SCIENCEFORECAST
A digital science library

Review Article
Published: 26 Jan, 2018

Journal of Otolaryngology Forecast

Hearing Problems: The Longo-Businco Questionnaire for the Full Evaluation of the Auditory and Vestibular Function

Di Rienzo Businco L[1], Longo P[2], Tortorella F[2], Lauriello M[3], Eibenstein A[3]*

[1]Otorhinolaryngology Unit, S.Spirito Hospital, Rome, Italy

[2]Clinical Research Unit, SIDERO Onlus, Rome, Italy

[3]Department of Applied Clinical Sciences and Biotechnology, L'Aquila University, L'Aquila, Italy

Abstract

Recurrent symptoms such as asking others to repeat themselves, having difficulty hearing certain sounds or background noises, speaking very loudly, stuffy nose sensation as well as the appearance of buzzing or vertigo, if neglected, may undermine the individual's wellbeing and psychophysical performance, but can also create the conditions for the involvement of the ear. In these cases, it is important to see a specialist as soon as possible to prevent the hearing loss from becoming chronic and thus irreversible. This is even truer for young people and some social categories, whose habits put them more at risk of hearing loss as a consequence of sound overstimulation.

The Longo-Businco 50 questionnaire is a new and quick tool, developed for initial screening, full and repeatable evaluation of the auditory and vestibular function of patients. In our experience, this self-administered questionnaire proved to be easy to understand and to use, quickly to complete (questions require no explanations from the physician) and allowed to obtain the specialized medical history in a considerably shorter time without disregarding any symptoms. The use of the Longo-Businco questionnaire by doctors who are not otolaryngologists or audiologist gave also very positive results in terms of facilitation of the dialogue among the various professional caregivers in the field, speeding up and optimizing communication among colleagues.

Keywords: Questionnaire; Longo-Businco; Hypoacusia; Noise-related hearing-loss; Sound overstimulation; Vertigo; Auditory evaluation; Screening; Hearing problems; Auditory function; Vestibular function

OPEN ACCESS

Correspondence:
Di Rienzo Businco L, Otorhinolaryngology Unit, S.Spirito Hospital, Rome, Italy.
E-mail: *ldirienzo@businco.net*

Received Date: *03 Dec 2017*
Accepted Date: *15 Jan 2018*
Published Date: *26 Jan 2018*

Citation: *Di Rienzo Businco L, Longo P, Tortorella F, Lauriello M, Eibenstein A. Hearing Problems: The Longo-Businco Questionnaire for the Full Evaluation of the Auditory and Vestibular Function. J Otolaryngol Forecast. 2018; 1(1): 1002.*

Abbreviations

WHO: World Health Organization; OECD: Organisation for Economic Co-operation and Development; dB: decibel; dB (A): decibel A; INAIL: Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro - National Institute for Insurance against Accidents at Work; SC: semicircular canals; EAC: external auditory canal; BPPV: benign paroxysmal positional vertigo; GP: general practitioner.

Introduction

Asking others to repeat themselves, having difficutly hearing certain sounds and background noises, speaking very loudly, as well as the appearance of buzzing and dizziness: 30 percent of Italians suffer from hearing loss. Sometimes, this is due to the consequences of a neglected cold, of a plug of earwax or the presence of a foreign body in the ear. In most cases, hypoacusia (reduction in hearing ability) is the effect of increasing age or, especially in young people, of acoustic overstimulation due to excessive use of music players, of frequenting noisy environments and, last but not least, the excessive use of earphones. After age 30, the auditory system is subject to a natural progressive decline, as is also the case for sight with the loss of elasticity in the crystalline lens. This may become pathological in those who perform particular jobs, are subject to acoustic overstimulation or take specific drugs. Certain factors can also predispose to or accelerate hearing loss, such as obesity, sedentariness, high blood pressure, some cardiovascular diseases, impaired nasal breathing. The nose is closely connected with the ear, which must always be well aerated to function properly; often, the inflammatory states of the nose spread to involve the delicate auditory system. These conditions lead to the appearance of the initial symptoms of hypoacusia.

The effects of noise on hearing, health, learning, behavior and rest

Nowadays, noise is the main physical form of pollution and is an issue of major socio-economic importance both for the number of exposed subjects and for its negative effects on human health and wellbeing. Noise, in fact, causes a series of annoying and unpleasant feelings that, over time, result in severe and irreversible damage to the auditory system and the whole body, affecting in particular, through complex mechanisms, the cardiovascular system, the endocrine system and the central nervous system.

