Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 3
Open Access

An Etiological and Clinical Study of Traumatic Tympanic Membrane Perforations and Results of Spontaneous Healing

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Cite this paper as: Majid ul Islam Masoodi,Younus Majeed, Viqar Khursheed Mir (2024) Relationship between Cardiac myosin binding protein–C with traditional risk factors in early diagnosis of acute coronary syndrome patients. *Frontiers in Health Informatics, 13* (3), 3350-3359

Abstract-

Introduction- *The tympanic membrane (TM) is crucial to sound transmission and in response to trauma it is vulnerable to rupture. Traumatic tympanic membrane perforation (TTMP) is the most prevalent kind of otological impairment caused due to trauma. Prevention, early diagnosis and appropriate treatment are important in managing such cases. So this research was planned to identify numerous TTMP etiologies and its clinical manifestations. It also focused on the outcomes of TTMP's spontaneous healing as well as the variables that may affect them.*

Material and method- *This study was a prospective analytical, observational hospital study conducted on 68 TTMP patients. Clinical history, otoscopic examination, and associated symptoms were used to diagnose TTMP. Pure tone audiometry (PTA) and tuning fork test was also done. Followup visits up to 12weeks were planned to observe the outcome. All the data were logged on premade proforma and was analyzed using the Statistical Package for Social Service (SPSS). P-value less than 0.05 was considered to be statistically significant.*

Result- *The mean age of the patients in our study was 30.5±15.10years with male dominance. Maximum patients were of the age group 18-40years. Majority of the patients suffered from tinnitus and had the injury because of physical assault. Association of age and etiology of the perforation with gender was found to be non-significant. Mainly left ear of the patients was affected with medium size and single perforation. Healing time in half of the patients was 2-6weeks with spontaneous healing in maximum of the patients*

Conclusion- *Physical assault appeared as the main cause of the injury with tinnitus as the main clinical presentation. Majority of the cases recovered with spontaneous healing without having any complications. Early identification and evaluation of TMP is essential to lower morbidity and consequences. So it is imperative to educate public on etiology, precautions and factors that are*

favorable for the prognosis of spontaneous healing of TTMP.

Keywords- *Trauma, TTMP, Injury, Perforation, Patients etc.*

Introduction-

The tympanic membrane (TM) is a thin fragile translucent membrane, which is crucial to sound transmission and in response to trauma it is vulnerable to rupture or perforate.[1] Simple traumatic tympanic membrane perforation (TTMP) is the most prevalent kind of otological impairment caused due to trauma.[2] According to certain research, 7.8% of patients evaluated in the ENT (ear, nose, and throat) department had tympanic membrane perforation (TMP). Few of the reasons for TTMP are abrupt elevation of ear pressure from slapping, aggressive syringing, caloric testing, blast, improper probing, ear cleaning, sudden fluid compression during diving and non-pressurized aircraft travel.[3] The raised occurrence of TTMP is probably a result of the unique characteristics of emerging nations, where there is a high rate of poverty, ignorance, and domestic violence. TTMP is increasing worldwide as well, due to increased industrialization, mishandling of weapons, and interpersonal aggression.[4] Abrupt excruciating pain, hemorrhage, tinnitus, hearing loss, disorientation, perilymphatic fistula, and damage to the facial nerve are all possible symptoms of TTMP.[5] The location and extent of the perforation determine this symptomatology. Reduced rates of spontaneous healing have been associated with larger perforations and those that are peripherally situated.[6-9] TTMP can be dealt with inactive vigilant waiting or can be treated with active or surgical intervention.[10] When there are no noticeable symptoms, TTMP resolves on its own in 2-3months.[11] The rate of spontaneous healing varies from 78-90%, according to various studies. Surgical procedures are necessary if the healing process fails on its own after six months or if problems such as facial paralysis, substantial sensorineural hearing loss, perilymph fistula, or severe vertigo are noted.[5] So early diagnosis and appropriate treatment are important for such cases.[11] A positive outcome requires uttermost attention to both prevention and minimization of problems, even though effective care is expedient. The mechanism, cause, course of treatment, and after effects of the injuries may also have an impact on the result. So this research was planned to identify the numerous TTMP etiologies and its clinical manifestations. It also focused on the outcomes of TTMP's spontaneous healing as well as the variables that may affect them.

