Case Report | Клинический случай
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Cochlear implantation in patients with chronic otitis media

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Abstract

Cochlear implantation is a highly technological method of rehabilitation for patients with profound sensorineural hearing loss. In most cases, cochlear implantation follows a standard technique, but there are cases that require meticulous attention in the selection of tactics. Recently, chronic otitis media was considered as a contraindication for cochlear implantation due to the risk of developing a number of complications. Despite these potential problems, cochlear implantation is the only solution to help patients with chronic otitis media and stage IV sensorineural hearing loss. There are various methods for managing the above-mentioned group of patients. Some authors describe performance of cochlear implantation with middle ear surgery in one stage, while other authors, in several stages. The issue of cochlear implantation in patients suffering from chronic suppurative otitis media has always aroused discussions among otosurgeons.

In this article, we analyzed a series of clinical cases (10 patients) with chronic otitis media who underwent middle ear sanation surgery and cochlear implantation. In our opinion, a single-stage cochlear implantation together with a sanation intervention on the middle ear can be considered as a technique that allows to accelerate the auditory-speech rehabilitation of patients with stage IV sensorineural hearing loss and epitympanitis. This is especially important for patients with acquired pathology of the inner ear and the risk of ossification of the cochlea spiral canal.

Keywords: cochlear implantation, epitympanitis, chronic otitis media, radical surgery of the middle ear, profound sensorineural hearing loss.
Conflict of interest: nothing to disclose.

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Кохлеарная имплантация у пациентов с эпитимпанитом

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Аннотация

Кохлеарная имплантация представляет собой высокотехнологичный метод реабилитации лиц, страдающих сенсоневральной тугоухостью высокой степени и глухотой. Чаще всего кохлеарная имплантация проводится по стандартной методике, однако нередко встречаются неординарные случаи, требующие более тщательного подбора тактики ведения пациентов. В прошлом хронический гнойный средний отит считался противопоказанием к кохлеарной имплантации из-за риска развития ряда осложнений. Несмотря на эти потенциальные проблемы, выполнение кохлеарной имплантации является единственным вариантом помощи пациентам с эпитимпанитом и двусторонней хронической сенсоневральной тугоухостью IV степени. Существуют различные методики ведения вышеуказанной группы пациентов. Одни авторы описывают проведение кохлеарной имплантации с санирующими операциями на среднем ухе в один этап, другие – в несколько этапов. Проблема кохлеарной имплантации у пациентов, страдающих хроническим гнойным средним отитом, остается предметом дискуссии среди лор-хирургов.

В статье мы проанализировали серию клинических случаев (10 пациентов) с эпитимпанитом, которым была проведена санирующая операция на среднем ухе и кохлеарная имплантация. На наш взгляд, одноэтапное проведение кохлеарной имплантации совместно с санирующим вмешательством на среднем ухе может рассматриваться как методика, позволяющая ускорить слухоречевую реабилитацию пациентов с двусторонней хронической сенсоневральной тугоухостью IV степени и эпитимпанитом. Это особенно актуально для пациентов с приобретенной патологией внутреннего уха и риском оссификации спирального канала улитки.

Ключевые слова: кохлеарная имплантация, эпитимпанит, хронический средний отит, радикальная операция на среднем ухе, двусторонняя хроническая сенсоневральная тугоухость IV степени.
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Список сокращений
ДХСНТ – двусторонняя хроническая сенсоневральная тугоухость;
КИ – кохлеарная имплантация; КТ – компьютерная томография;
НСП – наружный слуховой проход; СНТ – сенсоневральная тугоухость;
СП – субтотальная петрозэктомия; ХГСО – хронический гнойный средний отит.

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BACKGROUND

Chronic suppurative otitis media (CSOM) is one of the frequent medical conditions in otorhinolaryngology. Its rate of incidence is 4.76 cases (1.7 to 9.4) per 1,000 population (ca. 31 million cases per year), 22.6% of cases occur in children below 5 years old. The prevalence of this pathology among children and adults worldwide is from 0.3% to 15%, and 60% of patients suffer from a significant loss of hearing [1].