Epidemiology: According to the latest WHO data, it is estimated that in the OECD countries, over 150 million people are exposed to noise levels above the 65 dB (A), indicated by the WHO as the safety threshold.

Still in Europe, 28% of workers (over 60 million people) reported being exposed to high levels of noise, at least for half of their working time, such as to be forced to raise their voice above normal conversation standards to be heard, making normal conversation difficult. In Italy, the noise problem is more critical than in other European countries; recent data show that in most cities, the 65 dB (A) threshold has been exceeded, with 72% of the population exposed to higher noise levels than the maximum limits set by current regulations. Although the noise levels are decreasing, the damage caused by noise is still the third major cause of occupational disease reported to INAIL (Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro - National Institute for Insurance against Accidents at Work).

Pathological effects: Noise-induced hearing impairment may present differently from one person to another. This is because damage depends largely on very variable factors, such as the type and frequency of noise, the length and time of exposure, the conditions under which noise is produced, but also on the subjective characteristics of the exposed individual.

Regardless of the mechanism of action, acoustic trauma damages the hair cells of the inner ear thereby destroying large areas of the organ of Corti [1].

Sometimes, the acoustic damage is temporary with a transient decrease of the auditory threshold, appearance of hissing, buzzing, and a sense of ear fullness. Under other circumstances, following prolonged exposure to noise, the damage becomes chronic and permanent with decrease of the auditory threshold, chronic tinnitus, which has considerable negative effects on the whole body, appearance of stress, tiredness, reduction in work efficiency and performance, interference on sleep and rest, sudden mood changes and, in some cases, also anxiety and depression. Noise also interferes with mental activities that require attention, memory and ability to deal with complex problems. The adaptation strategies put in place to erase noise and the effort required to preserve performance are associated with increased blood pressure and elevated levels of stress hormones in the blood. These effects may have serious health repercussions and, depending on the conditions of the exposed subject, lead to:

- Cardiovascular problems, Hypertension, Ischemic Heart Disease and increased risk of Heart Attack.
- Reduced immune response
- Gastrointestinal problems
- Psychophysical stress

Effects on rest and sleep: Noise also has negative effects on sleep and rest, causing problems getting to sleep, unrestful sleep, decreased deep sleep phase, increased number of awakenings and adverse effects after awakening or after inadequate rest, such as fatigue and performance deficit. These effects may be avoided if the sound levels of the indoor environment are kept below 30 dB (A) of background level, or with a maximum peak level below 45 dB (A). These criteria should be strictly observed in working environments intendend for worker's rest shift.

Psychological and behavioral effects: The annoyance and malaise reaction caused by noise greatly increases with the noise levels; most human beings are annoyed by exposure to noise around 50 dB (A). High noise levels cause anxiety, aggressiveness and increase the likelyhood of aggressive behavior in particularly susceptible subjects. In addition, with exposure levels above 80 dB (A), instinctive reflexes in response to dangerous situations decrease with potential consequences in terms of safety.

Effects on communication: Speech is 100% understandable with background noise levels around 45 dB (A). With background levels over 55 dB (A) (average level reached by unaltered human voice), it is necessary to raise the voice pitch. Also, excessive background noise interferes with the ability to concentrate and induces communication with an altered voice pitch, thus increasing the background noise of the environment. The possible effects on safety should not be neglected: noise can in fact determine masking effects that interferes with verbal communication and the perception of acoustic safety signals, thus increasing the likelyhood of industrial accidents.

Effects on learning: Noise also has a negative effect on learning and this damages mainly children and teenagers, who can develop a deficit in the ability to concentrate when exposed to chronic noise. To cope with the distracting effect of noise, children and teenagers exposed to noise put unconsciously in place learning strategies that cause psycophysical stress, which has a negative impact on school achievement, especially on reading skills. Since spoken language skills and reading skills are connected, it would appear that noise is related to both.

Deafness in young people

Why have hearing disorders from overexposure to noise increased in young people?

