and at 3weeks.The patients are reviewed every week till the healing is complete.

Results: Mean age group was 22.5 years and 60% were males. Aural fullness was the commonest symptom with assault being the most common cause. Our study showed results of 96% healing rate with an average healing time of 4.7 weeks. 82% of them had left TM perforation and on presentation had a mean hearing loss of 26.73+/-18dB and at 3weeks had a mean hearing loss of 18.12 ± 3.52 dB.. In our study,57% patients had spontaneous healing of tympanic membrane perforation in the range of 3-5weeks, 23% in the range of 6-8 weeks, 8% in the range of 9-11weeks and 2% of patients were left with unhealed traumatic tympanic membrane perforation.

Conclusion: In our study we have come to the conclusion that traumatic tympanic membrane perforation is common in young adults following assault and accidental trauma and is very much on the rise. Wait and watch policy gives good results in these cases and usually does not leads to any complications like infection. TM perforation heal spontaneously with conservative management in most of the cases and 97% is the healing rate in our study.

1. INTRODUCTION

One of the most important factor of conduction of sound is the vibratory nature of the tympanic membrane which is most essential for transmission of sound in human beings (''). The incidence rate of traumatic tympanic membrane perforations yearly, are not usually reported but an estimate is that it varies between 1.4% and 86% per 100,000 persons (2) . Trauma patients consume more health care resources than heart and cancer patients combined, whereas mortality from heart disease and cancer is declining, the incidence from trauma is increasing (24).

Pulec and Kinney (5) classified traumatic tympanic membrane perforation as: - Compression injuries, Blast or pressure injuries, Penetrating injuries, Lightning injuries.

Keller studied the way compression injuries work which happens when pressure is applied in a closed space like the external auditory canal wherein he proved that a force of 25lb/Sq has to be applied for the tympanic membrane to give away. (®) A pressure of 30 lb/sq was necessary to rupture tympanic membrane in children whereas a force of 20 Ib/sq was necessary in cases of adults was studied in cadaver experiments by Zalewski and was later confirmed by Kerr & Byrne in a study on 60

tympanic membrane in a single blast in 1972(7. 8). Some examples of the above are assault, road traffic accidents, water skiing, trampoline accidents, diving etc. In Blast or Pressure injuries the injury is caused due to the pressure wave that is transmitted via a medium that is continuous with the patient's environment which could be water or air. Some examples of this are Blast and diving injuries. Weld slag or any molten metal injuries and other foreign body injuries comprises of penetrating injuries. Some foreign bodies include, most commonly ear buds, matchsticks, sticks, auto antenna, stem, twigs, pencils, wire, metal hair clasp, crotchet needle, safety pin, hair pin, hook, thorn and insects, which mostly enter when the patient is asleep. There are various reasons for this which could be due to direct or indirect trauma. Some of them are assault, self cleaning, falls, road traffic accidents, barotrauma due to diving and flying etc. Though it is not life threatening traumatic tympanic membrane perforation can cause conductive hearing loss, tinnitus and middle ear infection.The symptoms of traumatic TM perforation

include:-Impaired hearing, Aural fullness , Tinnitus,Otalgia, Bleeding from ear and Vertigo. Outcomes of traumatic tympanic membrane perforation were studied on basis of observation only versus active surgical intervention using various techniques and in these studies it has been shown that spontaneous closure rates are between 53% and 86 %(9.10.11)

2. METHODOLOGY

After obtaining clearance and approval from the Institutional Ethics Committee, 60 patients fulfilling Inclusion/Exclusion who gave Informed Consent was included in the study. A detailed history taking followed by complete clinical examination including Tuning fork tests was done in each of the patients. They were then subjected to Pure tone audiometry and analyzed for type and degree of hearing loss. They were treated medically with antibiotics, anti inflammatory drugs with emphasis on aural hygiene, after which they were asked to report back after a week. No further medical treatment was given and the patient was reviewed every week and observed for healing of perforation and improvement in hearing. Patient was also instructed to report immediately incase of developing Upper respiratory tract infections, ear discharge, itching in the ear and abrupt or sudden loss in hearing.The patients were reviewed every week till the healing was complete which ranged from 3-5 wks to 9-11wks.

