

Lecture 5

Occupational diseases from exposure to physical factors.

(2 hours)

Scientific and methodological substantiation of the topic

Intensive development of electronics and radio technology conditioned the necessity to study the impact of electromagnetic emanation onto those, who work in these spheres of the economy with the purpose of timely elimination of its negative effect.

Implementation of high-pace equipment, which generates vibration and is a noise source, into various spheres of industry, causes vibration disease or cochlear neuritis. And in spite of the developed means and methods to struggle against these factors, vibration disease is one of the most prevalent diseases in the structure of occupational pathology.

Thus, under conditions of modern production, occupational diseases still affect the health condition of working people. This situation needs correct evaluation of sanitary and hygienic conditions of work, intensiveness and duration of the influence of these factors in every case with the purpose of due diagnostics and treatment of patients with occupational diseases.

Literature

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Methodical support

1. Media presentation

Lecture time calculation

№	Questions	Time (min)
1.	Vibration disease 1.1 Vibration disease in the result of local vibration 1.2 Vibration Disease, Caused by the Impact of General Vibration 1.3 Vibration Disease, Caused by Combined Affection of General and Local Vibration	40
2.	Occupational pathology, conditioned by the impact of noise	20
3.	Occupational diseases bound with atmospheric pressure changes 5.1 Altitude sickness 5.2 Decompression sickness	Students' self-studying 30

Vibration disease

Vibration disease is a professional disease, caused by vibration. For the first time, this pathology was described by Loring in 1911 as a syndrome of “dead fingers” among scabblers, and in 1955, it got the name of “vibration disease”.

The main factor, which causes the development of the disease, is vibration. From the physical point of view, vibration is a mechanical oscillation, which is repeated at definite periods.

There is a l o c a l vibration, which impacts mostly onto hands of a worker when working with vibroinstruments, and a g e n e r a l vibration, which impact the whole organism. Local vibration takes place when workers use pneumatic and electric instruments (chisel hammers, riveting hammers and chopping hammers). The impact of the general vibration can be observed in case if a worker works with the vibrating equipment (vibroplatform and automatic concrete distributors), as well as in case of transfer of vibration from working engines, machines and equipment to the floor.

Expression and the time for the development of the disease is determined by the zone of the amount of oscillation energy, which is transferred to the body of a human being or his/her limited part, as well as factors, which assist to the development of vibration disease: forced body position, cooling and noise.

Among occupational diseases, the vibration disease still holds a leading place and is mostly encountered among those, who work in metal processing, machine engineering, metallurgic, construction, aircraft manufacturing, mineral resource industry, agriculture, transportation and many other spheres of national

economy.

Vibration disease appears mostly among workers of such professions as cutters, drillers, fettlers, face-workers (impact of low frequency local vibration), riveters, polishers, tool dressers (impact of high frequency local vibration), as well as drivers of heavy earth-moving machines (impact of general vibration).

Pathogenesis. In the basis of the vibration disease is a complicated mechanism of nervous and reflector disorders, which cause the development of nucleuses of stagnant agitation and to further stable changes both in receptor, as well as in various sectors of the central nervous system. A significant meaning in pathogenesis of the vibration disease is played by specific and non-specific reactions, which reflect adaptation and compensatory processes of the organism. It is considered that the vibration disease is a specific angiotrophoneurosis, when spasm of fine and bigger vessels can be observed. There are also thoughts that an angiotrophoneurous syndrome at this disease, connected with the affection of laminated bodies (Fater - Paccini).

Recent data proves that in the pathogenesis of vessel changes at the vibration disease takes place in the following:

- disorder of mechanisms of membrane transportation of calcium with the increase of basal concentration of the latter in unstriped muscular cells of blood vessels;
- increase of the speed of both active and passive transportation of potassium;
- replace of properties of pre-membrane spectrin and actinic complex, decrease of urgent skeleton proteins of erythrocytes - spectrin and actin;
- accumulation of primary and secondary products of lipid peroxidation and inactivation of ferments of antioxidant protection.

In the genesis of trophic disorders, which develop at this disease, a significant role is played by changes in microcirculation, rheological properties of blood, disorders in obtaining and utilization of oxygen. There are also disorders in hypothalamic-pituitary-adrenal system, changes in correlation of vasoactive substances of rennin-angiotensin-aldosteronogenic system and hormones of pituitary-thyroidcompex, content of nucleotide, increase of prostaglandins in blood, affection of vitamin and microelement balance, as well as change of immune indicators. Besides that, neurohumoral and nervous- reflector disorders have phase character. They depend on the degree of the expression of vibration pathology. Thus, in initial stages of the disease, there is an increase of the functional activity of sympathyco-adrenal system due to activation of mechanisms of adaptation and overexcitation of peripheral vegetative formations. Further, in case of progressing of pathology, this state changes by the normalization of excretion of catecholamines, and then inhibition of sympathico-adrenal mechanisms correspondingly to the decrease of adaptation possibilities of the organism.

Clinics. Due to the fact that manifestation of vibration disease is manysided and polymorphous, and until now the classification of E.Andreyeva- Galanian and V.Artamonova is still pressing; it considers its various forms, conditioned by the

action of local and general vibration. Prolong study of this pathology enabled to state various variants of its progressing with mainly the manifestation of neuro-vascular disorders or pathology of a locomotor system. E.Drogichyna and N.Metlina isolated seven syndromes of the disease: angiodystonic, angiospastic, syndrome of vegetative polyneuritis, neuritis, vegetomyofascitis, vestibular, and diencephal with neurocircular disorders. Isolation of these syndromes is conditioned by the fact that the impact of additional production factors together with vibration (cooling down, microtraumatism, and physical tension) enabled to isolate some syndrome of the disease in the clinical pattern. At the same time, the progress of the disease has changed lately, what conditioned the necessity of the consideration of this classification, taking into account the action of local vibration of various intensiveness.