Unfortunately, hearing impairments are increasing considerably among young people in our country, and the causes of this trend are mainly due to overexposure to sound in clubs, bars, cinemas, gyms and meeting places in general. The hearing problems due to prolonged use of smartphones or excessive use of headphones and earphones, often at high volume for long periods of time during the day, during travel or sports activities, should not be underestimated. This is compounded by an unhealthy lifestyle with excessive use of alcohol, caffeine, smoking, little physical activity and unhealthy foods: high cholesterol, triglycerides and diabetes lead to further deterioration of the auditory system.

In the past, we were used to seeing people over 60 with hearing impairments due to physiopathological causes or because they worked in excessively noisy environments.

Today, we are all more or less unconsciously immersed in noise. People who live in large cities have twice the risk of developing hearing damage than those who live in small towns or quiet small

villages. There are two categories of harmful sounds: sudden and high intensity sounds, such as for instance a hooter, the roar of a motorcycle, sirens, the explosion of a firecracker, or sounds and noises that are apparently not as loud and annoying, but are prolonged, such as diffused music in gyms and pubs, people shouting to make themselves heard, city traffic, the noise of industrial refrigerators or factories; yet the most harmful mixture is that of discos and concerts where people are exposed to sound above 120 dB for many hours. The average values recommended by the WHO to avoid hearing damage are 60 dB during daytime and 45 dB during nighttime. While the critical threshold for avoiding permanent hearing damage is 90 dB.

The warning signals are the need to turn up the volume of your TV or radio, to ask others to repeat themselves, muffled hearing sensation, trouble understanding a conversation in presence of background noise, difficulty interpreting verbal messages, buzzing and tinnitus in the ears, dizziness, temporary decrease in the hearing threshold and, not to be underestimated, also states of anxiety, stress, unrestful sleep, tiredness, fatigue and nervousness. If not treated promptly, these symptoms may become chronic and result in a possible change of the psychological and behavioral sphere and the establishment of a vicious circle. Firstly, the communication between individuals is compromised and this in itself will affect the normal daily activities and undermine psychophysical wellbeing. This will result in lower self-esteem and in a reduction of social and working relationships. This state, compounded by nervousness and mood changes, will drive more and more the person with deafness toward isolation. In a short time, this could lead to a cognitive decline that might result in senile dementia.

Furthermore, since, as already mentioned, noise interferes with mental activities that require attention, memory and ability to cope with complex problems, it is important to see a specialist immediately, in order to prevent damage and symptoms from becoming chronic, since today there are valid treatments and behavioral strategies capable of avoiding permanent damage.

Hypoacusia: onset, symptoms, diagnosis and prevention

Asking others to repeat themselves, having difficulty hearing certain sounds or background noises, speaking very loudly, as well as the appearance of buzzing or vertigo, when these symptoms are recurrent, it is important to see a specialist to prevent the hearing loss from becoming chronic and thus irreversible. One should also worry when experiencing recurrent inability to breathe fully or stuffy nose sensation. If neglected, these problems may undermine the individual's wellbeing and psychophysical performance, but can also create the conditions for the involvement of the ear. Be vigilant and prevent, because undergoing a procedure at age 40 or 50 is very different from doing so at age 70 or 80. The earlier you cope with hearing loss, the greater is your body's ability to recover and the greater is the chance to completely restore an individual to his/her social life and work. Not to mention that it will avoid years of malaise. This is even more true for young people whose habits put them more at risk of hearing loss. But everyone suffers from some degree of hearing loss. Hearing loss affects all social categories. Once, it only affected people who worked in airports because of the roar of airplanes. Today, this is also true for road maintenance workers, public transport drivers, professionals who travel to work by scooter, housewives and maids who listen to music on earphones while doing the housework and people who listen to loud music while practicing sports. This is the consequence of sound overstimulation caused by excessive use of mobile phones and earphones, by the noise in discos, pubs and gyms, as well as in very crowded places or with loud background noise. In addition, people living in urban areas are exposed to excessive sound pressure caused by traffic: sirens, the roar of motorcycles, the screech of buses breaks, hooters - they are all excessive sound stimuli that can cause irreparable damage to the cells whose function is to transfer sound from the ear to the brain. As already mentioned, according to the law, to be bearable sound should not exceed 60 dB, while noise in cities often reaches 80 or 90 dB and when listening to loud music is well over 100 dB. If exposure to noise is prolonged, for hours in the case of young people, at the end of the day overstimulation can cause irreversible damage. Finally, air travel can also cause hearing loss. This is known as catarrhal deafness and is caused by the pressure changes in the aircraft. To prevent it, it is useful to apply a decongestant nasal spray twenty minutes before the flight to clear the nose and ears in case of a cold. If this condition is neglected for more than three months, catarrhal deafness can lead to hearing loss.

