FIELD MEDICINE

FREQUENCY OF EAR PROBLEMS ASSOCIATED WITH DIVING AND THEIR PREVENTION IN PAKISTAN NAVY

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ABSTRACT

Objective: To determine the frequency of different ear problems among divers of Pakistan Navy and the factors contributing to them.

Study design: A cross sectional descriptive study.

Place and Duration of Study: This study was conducted in three major units of Pakistan Navy where active diving is going on all the times from March 2007 to July 2007.

Subjects and Methods: 100 divers were selected by consecutive sampling. They were examined and interviewed following a pre-designed questionnaire by the investigator.

Results: The overall frequency of ear problems was 54% including infection, barotraumas and deafness. Frequency of ear problems was more in those having more service as divers. It was about 8% in divers with diving experience 1-8 years, 32% in 9-16 years and about 66% in those with diving experience of more than 16 years ($p< 0.001$). There is an association between years of diving and sensorineural hearing loss. Frequency of ear problems was more in smokers (58%) as compared to non smokers (26%) and it was found statistically significant ($p<0.004$). Major factors contributing to the ear problems included Upper Respiratory Tract Infections and diving after long intervals.

Conclusion: Comprehensive medical examination should be done before selection of the divers for Prevention and early diagnosis.

Keywords: Divers, Pakistan Navy, Ear problems, Occupational health hazards.

INTRODUCTION

Diving puts the inner ear at risk [1]. Inner ear barotrauma (IEB) and inner ear decompression sickness can lead to permanent sensorineural hearing loss, tinnitus, and vertigo. If hearing function is measured only by air conduction, there is the possibility that the residual damage of middle ear barotrauma, which is the most common accident in diving may influence the hearing test results [2]. Most studies of diving-associated hearing loss reveal an association with occupational noise exposure [3]. In diving related barotrauma, compressed or expanding gas within the ears, sinuses and lungs causes various forms of neurological injuries and ear barotraumas [4]. The change in the ambient pressure underwater may cause physiologic alterations that may pose particularly challenging diagnostic and treatment-related dilemmas [5].

Barotrauma is an injury that occurs due to the result of rapid or extreme changes in pressure, and causes tissue damage due to expansion or contraction of enclosed air spaces as a result of such pressure changes, the greatest occurring near to the water surface. Infections involving respiratory tract and ears are also common [6]. Damage to the inner ear is relatively rare but can cause severe vertigo, loss of orientation, nausea and vomiting which causes serious threat to survival under water. Despite the fact that Ear, nose and throat problems are both frequent and may be life threatening, it is difficult to find data regarding morbidity and mortality of Ear, Nose and Throat problems in diving [7]. A study conducted in Sweden on Ear nose and throat problems in diving reported that 46 % of all medical problems in saturation diving in the Norwegian sector were related to Ear, nose and throat problems [7]. An audiometric survey was performed on a group of navy divers and 166 non-divers in Malaysia. The results of this survey revealed that at frequencies 4000, 6000 and 8000 Hz, the divers had higher mean hearing levels than non-divers and their

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Received: 08 Sep 2008; Accepted: 31 July 2009

hearing at those frequencies seemed to deteriorate faster [8].

Despite the commonly observed condition of middle and inner ear barotraumas among divers, there is also evidence of insidious and permanent development of sensorineural hearing loss associated with diving [9].

This study might be the first step to know the magnitude of problem in Pakistan and factors responsible for this. The objective of the study was to determine the frequency of different ear problems among divers of Pakistan Navy and to identify the factors contributing to occurrence of these ear problems. This study could also create awareness among the divers regarding different diving disorders related to ears and their prevention and early diagnosis.

SUBJECTS AND METHODS

Study Design: Descriptive Cross sectional

Place and Duration of study: This study was conducted in three major units of Pakistan Navy where active diving is going on all the times from March 2007 to July 2007.

Sample Size: Using WHO sample size calculator (Sample size determination in Health Sciences by S.K.Lwanga and S.Lemeshaw), where Confidence level= 95%,

Absolute precision= 10%,

Prevalence (taken from literature review) = 46% [7]

Sample Size = 96 (rounded off to 100)

Inclusion Criteria : The divers selected were as according to following criteria,

- Pakistan Navy Divers (males)
- Active Divers on duty
- Age group 21years- 50 years
- Diving experiences 1 year – 27 years

Exclusion Criteria

- Divers with acute signs/symptoms like nausea, vomiting, vertigo, dizziness etc
- Divers with chronic signs/symptoms like pus discharge from ear, Hearing threshold increased
- Divers who were otherwise medically fit with no Major Health Problems like Hypertension, Diabetes etc.

