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MODERN APPROACHES TO THE TREATMENT OF CHRONIC SENSORINEURAL HEARING LOSS: THE ROLE OF "AUDIOTONE" AND "TONSILLOR" DEVICES

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Abstract. Background and Objective: Chronic sensorineural hearing loss (CSNHL) remains one of the most significant unresolved challenges in modern otolaryngology. This study evaluates the efficacy and safety of combined physiotherapy devices "Audiotone" and "Tonsillor" in the treatment of CSNHL of vascular etiology.

Methods: A prospective clinical trial was conducted involving 62 patients (age 40-53 years) with CSNHL of vascular origin. Patients underwent comprehensive treatment using "Audiotone" and "Tonsillor" devices combined with conventional pharmacotherapy. Pure-tone audiometry was performed before treatment, immediately after treatment, and at 1-month follow-up.

Results: Subjective improvement in hearing and reduction of tinnitus occurred by days 5-6 of treatment. Statistically significant hearing improvement was demonstrated at frequencies 3, 4, 6, and 8 kHz (improvement of 14-17 dB) in patients with CSNHL grades I and II. Process stabilization was achieved in grade III CSNHL patients. Tinnitus intensity reduction was reported in 85.5% (53/62) of patients. Complete audiological recovery was not achieved in any group, but combined treatment demonstrated superior outcomes compared to pharmacotherapy alone.

The combined use of "Audiotone" and "Tonsillor" devices represents a safe, non-invasive, and effective adjunctive therapy for CSNHL of vascular etiology. This approach acts through multiple pathophysiological mechanisms: improvement of microcirculation, enhanced drug delivery, anti-inflammatory effects, and restoration of auditory function. Treatment outcomes were most favorable in early-stage disease with shorter symptom duration.

Keywords: chronic sensorineural hearing loss, Audiotone, Tonsillor, Cavinton, low-frequency ultrasound, magnetic therapy, laser therapy

СОЗЫЛМАЛЫ СЕНСОНЕВРАЛДЫ ЕСТУ ҚАБІЛЕТІНІҢ ЖОҒАЛУЫН ЕМДЕУДІҢ ЗАМАНАУИ ТӘСІЛДЕРІ: «АУДИОТОН» ЖӘНЕ «ТОНЗИЛЛОР» ҚҰРЫЛҒЫЛАРЫНЫҢ РӨЛІ

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Аңдатпа. Созылмалы сенсонеуралды есту қабілетінің жоғалуы (ССНЕҚЖ) қазіргі оториноларингологиядағы өзекті медициналық және әлеуметтік мәселелердің бірі болып табылады. Аурудың патогенезінің күрделілігі мен емдеу нәтижелерінің шектеулілігі тиімді терапиялық тәсілдерді іздестіруді талап етеді. Осыған байланысты физиотерапиялық технологияларды кешенді емдеу құрамында қолданудың клиникалық тиімділігін бағалау ерекше қызығушылық тудырады. Зерттеудің мақсаты – тамырлы этиологиялы созылмалы сенсонеуралды есту қабілетінің жоғалуын емдеуде «Аудиотон» және «Тонзиллор» физиотерапиялық құрылғыларын кешенді қолданудың тиімділігі мен қауіпсіздігін бағалау.

Зерттеуге жасы 40–53 жас аралығындағы тамырлы генезді созылмалы сенсонеуралды есту қабілетінің жоғалуы бар 62 пациент енгізілді. Перспективалық клиникалық зерттеу аясында барлық науқастарға стандартты фармакотерапиямен қатар «Аудиотон» және «Тонзиллор» құрылғыларын қолдану арқылы кешенді ем жүргізілді. Есту функциясының динамикасы таза тондық аудиометрия әдісімен ем басталғанға дейін, емдеу аяқталғаннан кейін және 1 айлық бақылау кезеңінде бағаланды.