To prevent damage from sound overstimulation, it would be useful to be at complete rest from sound for about one hour during the day, so as to allow the neurons of the ear to recover from the trauma. Just like for an athlete who takes a little rest to recover after an effort. Failure to do so will result in the loss of some frequencies: i.e., in the failure to hear the doorbell and then certain mobile phone rings, a sign of chronic hearing loss. This could preclude young people from embarking on some careers (or hobbies), such as that of pilot, interpreter, sound technician, speaker, soldier and the whole world of music and entertainment, including acting, as well as create psychological distress because an individual that doesn't hear well is often made fun of. The ideal thing would be to listen to music on headphone placed on the auricle, instead of using earphones, and to stop listening from time to time; to limit phone calls to a maximum of 10 minutes, to use earphones only during conversations instead of keeping them in the ears all the time because the telephone ring almost always exceeds 90 dB and causes a trauma. When not using earphones, the mobile phone should be kept at a distance from the auricle to avoid overheating of the ear, as thermal damage can also cause hearing problems. A sedentary lifestyle leads to high cholesterol, which obstructs like a plug the microcirculation of the ear. It is important to breath well from the nose, keeping the Eustachian tube (the canal that connects the ear with the nose) clear using inhalations of water and kitchen salt. Once again, always take a rest from sound. The natural decline of the human ear begins at age 30 with a slow but progressive loss of the very fine hairs of the so-called hair cells that transfer sound from the cochlea to the brain through the auditory nerve. Everyone at age 30, including those who can hear well, should undergo a medical examination and an initial audiometric test and then periodically compare the results to verify the evolution over time. But this doesn't usually happen: people undergo prevention examinations for their eyes, but underestimate the health of their ears. The diet in itself does not help protect from hearing loss, but certain foods have a protective effect, such as fruits and vegetables, that can also be eaten as centrifuged juices, legumes, milk and fish that contain mainly group B vitamins, as well as drinking a glass an a half of red wine at meals, which regulates the microcirculation of the ear, unless there are contraindications. On the contrary, red meat, sausages, strong drinks and smoke should be avoided. Obesity is also a risk factor for hearing loss, along with sedentariness, high blood pressure, certain cardiovascular diseases, high cholesterol

and poor breathing from the nose. In these conditions, the natural decline of the ear becomes pathological and the initial symptoms appear. Prolonged use of specific drugs, such as some antibiotics and diuretics, may also have side effects on the delicate functioning of the ears and result in hearing loss. It is healthy to avoid very noisy places, not to neglect the initial warning signs, to undergo periodic checks, especially categories at risk, to attend session of regenerative therapy and against the accumulation of free radicals (e.g., laser therapy, magneto therapy) and to use individual protection devices (hearing protection devices).

To properly diagnose hearing loss requires a thorough specialist examination of the ear and nose to be carried out at a center with modern equipments, with specific tests that last a few minutes and are painless. In particular, the audiometric test that determines the so-called minimum audibility threshold. Then, the impedance test used to determine the elasticity of the tympanic membrane. There are also other tests used to assess the integrity of the auditory nerve. Hearing loss does not always affect both ears at the same time. It is possible to hear less from one ear, but be able to listen thanks to the compensation created by the brain. However, this prevents from having stereophonic hearing, which is essential for determining the direction of sound. This is why it's not enough to hear from one ear only, but it's important to "repair" and to stimulate the damaged ear with appropriate treatments. Nothing is more harmful for the ear than a late diagnosis and this depends on the patient who would rather suffer and neglect himself/herself than obtain an early diagnosis to avoid permanent damage. Requesting and completing the free special self-administered questionnaire from Sidero Onlus at www.sidero.it a may provide an initial evaluation of the auditory status and determine whether an examination is needed or is urgent, (similarly to the Sidero-Businco 90 questionnaire, avalaible on the same website, for respiratory diseases evaluation) [2].