Often, epitympanitis results in complications that might cause deafness and that require cochlear implantation (CI). Today, CI is the most efficient and technological method of rehabilitation and social adaptation of people suffering from deafness and profound sensorineural haring loss [2–4]. Lack of a unified tactics of management of patients with epitympanitis makes the problem of CI a subject of ongoing debate among ENT surgeons.

Epitympanitis used to be regarded as a contraindication for CI due to the 'portal of entry' of infection which undoubtedly increases the risk of development of meningitis, relapsing choleteastoma and electrode extrusion to the cavity after the radical surgery in the middle ear due to damage to the fine epidermal lining [2, 5, 6]. Moreover, development of otitis media after the implantation might bring about intracranial complications, extrusion of the device or necessitate removal of the implant. Despite these potential problems, CI remains the only solution in assistance to patients with epitympanitis [7, 8].

Patients with a severe hearing loss due to CSOM are candidates for CI. However, they need close attention from respective specialists [9].

DESCRIPTION OF THE CLINICAL SERIES

The study included ten (10) patients who underwent surgeries at the Saint Petersburg Research Institute of Ear, Throat, Nose and Speech of the Ministry of Health of the Russian Federation from 2019 to 2025. The patients had grade IV bilateral chronic sensorineural loss of hearing and epitympanitis. There were 2 children and 8 adults among the patients. Within the specified period, 7 patients underwent single-stage surgery and 3 patients, two-stage surgery. Two patients had no ear surgeries prior to CI, 5 patients had a history of a radical surgery on the implanted ear. One patient had had antromastoidotomy on the implanted ear, and 3 patients had had tympanoplasty on the implanted ear.

Technique of Cochlear Implantation

Patient with epitympanitis and a history of antromastoidectomy on the implanted ear. CI was performed simultaneously with revision of the mastoid cavity. In the course of the operation, during harvesting of the soft tissue, a choleteastoma was visualized in the antromastoid cavity (**Fig. 1, 2**).

Using a burr, the antromastoid cavity was extended to the mastoid apex. Cholesteatoma matrices lined the plates of the middle and posterior cranial fossae, as well as the sigmoid sinus. They spread to the cells of the sinodural angle and to the area of the anterior semicircular canal. All the pathological mass was removed. The incus and malleus were eroded, their remnants covered with cholesteatoma tissue, which was removed. The tendon of the tensor tympani muscle was represented by a stump, and the chorda tympani was absent. Cholesteatoma tissue covered the tympanic section of the facial nerve, whose bony canal was partially eroded, and extended to the attic. Partial atticitomy and extended posterior tympanotomy were performed to the level of the bulb of the jugular vein. The pathological mass was removed. Cholesteatoma tissue was identified within the Eustachian tube and was also removed. At the transition between the mastoid and tympanic segments of the facial nerve, a herniation of the mastoid segment was observed, which was decompressed using a burr. The overhang over the cochlear window was removed with a burr, revealing a fibrosed membrane of the cochlear window with an area of fibrous obliteration. Diamond burs were used to drill out the fibrous obliteration of the descending cochlear turn, which extended approx. 7 mm. In the region of the basal turn, fibrous obliteration was identified and drilled through. A sponge soaked in dexamethasone was placed adjacent to the mastoid segment of the facial nerve. The implant was positioned and secured in its bed, with its active electrode fully inserted into the cochlea via the mastoid cavity and posterior tympanotomy. The excess electrode was covered along its entire course with autologous cartilage strips and a single fascial graft. The external auditory canal was packed with a MEROCEL hemostatic sponge.

One year after the surgery the patient presented a computed tomography (CT) scan of the temporal bones (**Fig. 3**). The postoperative cavity is clean with no pathological mass. No relapse of the choleteastoma or electrode extrusion were identified.