Нәтижелер. Емдеудің 5–6-күнінен бастап пациенттердің басым бөлігінде естудің субъективті жақсаруы және құлақтағы шудың қарқындылығының төмендеуі байқалды. I және II дәрежелі созылмалы сенсонеуралды есту қабілетінің жоғалуы бар науқастарда 3, 4, 6 және 8 кГц жиіліктерде есту табалдырығының статистикалық тұрғыдан маңызды төмендеуі анықталды, жақсару көрсеткіші орта есеппен 14–17 дБ құрады ($p < 0,05$). III дәрежелі ССНЕҚЖ бар пациенттерде аурудың үдемеуіне және клиникалық жағдайдың тұрақтануына қол жеткізілді. Құлақтағы шудың қарқындылығы 62 пациенттің 53-інде (85,5%) төмендеді. Толық аудиологиялық қалпына келу жағдайлары тіркелмегенімен, кешенді емдеу әдісі дәстүрлі фармакотерапиямен салыстырғанда жоғары клиникалық тиімділікті көрсетті.

Қорытынды. «Аудиотон» және «Тонзиллор» физиотерапиялық құрылғыларын кешенді қолдану тамырлы этиологиялы созылмалы сенсонеуралды есту қабілетінің жоғалуын емдеудің қауіпсіз, инвазивті емес және клиникалық тұрғыдан тиімді қосымша әдісі болып

табылады. Бұл емдеу тәсілі микроциркуляцияны жақсарту, дәрілік заттардың тіндерге жеткізілуін күшейту, қабынуға қарсы әсер ету және есту анализаторының функционалдық жағдайын қалпына келтіру сияқты бірнеше патогенетикалық механизмдер арқылы жүзеге асады. Ең жоғары терапиялық тиімділік аурудың ерте сатыларында және клиникалық симптомдардың ұзақтығы қысқа болған жағдайда байқалды. Алынған нәтижелер созылмалы сенсоневралды есту қабілетінің жоғалуын кешенді емдеу алгоритміне аталған физиотерапиялық әдістерді енгізудің клиникалық орындылығын көрсетеді.

Түйін сөздер: созылмалы сенсоневралды есту қабілетінің жоғалуы, Аудиотон, Тонзиллор, кавинтон, төмен жиілікті ультрадыбыс, магниттік терапия, лазерлік терапия

СОВРЕМЕННЫЕ ПОДХОДЫ К ЛЕЧЕНИЮ ХРОНИЧЕСКОЙ СЕНСОНЕВРАЛЬНОЙ ТУГОУХОСТИ: РОЛЬ АППАРАТОВ «АУДИОТОН» И «ТОНЗИЛЛОР»

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Аннотация. Хроническая сенсоневральная тугоухость (ХСНТ) остается одной из наиболее значимых нерешенных проблем современной отоларингологии. В данном исследовании оценивается эффективность и безопасность комбинированных физиотерапевтических устройств «Аудиотоне» и «Тонзиллор» при лечении ХСНТ сосудистой этиологии.

Методы: Было проведено проспективное клиническое исследование с участием 62 пациентов (возраст 40-53 года) с ХСНТ сосудистого происхождения. Пациенты прошли комплексное лечение с использованием устройств «Аудиотоне» и «Тонзиллор» в сочетании с традиционной фармакотерапией. Аудиометрия порогов слуха проводилась до лечения, сразу после лечения и через 1 месяц после лечения.

Результаты: Субъективное улучшение слуха и уменьшение шума в ушах наблюдались на 5-6 день лечения. Статистически значимое улучшение слуха было продемонстрировано на частотах 3, 4, 6 и 8 кГц (улучшение на 14-17 дБ) у пациентов с ХСНТ I и II степени. Стабилизация процесса была достигнута у пациентов с ХСНТ III степени. Снижение интенсивности шума в ушах было отмечено у 85,5% (53/62) пациентов. Полного

восстановления слуха не было достигнуто ни в одной группе, но комбинированное лечение продемонстрировало лучшие результаты по сравнению с одной только фармакотерапией.

Комбинированное использование устройств «Аудиотон» и «Тонзиллор» представляет собой безопасную, неинвазивную и эффективную вспомогательную терапию при ХСНТ сосудистой этиологии. Этот подход действует посредством множественных патофизиологических механизмов: улучшение микроциркуляции, улучшенная доставка лекарственных средств, противовоспалительное действие и восстановление слуховой функции. Результаты лечения были наиболее благоприятными на ранних стадиях заболевания с более короткой продолжительностью симптомов.