Data collection process

The divers were selected consecutively for this cross-sectional study. Informed written consent was taken. Clinical examination was done including General Physical examination, Systemic examination, as well as Ear examination including Otoscopy, selective Tympanometry in some cases and Pure Tone Audiometry.

Statistical Analysis

Statistical analysis was done by using SPSS version 15. Mean and standard deviation (SD) was calculated for quantitative data i.e. age, BMI and duration of experience. Frequency and percentages were presented for qualitative data i.e. gender, categories of BMI, and categories of duration of experience. Chi-square test was used to test significance of qualitative data. P-value < 0.05 was taken as statistically significant.

RESULTS

Total 100 divers were included in the study. Minimum age of the divers was 21years and maximum age was 48 years. Mean age was 31.5 years (SD=5.30). Thirty four percent divers were between age 21-30 year, while 62% divers were between age 31-40 and only 4% divers were between ages 41-50. Basal Metabolic index (BMI) was calculated on the basis of height and weight and no diver was found to be underweight (BMI<19) or obese (BMI>30). 30% divers were found to be overweight (BMI 25-29.99). About 33% overweight divers were having ear problem, while 34% divers with normal weight had ear problems. No association was found between BMI and ear problems. ($p>0.05$)

Diving experience of the divers ranged from a minimum of 1.5 years to a maximum of 27 years. Mean experience was of 12 years (SD=5.88). Ear problem was significantly associated with diving experience ($p<0.001$) (Fig. 1). Eighty percent divers claimed that there was no past history of ear problem while 10% divers did not remember about it and only 10% remembered past ear problem. 96% divers had been examined by the doctor within one year while only 04% had their last medical examination more than a year before. 32 %

divers had history of middle ear squeeze. 69% of divers had a history of upper respiratory tract infection while 31% were unable to perform Valsalva maneuver correctly.

Eight percent divers suffered from tinnitus. Out of them 50% were having upper respiratory tract infection and 25% suffered from some associated hearing problem. 50% consulted the doctor for medical advice (50%). 2% divers suffered from vertigo. Both had an associated tinnitus, upper respiratory tract infection and also attempted to clear ears forcefully. Symptoms developed immediately after dive and maximum depth of the dive was 10 meters. 4% divers had a history of discharge of pus from the ear and no diver used ear plug during diving.

Twenty four percent divers were smokers. Out of the smokers, majority (75%) used to smoke 5-20 cigarettes. 58% of the smokers had some ear problems while only 26% of the non smokers had ear problems as shown in figure 2 ($p = 0.004$).

Thirty five percent divers claimed that pre-existing upper respiratory infections increased chances of ear problems, 30% divers thought that inexperienced divers who do not perform valsalva correctly have more frequency of ear problems. 27% divers did not know about any specific cause related to ear problems. Otoscopic examination showed old healed scars in 4% divers. 4% divers had an abnormal audiometry showing a high frequency hearing loss in frequencies 4000-8000 Hz.

DISCUSSION

The age distribution in this study was from 21 years to 48 years with a mean age of about 31 years. No diver was found to be underweight [Body Mass Index (BMI<19)] or obese (BMI>30). Only 30% divers were found to be overweight (BMI 25-29.99), whereas in another study on Australian divers almost 47% were found overweight [10].

In this study minimum service as diver was 1.5 years and maximum was 27 years. Mean service as diver was 12 years. According to Figure no 1, with regards to diving experience, 26% were in the category of 1-8 years, 50% between 9-16 years and only 24% more than 16 years. Distribution of different ear problems among these categories was 8%, 32% and 67% respectively ($p<0.05$). Our data supports the fact that ear problems are more common in inexperienced divers who do not perform valsalva maneuver correctly or in older divers where ciliary functions of respiratory mucosa are diminished leading to respiratory congestion.