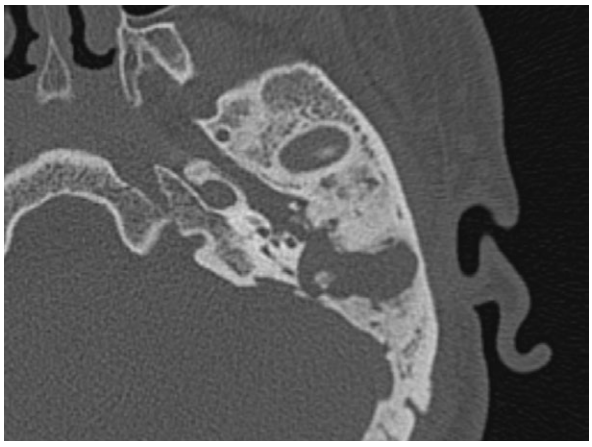

Figure 1. *CT of the left temporal bone of the patient before surgical intervention. The postoperative cavity after antromastoidotomy is totally filled with cholesteatomic masses, the labyrinth fistula is present, the tympanic segment of the facial nerve is exposed.*

Рисунок 1. *КТ левой височной кости пациента до проведения оперативного вмешательства. Послеоперационная полость после антромастоидотомии тотально заполнена холестеатомными массами, наличие фистулы лабиринта, обнажение барабанного сегмента лицевого нерва.*

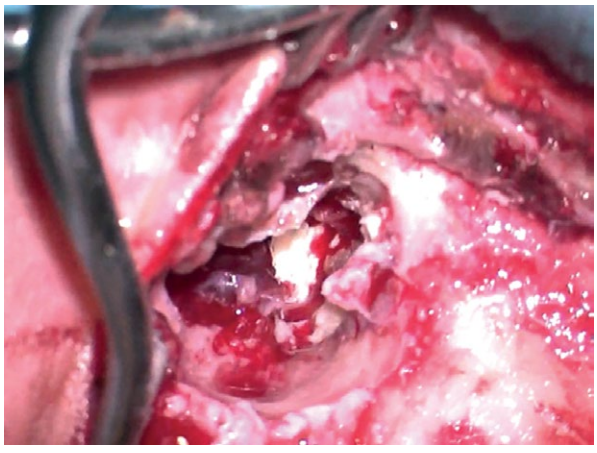

Figure 2. *Intraoperative photo of the patient with the exposed antromastoid cavity on the left, where a fragment of a cholesteatoma is visualized.*

Рисунок 2. *Интраоперационное фото пациента со вскрытой антромастоидальной полостью слева, где визуализируется фрагмент холестеатомы.*

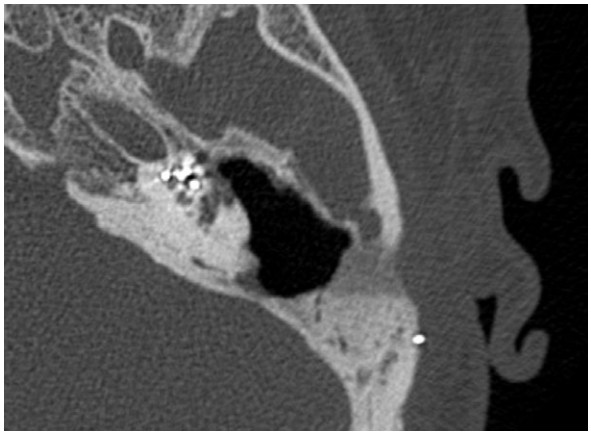

Figure 3. *CT of the left temporal bone of the patient 12 months after the surgery. The postoperative cavity is without pathological contents. There are no signs of recurrence of cholesteatoma and electrode extrusion.*

Рисунок 3. *КТ левой височной кости пациента через 12 месяцев после проведения оперативного вмешательства. Послеоперационная полость без патологического содержимого. Признаки рецидива холестеатомы и экструзии электрода отсутствуют.*

Patient with epitympanitis without history of surgical intervention on the implanted ear. CI was performed in two stages: Stage I, radical surgery with sanation of the infection focus; Stage II, six months after the radical surgery.

During Stage I, cholesteatomic masses were found that engulfed the eroded malleus and incus. The stapedial superstructure was absent, and partial destruction of the posterior wall of the external auditory canal was noted. A radical mastoidectomy was performed with removal of pathological contents from the tympanic cavity, eradication of the chronic infectious focus, and closure of the tympanic membrane defect. A distinctive feature of the procedure was the preservation of a slightly prominent 'spur' in the inferior part of the tympanic cavity to support the electrode over the mastoid segment of the facial nerve during the subsequent stage.