Based on data collected, various etiologies of traumatic tympanic membrane perforation along with their varied clinical presentations were grouped and sorted. Finally, the healing rate of the perforation is calculated with respect to time duration post trauma with masterly inactivity as the basis of treatment.

3. RESULTS

In the below table and graph, majority of the subjects i.e, 14 (23%) were in the age group of 21- 25 yrs and the least number of subjects i.e, 47%) were in the age group of 41 - 45 yrs. The age of the study participants ranged between 12 - 50 years. Among males the highest percentage of involvement was found to be in the age group of 16-20 yrs whereas among females highest percentage of involvement was found to be in the age of 21-25yrs.

Age	Gender		Total	%
	Male	Female		
> 15- 20	7	4	11	18%
> 20 - 25	6	8	14	23%
> 25 - 30	5	3	8	13%
> 30 - 35	6	2	8	13%
> 35 - 40	5	3	8	13%
> 40 - 45	2	2	4	7%
> 46 - 50	5	2	7	12%
Total	36	24	60	

Table:1 Gender and age distribution

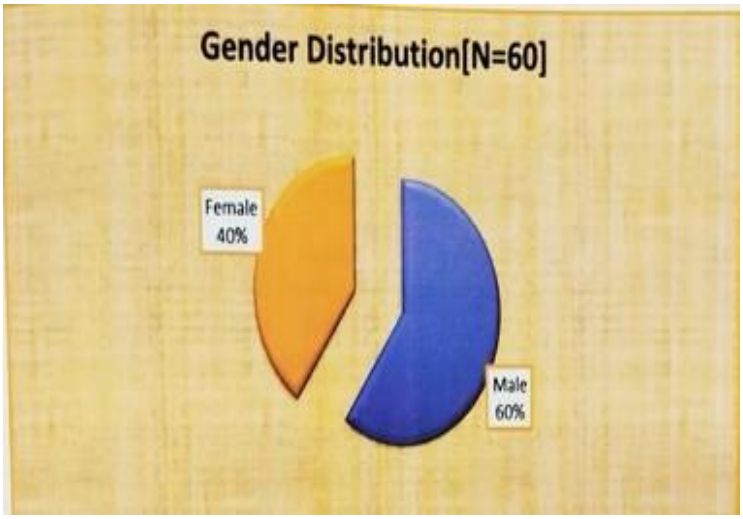

Figure:1 Gender distribution