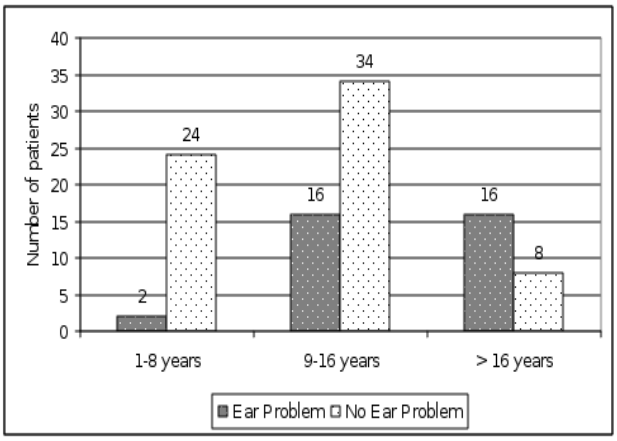

Fig - 1: Diving Experience & Ear Problems

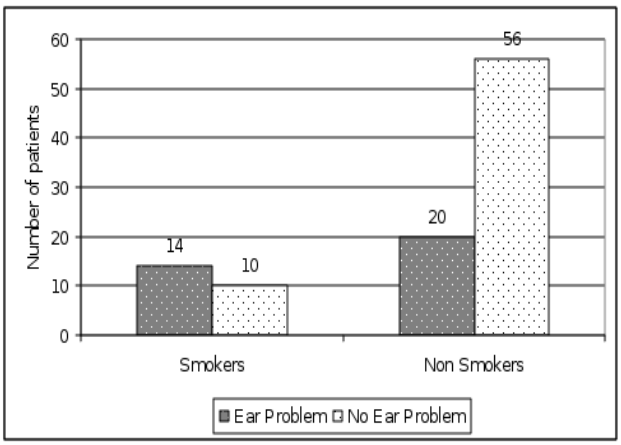

Fig-2: Frequency of Ear Problems in Smokers & Non Smokers

Table: Different Ear Problems in Divers

Ear Problems	Frequency	%
Middle ear barotrauma	40	74%
Inner ear barotrauma	2	4%
Ear infection	4	7%
Abnormal tympanic membrane	4	7%
Hearing loss (sensorineural)	4	7%
Total	**54**	**100%**

In our study 58% smokers had a history of some ear problem while 26% non smokers had a history of ear problem (p= 0.04).

This supports the facts already determined in previous literature. Role of smoking is through the effects on respiratory mucosa where it causes diminished ciliary movements and retention of secretions. This increases the chances of respiratory tract infections and blockade of Eustachian tube which is main cause of the diving related ear problems.

Eighty percent divers claimed that there was no past history of ear problem while 10% divers did not remember about it and only 10% remembered past ear problem. 32% divers in this study had history of middle ear squeeze. In other study on Australian and US divers it was almost 52% [11]. Eight percent divers in this study suffered from symptoms indicative of middle ear barotrauma. However none of these divers showed any signs of tympanic membrane rupture. In other study on Australian and US divers middle ear barotrauma along with tympanic membrane rupture (middle ear barotraumas grade 5) was 5.4% [9].

Fifty four percent divers were found to have some ear problem (Table). In other study carried out on UK divers the frequency of middle ear infection was 37.3% [12]. None of the divers used ear plug during diving in this study.

Otoscopic examination showed old healed scars in 4% divers. These were the same having history of discharge of pus from ears. This was a finding which confirmed that these divers had a middle ear infection. The same two divers had also suffered from Eustachian Tube Dysfunction (tympanic membrane retraction). Four percent divers had an abnormal audiometry showing a high frequency hearing loss in frequencies 4000-8000 Hz which is diagnostic of sensorineural deafness (Table). There was no history of any other ear problem. None of these 4% divers was smoker or overweight.

This clearly shows that there is an association between years of diving and sensorineural hearing loss. These results were consistent with the other study findings [13]. A study conducted on navy divers in Malaysia revealed that insidious development of high frequency sensorineural loss can be associated with diving. In that study the divers had higher mean hearing levels at frequencies 4000, 6000 and 8000 Hz than non divers and also their hearing seemed to deteriorate faster in those frequencies [14]. Another follow-up study in high exposure divers and low exposure divers revealed an association between the loss of hearing in left ear at 6 and 8 kHz and the total number of years of diving [15-17]. The etiology of this hearing loss was found out to be multifactorial and might have been related to repeated minor inner ear barotraumas [18].

CONCLUSION

This study might be the first step to know the magnitude of problem in Pakistan and factors responsible for Ear Problems in Navy Divers. Comprehensive medical examination and investigations should be done before selection of the divers for Prevention and early diagnosis.

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