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Review Article

WORK ENVIRONMENT AND ENT (EAR NOSE THROAT)

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ABSTRACT - Working environment of any employee may contain physical, chemical, biological and social hazardous elements and exposure to these hazards without personal protective measures can lead to occupational diseases. Pre placement medical examination and thorough periodic monitoring help to detect these occupational diseases in early stages when majority of these conditions can be reversed or treated completely.

The parts of human body like Ear, Nose and Throat are liable to be affected by many of the industrial hazards like Noise, Atmospheric Pressure changes, Allergens, Carcinogens and Trauma. These parts can be the conduit for allergens or carcinogens to other parts of the body like Lungs, Gastro intestinal tract and Brain. Once Occupational disease conditions are found irreversible the workers are to be provided with rehabilitation measures so that they can also achieve improved quality of life. Prevention of Occupational diseases by creating awareness among workers in hazardous industries regarding usage of Personal protective equipment's and control of Sound pollution by educating the employers and general public should be the main stay of Occupational Health activities in the country. No worker should endanger his/her health in order to live a life of dignity. 'Prevention is better than cure' this should be the motto of each worker so that they help each other and the country in the improvement of health of the work force and country's economy in a large way.

WORK ENVIRONMENT AND E.N.T

Occupational Diseases– Interaction of workers with the working environment can lead to impairment of health thereby causing work related or Occupational diseases.

The most important tool for the diagnosis of these illnesses is the Occupational history stressing upon the exposures to hazards. Work Environment^[1] – It has got 4 components: Physical, Chemical, Biological and Social.

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a. Physical environment – The hazardous factors in this environment are Heat, Cold, Light, Noise, Ionizing Radiation, Vibrations, Changes in Atmospheric Pressure, Electricity etc.

Out of these Noise^[2] is one of the common hazards in most of the industries. Noise is Sound in a different form. Sound is a part of our life. It provides enjoyment as music, singing of birds etc. It allows verbal communication. It alerts us as Door-bell or Alarm at work place. In modern society many sounds are annoying to our ears.

Sound is a form of energy, produced by a vibrating object. It travels through the media as waves. Wave consists of compression and rarefaction of the molecules of the medium in which it travels. When these waves hit the Tympanic membrane of the ear, sound is perceived.

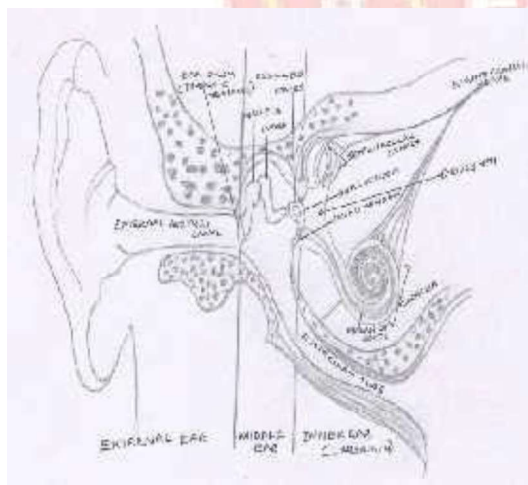


Diagram1: Structure of the Ear

The ear has 3 parts ^[3], External, Middle and Inner. Outer ear (Pinna), Ear canal (External Auditory Canal) up to the Tympanic membrane is the External ear. The middle ear is a six sided box which contains three bones called Ossicles which are in the form of a chain. Ossicles conduct energy from vibrations of TM through Oval window at the Foot plate of Stapes where it is transmitted as pressure changes in Inner ear fluids

thereby moving the Basilar membrane which in turn stimulates the hair cells in the Sensory organ of hearing called Organ of Corti. The hair cells act as Transducers which convert mechanical energy to electrical impulses along Auditory Nerve to the Auditory Cortex of the Brain where sound is perceived. The damage due to high noise is mainly to the hair cells in the Organ of Corti. NOISE^[2,6]: These are unpleasant and unwanted sounds. They are complex and having little or no periodicity. They cannot be measured or their characteristics analyzed. Noise is a byproduct of many industries. In high levels Noise causes Hearing Loss as well as other harmful effects. Some noises though not powerful can disturb our sleep. For e.g. Sound of a vehicle, mewing of a cat, Water dripping from the tap, sound of a radio, sound of mosquitoes etc.