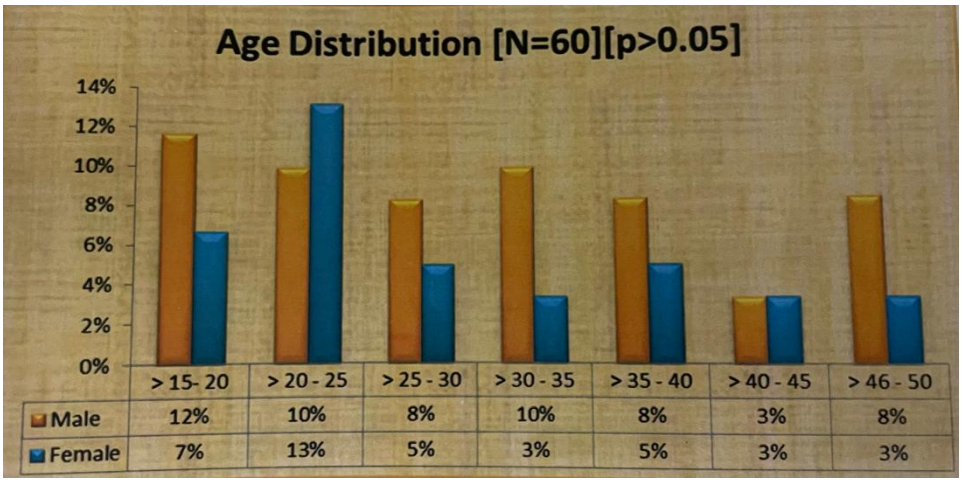

Figure :2 Age distribution

	Mean	SD	Std. Error	95% CI for Mean Lower	Maximum	Sig.
Male	31.14	10.1	1.683	27.72	48	
Female	29.58	9.882	2.017	25.41	48	>0.05
Total	30.52	9.958	1.286	27.94	48	

Table:2 Mean age with gender

The above table and graph shows that among the 60 cases studied majority i.e. 36 (60%) were males and 24 (40%) were females. The mean age and standard deviation of females was 29.58 ‡ 9.882 yrs and males was 31.1+ /-10.1yrs respectively.

The below table and chart showed 11(18%) of right sided TM perforations whereas left side had 49 (82%) of TM perforation

LATERALITY	n	(%)
RIGHT	11	18%
LEFT	49	82%
Total	60	100%

Table:3 Laterality

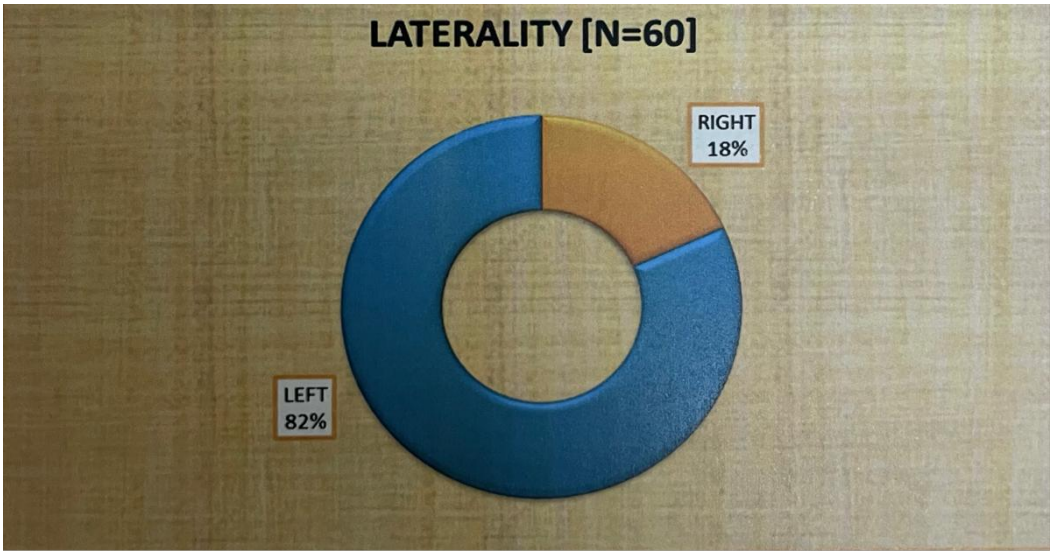

Figure:3 Laterality

Out of 60 patients, 28 (47%) patients were inflicted with traumatic TM perforation due to assault, 12 (20%) patients due to RTA, self cleaning and iatrogenic causes 5(8%) patients each and finally followed by 2(3%) patients due to explosion and 1(2%) patients due to weld slag.

