

3-3-2020

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Recommended Citation

Khasanov, Ulugbek S.; Abdullaev, Ulugbek P.; and Akhmedov, Sulton E. (2020) "COMPLEX TREATMENT OF ACUTE SENSORINEURAL HEARING LOSS USING HYPERBARIC OXYGENATION," *Central Asian Journal of Medicine*: Vol. 2020 : Iss. 1 , Article 12.

Available at: <https://uzjournals.edu.uz/tma/vol2020/iss1/12>

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COMPLEX TREATMENT OF ACUTE SENSORINEURAL HEARING LOSS USING HYPERBARIC OXYGENATION

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ABSTRACT

Introduction. Acute sensorineural hearing loss (ASHL) is one of the common diseases, and the number of patients suffering from this pathology is steadily growing. Therefore, the study and implementation of modern therapeutic measures to eliminate ASHL is considered a relevant issue in otorhinolaryngology. **The aim of the study** is to analyze the comparative effectiveness of hyperbaric oxygen therapy in the treatment of acute sensorineural hearing loss. **Material and methods.** The research involved 46 patients with a diagnosis of ASHL I - IV degrees in the period from February, 2018 to November, 2019. All patients were under observation in the ENT department of the multidisciplinary clinic at the TMA. In addition to the prescribed medicinal treatment, the patients underwent HBO treatment consisting of 10-12 sessions course, performed in the pressure chamber "Yenisei" -3 and BLKS-301M. **Results and discussions.** All clinical examinations were performed in the period before the treatment, after 10 days and 3 months after the treatment. Patients underwent an audiological examination (tonal threshold, speech audiometry), impedancemetry, blood pressure monitoring, as well as a study of the lipid profile and blood rheological parameters. The obtained results were summarized and the average indicators were identified. The following criteria for evaluating the effectiveness of the treatment have been established: decrease in a sound perception threshold; decrease in ear noise; speech intelligibility. **Conclusion.** The treatment results in the 1st and 2nd groups showed that HBO is most effective in the complex treatment of sensorineural hearing loss.

The greatest effectiveness in the treatment of patients with auditory function and reduction of ear noise using the HBO method was observed in patients aged 20 to 41 years with an average hearing loss of 21-40 dB ($p < 0.05$). It can be assumed that HBO, as the treatment method of sensorineural hearing loss, has a greater effect in combination with basic medicine therapy. The best results were obtained in acute forms of the disease, substantiated pathogenetically.

Keywords: acute sensorineural hearing loss, hyperbaric oxygenation, medicine treatment, Cavinton, steroid therapy, audiometry.

Introduction.

To date, acute sensorineural hearing loss (ASHL) is one of the common diseases, which is considered to be an urgent problem of otorhinolaryngology. Every year the number of patients suffering from this pathology is steadily growing. Probably, this is due to better diagnosis (widespread adoption of audiometric equipment in outpatient practice). On the other hand, a real increase in the number of acute hearing impairments of the sensorineural type cannot be excluded. In recent years the problem of ASHLs is given a great social importance and makes 6% of the world's population [1,3,5]. Clinical studies of recent years show that, despite the successes and achievements of practical medicine, there is still no tendency to a decrease in the incidence of ASHLs and the number of such patients increases by 1.5-2% annually [2,6,7].

It should be noted that ASHL was defined as a separate nosological form from all other forms of sensorineural hearing loss relatively recently [3,8] and German and English researchers have been accepting it since 1960 [4,9,10]. In Uzbekistan, this problem was paid attention only in the 90s of the last century, and the ENT clinic of the Tashkent Medical Academy (TMA) was the founder in this field.

In 1997, the World Health Organization approved a unified classification of hearing loss degrees, presented in the Table 1.

Table 1

The international classification of hearing loss degrees

Hearing loss degree	The average value of audibility thresholds in the air at frequencies of 500, 1000, 2000 and 4000 Hz (dB)
I	26-40
II	41-55
III	56-70
IV	71-90
Deafness	≥ 91

Clinically congenital\acquired SHL and deafness are defined. Acquired SHL is divided into:

- *sudden (hearing loss develops in the period to 12 hours);*
- *acute (hearing loss develops within 1-3 days and lasts up to 1 month);*
- *subacute (hearing loss lasts for 1-3 months.)*
- *chronic (hearing loss lasts for more than 3 months and can be stable, progressive and fluctuating).*

Depending on the side of the lesion, SHL is divided into:

- *unilateral;*
- *bilateral (symmetric and asymmetric).*

Among all variety of etiological factors, a significant pathogenetic role is played by hemodynamic dysfunctions in the vertebro-basilar basin already registered on early stage. The emerging angioneurotic changes lead to disruption in the delivery of oxygen, enzymes, hormones and other substances necessary for the metabolism of the neuroepithelium [11,12,13]. The lack of oxygen in the labyrinth fluids due to the vascular factor is an essential component of pathogenesis. Active metabolism generally occurs in the vascular strip, spiral organ and spiral ganglion. A metabolic disorder leads first to a loss of function, and then to the death of hair cells. From the above stated it follows that one of the main aims in the treatment of sensorineural hearing loss is reduction of tissue hypoxia. For this purpose, medications are prescribed for stabilization of cell membranes and improvement of hemorheology and venous outflow from the cranial cavity (Cavinton, Trental, Tanakan, Ginkor forte, Mexidol, Curantyl, etc.), as well as various physical methods of treatment, which include a hyperbaric oxygen therapy (HOT) [14,15,16,17]. HOT is an oxygen treatment method under a high pressure in a medical pressure chamber. Due to the increase in oxygen pressure in the inhaled air, not only red blood cells are saturated with oxygen, but also blood plasma and interstitial fluid, which, in turn, eliminates the effects of oxygen starvation in damaged organs and tissues. The inclusion of the hyperbaric oxygenation in the complex of ASHL treatment in the first month from the disease onset can contribute to almost completely restore hearing [18,19,20,21]. Hyperbaric oxygenation sessions are contraindicated in:

- presence of epilepsy or other convulsive seizures in disease history;
- claustrophobia
- hyperthermia
- arterial hypertension (increase in blood pressure over 160/100 mm RT. Art.);
- hypotension (lowering blood pressure by more than 40 mm RT. Art.);
- pulmonary diseases (pneumonia, pneumothorax, abscesses or air cysts);
- acute respiratory diseases, sinusitis;
- violation of the patency of the Eustachian tubes and canals connecting the paranasal sinuses with the external environment;

- prematurity and immaturity of newborns;
- hypersensitivity to oxygen.

Material and methods. Between February 2018 and November 2019, 46 patients with a diagnosis of acute sensorineural hearing loss of I - IV degree were examined in the ENT department of the multidisciplinary clinic at the TMA. Among them, there were 19 men and 27 women aged 19 to 55 years. 37 patients of 46 were diagnosed with unilateral acute sensorineural hearing loss. In 9 patients, the lesion was bilateral. The duration of the disease ranged from 5 days to 2 months.

All patients underwent an audiological examination (tonal threshold, speech audiometry), impedancemetry, blood pressure monitoring, as well as a study of the lipid profile and blood rheological parameters.

By the alleged reason of ASHL, patients were divided into groups:

- 18 patients with ASHL as a result of vertebro-basilar insufficiency (hypertensive crisis, cerebral arteriosclerosis, osteochondrosis of the cervical spine, hypervascular or hypotonic vegetative-vascular dystonia).

- 20 patients with ASHL as a result of an infectious diseases: acute inflammation of the nose and SHL, influenza, epidemic parotitis, acute respiratory viral infection, cytomegalovirus, herpes virus and others.

- 8 patients with ASHL as a result of external physical factors. An increased sound volume or a sharp drop in barometric pressure was observed in the history of these patients, which suggests the possibility of middle ear membranes rupture.

On the basis of the medical history, data of the clinical results of the study, and the treatment program approved by us, the following groups of patients were identified:

Group 1: 23 patients diagnosed with ASHL who received only basic medicine treatment.

Group 2: 23 patients diagnosed with ASHL who received basic medicine treatment in combination with HBO;

Basic medicine therapy, with a course of 10 days, was carried out according to the following scheme: systemic steroid therapy; antihypertensive medications; pentoxifylline 2% - 5.0 i/v drips on physical solution 200.0 - 10 days, Piracetamum 20% 5 ml iv once a day; Cavinton 0.5% 2 ml iv drip, diluting in 200 ml of saline; Nicotinic acid 1% 1 ml iv once a day; Vitamin B1 2.5% 1 ml im every other day, alternating with vitamin B6; Vitamin B6 5% 1 ml im every other day, alternating with vitamin B1.

HBO treatment consisting of 10-12 sessions course was carried out in the pressure chamber "Yenisei" -3 and BLKS-301M.

Results and discussions. At the end of the treatment course, patients under observation underwent a second examination. All clinical examinations were performed in the period before the treatment, after 10 days and 3 months after the treatment. The obtained results were summarized and the average indicators were identified. The following criteria for evaluating the effectiveness of the treatment have been established:

1. Decrease in a sound perception threshold;
2. Decrease in ear noise;
3. Speech intelligibility.

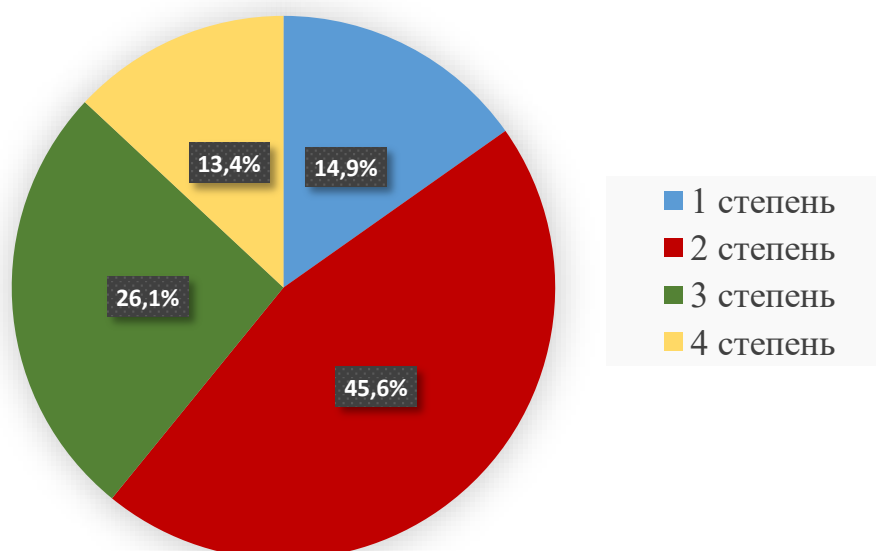


Figure 1. The initial distribution of patients according to the degree of hearing impairment

According to data of tonal threshold audiometry, 6 (13.4%) patients showed hearing loss of up to 80-90 dB (which corresponds to the 4th degree of sensorineural hearing loss), and in 12 patients (26.1%), up to 60-70 dB (the 3rd degree), in 21 patients (45.6%) - up to 41-50 dB, in 7 patients (14.9%) - up to 25-30 dB (1st degree).

All patients were divided into 2 equal groups by the method of a randomized blind study. Thus, the 1st group consisted of 23 patients, the 2nd group also consisted of 23 patients.

Table 2

Averages of hearing thresholds (dB)

Terms of the treatment	1 st group	2 nd group
Before the treatment	66,5	64,1
After 10 days	60,4	32,7
In 3 months	57,3	29,2

In the 1st group after the basic medicine treatment, the following results were obtained: no complete hearing restoration was observed in any patient, hearing improvement up to 10-20 dB was revealed in 16 patients (72.2%) and up to 0-5 dB in 4 (16.7%) patients. In 3 (11.1%) patients who had no positive dynamics of the treatment more than 50 years. As can be seen from the table, the average values of hearing thresholds in the 1st group before the treatment were 66.5 dB. After 3 months, the average hearing thresholds composed 57.3 dB. Accordingly, within 3 months of therapy, the average values of hearing thresholds in this group decreased by 9.2 dB. The greatest effect was observed on the 10th

day after therapy – reduction of threshold average values by 6.1 dB. By the 3rd month - for 3.1 dB. As a result of the improvement in the sound perception threshold, ear noise reduction in 10 (44.4%) patients and speech intelligibility increase in 14 patients (61.1%) were noted.

In the process of research, repeated hypertensive crises were observed in 7 patients and oncopathology was determined in 2 patients.

In patients of the 2nd group (23 patients) receiving complex treatment (HBO in combination with basic medicine therapy), the results were as follows: in 15 (65.2%) patients, hearing improved up to 30-40 dB, in 3 of them (13%), hearing improvement was 15-20 dB, in 1 patient (4.34%) for 5-10 dB. 4 patients had sudden changes in barometric pressure, no improvement in hearing was observed due to rupture of the auditory ossicles chain, confirmed by CT scan and tympanometry data. The average values of hearing thresholds in the 2nd group before the treatment were 64.1 dB. 3 months after the treatment start, the average values of hearing thresholds in this group were 29.2 dB. This group, as well as the 1st group, had the greatest effect 10 days after of therapy start – reduction in the average values of hearing thresholds by 31.4 dB. After 10 days, 18 (78.6%) patients confirmed a decrease in ear noise. And 20 (89.1%) patients had an increase in speech intelligibility.

Conclusion. Comparison of the treatment results in the 1st and 2nd groups showed that HBO is most effective in the complex treatment of sensorineural hearing loss. The age of the patients and therapy starting terms have a great influence on the effectiveness of the treatment.

The greatest effectiveness in the treatment of patients with auditory function and reduction of ear noise using the HBO method was observed in patients aged 20 to 41 years with an average hearing loss of 21-40 dB ($p < 0.05$).

It can be assumed that HBO, as the treatment method of sensorineural hearing loss, has a greater effect in combination with basic medicine therapy. The best results were obtained in acute forms of the disease, substantiated pathogenetically.

Thus, hyperbaric oxygenation improves tissue nutrition, has beneficial effects on the cells of the auditory zone of the cerebral cortex, normalizes the patency of the auditory tube, immune system state, and also participates in the transmission of intracellular signals. Therefore, the use of HBO in combination with basic therapy is fully proved and pathogenetically substantiated, that is confirmed with the present research.

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