Material and Methods-

This study was a prospective analytical, observational hospital study conducted on the TTMP patients visiting ENT department of SKIMS medical college and hospital, Bemina, Srinagar, Jammu and Kashmir for around 1.5year i.e. September 2022 to February 2024. In total, 68 individuals of all ages and genders, who had experienced ear trauma within the last two weeks that confirmed a TMP were included in the study. Nevertheless, the following patients were excluded from the study: those with a history of external or middle ear disease; those who were unconscious; those who had experienced polytrauma; those whose TM could not be evaluated; and those who could not manage minimum follow-up visit, scheduled for six weeks after the injury. Every patient who met the aforementioned

requirements gave their written informed permission. Ethical clearance was provided by Institute's Ethics Committee provide clearance. Clinical history (including type, cause, mechanism, and mode of trauma), otoscopic examination (including presence, size, and location of perforation as well as association with bleeding), and associated symptoms (such as ear discharge, vertigo, otalgia, tinnitus, and gradually progressive deafness) were used to diagnose patients with TTMP. Every subject underwent pure tone audiometry (PTA) and the tuning fork test. Along with the perforation's features, such as its size and location, all the demographic and clinical data were logged and methodically assembled in premade proforma. The relative sizes of the perforations were estimated using the following criteria: Large perforation, encompassing 50-75% of the TM or more than half of the area. Medium perforation, 25-50% of the TM or less than half of the area involved. Small perforation, less than 25% of the TM or less than 1/4th of the affected region. For each patient, the evaluation of follow-up visits was documented for at least four times. The first four follow-up appointments were planned with a sufficient week's break, and subsequent follow-up was according to the requirement of the specific patient. PTA was conducted again on 2nd and 4th follow up visit of the patient. If the patient was in discomfort on the day of presentation then PTA assessment was postponed for seven days. All the patients were instructed to keep their ears dry and in case of any discharge the session was preponed. The assessment of the injury's outcome, including the healing of the perforation and any related consequences, was conducted at around 12 weeks post injury and minimum of six weeks post-injury. The surgeon who made the final determinations regarding the result was the same one who first evaluated and recorded the severity of the injury. The outcome was categorized as follows: Poor or persistent TM perforation in cases where the perforation did not close or problems developed; and Good or healed TM in cases where the perforation closed completely or partially. A conservative management strategy was used, except for those with bloody or watery discharge who received antibiotics to avoid infection. All the data was analyzed using the Statistical Package for Social Service (SPSS). P-value less than 0.05 was considered to be statistically significant.

Result-

The present study was done on 68 TTMP patients with mean age of 30.5±15.10years. As visible from figure 1, patients were divided into 3 age groups with maximum patients i.e. 55(80.88%) into the age group of 18-40years followed by other groups i.e. >40years with 7(10.29%) and <18years with 6(8.82%) patients.