Cause	No. of study subjects	%
Assault	28	47%
Barotrauma	4	7%
RTA	12	20%
Self cleaning	5	8%
Explosion	2	3%
Fall	3	5%
Iatrogenic	5	8%
Weld slag	1	2%
Total	60	

Table:4 Causes of affected ear

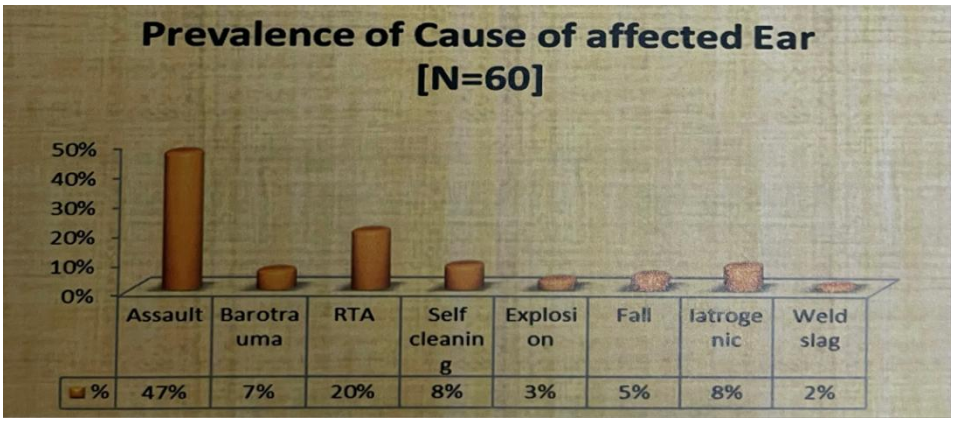

Figure:4 Prevalence of cause of affected ear

In this study it was found that 33 (55%) patients presented with Aural fullness, 20 (33%) patients presented with Ear pain, 4(7%) patients presented with Hard of hearing, 2 (3%) patients presented with Tinnitus, 1(2%) patient presented with Ear bleed.

SYMPTOMS	No. of Study Subjects	%
Aural fullness	33	55%
Ear pain	20	33%
Hard of hearing	4	7%
Tinnitus	2	3%
Ear bleed	1	2%
Total	60	

Table:5 Symptoms of affected ear

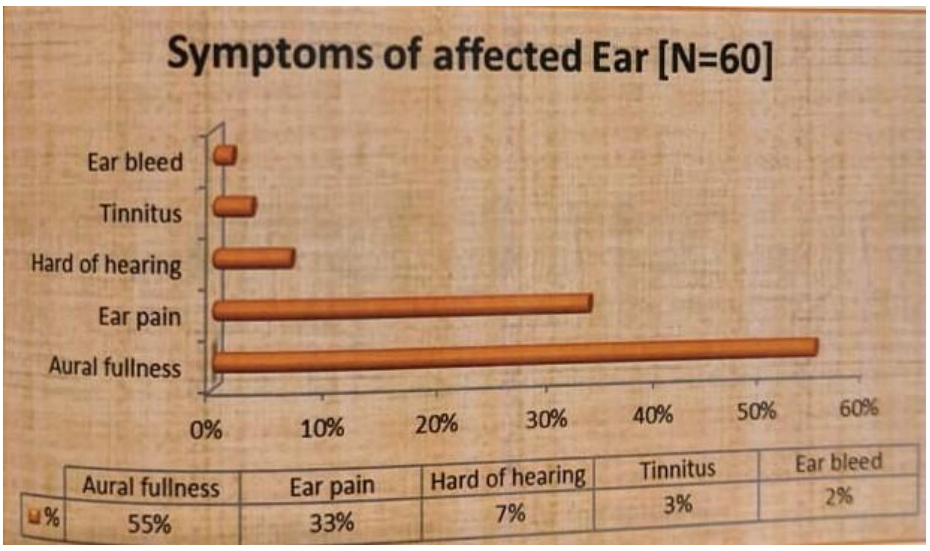

Figure:5 Symptoms of affected ear

The following table and graph showed that in Assault patients most common presentation is that of Aural fullness seen in 16 (57%) patients, Barotrauma patients most common presentation is that of Aural fullness seen in 3 (75%) patients and ear bleed seen in 1 (25%) patient. in RTA 7(58%) patients presented with ear pain and 5 (42%) patients presented with aural fulness. In patients with injury due to self cleaning the most common Presentation is that of ear pain seen in 5(60%) patients followed by 3(40%) Patients of aural fullness.