The clinic of the vibration disease is complicated, and it is distinguished by its variability and is not always specific. The disease develops gradually, thus for a long time patients might not go to the doctor due to seeming improvement of their state when working. Only an active medical examination can help to make a diagnosis. Depending on the character of the work, physical parameters of the acting vibration, total amount of time of its impact, place and area of collision with the source of vibration, symptoms manifest differently and peculiarly.

The clinical symptoms of any form of the vibration disease consist of the neurovascular disorder, disorders in neuro-muscular system, locomotor system, and metabolism. The main place in the clinics is possessed by angiodystonic syndrome with phenomena of angiospasm of peripheral vessels. At the same time depending on the form if their manifestation is a localization of vascular and nervous - muscular disorders can be conditioned by the character of the action of vibration, in the range of which there are high and low frequencies. Thus, complaints of patients in the result of the action of low frequency vibration and significant "recoil" of a vibrating instrument can be numerous in the first stage already. These patients develop a vibration disease with mostly the affection of muscles, bone changes, angiodystonic manifestation, vascular hypotonia, atony of lesser vessels, pattern of polyneuritis, mostly vegetative, and a rather marked pain syndrome.

The vibration disease in the result of vibration, in the range of which high frequencies prevail, differs by the peculiarity of vascular disorders, and more marked cardiovascular syndrome.

Vibration disease in the result of local vibration

In compliance with the existing classification of this form of the vibration disease, it has three forms of severity:

I - *initial manifestations*: 1) peripheral angiodystonic syndrome of upper extremities, including rare angiospasm of fingers; 2) syndrome of sensor (vegetative-sensor) polyneuropathy of upper extremities.

II - *moderately marked manifestation*: 1) peripheral angiodystonic syndrome of upper extremities often with angiospasmic fingers; 2) syndrome of

vegetative-sensor of polyneuropathy of upper extremities: a) often with angiospasm of fingers; b) with stable vegetative-trophic disorders of hands; c) with dystrophic disorders of a locomotor system for upper extremities and their belt (myofibrosis, periathrosis and arthrosis); d) with cervicobrachial plexopathy; and e) with cerebral angiodystonic syndrome.

III - *marked manifestations*: 1) syndrome of sensorimotor polyneuropathy of upper extremities; 2) syndrome of encephalopolyneuropathy; and 3) syndrome of polyneuropathy with generalized acroangiospasm.

Initial manifestations of the disease progress in the form of peripheral angiodystonic syndrome or the syndrome of sensor polyneuropathy hands. The disease starts slowly with passing paresthesia. Patients complain to have numbness, pricking, feeling of butterflies in the stomach, ache in distal parts of arms, increased sensitivity to cold in fingertips. Pain and paresthesia can be noted only in calm state, after work and at night. Besides, manifestations take place when cooling, and in case of the change of atmosphere pressure, when doing heavy physical work. After prolonged breaks in work, unpleasant sensations in hands disappear.

Patients with vibration disease in this stage the following symptoms can be observed: cyanosis, hypothermia of hands, hyperhidrosis, sometimes, palm dryness, and mottled skin. All these show the disorder of peripheral blood circulation in palms; these symptoms are not stable. Peripheral angiodystonic syndrome can be accompanied by finger whitening at general or local cooling. Acroangiospasm develops either on both palms simultaneously, or at first on the hand, which suffers from the vibration impact. At first they usually appear during cold periods of the year at general cooling down: suddenly there might be sudden whitening of tips of one or several fingers (except the first one) and lasts for several minutes, and then are replaced with cyanosis (stage of angiohypotonia), which can be accompanied by paresthesia. If the process develops, angiospasm can be spread onto other phalanges, and then appear on the other hand. In the initial stage of the disease, Reynaud syndrome takes place rarely (about 1 or 2 times a month).

The perception of vibration and pain sensitivity decreases. At initial manifestations of vibration disease, there can be hyperesthesia of fingers, which is replaced with hypoesthesia. Zone of the decrease of sensitivity gradually spreads onto palms and forearms. Trophic disorders in this stage of the disease are limited by the worn out pattern of fingers and X-disease of palms.

Peripheral angiodystonic syndrome is actually a clinical manifestation of vegetative polyneuropathy of upper extremities. With intensified pain and paresthesia in distal sectors of arms, expanded zones of hypoesthesia beyond palms diagnose the syndrome of vegetative and sensor polyneuropathy of upper extremities.

Moderate marked manifestations of the disease can be characterized by more marked intensiveness of pain and paresthesia in arms and intensification of the frequency of the development of acroangiospasm. Pain and paresthesia in distal sectors of upper extremities become more stable during a day. After work and at night they are intensified; sleep is affected; patients toss in bed and rub hands at

night. During vacations or treatment, this unpleasant sensitivity in hands usually decreases, however it does not pass completely.

The growth of expression of peripheral vegetative and vascular, sensor and trophic disorders takes place. In the morning, patients have swelling fingers, slow moving of fingers, which together with pain and paresthesia usually disappear or decrease soon after the work is commenced. Cold angiospasm of fingers develops after washing hands with cold water, or sometimes spontaneously. Fits of angiospasm can involve all the fingers; its duration grows up to 30 to 40 minutes. It is over with angiohypotonia with pain reaction and prolong ones (1 to 2 hours) with cyanosis of fingers. Here, the spasm of capillaries changes with their atony. Peripheral vegetative and vascular disorders at this stage do not develop independently, but are a part of the syndrome of vegetative and sensor polyneuropathy of upper extremities. Further increase of the threshold of vibration sensitivity, decrease of superficial sensitivity not only in distal, but also in proximal sectors of extremities can be observed. Sometimes, the zone of hypoesthesia expands to the chest and head.