Ключевые слова: Хроническая сенсоневральная тугоухость, «Аудиотон», «Тонзиллор», Кавинтон, низкочастотный ультразвук, магнитотерапия, лазерная терапия

Introduction. Chronic sensorineural hearing loss (CSNHL) represents one of the most prevalent diseases and urgent problems in otolaryngology. According to epidemiological data, 1-6% of the global population suffers from significant hearing impairment, with CSNHL accounting for 74% of all hearing loss cases [1]. This condition constitutes an important medical and social problem, particularly affecting economically active individuals aged 30-50 years. CSNHL is a polyetiological disease characterized by progressive damage to the cochlear receptor apparatus, auditory nerve, and central auditory pathways [2, 3]. The progressive nature of the condition leads to severe communication restrictions, reduced professional activity, and significant psychological alterations [4].

Recent attention has focused on vascular, metabolic, and neurodegenerative mechanisms in CSNHL pathogenesis. Microcirculatory disturbances of the inner ear, leading to hypoxia and damage to neurosensory cells of the organ of Corti, play a crucial role [5, 6]. The internal auditory artery, a terminal branch of the vertebrobasilar system, lacks collateral circulation, making the inner ear particularly vulnerable to ischemic insult even during brief vascular disturbances [7, 8].

Recent advances in understanding the blood-labyrinth barrier have revealed its critical role in inner ear homeostasis. Dysfunction of this barrier leads to microcirculatory changes, oxidative stress, and neurosensory damage [8]. Pericytes-vascular wall cells regulating capillary blood flow and vascular permeability-have emerged as important targets for therapeutic intervention. Pericyte dysfunction can reduce cochlear capillary perfusion, leading to progressive hearing deterioration [9].

Traditional CSNHL therapy employs vascular, nootropic, and metabolic agents; however, treatment efficacy remains limited. This has prompted development of physiotherapeutic methods targeting local blood flow enhancement, inflammation reduction, and improved drug delivery to inner ear tissues. The "Tonsillor" and "Audiotone" devices (NPP Metromed, Omsk, Russia) represent innovative physiotherapy instruments combining low-frequency ultrasound (LFUS), electrical microcurrent stimulation, magnetic therapy, and infrared laser therapy [11, 12]. These devices enable simultaneous modulation of multiple pathophysiological mechanisms [1].

Objective. To assess the efficacy of the physiotherapy complex "Audiotone" and "Tonsillor" in the treatment of chronic sensorineural hearing loss of vascular etiology.

Material and Methods

1 Study Design. A prospective comparative clinical trial was conducted at the Department of Otolaryngology, Course of Otolaryngology, Department of Special Surgical Disciplines at Khoja Akhmet Yassawi International Kazakh-Turkish University, Shymkent, Kazakhstan. The study was performed in accordance with the ethical principles of the Declaration of Helsinki (1964, revised 2000). Informed consent was obtained from all participants.

2 Study Participants. Sixty-two patients (28 men, 34 women) aged 40-53 years (mean age 47 years) with CSNHL of vascular etiology were enrolled. Inclusion criteria: clinically confirmed CSNHL, disease duration exceeding 3 months, stable disease course, and informed written consent. Exclusion criteria: acute inflammatory ENT diseases, neoplastic processes, decompensated somatic conditions, and pregnancy. Based on pure-tone audiometric results, patients were classified as: grade I (n=15, 24.2%), grade II (n=33, 53.2%), or grade III (n=14, 22.6%).

3 Assessment Methods. All patients underwent comprehensive evaluation: otorhinolaryngologic examination, pure-tone threshold audiometry, high-resolution computed tomography/magnetic resonance imaging of temporal bones (when indicated), complete blood count, urinalysis, electrocardiography, chest radiography, and consultations with neurology and internal medicine specialists. Treatment efficacy was evaluated based on: (1) changes in auditory thresholds (dB) at key frequencies; (2) subjective hearing assessment; (3) presence/reduction of tinnitus; (4) audiometric assessment at baseline, post-treatment, and 1-month follow-up.

4 Treatment Protocol. All patients received comprehensive treatment employing "Audiotone" and "Tonsillor" devices over 10 consecutive days. "Audiotone" treatment included: (1) Magnetic therapy to the inner ear: endaural magnetic probe application, 20 minutes daily for 10 days; (2) Electrophoresis: endaural electrode placement with Cavinton-soaked gauze, electrical nerve-receptor stimulation of cochlear apparatus with adjustable frequency and amplitude, 10 minutes daily for 10 days; (3) Infrared laser therapy: infrared laser beam directed at the promontory with penetration into middle and inner ear structures, 15 minutes daily for 10 days.