Among patients with TM perforation due to explosion of fire crackers, the commonest presentation was that of Aural fullness seen in 1 (50%) patient and Tinnitus in 1 (50%) patient. In patients who sustained injuries due to falls, 2 (67%) patients presented with aural fullness and 1 (33%) patient presented with ear pain. In Trauma due to iatrogenic injuries, 4 (80%) patients presented With aural fullness and 1 (20%) patient with ear pain. Weld slag injury was seen in one patient who presented with tinnitus (50%). It was found that there is a relationship between cause and symptom as the P value was found to be below 0.001.

	Symptoms			
Cause	**Aural fullness**	**Ear pain**	**Hard of hearing**	**%**
Assault	16	8	4	47%
Barotrauma	3	0	0	7%
RTA	5	7	0	20%
Self cleaning	2	3	0	8%
Explosion	1	0	0	3%
Fall	2	1	0	5%
Iatrogenic	4	1	0	8%
Weld slag	0	0	0	2%
Total	**33**	**20**	**4**	

Table:6 Prevalence of different causes with symptom

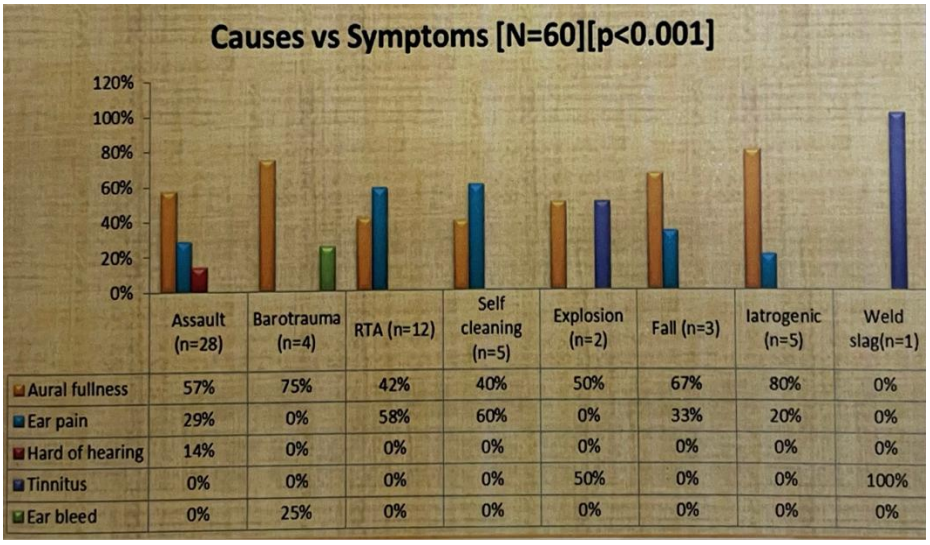

Figure: 6 causes Vs symptoms

In this study it was found that the subjects on presentation had a mean hearing loss of

26.73 ± 7.18 dB and at 3weeks had a mean hearing loss of 18.12± 3.52dB.

	Mean	SD	Std. Error	Maximum	Sig
HEARING ON PRESENTATION (dB)	26.73	7.18	0.93	42	
HEARING AT 3 WEEKS (dB)	18.12	3.52	0.45	26.6	<0.001
Total	22.42	7.10	0.65	42	