In case of presence of stable swelling of fingers and palms, slow moving and moderately marked bending contracture of fingers, deformation of interphalanges, limbs, X-disease of palms, changes of form and feeding of nails, a diagnosis can be made as to the syndrome of stable vegetative and trophic disorders. Here, nail plates can be in the form of watch crystalline lens, often they are thickened or thinned and dim.

Dystrophic disorders in tissue of a locomotor upper extremities and their belt, and also can be manifested in the form of myalgia and myositis of extensors of palms and fingers, suprascapular muscle, periarthrosis and deforming of arthrosis of elbow, shoulder and interphalanges limbs.

From the side of the central nervous system, there is a neurosis-like syndrome, with mild vegetative dysfunction. In the measure of the development of the disease, patients have intensified irritability, fatigability, headache, sleep disorder, cardialgia, dizziness, lability of pulse and arterial blood pressure.

Thus, if to sum up, it is characteristic for Stage II of the vibration disease to have deepening of clinical manifestations of the syndrome of a vegetative and sensor polyneuropathy of upper limbs with more diffused decrease of superficial sensitivity, more marked peripheral angiodystonic syndrome, stable vegetative and trophic disorder of bones, frequent angiospasm of fingers, as well as the development of myofibrodystrophic syndrome.

Nowadays, *marked manifestations* can be met very seldom. Such patients have a syndrome of sensomotor polyneuropathy of upper extremities with the intensification of pain and paresthesia, manifestation of weakness in hands, as well as decrease of force in them. Here, there is hypotrophy of bone muscles, forearms, and the decrease of tendinous reflexes.

Some patients might have generalization of angiospasm and manifestation of the latter on toes as well. In such cases, a syndrome of vegetative and sensor polyneuropathy with generalized acroangiospasm can be diagnosed.

It is also necessary to make a stress, which is in the basis of clinical pattern of these forms of the vibration disease, which can be encountered today, initial manifestations of the disease and symptoms are put in the basis of the local vibration, which can be considered as a transitional one from initial to moderately marked manifestations. Besides that, there are symptoms of visceral pathology, e.g. change of the level of arterial pressure with overbalancing of hypertension, functional disorder of the activity of alimentary gland, dyskenesia of a stomach, intestines, gall tracts, disorder of vitamin balance, as well as carbohydrate, protein, and mineral exchange. It is considered that these changes have reflector character and are conditioned by the disorder of endocrine and vegetative regulation.

Vibration Disease, Caused by the Impact of General Vibration

Classification. There are three stages of the severity of a pathological process:

I - initial manifestations: 1) angiodystonic syndrome (cerebral or peripheral); 2) vegetative-vestibular syndrome; and 3) syndrome of sensor (vegetative-sensor) polyneuropathy of lower extremities.

II - moderately marked manifestations: 1) cerebral-peripheral angiodystonic syndrome; 2) syndrome of sensor (vegetative-sensor) polyneuropathy together a) with polyradicular disorder (syndrome of polyradiculoneuropathy); b) with secondary lumbosacral plexus syndrome (due to osteochondrosis of the lumbar sector of the spinal cord); and c) with functional disorders of the nervous system (syndrome of neurasthenia).

III - marked manifestations: 1) syndrome of sensorimotor polyneuropathy; and 2) the syndrome of dyscylindar encephalopathy together with peripheral neuropathy (syndrome of encephalopolyneuropathy).

Clinics. Patients in *the initial stage* of the disease complain to have headache, irritability, fatigability, and sleep disorder. Here, we can observe the lability of pulse and arterial pressure, though predominant signs are hypertension, hyperhidrosis, and affection of dermatographic reaction. All these prove the development of cerebral angiodystonic syndrome. Together with this syndrome, there are manifestations of peripheral angiodystonic syndrome, for which it is characteristic to have unstable and moderately expressed paresthesia and pain in lower limbs, sometimes cramps of sural muscles. During the examination, it is possible to observe cyanosis or mottled skin, hypothermia of feet, hyperhidrosis of soles, reduction of perception of vibration and pain sensitivity on toes. If there is intensification of pain and paresthesia in feet, expression of peripheral vegetative and vascular disorders, decrease of superficial sensitivity on the polyneurotic type, mostly in distal sections of lower extremities prove the presence of the syndrome of vegetative and sensor polyneuropathy of lower extremities.

In case of the development of the disease of Stage II, there are *moderately marked* symptoms of the syndrome of vegetative and sensor polyneuropathy of lower extremities. In some cases, similar symptoms may take place in hands as well. Together with vegetative and sensor polyneuropathy, secondary lumbosacral

syndrome develops in the result of osteochondrosis of the lumbar part of the spinal cord.

Marked manifestation (Stage III) of the disease can be observed very rarely. For this stage of the disease, it is characteristic to have sensomotor polyneuropathy (pain and weakness in lower limbs when walking, reduction of force and hypotrophy of specific muscles of shins and feet, pain in nerve trunks when palpating).

Vibration Disease, Caused by Combined Affection of General and Local Vibration

Classification. There are stages of three stages of the disease:

- I - *initial*;
- II - *functional*;
- III - *marked manifestation*.