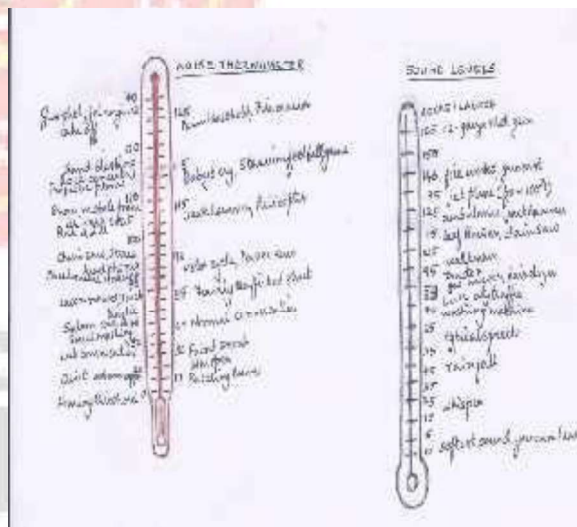


Diagram2: Noise Thermometer

Industrial and urban noise is increasing day by day due to the emerging industries, large number of vehicles and introduction of highly amplified advertising sounds. In industry, increased mechanization leads to increased noise levels. Such occupations carry high risk of health problem for e.g. mining, tunneling, quarrying, drilling, heavy engineering, powerful combustion engines, textile machines etc.

Effect on human beings	Sound level in dBA	Sound Source
Highly injurious	140	Jet engine
	130	River hammer
PAIN THRESHOLD		
	120	Propeller Plane
Injurious	110	Rock drill, Chain saw
	100	Sheet-metal work shop
	90	Heavy truck
Risk	80	Heavily trafficked street
Speech masking	70	Saloon car
Irritating	60	Normal conversation
	50	Low conversation
	40	Quiet radio music
	30	Whispering
	20	Quiet urban apartment
	10	Rustling leaves
0 HEARING THRESHOLD		

Table 1: Effect of Sound on Human beings
HISTORY: Blacksmith’s deafness is the first among Occupational deafness. Thomas Barr of Glasgow did studies on the Boiler makers’ Hearing Loss. Non-Auditory effects of high level Noise exposure: There can be increase in accident rates, medical problems like increased breath rate, Heart rate, Blood Pressure, Constriction of pupils, Constriction of Blood vessels, Vascular Neuropathy, Migrainous Headache, Myopathy, Psychological effects like Stress, Anxiety, Irritation, Gastric problems, Absenteeism in work, Communication interference, Low productivity

and low performance. Harmful effects due to noise are related to several factors [2,6]:



Diagram 3 : Examples of Hazardous industries

- (1) Intensity. The Sound Pressure Level is expressed in dB.
- (2) Frequency. High frequency sounds are more dangerous.
- (3) Duration. Adverse effects are proportional to the duration of exposure, i.e. the total amount of energy reaching the ears. 90dB for 8hours per day for 5 days a week is the maximum safe limit recommended by the Ministry of Labour, Government of India. Sound having intensity more than 115 dB is not at all permitted.

NOISE LEVEL dB (A)	Permitted Daily Exposure (Hrs)
90dB	8
92	6
95	4
97	3
100	2
102	1 1/2
105	1
110	1/2
115	1/4

Table 2: Noise levels and permitted daily exposure

- (4) Nature of Noise. Whether it is Continuous, Fluctuant, Intermittent or Explosive. Continuous noise is more harmful.
- (5) Susceptibility of individual. Whether the person had history of Meningitis, treatment with Ototoxic drugs, having familial tendency of early deafness, history of Diabetes Mellitus, Arterial Hypertension, age above 55yrsetc.
- (6) Preexisting ear or medical illness like Intoxication, Injury, Labyrinthitis, Presbycusis etc.
- (7) Synergy of more than one among the above factors.