Table: 7 Mean audiometric thresholds of the affected ear

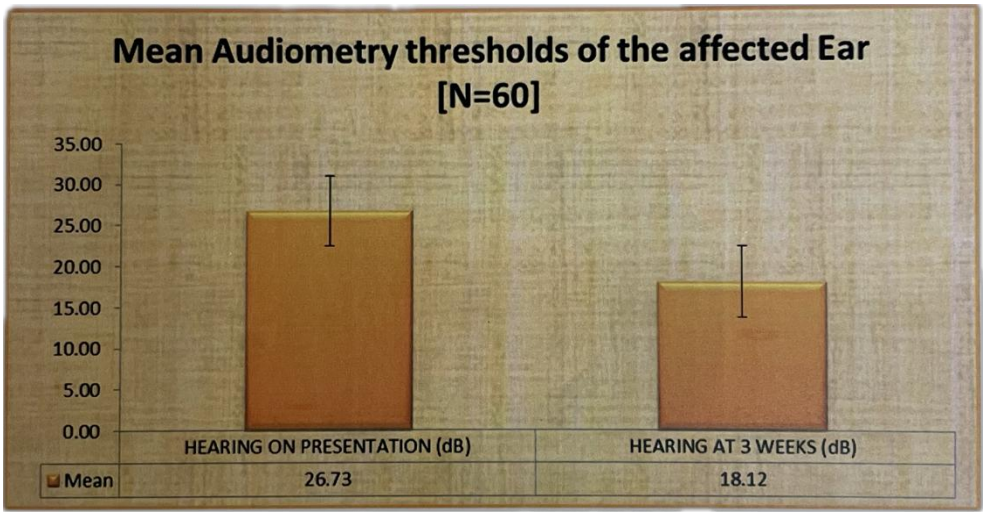

Figure :7 Mean audiometric threshold of the affected ear

In the above study it was found that 34 (57%) patients with traumatic tympanic membrane perforation had spontaneous healing in the range of 0-5 weeks, 14 (23%) patients in the range of 6 - 8 weeks, 5 (8%) patents en in the range of 9 - 11 weeks and less than 2 weeks and finally 2(3%) patents were left with unhealed traumatic tympanic membrane perforations.

Healing Time	No. of study subjects	%
< 2	5	8%
>2 - 5	34	57%
>5 - 8	14	23%
>8 - 11	5	8%
unhealed	2	3%
Total	60	

Table:8 Prevalence of healing time(weeks) of the affected ear

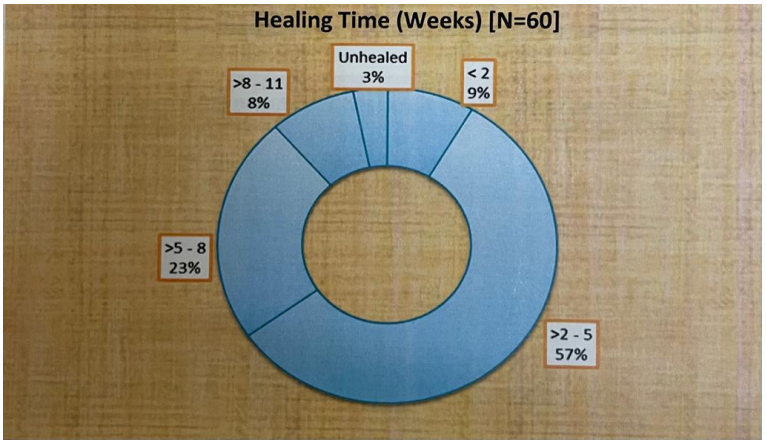

Figure:8 Healing time (weeks)

We came to the conclusion that among the 33 patients in our study who presented with aural fullness majority of the patients, 24 (73%) had spontaneous healing in the range of 3 - 5 weeks, among 20 patients of ear pain majority of the patients 8 (40%) with spontaneous healing in the range of 3 - 5 weeks, 4 patients of hard of hearing had majority of the patients 2 (50%) with spontaneous healing in less than 2 weeks. 2 patients of tinnitus had 1 patient healing in the range of 6 -

8 weeks and patient with ear bled had spontaneous healing in 3 - 5 weeks. It was found that 1 patient of aural fullness and 1patient of tinnitus had unhealed TIM perforations.