Clinics. The disease starts gradually. Patients complain to have headache, dizziness, increased irritability, general sickness, and fast fatigability, ache in lower extremities, as well as their numbness and paresthesia. There can be fits of whitening of toes. The disease at this stage (initial) is manifested through neurasthenic syndrome with phenomena of vegetative dysfunction. The disease has compensated character, and after the termination of contact with vibration, the ability of the sick to work is renovated.

Further, headache becomes constant, agitation increases, and desire to whine appears. Periodically, there are “vegetative crises”: nausea, short-term lapse of memory, dizziness, and increased general hyperhidrosis. Skin coverlets become pale, eyes become brighter, pupils widen, muscles are tensed, and the body temperature increases. Fits end up with profuse hidrosis with further development of prostration. This stage (*functional*) can be characterized by the development of general angiodystonic phenomena with “vegetative crises”, lability of cardiovascular system, and vegetative-sensor polyneuropathy of extremities. There is a marked asthenic syndrome.

At later stages of the disease, there are following signs: worsening of memory, sleep disorder, formation of diencephal syndrome (weight loss, anorexia, acute asthenia, microorganic symptoms of the affection of stem portion of brain and hypothalamic sector), there are changes in the cardiovascular system (bradycardia, and arterial hypotension). This stage (marked manifestation) has a number of peculiarities: headaches become more permanent. Crises with short-term loss of consciousness become more frequent, vegetative and sensitive polyneuropathy of extremities develops, as well as encephalopathy and diencephal syndrome.

Differential diagnostics. Differential diagnostics of the vibration disease is conducted to determine such diseases as Reino syndrome, syringomyelia, vegetative polyneuritis and myositis.

Reino disease mostly develops at women; its development does not depend on the occupation. Clinically, it can be characterized by marked angiodystonic

syndrome of peripheral vessels, presence of disorders of vibration, pain, temperature and tactile sensitivity, as well as changes in the internal organs, and locomotor system.

Syringomyelia starts gradually. It is characteristic for it to have segmental disorder of sensitivity, atrophy, pareses, and paralyses; also finger whitening can sometimes take place. Together with disorders of pain temperature sensitivity according to the segmental type, there is tactile and muscle sensitivity.

Vegetative polyneuritis can be characterized by disorders of sensitivity on polyneuritic type; disorders on polyneurotic type; it is not characteristic for it to have affection of vibration sensitivity and fits of angiospasm. In addition, affection of trophism, temperature and tactile sensitivity decrease can take place.

Myalgia and myositis have definite connection with the occupation. They can be characterized by pain when palpating muscles, absence of peripheral vessels, specific disorders of sensitivity at plexitis (disorder of pain sensitivity at the absence of disorders of vibration, temperature and tactile sensitivity takes place).

Treatment. Etiological principles of treatment of patients with vibration disease involve the principles of elimination (temporary for the period of treatment or full-time in case of absence of therapeutic effect) from the work under conditions of the impact of vibration and other unfavorable factors of production environment.

Among generally strengthening and treatment/preventive measures, it is necessary to consider aero-, gelio and hydrotherapy with the utilization of natural factors of the external environment: air baths, dosed sun irradiation, and swimming in open pools in summer.

As to special treatment - preventive measures, it is necessary to recommend vitamin therapy (ascorbic acid, B₆, PP and B₁₂), irradiation with UV rays, preparations, which increase non-specific reactivity of organism.

To conduct pathogenic therapy, it is recommended to use anticholinergic drugs, ganglionic blockers and acupuncture. Among anticholinergic drugs, good results are shown by spasmolytin and benactyzine; and ganglionic blockers - pachykarpin, benxohexamethonium and hexamethon. More positive result is given by combining ganglioblockers and anticholinergic drugs with preparations, which are capable to expand vessels (nicotine acid and papaverine). Nowadays, new data as to positive effect of the recommended calcium channel blocking agents, first of all, the group of nifedipine (corinfar and cordafen, 10 mg three times a day for three weeks), and particularly, corinfar and unithiol (5 ml of 5 % solution, 10 injections), show fast improvement of the condition of patients, which is accompanied by weakening of pain, acroparaesthesia in hands, disappearing of angiospastic attacks, earlier appearing of the feeling of warmth in hands, and sleep improvement. Together with this, structural and functional state of membranes of erythrocytes, indications of peripheral and central hemodynamics, and rheological properties of blood get normal.

Among physical methods of treatment, it is recommended to have iontophoresis of 5 % solution of Novocain onto hands; diathermy on cervical

ganglions; UV irradiation of cervical ganglions; and utilization of two or four chamber galvanic baths.

It is recommended to conduct a spinal blockade 0.25 % solution of diphacyl together with Novocain, UV irradiation on the level of segments C₃-C₄ and D₅ and D₆, starting with 2 or 3 biodoses, increasing it to 3 or 4; course is 7 to 8 sessions. It is also recommended to undergo hydrogen sulfide, nitric-thermal, rhodon baths and mud cure (37 - 38 °C) as well as rational meals.

Verification of the ability to work. At the disease of Stage I for patients, they are temporarily (for one month) employed at work beyond the action of vibration (with the provision of a leave on occupational inability to work in case of the decrease of earnings). When qualification of a worker at change of employment is decreased much, then a percentage of the loss of the ability to work for the period of re-qualification is set by the decision of a treatment - expert commission (one year).

Similarly, issues can be solved in case of vibration disease of I to II stages. Only to achieve a stable effect of such diseases, patients are transferred to work beyond the action of vibration for the period of two months.

Treatment of patients with Stage II of the disease should be done in hospital with further transfer to work, which is not connected with the impact of vibration or cooling down to fix results of treatment for 1 or 2 months. In case of acute decrease of qualification at the change of work, they can be assigned to undergo expert examination to determine the degree of the loss of the ability to work for the period of re-qualification (1 - 2 years).