NOISE LEVEL	Daily Exposure/ Duration	Risk of Hearing Loss
</= 75dB	8hrs	Negligible
85dB	8hrs/5yrs	1%
	10yrs	3%
	15yrs	5%
90dB	8hrs/5yrs	4%
	10yrs	10%
	15yrs	14%
95dB	8hrs/5yrs	7%
	10yrs	17%
	15yrs	24%

Table 3: Noise Exposure – Effect relationship

Mechanism of action of Noise

a. Acute Acoustic Trauma. This is due to a single brief exposure of intense sound like Explosion, Gunfire, Powerful cracker, the intensity of which comes to about 140dB to 170dB. Such a sound can damage the Outer hair cells, can disrupt the Organ of Corti, can rupture Reissner’s membrane and can disrupt the ossicular chain.

b. Noise Induced Hearing Loss^[2,4,6]. (1) This can be temporary called Temporary Threshold Shift or Auditorv fatigue which lasts for few minutes to hours. Very high intensity sounds can cause Temporary Threshold Shift which lasts for several days. (2)In Permanent Threshold Shift, the hearing loss is permanent and does not recover. The Shift is the quantity of Hearing loss attributable to the Noise alone, values of Presbycusis subtracted. There will be pathological changes in Cochlea and basal hair cells. The Audiogram^[5] will show Sensory Neural Hearing Loss with both Air Conduction and

bone conduction lowered with no Air Bone Gap. There will be a typical notch at 4 Kilo Hz. When the duration of noise exposure increases, the notch

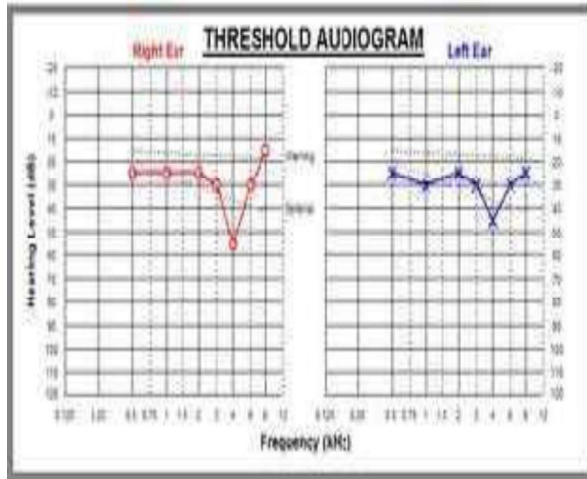


Diagram 4: Audiogram in Noise Induced Hearing Loss will become deeper and wider and affect other frequencies. Audiogram is usually symmetric. The hearing loss will be clinically

by Personal Sound Dosimetry. Medical examination is done to rule out preexisting medical or ear conditions. Pure Tone Audiogram and the typical notch observed. The Audiogram will be Sensory Neural Hearing Loss type with super positioning of AC and BC curves with Recruitment. Usually bilateral, symmetrical, permanent and stable.

Differential Diagnosis: Damages to the Auditory nerve, Otosclerosis, Middle Ear disease like Chronic Otitis.

Management: In case of Acoustic Trauma, use of Hyperbaric Oxygen or Carbogen (10% CO₂ + 90% O₂) will have a vasodilatory effect on Cochlea.

Rehabilitation: Increased signal to noise ratio of various signals like Door bells, telephone and personal television amplifier will be of help. Hearing aid⁷ is indicated in severe Hearing loss.

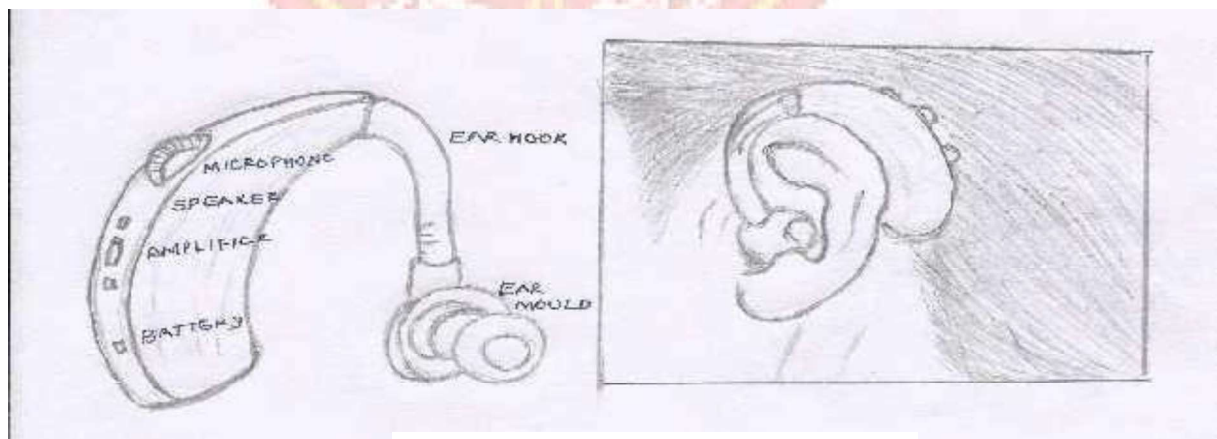


Diagram 5: Hearing Aid

apparent when speech frequencies i.e. 500Hz, 1KHz and 2KHz are affected.