	Symptoms				
Healing Time	Aural fullness	Ear pain	Hard of hearing	Total	%
< 2	2	1	2	5	8%
>2 - 5	24	8	1	34	57%
>5 - 8	5	7	1	14	23%
>8 - 11	1	4	0	5	8%
unhealed	1	0	0	2	3%
Total	33	20	4	60	

Table: 9 Frequency of healing time with symptoms

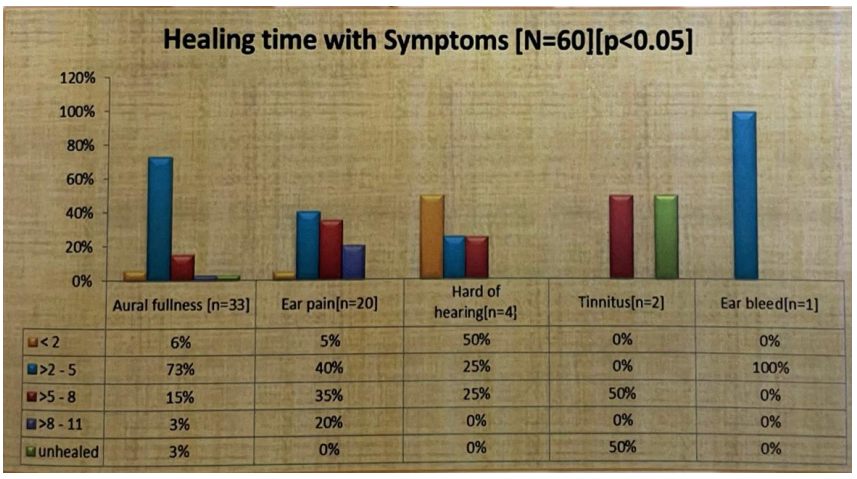

Figure:9 Healing time with symptoms

4. DISCUSSION

The present study includes 60 patients of traumatic tympanic membrane perforation without evidence of temporal bone fractures between the age group of 12 - 50 years who attended the ENT out patient department and casualty.

Gacek and Berger et al in their study found that traumatic tympanic perforation is seen to be common in the middle age group (47) same as a study done in south eastern part of Nigeria which had highest incidence in middle age group with a mean age of 27.6 yrs (48). The present study as shown that the most commonly affected are in the age group of 20 -25 yrs and the justification could be that this age group is in a more active phase of life. It was also found that among males the common age group to be affected was 15yrs - 20 yrs (12%) while among females it was the age group of 20yrs -25yrs (13%).

In the present study among 60 patients, a male preponderance was seen with 60% of males being affected and 40% females which is found to be in concurrence with a study wherein the was a high predominance among males (72%) and females (28%) and a male to female ratio of 2.5: 1(49), same as many other studies with similar results (5,39,40). This probably holds true as they are exposed to more of trauma.

Lindeman et al (50) and Berger (51) et al reported in various studies that left ear is found to be the subject of traumatic tympanic membrane perforation more than the right owing to the fact that it could be associated with the fact that the attacker would have been right handed hence would have committed acts of violence against the victim facing him hence would have resulted in making the left ear more vulnerable. Other than the study above our present study where in the ear most commonly affected was found to be the left ear 49 (82%) and the right ear 11 (18%) was found to be in consensus with two other studies (49,52)

Wani A, Rehman A, Lateef S, Malik R et al (49) in their study found that the maximum number cases of traumatic tympanic membrane perforations were due to physical assault (69.42%), followed by foreign body removal (13.42%), syringing of the ear (11.7%) and explosions (5.4%) which was the least. S Saimanohar, Raveendra P Gadag also reported that maximum number of patients in their study of traumatic tympanic membrane perforations were due to assault after which came due to falls. Similar results were found in various studies with hand slap as the most frequently inflicted trauma followed by barotrauma due to diving injuries and penetrating injuries. (53,54) All these studies have found to be in agreement with the study we conducted where it was found that the primary etiological agent for traumatic tympanic membrane perforation was found to be assault (47%) followed by RTA (20%), self cleaning of ear & iatrogenic (8%), Barotrauma (7%), explosions (3%) and weld slag (2%) .We found that most of the assault cases were caused by hand slaps which produced a triangular or linear tear of the tympanic membrane which was the result of fights between youth or between spouses due to marital conflict. The. Explosions are not very common in our region as obviously it is not a war zone so the few cases of perforations were due to firecrackers. Some other etiologies for TM perforations were due to unskilled attempt by general physicians, parents and children to clean ears or for wax removal causing penetrative injuries of the tympanic membrane.