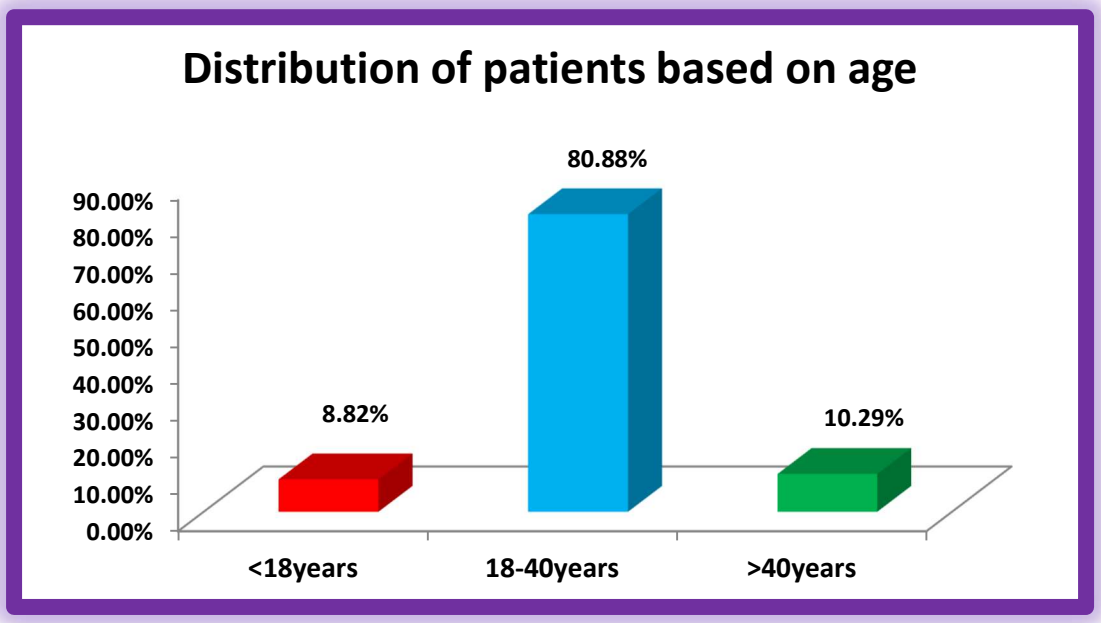

Figure 1- Distribution of patients based on age

Our study showed male dominance with 48(70.58%) cases as seen in figure 2 and 20(29.41%) patients were females in present study.

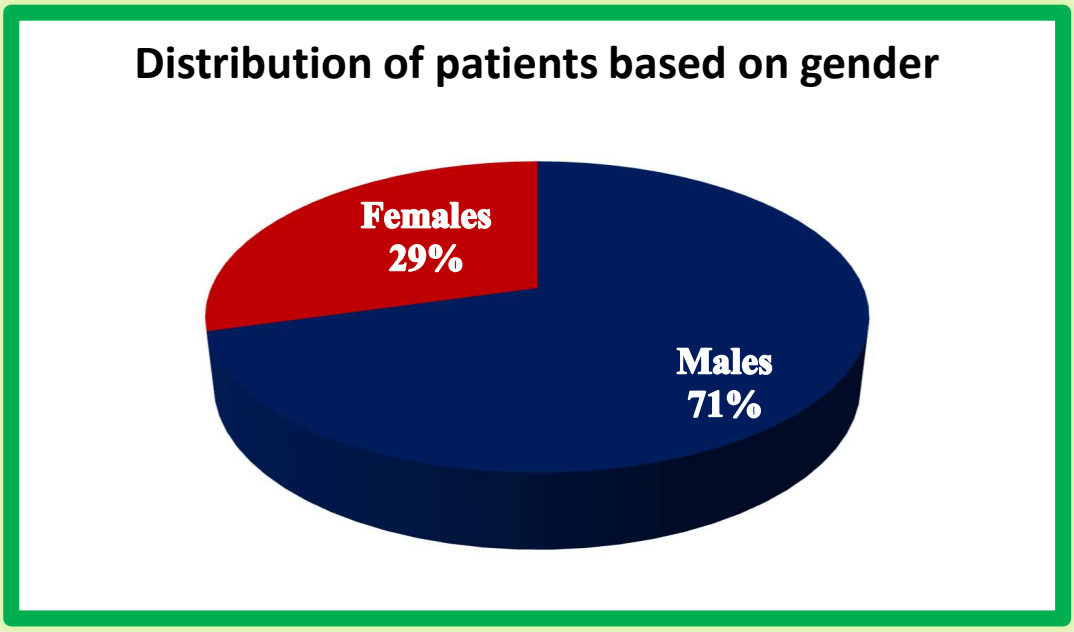

Figure 2- Distribution of patients based on gender

Clinical history of the TTMP patients visiting the hospital underlined many causes behind the injury. Table 1 represents the distribution of patients based on the etiology of injury. Majority i.e. 34(50.00%)

of the patients had the injury because of some kind of physical assault, which was further categorized into domestic, security personnel, community, armed robbery assault with 19(27.94%), 6(8.82%), 6(8.82%) and 3(4.41%) cases respectively. Road traffic accident (RTA) and self imposed injury were also one of the noticeable causes behind the injury with 13(19.11%) and 9(13.23%) patients respectively. Iatrogenic and ear cleaning or syringing was observed as etiology in 5(7.35%) patients followed by fall injury and blast injury or explosion with 1(1.47%) cases.

Table - 1 Distribution of patients based on the etiology of perforation

Etiology of Perforation		**No. of patients n(%)**
Physical Assault 34(50.00%)	Domestic	19(27.94%)
	Security personnel	6(8.82%)
	Community	6(8.82%)
	Armed robbery	3(4.41%)
Road traffic accidents		13(19.11%)
Self Imposed or Self-inflicted		9(13.23%)
Fall injury		1(1.47%)
Iatrogenic		5(7.35%)
Ear cleaning and Syringing		5(7.35%)
Blast injury or explosion		1(1.47%)

