

D. Noise

Unwanted sound, TLV (85 dB)

The unit used to measure noise is decibel (dB).

The intensity of sound is expressed in terms of the square of the sound pressure. By convention the units are in steps or ratios of tenfold intensity, each unit known as a bel . For practical purposes units of one-tenth of a bel, the decibels (dB) are used. The loudness of a sound correlates with the amplitude or intensity and is measured in decibels (dB).

Pitch correlates with the frequency or cycles per second and is measured in Hertz (HZ). The auditory field lies between 20 and 20,000 HZ. The threshold of audibility is at its minimum at 4000 HZ and at this frequency is located the zone of impairment of high pitched tones that occurs in the early stages of hearing loss.

Noise-Induced Hearing Loss (NIHL).

Noise is a major occupational health risk, NIOSH has identified NIHL as one of the 10 leading work-related disorders. Although certain work duties in virtually any industry can present a risk to hearing, some industries have a greater proportion of workers at risk of NIHL. In the petroleum, lumber, food-processing industries, as many as 25% of the work force may be exposed to level of 85 dB {time-weighted average (TWA)}.

Manufacture of furniture, metals, rubber, and plastics also presents risks to human hearing, if workers are not properly protected from hazardous levels of noise.

The effects of environmental noise on human health has also aroused concern. However, ambient noise from road traffic, aircraft and construction activities has not yet attracted well-controlled epidemiologic studies. Attempts have been made to link disease risk, and hypertension.

Automobile traffic had higher rates of hypertension when in the later study, inhabitants of areas near aircraft and compared to subjects living in another, less noisy, area.

Damage to human hearing from exposure to noise, can take two forms:

1. Acute (temporary hearing loss or temporary threshold shift) which is secondary to a loud noise such as blasts, explosion, or other high impulse noises that lead to hearing deficits. Given an adequate period of auditory rest, hearing usually returns to preexposure levels.
2. Chronic (permanent hearing loss or temporary threshold shift) which is due to long-term exposure to unsafe levels of noise that lead to sensorineural hearing impairment.

Irreversible condition in which, despite a prolonged period of auditory rest, hearing does not return to normal.

The human auditory system consist of three parts

1. external ear(external acoustic meatus and canal)
2. middle ear(tympanic membrane and three ossicles, from out side to inner side tympanic membrane and malleus, incus, stapedius.
3. inner ear consist of semicircular canals, cochlea, vestibular nerve and cochlear nerve.

High noise level can damage the tympanic membrane, middle ear, conducting, and sensor cells in the inner ear (cochlea). Prolonged exposure to noise primarily damages the inner ear, especially the hair cells of the organ of Corti, cochlear blood vessels, the stria vascularis, and nerve endings associated with the hair cells can also be damaged. Initially, the hair cells of the cochlea are affected, this area is responsible for perception of high-frequency sound. Eventually, disruption of the medial and apical areas occur as well.

Although the risk of suffering NIHL tends to increase with advancing age as well as high length of employment. Most noise-related effects occur within the early phases of exposure to noise. In fact, most of the damage that occurs to the hearing mechanism tends to occur within the first 10 years.

Presbycusis, the impairment of hearing due to advance age, result in diminished hearing ability usually beginning in the mid-40s and continuing thereafter. People who suffer from sensineural hearing loss, however, do not usually recognize early changes in their ability to hear. Early changes can usually be documented by audiometric monitoring. Early symptoms of NIHL reflect a persons ability to distinguish higher-pitch consonant sounds, for example the fist may sound fish.

Risk factors

- The major risk factors for suffering noise induced hearing loss is prolonged unprotected exposure to levels of noise beyond 85 dB.
- Hyperproteinemia
- Diabetes
- Solvents
- Cigarette smoking
- Eye color
- Thyroid abnormalities

The acoustic reflex

The ear is protected to some extent from noise by acoustic reflex. In response to loud sounds, the stapedius and tensor tympani muscles contract with result that less energy is transmitted to the sound receptors of the inner ear, the protection afforded is limited by muscle fatigue and by the delay in response so that it is impossible to cope with sudden, unexpected sounds.

