Hear Today, Gone Tomorrow
Noise-Induced Hearing Loss

Significance: As the use of personal listening devices has increased tremendously in the past decade, noise-induced hearing loss has become a prevalent issue in today’s medical field [1]. A prolonged listening of these devices can lead to a noise induced threshold shift, thus lowering the hearing ability of many individuals, particularly adolescents [2]. Hearing loss can have psychosocial consequences not just for the individual patient but also for his or her relationships with friends and family members [3]. The goal of this activity is to address these implications and provide practitioners with the means to communicate this information.

Audience: The target audience of the presentation is a group of family practitioners. The following information is focused on increasing awareness of the implications of noise-induced hearing loss and providing these doctors the means to provide the highest quality of care for their patients who may be experiencing such hearing loss.

Learning Objectives: Upon completion of this activity, practitioners will be able to:

- Identify patients who are at risk or are already suffering from noise-induced hearing loss;
- Understand which information regarding hearing loss should be relayed to the patients and their families;
- Recommend when patients should take further action and what corresponding steps should be followed.

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Introduction

Noise-induced hearing loss (NIHL) is a preventable disorder that results from exposure to high-intensity sound, especially over a long period of time [4]. It affects all demographics of the population. Currently, there is little public knowledge regarding the causes and effects of NIHL [4].

Frequently, the effects of repetitive high-intensity noise exposure are not seen until much later in life [5]. It is estimated that 12.5% of children aged 6 to 19 years have noise-induced threshold shifts [5]. In 1985, a study reported that 40% of students aged 16 to 25 years had audiometric evidence of NIHL, and in 1996, it was reported that 1% of all school-aged children have some degree of NIHL [5]. Furthermore, the majority of the people studied reported that they either heard little information about preventing NIHL or they ignored the advice and information given to them [5].

Case Study

A teenager is screened at her school and found to have a 30 decibel mild elevation of hearing thresholds at 4000 Hz [4]. An audiogram determined this noticeable notch that indicates hearing loss. The girl noted that she listens to music with headphones several hours each day with no detailed attention to volume level. Occasionally the teenager attends concerts where she is exposed to high decibel levels. Later, she experiences the sensation of ringing in the ears, also known as tinnitus [6]. Due to this repetitive noise exposure, she is now having more long term effects. Thus, she is an example of a patient experiencing noise-induced hearing loss or NIHL.
Causes

The ear is composed of three major components: 1) the outer ear consisting of the pinna and external canal; 2) the middle ear made up of the tympanic membrane and ossicles; 3) the inner ear having the cochlea and semicircular canals [7]. These three main structures can be seen in the figure below. The cochlea is a coiled structure filled with fluid that moves with the vibrations of the ossicles in the middle ear [7]. The inner ear is the most essential part for hearing. Movement of the fluid affects the hair cells that are located in an area of the cochlea known as the Organ of Corti [7]. As these hair cells move, this signal is converted to nerve impulses which are carried to the brainstem and then processed in the brain [7].

As sound is transmitted at differing frequencies, the corresponding hair cells receive the signal and transmit their message [8]. However, once the hair cells for a particular frequency have been repeatedly stimulated, those hair cells become damaged and do not regenerate [8]. Thus, with continuing noise at distinct frequencies, messages for these frequencies will no longer be able to be sent to the brain and the individual will not perceive that noise [8].

Typically high frequency sounds are lost first, but after further noise insult, both high and low frequencies can be harder for the individual to detect [8]. Hearing loss through this mechanism is known as sensorineural hearing loss (SNHL) [5].

Social causes have also attributed to the increase of NIHL [9]. With the advancement of technology leading to longer battery life and better quality sound for personal listening devices, individuals are more likely than before to listen to music in areas with a large amount of
background noise. When there is a significant amount of background noise, the volume is usually increased, wearing down hair cells at a faster rate [9].

**Effects**

NIHL has several possible consequences. Hearing loss aside, NIHL can also lead to tinnitus, or the ringing of the ears, elevated blood pressure, changes in brain chemistry, and increased heart rate, which are quantitative physical changes that disturb patients [6]. These physical symptoms have far-reaching social consequences, including reduced social interactions, isolation, reclusion, and depression [6]. While some of these symptoms do not immediately appear to fit with NIHL, the changes in brain chemistry and hearing loss can make it significantly more difficult to have typical social interaction, especially as adolescents [6]. These effects are not lethal, but they have far-reaching effects, especially considering that 12% of children ages 6-12 have noise induced hearing loss and some of the symptoms described above [6].