Six months later, during the CI, the burr cavity was opened and expanded, and bored were used to prepare the implant bed, the groove for the positioning of the electrode in the mastoid segment of the burr cavity, and the tunnel in the 'spur'. The implant was positioned and stabilized in the bed, the active electrode being fully inserted in the cochlea via mastoid cavity, groove above the 'spur' and the secondary tympanic membrane opened earlier. The excess electrode was covered along its entire course with autologous cartilage strips and fascial grafts. The packing of the external auditory canal was done with a silicone protector and "Belkozin" hemostatic sponge.

Recurrence of the cholesteatoma was not observed in the patients with a prior radical surgery on the implanted ear. The difficulty of the CI was in the positioning and stabilization of the active electrode in the mastoid and tympanic segments to prevent its extrusion. For that purpose, the electrode was covered with autologous cartilage and fascial grafts. In five patients, an allograft cartilage was used (**Fig. 4**). Throughout the entire follow-up period, extrusion of the electrode was not observed.

Patient with grade IV bilateral chronic sensorineural loss of hearing and history of antromastoidoectomy. CT scans of the temporal areas visualize cholesteatoma completely filling the antromastoid cavity. A decision was made to perform a simultaneous sanation surgery on the middle ear and cochlear implantation. In the course of the operation, cholesteatomic masses were found that extended in the entire antromastoid cavity and penetrated into the attic. Atticotomy was performed with preservation of the posterior wall of the external auditory canal. The cholesteatomic masses were removed. Following the posterior tympanotomy and opening of the secondary membrane of the cochlea, the electrode grid was placed in the *scala timpani*. The preservation of posterior wall of the external auditory canal excluded the necessity of additional

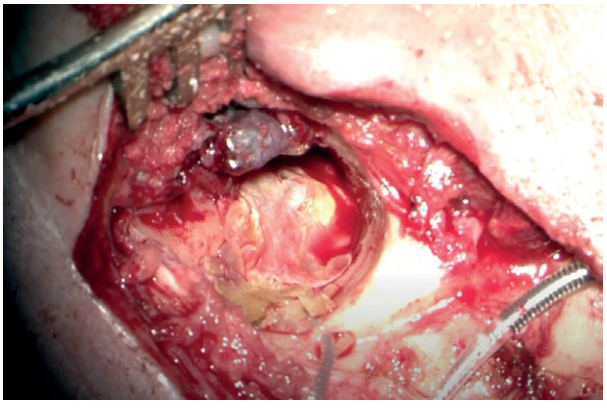

Figure 4. *Intraoperative photo of the electrode being covered with autofasciation and allogeneic cartilage during cochlear implantation after radical surgery of the left ear.*

Рисунок 4. *Интраоперационное фото укрытия электрода аутофасцией и аллогенным хрящом при проведении кохлеарной имплантации после радикальной операции на левом ухе.*

coverage of the electrode and reduced the risk of its extrusion in the postoperative period.

The cholesteatoma was found intraoperatively in three patients: 1) the patient with a history of antromastoidotomy on the implanted ear, 2) the patient with a history of separate atticoantrotomy and 3) the patient with no history of ear surgeries (in case of the latter, the CI was performed in two stages).

The posterior wall of the external auditory canal had to be removed in two patients.

All patients underwent planned postoperative otomicroscopy 1 month and 6 months, during their rehabilitation course. No postoperative complications were observed in any of the patients. The results of hearing and speech rehabilitations were similar to those in patients of the respective age groups who had no epitympanitis.

DISCUSSION

Contemporary literature presents extensive data on methods of treatment and tactics of management of patients with epitympanitis who underwent or are planning to undergo CI. At the same time, the views of specialists on the surgical tactics differ, especially with respect to staging of surgeries.

Thus, J. T. F. Postelmans *et al*. (2009) believe that cochlear implantation is to be performed in stages for patients with signs of active chronic suppurative otitis media. CSOM patients with a cavity after a radical surgery without any pathological changes may benefit from a single stage CI. It is generally accepted that CI would be safe for patients with non-acute epitympanitis. At the same time, their results show that there is still a possibility of serious complications with subsequent replacement of the cochlear implant [10].