As a rule, patients with vibration disease of Stage III have limited ability to work. They obtain a percentage of the loss due to occupational inability to work or an invalidism group (III) due to the occupational disease.

Patients with vibration disease of the 1st degree do not lose their ability to work due to general vibration. They undergo treatment, and then to stabilize its results, they are transferred for a month or two to work that is not connected with the impact of vibration, intensive noise, and receive a leave as to their inability to work.

At well-marked pathological changes of the 2nd degree, it is necessary to undergo rational employment with the definition of the degree of the loss of the ability to work (for one year).

For patients with vibration disease of Stage III, it is characteristic to have the decrease of occupational and general ability to work. They can obtain 2nd or 3rd group of invalidism in the result of the occupational disease.

Preventive measures. Technical measures - decrease of vibration in the source of their formation, utilization of carious shock-absorption means, provision of normal microclimatic conditions in premises, where work on vibration instruments and equipment is carried out; hygienic formation of the level of vibration; as well as organization of the regime of labor at minimal contact with those, who work with vibrating instruments.

It is recommended to conduct hydraulic procedures - bathes for hands with

the temperature of water 37 °C together with self-massaging; UV irradiation sub erythematous dosages of mostly cervical areas; gymnastics and regular medical check-ups.

OCCUPATIONAL PATHOLOGY, CONDITIONED BY THE IMPACT OF NOISE

Noise is a chaotic combination of sounds, i.e. mechanical vibrations in the zone of frequency from 20 Hz to 16 kHz, which are perceived by a hearing analyzer.

Under conditions of the production of the noise impact, there are engine testers, riveters, cutters, copper-smiths, weaver and spinners. Noise is an unfavorable factor of production environment impacts mechanization experts in agriculture, as well as repair shop workers.

A hearing apparatus of a human being can perceive a sound with the frequency from 16 to 20 000 vibrations a second. As to the spectral composition, it is possible to distinguish high frequency noise with the predomination of levels on the frequencies higher than 800 Hz, and low frequency - with most levels on frequencies lower than 300 Hz and mean frequency, which cover an intermediate diapason of frequency (300 to 800 Hz). The character and degree of expression of the action of noise onto the hearing organ is determined by its intensiveness, key, periodicity, as well as joining of noise with other occupational factors, in particular with vibration.

Pathogenesis. Until 1960's, it was considered that noise causes affection on only a hearing analyzer. It was stated that in the basis of occupational partial deafness, there are destructive changes of both hair cells of cochlea, and also in spiral ganglion and in hairs of a cochlear nerves. And only for the last twenty years, a possibility was proved of a non-specific action of noise onto an organism was proved, which manifested itself in the affection of the functional state onto the organism, which manifested itself in assumption in disorder of the functional state of the nervous and cardio-vascular systems.

At first, hair cells of the lower cochlea of helix, which perceive sounds of high tones. If further impact takes place, support cells of Deiterse and internal hair cells are involved. A number of nervous fibers of external hair cells decreases. Cells of spiral ganglion look pressed together and their number is decreased. At the occupational partial deafness, sound-perceiving apparatus is affected (a spiral organ and a plexus of fibers of a helix of vestibulocochlear nerve around hair cells), i.e. occupational worsening of hearing belongs to perceptive partial hearing.

It is necessary to remember that in the development of pathology of the vestibulocochlear nerve, a significant role is played by the affection of nervous and cardio-vascular system, conditioned by disorders of blood circulation and tissue trophism. Under the impact of intensive and prolong noise, agitation of the hearing center is transferred to the mesh substance and reticular formation.

High frequency noise is transferred subjectively worse and it has more dangerous impact onto the organism. Impulse noise is considered harmful than

constant one.

Clinics. With the development of occupational partial deafness, there are four stages of loss of hearing (Table 9). Occupational partial deafness develops according to the type of cochlear neuritis and can be characterized by gradual development. At first, there is noise in ears, which becomes more intensive and stable gradually. At research with a tuning fork or with audiometry already at early stages, there is a decrease of perception of high frequencies (4000 - 6000 Hz) and the reduction of bone conduction. Gradually, worsening of hearing, there are also other tones, and the level of perception of whispering reduces as well. Bad hearing of whisper attracts attention as well, though hearing of speech is still good. The latter is affected only in case of presence of a very large work period under conditions of the impact of noises (20 years and more). Otoscopic pattern goes without changes.

Table 1

Criteria of Evaluation of Hearing Function for People, Who Work under Conditions of Impact of Noise and Vibration (According to V.Ostapkovich and N.Ponomarev)

Disease Degree	Indications	Tonal Threshold Audiometry		Distance, whisper is perceived at
		loss of hearing at audio frequency 0.5; 1 and 2 kHz, dB	Loss of hearing at 4 kHz and limits for possible oscillation, dB	
I	Signs of noise impact onto a hearing organ	up to 10	50 ± 20	5 ± 1
	Cochlear neuritis			
II	with mild degree of hearing worsening	11 - 20	60 ± 20	4 ± 1
III	with mean degree of hearing worsening	21 - 30	65 ± 20	2 ± 1
IV	with severe degree of hearing worsening	31 - 45	70 ± 20	1 ± 0.5

Thus, for patients with occupational partial deafness of the *1st degree*, whisper can be perceived at the distance of 5 m and at audiometric research, at the audio frequency of 4 kHz, it is possible to register the decrease of hearing up to 50 dB.