New solutions: innovative drugs, minimally invasive soft surgery, digital technologies

The therapy is aimed first of all to the resolution of any inflammatory processes using drugs. *Very innovative drugs* can slow down hearing loss or even allow recovery of some frequencies. These drugs micro-regulate inner ear circulation and fight free radicals and oxidative stress, or provide multi-vitamins and oligoelementi, or strengthen the nerve. Then there are other drugs that can be combined with *magneto therapy* or *laser therapy*, indicated for regeneration of the cochlea cells that are stressed or damaged by overexposure to sound [3]. There is also modern *ear protection devices,* i.e. medical individual protection devices specially designed for the auditory system and custom made for the individual subject. This allows keeping communication skills active, while eliminating background sound. They are a sort of technological plugs in the ears capable of reducing ear damage caused by noise, such as for instance city noises. They are designed by the otolaryngologist for specific professional categories and are equipped with special filters capable of screening only the sound that causes annoyance. For instance, a bus driver who uses an ear protection device no longer hears the constant screaking of brakes or suspensions, but can clearly hear the passengers' voices, or people who work in night-clubs with very loud music are able to talk to customers. Where a satisfactory functional recovery was not obtained with medical therapy, there is the possibility of resorting to minimally invasive soft surgery with new devices (balloon, tube balloon, third-generation radiofrequency) [4]. The current opportunities offered by minimally invasive endoscopic surgery allow to improve ventilation of the nasopharyngeal-tube system in its entirety and, therefore, contribute to the recovery of the mucosal inflammation component through a uniquely functional approach, which aims precisely at the preservation and, as much as possible, physiological recovery of the normal function of the respiratory and auditory system [5]. This is all done through the natural canals, without using tampons, and the procedure is bloodless and virtually painless. The close link between correct ventilation of the ear and its health – an unquestionable concept – together with the modern minimally invasive technologies, which have given everyone the opportunity of benefiting from procedures with very low impact on the patient and quick functional recovery for adults and children, are driving modern treatment protocols more and more towards synergy between medical therapy, soft surgery and prosthetic therapy, improving by their integration the efficacy of every single approach when individually applied. [6, 7] Today, also digital technology has completely revolutionized hearing aids. They are not only totally invisible, but are sophisticated, very small and can be regulated on various frequency ranges, in addition to having a state subsidy. They contain powerful microchips, like those used for computers, and a technology that analyzes external noise 100 times per second. They are able to capture background noise and to compensate for it so that the individual can hear normally, with the same wealth of nuances as a person without hearing problems.

Anatomo-physiopathology of the auditory and vestibular systems

The human ear performs two closely related peculiar activities: the auditory function and the vestibular function. The former is carried out through the transformation of mechanical vibration energy into neural signals, which are decoded by the brain for auditory communication of sounds and words, a process that involves the participation of the outer ear, middle ear and of the anterior or cochlear part of the inner ear. The latter contributes, together with other systems (visual and proprioceptive), to maintaining balance by evaluating the position of the head in space in relation to the stimulations excercised by gravity and by angular or linear accelerations. This activity is carried out exclusively by the posterior part of the inner ear, the vestibule (labyrinth). From the anatomo-functional viewpoint, the auditory system is comprised of three parts: the *transmission* system, the *transduction* system and the *perception* system.

The transmission system of mechanical vibration energy amplifies and transmits sound waves to the transduction system, which analyses vibration energy and converts it into neural signals. The perception system, instead, decodes neural impulses into auditory sensation capable of distinguishing pure tones from complex tones, thus allowing to identify and interpret human language.

The transmission system is composed of the outer ear, the middle ear, the labyrinth fluids and the membrane structures of the inner ear. The main function of this system is to collect vibrations and trasmit them to the neurosensory cells with the least possible loss of sound pressure.

The process begins in the outer ear thanks to the pinna function, a cartilage structure with surface protuberances capable of collecting sound waves in the tympanic cavity and to funnel them in the ear canal in a narrower area where the sound pressure begins to increase. The ear canal, in accordance with its anatomy and size, acts as an elective resonator and, overlapping the action performed

by the pinna, determines a further increase of sound pressure in the eardrum, which is located at the far end of the ear canal itself [6].

At this point, the eardrum is caused to vibrate by the sound wave that has reached the middle ear which, in turn, vibrates the ossicular chain, from the malleus to the footplate of the stapes. Once the sound vibrations reach the footplate of the stapes, they are transmitted inside the cochlea to the perilymph of the scala vestibuli which, in turn, transmits them to the membrane structures and the perilymph of the underlying scala tympani.