**Risk Factors**

There are several factors that have shown to correlate with the presence of NIHL. For instance, there are correlations between patients with NIHL and blood type O [6]. Additionally, NIHL is more common in people of short stature and those who are of a race other than Caucasian [6]. Other than these non-modifiable factors, there are several factors influenced by the patient’s behavior and environment. Smoking, non-use of hearing protection in the presence of high sound intensities, tooth loss, and cardiac disease are common risk factors [6]. Although these correlations do exist, the mechanisms by which these factors are related to NIHL are still unknown.
Screening

The standard way to test for noise induced hearing loss is to use a type 2 sound level meter, which can be found at local electronic stores [10]. These sound meters measure the sound intensity at an error range of ± 1 dB, and produce sounds at 1000, 2000, and 4000 Hz using tuning forks [10]. A new study has proposed using 6000 Hz as well, but this may not be as practical since it is expected that more than half of a given population would fail the test at this frequency [10]. If a patient cannot hear the sound produced at any of these given frequencies, they have some form of hearing loss and should be referred to an audiologist. The audiologist will then perform a more precise test on both ears. The results will be plotted on an audiogram, which has a scale from normal hearing to profound hearing loss, with 4 intermediate levels aiding in determining the extent of hearing loss [4, 11].

Treatment

The treatment options for NIHL include hearing amplification devices and patient counseling [4]. Hearing aids are the common treatment option for mild to severe hearing loss [2]. If the patient is found to have severe hearing loss and hearing aids and other methods are ineffective, cochlear implants are an advanced treatment option [11]. Counseling involves encouraging the patient to seek treatment options and helping the patient cope with the hearing disability [4]. Patients also may be referred to a vocational rehabilitation center if they are having trouble with speaking as a result of their NIHL [4].

Suggestions

Patient education is critical, and the most important message is that hearing loss is permanent. Although hearing aids and other devices may help, they will not fully fix the problem [4]. Further, continued use of personal listening devices (e.g., Mp3 players) at a high
volume will exacerbate hearing loss. With regard to personal listening devices, suggestions for patients include: 1) use devices less frequently; 2) use devices with noise-filtering headphones, which reduce background noise hence reduce the need for volume [5]; 3) listen to personal listening devices at 70% of the max volume only [12]. It may be beneficial to have sample ear plugs and advise the patient that these and other noise-dampening devices can be found at local convenient stores to use in areas with a large degree of background noise (e.g., concerts, football games, pep rallies) [4]. These noise-dampening devices, such as earplugs, have been shown to reduce perceived sound levels by 20-40 decibels [4]. Some other lifestyle suggestions that reduce the risk for NIHL include changing diet, regular exercise, maintaining good oral hygiene, and discouraging smoking [6]. Finally, educate patients about the physiological and psychological consequences of developing NIHL.

Test

1. Which of the following is not a sign of early noise-induced hearing loss?
   A. Not being able to hear high-pitched sounds, but able to hear low-pitched sounds
   B. Not being able to hear low-pitched sounds, but able to hear high-pitched sounds
   C. Having trouble understanding what people say
   D. Needing to turn the TV sound higher

2. Where in the ear do the physiological changes from repetitive loud sounds occur?
   A. Outer ear
   B. Middle ear
   C. Inner ear

3. What is the most significant advice physicians can give patients in hopes of preventing future noise-induced hearing loss?
   A. Lower the volume of personal listening devices and use ear plugs
B. Wear hearing aids
C. A patient should see an audiologist regularly to test for hearing loss
D. Talk to your family members

4. Rank the following treatments in order of increasing severity of hearing loss: hearing aids [1], cochlear implants [2], significant change in music lifestyle [3].
   A. 1,2,3
   B. 2,1,3
   C. 3,2,1
   D. 3,1,2
   E. 2,1,3

5. True/False: Do environmental factors lead to an increase of NIHL?
References