Z-C Lou et al. reported in his study that all his subjects presented with ear fullness and tinnitus, no matter what may be the etiology of the trauma which caused traumatic tympanic membrane perforation 27) Similarly in our study we found that 55% of our study patients presented with aural fullness followed by 33% of patients who presented with ear pain. However, Wani et al (49) reported in his study that though the etiology and presentation had no connection, maximum patients had tinnitus (90%) as the most common complaint followed by reduced hearing (56.60%). Bergerli) et al and Lilly-Tariah and Somefun (55) came to the conclusion that the common complaints encountered by him in his study is tinnitus and ear pain which presented after hearing loss.

J.R Grant et al (56) reported that in his study on outcomes of traumatic hearing loss, subjects with tympanic membrane perforation showed hearing loss of 30 to 60 dB and speech discrimination score of 50 % to 60% and on followup showed an improvement of less than 30 dB and speech discrimination score of more than 70%. Thus he came to the conclusion that traumatic conductive hearing loss incurred due to traumatic tympanic membrane perforation would improve without any intervention within 6 months. In another study by Wani et al he stated that as the size of the perforation increased so did the conductive hearing loss increase at each frequency. This was given clarity in two studies (57), (58) which said that impedance matching is due to the difference in the size of the footplate which causes the hydraulic action and that due to this surface area is reduced because of the perforation thereby causing a decrease in amplification. The present study also has come to a similar conclusion where there was an improvement from the initial presentation of 26.73 dB of hearing loss and follow up of 18.12dB.

Z. -C. Lou et al. (9) in his study came to the conclusion that 70% of small and medium sized tympanic membrane perforations had total closure spontaneously by the fourth week and that regarding large perforation only 25 % healed at the same time of four weeks. Hence according to him there was definite relationship between size of the perforation and the rate of healing and healing time. He also proved that the rate of healing was better in wet conditions with serosanguinous discharge compared to dry perforations of TM.It could be explained by the completion of the processes of epithelial cell proliferation, endothelial cell migration, granulation tissue formation in the margins in case of dry perforation which prevents angiogenesis from happening. While in the other case these processes do not happen due to the dry condition and sometimes curled margins

of the perforation which is a hindrance for closure (59) Orji, F.T & Agu, C.C et al, asserted after their study that at 12 weeks there was 94% closure of TM perforation with three unhealed perforation which was due to syringing of the ear as it led the opportunistic organisms residing in the external auditory canal or else where into the middle ear through the perforation(60). Lou ZC, Lou ZH, Zhang QP (27) reported that in their study their subjects achieved a healing rate of 92% in 22.8 days and some of the cases of unhealed perforations arose because of tympanosclerosis, large perforations and injury to the malleus.Our study showed similar results of 96% healing rate with an average healing time of 4.7weeks.

5. CONCLUSION

In our study we have come to the conclusion that traumatic tympanic membrane perforation is a fairly common event and is very much on the rise .

The commonest reason for its incidence was found to be assaults, hence from our side we should advise the patient or victim that it is a grievous injury and a punishable offense; hence has to be reported.

There is a need to inculcate the habit of referral of patients to the otolaryngologists for proper removal of foreign body or wax from the ear rather than an unskilled attempt either by primary care physicians , parents or patient themselves.

Just as many authors came to the conclusion that a 3-6 months waiting policy after injury should be adopted before surgical repair is to be attempted in case of traumatic tympanic membrane perforation we have as well proved the same in our study (53.61-63)

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