Therefore, in this complex auditory system takes place the transmission of the sound wave in a very articulate manner from a gaseous medium (air) to a solid medium (tympanic membrane and ossicular chain) and to a liquid medium (perilymph).

The Eustachian tube, the canal that links the nasopharynx to the middle ear is also an integral part of the middle ear and plays a crucial role in the state of health of the entire transmission system helping prevent inflammatory diseases. Its dysfunction, often overlooked in the evaluation of cochleovestibular disorders, is responsible for the annoying sensations of ear fullness, noise in the ears that reduces hearing and difficulty compensating for pressure changes. The correct functioning of the tube should not be underestimated in all patients suffering from auditory system disorders, because often the distorted perception of hearing aids, as the persisting or recurrent inflammatory or catarrhal disorders of the eardrum or post-nasal regions can be easily and definitively resolved by restoring the physiologic ventilation of nose and Eustachian tube [7].

The transduction system has the task of transforming a mechanical event, such as the vibration of molecules of a physical medium (air, solid and liquid), to a bioelectric signal that can be transmitted and analyzed by the nerve centers to give rise to auditory sensations.

The transduction function is carried out by the organ of Corti that, through activation of the inner hair cells, analyzes the auditory signal defining its frequency and intensity. The signal analyzed by the cochlea is fragmented into its frequency components and decoded thanks to the tonotopy of the cochlea itself. The sound wave transmitted to the basilar membrane takes the form of a wave-like movement which, from the base of the cochlea, is funnelled through the cochlear duct. The physical characteristics of the basilar membrane allow it to vibrate in different areas depending on the frequency of the sound signal; in particular, acute frequencies vibrate only the proxymal part of the basilar membrane (basal cochlear gyrus), while the low-pitched frequencies vibrate mainly the distal part (apical cochlear gyrus). The movements transmitted via the perilymph to the basilar membrame move the hair cells and the tectorial membrane. These movements cause the stereocilia to bend, an event that allows cell depolarization and release of a neurotransmitter, glutammate, which activates the afferent nerve fiber.

The cells responsible for signal transduction are the inner cilia, while the primary role of the outer hair cells is to amplify the vibration of the tectorial membrane and, therefore, they are not activated by low-intensity stimulations for which the movement of the basilar membrane is sufficient to bring the stereocilia into contact with the tectorial membrane. On the contrary, outer hair cells, being always in contact with the tectorial membane, are activated also in the presence of less wide oscillations of the basilar membrane. Their depolarization causes contraction of contractile proteins within them; the resulting shortening of the inner hair cell results in traction on the tectorial membrane, which is brought into contact with the inner hair cell stereocilia, which are then depolarized.

High-intensity stimuli directly activate the inner hair cells. The contractile capacity of the outer hair cells also allows greater selectivity in the frequency analysis of the sound stimulus. After this process, the sound signal is transmitted to the nerve centers where, at different levels, is reassembled and transformed into an actual auditory sensation [8].

The perception system that transfers nervous energy and transforms it to auditory sensation consists of the nerve fibers of the auditory nerve, the centripetal auditory pathway and its nuclei.

Acoustic information travels from the auditory nerve along the nerve fibers and reaches the cochlear nuclei and the nerve centers on the central auditory pathway: it is here that the transformation of the nerve stimulation into auditory sensation begins.

The cochlear nuclei send auditory input to the auditory cortex where the final auditory stations are located and where the transformation of sound into proper sound perception takes place, thereby enabling identification of different sounds and human language [9].

The vestibular system ensures balance by detecting the position and movement of the head in space. It contributes to spatial orientation and keeping of the postural tone by acting in synergy with two other systems that are responsible for physical balance: somatosensory and visual. The vestibular system monitors information from each of the movements in the six "degrees of freedom" of the three dimensions in space: three translation and three rotation movements. The former are ensured by the utricle and saccule and the latter by the semicircular canals (SC), i.e. sensory organs filled with endolymph that make up the vestibular system [10].

Evolution of symtoms in related pathologies

Transmission system pathologies may fall into the category of outer year, middle year diseases and diseases of part of the inner year. The following is a classificaton of different possible case histories.