Symptoms: Tinnitus is the main symptom of NIHL. It can be high pitched, buzzing, ringing or roaring type. It can be felt from one or both sides.

Assessment of NIHL: Medical and Occupational history should be taken and careful evaluation is done. Noise exposure is assessed by the intensity, frequency and duration of exposure. This is done

High frequency emphasis aid with open or vented ear mound is advised. Psychological aspects, impact on family life, withdrawal from verbal interaction, denial of problem etc. should be looked into.

Control of Noise: It can be done at three different points. Source, Air path and Receiver.

Sources: The methods are Relocation, Isolation, Muffling, Substitution and Engineering measures

like solid foundation of machines, use of Rubber padding, proper maintenance of machines and installation of suitable Sound absorbers and Sound level meters.

Air path: We can do lining of walls and ceiling by acoustic boards. Proper housekeeping is to be done. We can increase the distance between source and receiver.

Receiver: Training and education of the workers, rotation of workers is to be done. Transfer the patient from the noisy work. Personal monitoring devices^{2,6,7} like Dosimeter and Personal Protective Devices like Ear plugs or Ear muffs are to be used.

Hearing Conservation Program ^[1,6,7,11]: This program should be introduced in all industries with Noise as the main byproduct. The program includes methods of noise reduction, designating high noise areas with signal boards, Audiometry testing both pre placement and periodic, Audiogram evaluation by Specialists, Hearing protectors and Health training to the workers. India in general, and Kerala in particular is one of the noisiest places in the world. Noise pollution has grave social, emotional and health effects. I.M.A, Kerala and Association of Otolaryngologists in India (AOI), Kerala have launched an awareness campaign called **National Initiative for Safe Sound (NISS)** with the help of prominent public personalities and NGOs, who are committed to this mission. The main objective is to educate the public on the ill effects of noise pollution and the precautions we should take to prevent those effects.

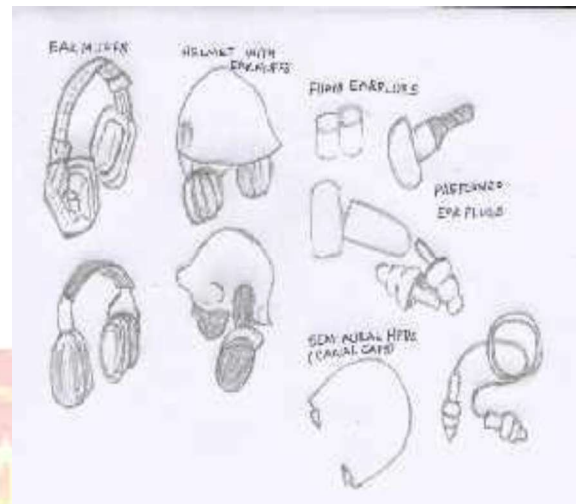


Diagram 6: Personal Protective Devices

NISS is registered as a non-profitable society. The programmes of this society include:

- ☑ Organizing Youth Awareness Campaigns with the support of Student Police Cadets and teachers
- ☑ Publishing information booklets on noise pollution for public awareness
- ☑ Broadcasting awareness programmes on TV, movie and social media
- ☑ Conducting seminars in association with residents' associations, trade unions, NGOs etc.
- ☑ Providing helpline and legal support to victims of noise pollution

a. Physical Hazards Work Environment Changes in Atmospheric Pressure or Dysbarisms^[8,10]: This can affect workers in Compressed air tunneling, Caisson Operation, during descent of flight and Diving. Compressed air causes MIDDLE EAR BAROTRAUMA due to failure of equalization of air pressure difference on the two sides of the Tympanic membrane. If Eustachian tube is blocked for any reason, during descent air pressure in Middle ear cannot equalize with Atmospheric pressure and the low middle ear pressure can lead to Otagia, Congestion and Hemorrhagic effusion with an associated

Conductive hearing loss and sometimes tinnitus and vertigo. TM can be physically damaged or ruptured. During compression, sinus cavities must be open or else it may cause severe pain called SINUS BAROTRAUMA. Frontal sinuses are affected in common. INNER EAR BAROTRAUMA also reported due to faulty functioning of the Eustachian tube in divers. If middle ear pressure is raised with opening of the Eustachian tube, rupture of the round window membrane or disruption of stapes foot plate can occur. If Eustachian tube remains closed, the increase in intra cranial pressure can be transmitted to the Cochlea of the inner ear. Use of SCUBA (Self-contained under water breathing apparatus) can prevent barotraumas in divers. Preventive measures like frequent swallowing, use of topical decongestants advised in air travelers.