For the *2nd degree* (cochlear neuritis with a mild degree of hearing worsening) - whisper can be perceived at the distance of 4 m and at audiometric research, at the audio frequency of 4 kHz, it is possible to register the decrease of hearing up to 60 dB.

For the *3rd degree* (cochlear neuritis with a mean degree of hearing worsening) - whisper can be perceived at the distance of 2 m and at audiometric research, at the audio frequency of 4 kHz, it is possible to register the decrease of hearing up to 65 dB.

For the *4th degree* (cochlear neuritis with a severe degree of hearing worsening) - whisper can be perceived at the distance of 1 m and at audiometric

research, at the audio frequency of 4 kHz, it is possible to register the decrease of hearing up to 70 dB and more.

Thus, at the initial stage of the disease, perception of whisper (diapason of frequencies within limits of up to 2.5 kHz) does not almost change, and workers do not notice the decrease of their hearing. However, special checking with the help of audiometer at frequencies of 4 to 6 kHz demonstrates the decrease of hearing well. At this, both air and bone perception is affected on the same level; the process has symmetrical character, affecting both right and left ear. Along with progressing of the disease under the impact of noise, perception in the area of audio frequencies of 2, 1 and 0.5 kHz decreases; it usually develops gradually and slowly, and it increases with the period of work on the position, what curves of hearing threshold are shown (Fig. 1 - 4).

Complaints to have complaints on general sickness, increased irritability, bad sleep, headache, dizziness, and sound of noise or ringing in ears take place. Some patients complain to have pain in hear, often of complaining character with the irradiation under the left shoulder-blade. In future, there are complaints to have the decrease of hearing of both ears. At objective examination, there are vegetative disorders on the general neurotic background, which takes place in the form of instability in the position of Romberg, trembling of stretched our arms, red stable dermographism, as well changing of a reflector sphere.

At noise pathology, there are disorders in metabolic process. Change in protein exchange is manifested through the increase of general protein and globuline.

Clinical observations show the change of heart activity among those, who are subject to noise impact. Thus, on electric cardiograms, there is lability of pulse and slowing down of intra-ventricle and intra-atrial heart conductivity.

The majority of researchers consider that under the impact of a prolong and systematic noise, arterial blood pressure is increased, thus noise can be a factor of risk in the development of hypertonic disease.