Outer ear pathologies can be divided into:

- Malformations (congenital aural atresia, aplasia of the earlobes, coloboma auris, genetic ear malformations);
- Infectious (otite externa, micosis of the external auditory canal-EAC, herpes zoster - or shingles -, impetigo, EAC furuncle);
- Inflammatory (erysipelas, perichondritis);
- Allergic (eczema, dermatitis);
- Neoplastic (osteomata, carcinomas of the auricle or EAC);
- Hyperproductive (exostoses of the EAC, earwax build up, epidermal build up);
- Traumatic (auricular hematoma, auricle or EAC injuries, lacerations or perforations of the tympanic membrane).

Middle ear pathologies can be divided into:

- Inflammatory-dysfunctional: Eustachian tube inflammation, Eustachian tube dysfunction, barotrauma, ossicular malformations;
- Inflammatory-infectious (acute and chronic otitis media,

catarrhal otitis, adhesive otitis, cholesteatoma);

- Osteodystrophic (tympanosclerosis, otosclerosis).

The inner ear pathologies can be classified as:

- Angioneurotic (endolymphatic hydrops, Ménière's disease).

The transmission system diseases exhibit audiological patterns for transmissive and mixed hypoacusias.

Transduction system diseases are all caused by damage to the organ of Corti and can be divided into:

- Traumatic (acute acoustic trauma, chronic acoustic trauma from overexposure to noise, media-related pathologies);

- Degenerative (presbycusis);

- Genetic (autosomic dominant, autosomic recessive, X-linked);

- Toxic (ototoxic hearing loss, from drugs, chemotherapy, radiotherapy);

- Extra-auricular (vascular or metabolic hypoacusia);

- Ischaemic (microembolism, thrombosis);

- Infectious (viral, cochleo-labyrinthitis);

- Idiopatic (sudden hypoacusia).

Transduction system diseases almost always result in sensoryneural hearing loss and the treatment of choice, in addition to drug or hemodynamic therapy, is prosthetic rehabiliation therapy [11].

Transfer system pathologies are a set of diseases that affect the retrocochlear pathways throughout the centripetal path to the central acoustic regions (cranial nerve VIII, brain parenchyma, vascular system) that can be summed up as follows:

- Neoplastic (vestibular Schwannoma, paragangliomas, brain tumours, metastases);

- Infectious (viral, neuronitis, encephalitis);

- Ischemic (gliosis, microembolism, thrombosis);

- Degenerative (degenerative brain diseases, auditory diseases).

The treatment of choice for transfer system diseases also depends on the type and mainly the state of degeneration. After a proper drug therapy, surgery, a hemodynamic approach or prosthetic rehabilation, therapy may be on option. The differential diagnosis of many vestibular diseases can be easily made by studying the nystagmus, a spontaneous or provoked conjugate movement of the eyes that can guide the physician towards an accurate topodiagnosis of the problem.

Vestibular system pathologies can be summed up in some main categories:

- Inflammatory (vestibular neuronitis);

- Infectious (virosis, bacterial);

- Mechanical (BPPV);

- Toxic (drugs, foods);

- Neoplastic (vestibular Schwannoma, brain tumours).

Conclusion

The modern vision of translational medicine and, above all, the holistic and multidisciplinary approach to the patient, with the undeniable advantages derived from a comprehensive view and treatment addressed to the individual as a whole and not to the single disease, has created objective difficulties for physicians who are faced with clinical diagnoses related to super specialty experience with which they do not always have the necessary familiarity.

In recent years, the theme of hearing and balance disorders has considerably evolved from the diagnostic and physiopathological point of view, and it is increasingly common to encounter difficulties in the clinical dialogue among different specialists in the field, with inevitable repercussions on the patient in terms of delays or diagnostic errors. The patients themselves lack the necessary cultural and lexical tools to provide useful information for the physician to formulate an accurate and early diagnosis - particularly needed today - of the hearing and vestibular pathologies. For these reasons, we have developed the Longo-Businco 50 questionnaire to provide guidance to patients and doctors who approach all the hearing and balance disorders, without neglecting any of the aspects that contribute to an accurate diagnosis, by properly evaluating each symptom and focusing in particular to all those psychosomatic and psychological phenomena that are often associated with hearing and vestibular system disorders.