Auditory fatigue and masking

Auditory fatigue and masking are physiological effects noted on exposure to noise. Auditory fatigue causes a temporary shift in threshold with a consequent decrease in hearing. As the intensity of the sound increases, auditory fatigue becomes more marked and may be associated with tinnitus. It is greatest at 4000 Hz.

Recovery may take several hours, especially if the threshold has risen by more than 50 dB. Pure tones have more effect than broadband noise, and intermittent sounds more than continuous sound. In individual with a high susceptibility towards a temporary threshold shift there appears to be an association with occupational hearing loss.

Masking refers to the process whereby the threshold of hearing of one sound is raised by the presence of another. The effects become more noticeable as the frequencies of the two sounds approach each other. Masking can interfere with the understanding of speech and this can have important repercussions in industry, limiting communication or threatening safety.

Hearing loss.

The effects of noise tend to occur in the organ of Corti within the cochlea of the inner ear. This structure has three outer rows and one inner row of hair cells, with the tectorial membrane suspended above them. The hair cells contain cilia that project toward the tectorial membrane. The energy transmitted from the tympanic membrane via the ossicles to the cochlea vibrates the cilia and is then coded into nerve impulses in the acoustic nerve. The hair cells are quite susceptible to the trauma of loud noise. The cell bodies swell with repeated exposure to loud noise and ultimately the hair cells are destroyed. Studies have indicated that the vascular supply of the basilar membrane is disrupted when high noise levels are applied. Capillary vasoconstriction in response to loud noise may result in diminished oxygen tension and local hypoxia within cochlea.

Occupational hearing loss usually has a gradual and often unsuspected onset. The first sign is a slight impairment of hearing, detected by audiometry in the 4000 Hz range, spreading at a later stage to the 3000-6000 Hz range.

This characteristic pattern allows occupational hearing loss to be differentiated from other forms of deafness. The patient may be completely unaware of any defect in hearing until the speech frequencies are affected. The speech frequencies lie between 500-2000 Hz and may be sub-divided into vowel (500-1000 Hz) and consonant frequencies (1000-2000 Hz).

When hearing loss occurs in these frequencies, speech becomes increasingly difficult to understand, and the patient suffers from some degree of social handicap. It may take years for deafness of this severity to develop but there is no possibility of its reversal since it implies permanent damage to the organ of Corti.

Impulse noise is the most dangerous form; gunfire being notorious for damaging the hearing of those behind the rifles.

The intermittent noise of drop-forging is another source which can lead to a rapid deterioration in hearing.

Nonauditory effects of noise.

1. hypertension

the basis of the relationship between longterm exposure exposure to noise and hypertension is grounded in the stress response, that is as a result of noise, release of adrenocortical hormones and sympathomimetic mediators lead to increase heart rate and eventually higher blood pressure.

2. increased respiratory rate.

3. cardiac output is generally decreased and peripheral vaso-constriction may cause blanching of skin in some people.

All the changes reflects a response on the adrenal gland or the autonomic nervous system to the noise stimulus analogous to those demonstrated to someone frightened.

4. psychological effects

Noise can effect the performance of psycho-motor tasks.

5. Noise and mental illness.

Deafness is associated with significantly higher rates of mental illness in the community and in hospital populations.

- Some points to be remember in the evaluation of suspected NIHL; include the followings :-
 1. Chronic NIHL is usually symmetric; other otologic disorders, especially the more serious, as well as treatable types are often asymmetric.
 2. NIHL usually develops gradually, other otologic disorders may progress rapidly.
 3. NIHL usually causes high-frequency threshold shifts.
 4. Regardless of the cause, a pure-tone threshold average in excess of 25 dB in either ear is likely to cause hearing difficulties.

Hearing conservation program (HCP)

Hearing conservation program (HCP) are required when workers are exposed to levels above 85 dB. The fundamentals of an (HCP) include the following measures:-

1. noise level assessment
2. noise control measures
3. audiometric monitoring
4. education and training

5. hearing protection devices (ear plug, earmuff)

Noise control measures by engineering controls such as:-

1. equipment modification
2. enclosure
3. sound absorbent surroundings
4. improved maintenance
5. silencing exhaust systems