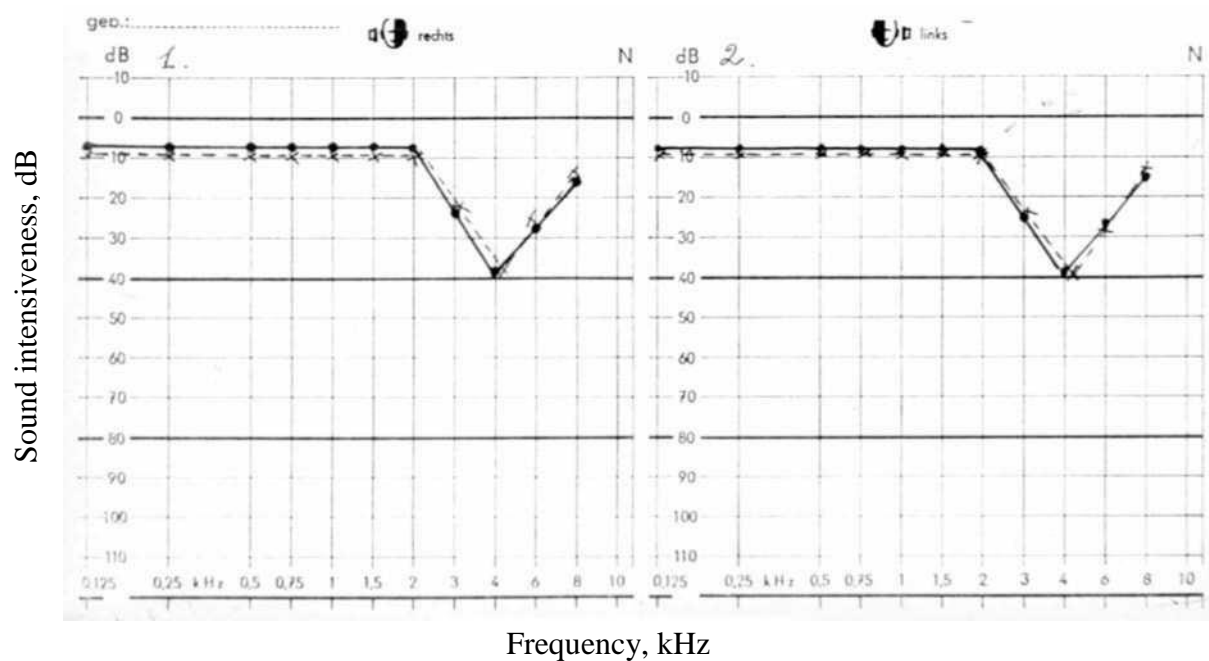


Fig. 1. Audiogram at initial sings of the impact of noise onto hearing organs

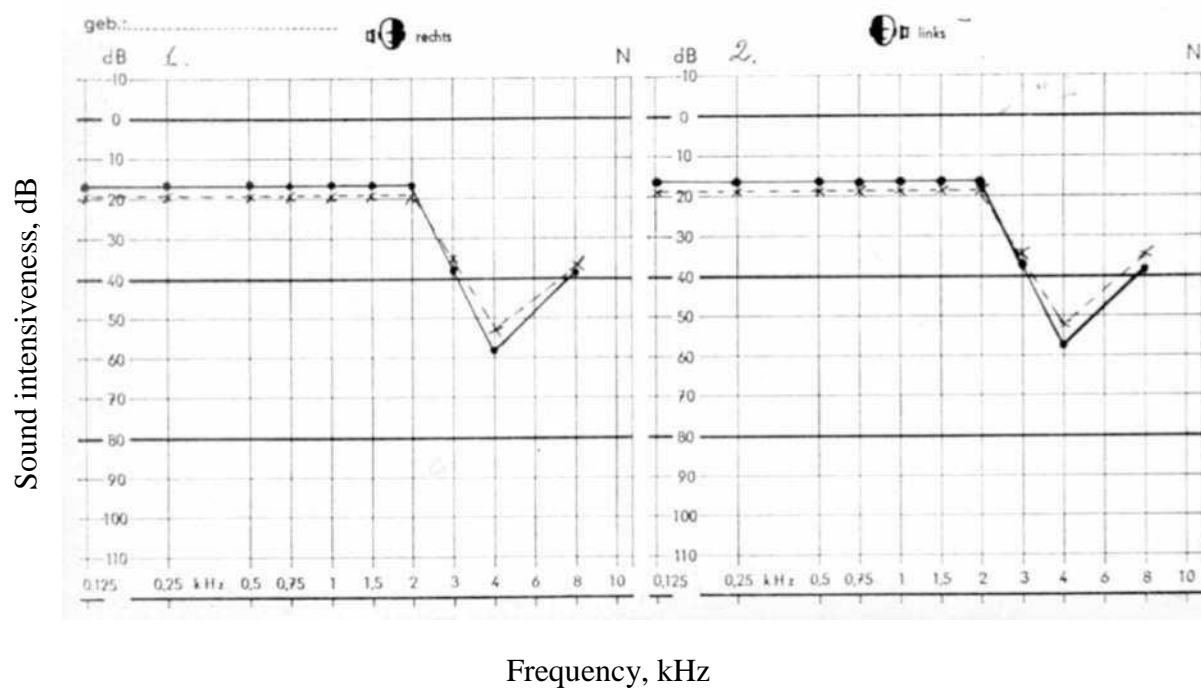


Fig. 2. Audiogram at cochlear neuritis with a mild degree of hearing worsening

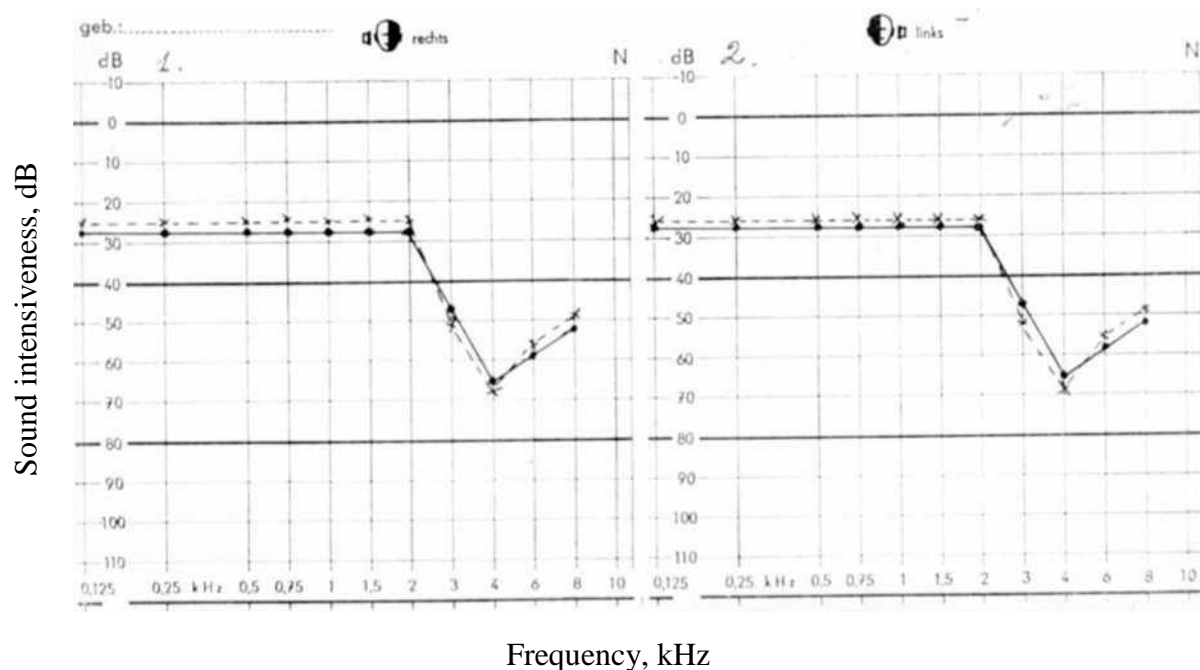


Fig. 3. Audiogram at cochlear neuritis with a mean degree of hearing worsening

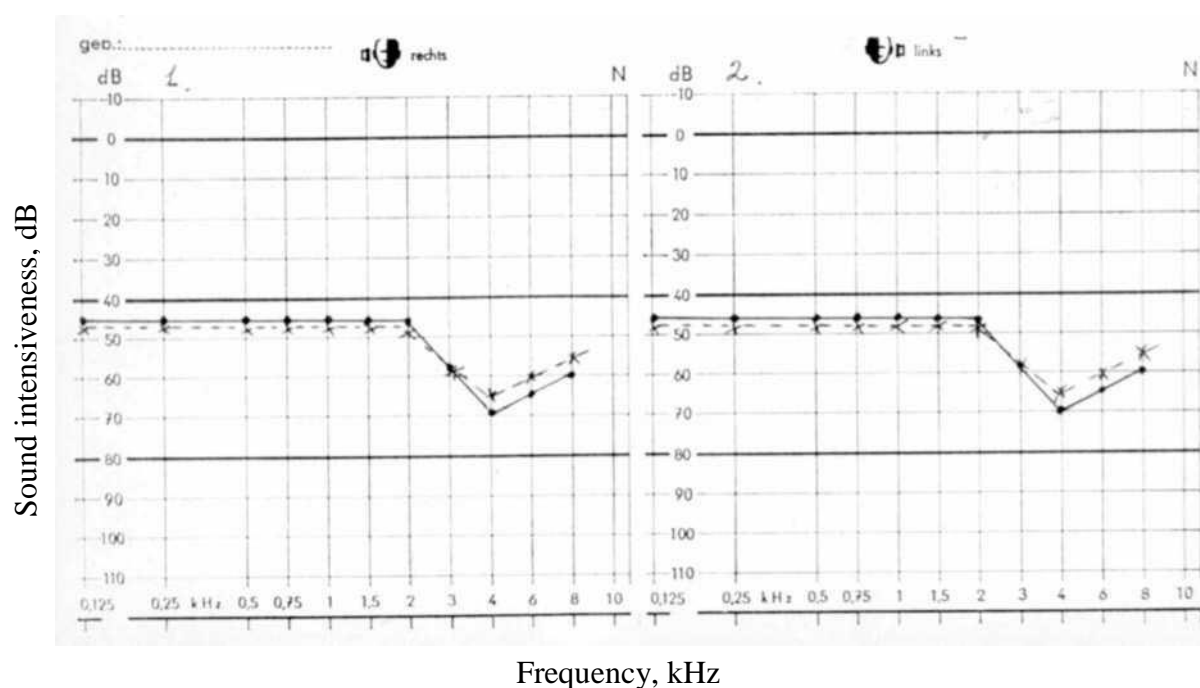


Fig. 4. Audiogram at cochlear neuritis with a severe degree of hearing worsening

Diagnostics. The diagnose of cochlear neuritis is made based on occupational guidelines, sanitary and hygienic characteristics of labor conditions, study of complaints of a patient, anamnesis of the disease and life, instrumental examination of hearing and vestibular analyzers.

For occupational partial deafness, it is characteristic to have the following: gradual development of the process; presence of correlation between disorders of the function of the central nervous system and a number of other organs and systems with changes of hearing sensitivity; presence of similar cases of the disease among workers of the professional group; absence of indications in the anamnesis as to the beginning of this disease during the period, which was prior the contact with occupational hazardous factors; and loss of hearing takes place in the result of affection of air and bone conductivity; whereas deafness is stable and permanent even when the source of noise is eliminated.

Treatment. Considering the peculiarity of the clinical manifestation of syndromes, conditioned by the action of noise, it is necessary to approach selection of therapeutic means in a differentiated way. First, it concerns generally strengthening therapy, organization of regular meals, sleep regime, obligatory staying in the fresh air for 1 to 2 hours, every day.

Among medical grudges, it is recommended to use bromide, elenium, trioxazine, benactyzine, as well as glutamine acid and rutin, depending on the expression of an accompanying syndrome and cochlear neuritis.

With the purpose of generally strengthening action, it is recommended to use ascorbic acid in dosage of 300 to 500 mg, as well as a complex of vitamins of group B.

At the presence of angiodystonic syndrome, it is recommended to use spasmolytic means and ganglionic blockers (bromides, aminazine, mepropane together with bensohexamethonium and penthamine).