"Tonsillor" low-frequency ultrasound treatment: 4.0-5.0 mL Cavinton solution introduced into external auditory canal with endaural waveguide applying ultrasonic impregnation (frequency 26.5 kHz, amplitude 10-40 μ m, pulsed mode, 20-30 seconds daily for 10 days).

Following physiotherapy, nasal decongestant (0.05% oxymetazoline) was applied, and Politzerization and pneumomassage of tympanic membranes were performed.

Results

1 Clinical Outcomes. Subjective improvement in hearing, tinnitus reduction, and general symptom improvement were reported by patients on days 5-6 of treatment. Pure-tone audiometric analysis demonstrated statistically significant hearing threshold improvement at frequencies 3, 4, 6, and 8 kHz (14-17 dB improvement) in patients with CSNHL grades I and II. In grade III CSNHL patients, process stabilization was achieved. Tinnitus intensity reduction was reported by 85.5% (53/62) of patients. Most favorable treatment outcomes were observed in early-stage disease with shorter symptom duration.

2 Proposed Mechanisms of Clinical Benefit. The clinical efficacy observed in this series likely results from the combined effects of multiple therapeutic modalities:

Magnetic Therapy: Water molecules in blood and lymph become magnetized, enhancing cellular metabolism, promoting restoration processes, improving blood circulation, and normalizing vascular caliber and tone.

Electrophoresis with Cavinton: Cavinton ionizes and penetrates skin layers of the external auditory canal and middle ear structures (tympanic membrane, ossicular chain, tympanic mucosa) to reach the cochlear nerve-receptor apparatus, achieving high local concentrations with sustained bioavailability. This stabilizes microcirculation and enhances drug tissue penetration.

Infrared Laser Therapy: Produces biochemical changes at subcellular, cellular, tissue, and organism levels. Improves microcirculation, stimulates neovascularization, enhances blood flow, activates transcapillary transport, and reduces interstitial and intracellular edema.

Low-Frequency Ultrasound: Produces micromassage and loosening of external auditory canal skin, facilitating deep Cavinton penetration and enhancing microcirculation. Ultrasound induces cavitation, thermal, and physicochemical effects, increasing Cavinton concentration in cellular and extracellular compartments.

Discussion. This study demonstrates that incorporation of "Audiotone" and "Tonsillor" devices into comprehensive CSNHL treatment promotes auditory function improvement, reduces subjective tinnitus, and enhances quality of life. The most pronounced therapeutic effects were observed in patients with initial and moderately severe disease stages and relatively short symptom duration. Most favorable outcomes occurred in grade I-II CSNHL patients, while grade III patients demonstrated disease stabilization without further deterioration.

The positive effects of "Audiotone" are attributable to improved microcirculation, stimulation of metabolic processes in the inner ear, and neuroprotection of auditory analyzer structures. Low-frequency ultrasound reduces ischemic cochlear changes, improves tissue nutrition, and facilitates functional recovery of inner ear receptor apparatus. The non-invasive nature, excellent tolerability, and potential for repeated treatment courses support consideration of this approach as a pathogenetically justified, promising therapeutic modality.

Study limitations include single-center design and relatively small sample size. Multicenter randomized controlled trials with larger patient populations and extended follow-up periods are warranted to confirm these findings and elucidate long-term recurrence patterns.

Conclusion. The combined use of "Audiotone" and "Tonsillor" physiotherapy devices represents a modern, highly effective, safe, and patient-friendly adjunctive treatment for chronic sensorineural hearing loss of vascular etiology. This multimodal approach acts through complementary mechanisms targeting vascular, inflammatory, and neurotropic disease pathways. Treatment demonstrates excellent tolerability, non-invasive delivery, and capacity for repeated therapeutic courses. In early-stage disease with shorter symptom duration, outcomes are most favorable. This approach offers a valuable alternative or complement to conventional CSNHL management strategies.

Declarations

Ethical Approval. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki (1964, revised 2000). Institutional ethical approval was obtained prior to study initiation. Informed written consent was secured from all participating patients.

Informed Consent. All patients provided written informed consent prior to enrollment in the study.

Conflicts of Interest. The authors declare no conflicts of interest relevant to this manuscript.

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Data Availability. The datasets analyzed in this study are available from the corresponding author upon reasonable request, subject to institutional ethics review board approval and patient confidentiality requirements.

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