Further in present study association of age and etiology of perforation with gender was evaluated which is depicted in table 2. Majority of both the genders were of age group 18-40years with 41(85.41%) males and 14(70.00%) females followed by 5(10.41%) males of age group >40years and 4(20.00%) females of age group <18years. Least number of males and females with 2(4.16%) and 2(10.00%) were seen in <18years and >40years age groups respectively. Association of age with gender in present study was found to be non-significant. Further it was observed that physical assault was the main etiology of perforation in both the sexes. Among the categories of the physical assault, dominance of domestic assault was seen in both the genders with 13(27.08%) cases in males and 6(30.00%) in females, followed by community assault in 6(12.50%) males and security personnel assault in 2(10.00%) females. Least number of males i.e. 3(6.25%) reported armed robbery assault and none of the females reported community and armed robbery type of physical assault in our study. In males road traffic accident was also the major reason for the injury with 11(22.91%) patients followed by self imposed injury with 5(10.41%), iatrogenic and ear cleaning or syringing with 2(4.16%) cases. None of the females and minimum number of male patients i.e. 1(2.08%) had fall and blast injury or

explosion as the etiology of perforation. In females, self imposed injury was seen in 4(20.00%), iatrogenic and ear cleaning or syringing in 3(15.00%) and RTA as etiology of perforation in 2(10.00%) patients. The association of etiology of the injury with gender in our study was also observed to be non-significant.

Table 2- Association of age and etiology of perforation with gender.

Parameter			Males n=48	Females n=20	p-value
Age		<18years	2(4.16%)	4(20.00%)	0.109
		18-40years	41(85.41%)	14(70.00%)	
		>40years	5(10.41%)	2(10.00%)	
Etiology of Perforation	Physical Assault	Domestic assault	13(27.08%)	6(30.00%)	0.244
		Security personnel assault	4(8.33%)	2(10.00%)	
		Community fracas/assault	6(12.50%)	0(0.00%)	
		Armed robbery	3(6.25%)	0(0.00%)	
	Road traffic accidents		11(22.91%)	2(10.00%)	
	Self Imposed or Self-inflicted		5(10.41%)	4(20.00%)	
	Fall injury		1(2.08%)	0(0.00%)	
	Iatrogenic		2(4.16%)	3(15.00%)	
	Ear cleaning and Syringing		2(4.16%)	3(15.00%)	
	Blast injury or explosion		1(2.08%)	0(0.00%)	

Table 3 shows the distribution of patients based on clinical presentation and outcome of the injury. It was observed that in majority of the cases left ear was affected i.e. 28(41.17%) followed by right ear in 27(39.70%) and both ears in 13(19.12%) cases. Single perforation showed predominance with 61(89.70%) cases over multiple perforation in 7(10.29%) patients. Depending on the area involved size of perforation was categorized into 3 groups. Maximum patients had medium size of perforation with 44(64.70%) cases followed by small and large perforation in 19(27.94%) and 6(8.82%) patients respectively. Further majority of cases suffered from tinnitus i.e. 54(79.41%) followed by sudden reduced hearing or hearing loss, ear pain, aural fullness, discharge, aural bleeding and vertigo observed in 44(64.70%), 19(27.94%), 10(14.70%), 5(7.35%), 4(5.88%) and 1(1.47%) cases respectively. As far as healing time is concerned, half of the patients i.e. 34(50.00%) recovered in 2-6weeks, 23(33.82%) in 7-9weeks and rest 11(16.17%) patients were healed in 10-12weeks. Spontaneous healing was seen in maximum of the patient i.e. 63(92.64%). In present study, 4(5.88%) patients required some kind of

intervention for recovery and 1(1.47%) had residual perforation.

Table 3- Distribution of patients based on clinical presentation and outcome of Injury.

Parameter		No. of patients n(%)
Side of ear	Right	27(39.70%)
	Left	28(41.17%)
	Bilateral	13(19.12%)
Number of perforations	Single	61(89.70%)
	Multiple	7(10.29%)
Size of perforation	Small	19(27.94%)
	Medium	44(64.70%)
	Large	6(8.82%)
Clinical Presentation	Tinnitus	54(79.41%)
	Ear pain	19(27.94%)
	Vertigo	1(1.47%)
	Aural bleeding	4(5.88%)
	Sudden reduced hearing or hearing loss	44(64.70%)
	Aural fullness	10(14.70%)
	Discharge	5(7.35%)
Healing time (Weeks)	2-6	34(50.00%)
	7-9	23(33.82%)
	10-12	11(16.17%)
Type of Recovery	Spontaneous healing	63(92.64%)
	Surgical and non surgical Intervention	4(5.88%)
	Residual perforation	1(1.47%)