The Longo-Businco 50 questionnaire for the evaluation of hearing and balance as a practical aid for early diagnosis and prevention especially in young people

The Longo-Businco questionnaire consists in 50 items/questions with answers, each with 4 levels of increasing severity ("never" = 0 point, "sometimes" = 1 point, "often" = 2 points, "always" = 3 points) that investigate in an unordered manner, so as not to influence the patient, all signs and symptoms of the two systems dysfunction.

The choice of the language and contents of the questions attempts to actualize some specialized concepts of the cochleo-vestibular pathology so that even those who are not usually familiar with these syndromes do not risk forgetting some aspects or disregarding symptoms that are useful to a possibly early diagnosis.

The questionnaire is intended as a screening tool which, besides providing useful indications for differential diagnosis, allows a repeatable evaluation of the same patient in order to assess changes in the case history (for instance, after treatment) and to objectively monitor the evolution of the pathology.

We have also identified 3 levels of increasing severity of the patient case history based on the scores collected from answers to single questions, the sum of which contributes to determine a staging of 1 to 3 (stage I: from 0 to 50 points, stage II: from 51 to 100 points and stage III: from 101 to 150 points).

In our experience from more than one thousand examined patients, the Longo-Businco questionnaire proved to be easy to understand and to use, quick to complete and self-administered (questions require no explanations from the physician) and allowed to obtain the specialized medical history in a considerably shorter time without disregarding any symptoms. The first experience from the use of the questionnaire by doctors who are not otolaryngologists or audiologist gave very positive results in terms of facilitation of

the dialogue among the various professional caregivers in the field (hearing aid technician, geriatrician, GP, neurologist, physiotherapist, osteopath), speeding up and optimizing communication among colleagues. We have on-going studies to analyze the correlation between the questionnaire findings and the case histories to carry out a detailed evaluation of sensitivity and specificity.

We hope that the Longo-Businco 50 questionnaire will have a wide dissemination (it's available for free at www.sidero.it) so as to increase useful information on prevention and epidemiological analyses that can be shared online among specialists, and above all in order to detect cochleo-vestibular function disorders as early as possible to avoid progression of such a disabling disease that is also burdened by social costs.

References

1. Liberman MC, Kujawa SG. Cochlear synaptopathy in acquired sensorineural hearing loss: Manifestations and mechanisms. Hear Res. 2017; 349: 138-147.
2. Di Rienzo Businco L, Di Mario A, Tombolini M. Questionario Sidero Businco-90 per la valutazione del Benessere Respiratorio. Boll SMORRL. 2015; 36: 10-13.
3. Lefèbvre P, Malgrange MB, Moonen MG. Regeneration of hair cells and auditory neurons in the ear. Bull Mem Acad R Med Belg. 2008; 163: 391-396.
4. Di Rienzo Businco L. Trattamento dilatativi con balloon nelle rinosinusiti e nelle stenosi tubariche: una diversa opportunità terapeutica per il paziente, in: Ricostruzione e ricostituzione anatomica, funzionale ed estetica in ORL. Pacini Editore. 2014.
5. Di Rienzo Businco L, Laurino S, Cipriani O, Bucci P, Lauriello M. Balloon dilation tuboplasty and tubaric ostium shrinkage in the treatment of Eustachian tube obstruction. Int Adv Otol. 2012; 8; 354-359.
6. Di Rienzo Businco L, Di Mario A, Tombolini M, Mattei A, Lauriello M. Eustachian tuboplasty and shrinkage of ostial mucosa with new devices: including a proposal of a classification system. HNO. 2017; 65: 840-847.
7. Di Rienzo Businco L, Di Mario A, Longo P, Tombolini M. Respiratory syndrome: a new nosological entity with a high social impact. Minerva Med. 2017; 108: 383-384.
8. Stöver T, Diensthuber M. Molecular biology of hearing. GMS Curr Top Otorhinolaryngol Head Neck Surg. 2011; 10: 06.
9. Alper CM, Luntz M, Poe DS. Panel 2: Anatomy (Eustachian Tube, Middle Ear, and Mastoid-Anatomy, Physiology, Pathophysiology, and Pathogenesis). Otolaryngol Head Neck Surg. 2017; 156: S22-S40.
10. Della-Morte D, Rundek T. Dizziness and vertigo. Front Neurol Neurosci. 2012; 30: 22-25.
11. Ahmed H, Shubina-Oleinik O, Holt JR. Emerging Gene Therapies for Genetic Hearing Loss. J Assoc Res Otolaryngol. 2017; 18: 649-670.