In case of development of neurocirculatory dystonia of hypertonic type at the patient, it is recommended to prescribe bromide, valerian, and diazepam in combination with spasmolytics. As neurotropic drugs, it is recommended to prescribe reserpine and rhaunatin, which initiates processes of the connection of noradrenaline and dopamine in depositing granules of ends of post-angliar simpatico fibers, and do not let to deposit noradrenaline, which circulates in blood, also has tranquilizing and neuroleptic action.

Among physical methods of treatment, galvanization on the method of Scherbak, darsonvalism, and UVF onto carotid sinus zone are used. To conduct balneotherapy, it is recommended to take salt-coniferous, carbonic acid gas, and hydrogen sulfide baths.

To treat neuritis of hearing nerves, it is necessary to use diabasol, nicotine acid, sulfate atropine and tropacine.

Among physiotherapeutical methods, good results are shown by diathermy onto the zone of mammiform process, and mud application onto the ear area.

Verification of the ability to work. At the neuritis with mild decrease of hearing, the work ability of a patient is saved as a rule. It is necessary to conduct dynamic doctor observation, and conduct of outpatient treatment with utilization of sanatorium-preventoriums.

At cochlear neuritis with a mean degree of the decrease of hearing of a qualified worker with long occupational period of work, it is also possible for them to keep their work under thorough observation and conduct of outpatient treatment.

In a number of cases, if general disorders prevail, in compliance with occupational medical leave, it is expedient to transfer a patient to another occupation, which is not connected with the impact of sound. However, young people with a short period of work, as well as unqualified workers and people who are subject to impulse noise, especially in case of fast progressing of the process, it is necessary to recommend rational employment beyond noise.

At cochlear neuritis with a sever degree of hearing worsening, it is recommended to have rational employment, which is not connected with the impact of noise. In all these cases, if rational employment is impossible without the demotion of qualification, patients are to be sent to the expert commission to determine a group of invalidism of an occupational character.

Preventive measures. Introduction of various earplugs and cotton wool; anti-noise bushes of the type of “Earplug”; as well as utilization of earphones and helmets. Preliminary and periodical medical examinations are recommended.