Discussion-

The current research was conducted on 68 TTMP patients visiting ENT department of SKIMS medical college and hospital, Bemina, Srinagar, Jammu and Kashmir.
TM plays a significant role in sound conduction so any trauma to TM leads to TTMP. TTMP are seen in all age groups but in our study it was maximally observed in age group of 18-40years similar to the study by Asef wani et al.,[12], Sarojamma et al.,[13] and Evaristus E et al.[14] TTMP was more common in the young, active age groups, as indicated by the study's mean age of 30.5years, which is in accordance with the study by Olusola A Sogebi et al.[15] as they also found mean age of 33.8years. The mean age in other studies ranged from 29.2-33.6years.
Our study's male preponderance is consistent with that revealed in another study by Olusola A Sogebi et al.,[15] Roshan Acharya et al.,[16] and Evaristus E et al.[14] but contrasts to the findings by Sannigrahi R.[17] The major etiology of the injury in our study was physical assault mainly domestic assault and the fall injury and blast injury were seen in the least number of patients. This finding is strongly in agreement with the study by Shahid Rasool et al.,[18] Roshan Acharya et al.,[16] and Evaristus E et al.,[14] but the study by Fida HAT et al.[19] is in contrast to our study as they found accidental trauma as the main cause of injury. Further in our study, the association of age and etiology of the injury with gender was observed. Majority of both the genders were of age group 18-40years and association of age with gender was non-significant, which is in harmony with the study by Roshan Acharya et al.[16]. In both the sexes of the current study, physical assault was the main etiology of perforation and fall and blast injury was seen in least number of patients. It can imply that there is no decrease trend in the number of physical ear injuries in our surroundings. The association of etiology with gender was also non-significant in our study. These findings are in accordance with the study by Evaristus E et al.[14] However study by Olusola A Sogebi et al.[15] is in disagreement with our findings as they found significant association of etiology with gender along with RTA in males and physical assault in females as the main etiology. In present study, clinical parameters associated with outcome of the injury were also explored and it was seen that left side of the ear was more affected.
This may be related to the fact that the majority of attackers were right handed and that most traumatic acts, i.e. physical assault happened when the victim and the attacker were facing each other, increasing the risk of harm to the left ear.[14] The findings are in agreement with the study by Wani A et al.,[12] Roshan Acharya et al.,[16] Fida HAT et al.[19] and Olusola A Sogebi et al.[15] Mainly patients had single perforation and depending on the area involved, the size of perforation was categorized into 3 groups. Maximum patients had medium size of perforation followed by small and large perforation as seen in the study by Wani A et al.[12] but in contrast to the study by Acharya et al.,[16] Irfan Ul Shamas et al.[20] and Fida HAT et al.[19] as they maximally observed small perforation in their study followed by medium and large size. The clinical presentations observed in current study revealed that majority of cases suffered from tinnitus followed by sudden reduced hearing or hearing loss, ear pain, aural fullness, discharge, aural bleeding and vertigo. The study by Wani A et al.[12] also found tinnitus as the main and vertigo as the least observed clinical presentation. However in study by Olusola A Sogebi et al.[15] and Shahid Rasool et al.,[18] patients mainly suffered from sudden hearing loss followed

by tinnitus. Another study by Fida HAT et al.[19] found ear pain as the chief clinical presentation. As far as healing time is concerned half of the patients recovered in 2-6weeks and spontaneous healing was seen in maximum of the patient i.e. 63(92.64%). This finding is in concordance with the study by Wani A et al.[12] and Rajarshi Sannigrahi et al.[17]

Conclusion-

TTMP is a prevalent injury in contemporary society that affects young people with a predisposition to conductive hearing loss with men as the main sufferers. Majority of the cases recovered with spontaneous healing without having any complications. Rest, however, may result in consequences that require non-surgical or surgical treatment. Physical assault appeared as the main cause of the injury with tinnitus and sudden hearing loss as the main clinical presentations. Therefore, it is imperative to educate public on precautions, risk factors and etiology of the injuries along with the factors that significantly impact on outcomes of spontaneous healing. Early identification and evaluation of TMP is essential to lower morbidity and consequences. Improper management of TMPs can result in more serious consequences. Therefore, rigorous aural precautions and attentive care are favorable for the prognosis of spontaneous healing of TTMP.

Conflict of Interest: None

Source of funding: NIL

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