In the study of P. Canzi *et al*. (2023) that included data of patients who underwent surgeries from 2005 to 2022, the single-stage surgery was demonstrated to be the optimal tactic. Multiple-stage surgeries are mainly recommended in the event of presence of cholesteatomic masses, but not in an active inflammatory process [11].

As early as in 2009, C.A. Hellingman and E.A. Dunnebier analyzed literature data and came to the conclusion that the patients with cholesteatoma would benefit from separate atticoantrotomy or a radical surgery of the middle ear with subsequent CI in stage II using a non-obliterative technique. IF a cavity remains after a radical surgery, a non-obliterative procedure is recommended after the mastoidectomy (revision mastoidectomy) to prepare the ear for the implantation and to ensure protection of the electrodes, preferably without closure of the external auditory canal, which simplifies control in the follow-up period [12].

The problem of CI in CSOM is analyzed in detail in the retrospective study of A. Vashishth *et al*. (2018) including 35 patients. In 31 cases, the implantation was performed simultaneously with the sanation operation, and in 5 cases, in two stages. The average follow-up period was 7 years. Explantation was required in 4 patients (11%) due to electrode extrusion and infection; in three patients, recurrent implantation was performed. No relapse of choleasteotoma was observed. The authors concluded that CI was possible in this category of patients, and the simultaneous tactics was possible when there was no active inflammation, yet the risk of explantation was higher than in the cases of conventional implantation [13].

Young Hoon Yoon *et al*. (2020) assessed remote outcomes of different tactics of CI in CSOM. The average follow-up period was 3 years (ranging from 0.5 to 9 years). One patient with a staged CI in the cavity after a radical surgery experienced electrode extrusion. The treatment of this complication involved subtotal petrosectomy (SP) and obliteration of the cavity. No significant differences were observed in the outcomes of the hearing and speech rehabilitation between single- and multiple-stage CI [14].

S. Lee *et al*. (2020) conducted a retrospective study of 31 patients with simultaneous CI and subtotal petrosectomy. Significant improvement of results of hearing and speech rehabilitation was seen in all patients, as compared to preoperative observations. Complications developed in three patients (9.6%). One patient had a defect of closure of the external auditory canal, and two more had migration of the transceiver of the cochlear implant. The migrations occurred despite stabilization of the device in the temporo-parietal area. Migrated implants were returned into position in a revision surgery. The authors concluded that simultaneous CI with SP was an effective and safe surgical method with a relatively low incidence of complications [15].

CONCLUSION

Single-stage cochlear implantation with sanation on the middle ear may be regarded as a method facilitating faster hearing and speech rehabilitation of patients with grade IV of bilateral chronic sensorineural loss of hearing with epitympanitis. This is even more important for patients with an acquired pathology of the middle ear and the risk of ossification of the spiral canal of the cochlea.

ADDITIONAL INFORMATION	ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ
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Compliance with patient's rights. Written consent was obtained from the patients for publication of relevant medical information and all of accompanying images within the manuscript.	***Соблюдение прав пациентов.*** Пациенты добровольно подписали информированное согласие на публикацию медицинских данных и фотографий в обезличенной форме.
Contribution of individual authors. Lilenko A.S., Sugarova S.B., Kuzovkov V.E.: concept and design of the article, editing of the article. Lilenko A.S., Kharitonova P.R., Timofeeva P.R.: writing of the text. Korneva Yu.S., Timofeeva P.R.: collection and processing of material. The authors gave their final approval of the manuscript for submission, and agreed to be accountable for all aspects of the work, implying proper study and resolution of issues related to the accuracy or integrity of any part of the work.	***Участие авторов.*** Лиленко А.С., Сугарова С.Б., Кузовков В.Е. – концепция и дизайн статьи, ее редактирование. Лиленко А.С., Харитонова П.Р., Тимофеева П.Р. – написание текста. Корнева Ю.С., Тимофеева П.Р. – сбор и обработка материала. Все авторы одобрили финальную версию статьи перед публикацией, выразили согласие нести ответственность за все аспекты работы, подразумевающую надлежащее изучение и решение вопросов, связанных с точностью или добросовестностью любой части работы.
Statement of originality. No previously published material (text, images, or data) was used in this work.	***Оригинальность.*** При создании настоящей работы авторы не использовали ранее опубликованные сведения (текст, иллюстрации, данные).
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