Ionizing Radiation: This can cause acute and chronic problems like Carcinoma of Skin, Blood and Bone.

b. Chemical Environment

The hazards in chemical environment are general toxic air borne contaminants. These can enter the body through Inhalation, Skin absorption or Ingestion by mouth.

Inhalation: Gaseous and particulate substances find way to the lungs by this route of entry.

Skin absorption: Phenol, Cresol, Organophosphate insecticides like Parathion takes this route.

Ingestion: Contaminants enter the body along with food in work room where housekeeping is bad and workers careless.

The hazardous substances in the Chemical environment are metals, aromatic carbons, aliphatic compounds, noxious gases and dusts.

These can be in the form of mist, fog, fumes, dust

or smoke. The size of these substances is measurable in microns. All these behave in the same way when air borne. Assimilation and subsequent toxic manifestations vary from worker to worker in same type of work, due to the phenomenon of personal susceptibility and individual habits.

Examples of some occupational diseases caused by these Chemical hazards:

Pneumoconiosis, Occupational Asthma – caused by Cotton dust in Textile industries and Flour dust in Food industries. Nose and throat act as conduits connecting the lower respiratory tract with the atmosphere for the passage of these harmful agents.

Extrinsic Allergic Alveolitis – Starting as Allergic Rhinitis, caused by Fungal Spores.

Cement Dermatitis – By handling of cement, Primary Irritant Dermatitis is caused. By inhalation of cement dust, Ulcerations of Oral and Nasal mucous membranes occur.

Nasal cavity Malignancy – Organic contaminants like Isopropyl oil is a culprit.

Wood dust in Furniture workers is a cause.^[12]

Leather dust also is a cause.

Carcinoma of Para nasal Sinuses – Inorganic contaminants like Nickel in Refinery workers is the main causative factor.

Nasopharyngeal Cancer – Causative agents are Formaldehyde dust & smoke particulates and certain aromatic Hydrocarbons. This malignancy is more in Tobacco and Alcohol users.

c. Biological Environment

The hazards in the Biological environment are Infectious agents and parasitic agents that

cause diseases like Anthrax, Weil's disease etc. in workers dealing with animals, cultivation etc.

d. Social Environment

The hazards in social environment are Accidents, Alcoholism etc. A broad spectrum of injuries may cause trauma to the ears. Blunt head injury or falls are by far the most common causes of traumatic hearing loss⁹. Conductive hearing loss that persists more than 3 months after injury is usually the result of a Tympanic membrane perforation or disruption of ossicular chain. Traumatic membrane perforations usually heal spontaneously if secondary infection does not develop. Otherwise these lesions are suitable for surgical repair. Trauma to the inner ear may cause rupture of the round and oval window membranes, which can lead to leakage of inner ear fluids or perilymph fistula causing vertigo and hearing loss.

Conclusion

In short, each worker needs to be medically monitored for assessing the state of his health. Before employed and while placed in a particular job, he should undergo thorough medical examination along with necessary special tests like PTA and record keeping done properly. Periodic examinations at frequent intervals in order to detect any absenteeism or ill health are compulsory. These measures help to detect occupational diseases in early stages when majority of these conditions can be reversed or treated completely. Once Occupational disease conditions are found irreversible the workers are to be provided with rehabilitation measures so that they can also achieve improved quality of life. The parts of human body like Ear, Nose and Throat are liable to be affected by many of the

industrial hazards like Noise, Atmospheric Pressure changes, Allergens, Carcinogens and Trauma. On the more, these parts can be the conduit for allergens or carcinogens to other parts of the body like Lungs, Gastro intestinal tract and Brain.

Prevention of Occupational diseases^[9,10] by creating awareness among workers in hazardous industries should be the main stay of Occupational Health activities in the country. No worker should endanger his/her health in order to live a life of dignity. We should teach them that '**Prevention is better than cure**'.

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