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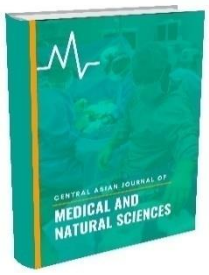

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Computed Tomography and Magnetic Resonance Imaging Play an Important Role in Determining the Local Degree of Spread of Malignant Tumors in the Organ of Hearing

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Abstract: **Introduction.** Computed tomography (CT) and magnetic resonance imaging (MRI) are the main methods of radiation diagnostics, which allow to objectively assess the local prevalence of malignant tumors of the organ of hearing and decide on the possibility of surgical intervention.

The purpose of the study was to determine the main indications for surgical intervention, taking into account radiological criteria for lesions of the temporal bone (CT, MRI) in locally advanced skin cancer of the outer ear. Materials and methods. The present study is based on a retro- and prospective analysis of data from a comprehensive examination and treatment of 45 patients with locally advanced skin cancer of the external ear treated from 2021 to 2023.

Results. The prevalence of the tumor process in skin cancer of the external auditory canal in accordance with the staging system for tumor lesions of the structures of the temporal bone, developed in 1990 (University of Pittsburgh), taking into account CT and MRI signs of damage to the temporal bone and adjacent anatomical structures, a factor that significantly affects long-term results of treatment (for recurrence- free survival - risk ratio (RR) 4.76, 95% confidence interval (CI) 1, RR 4.25, 96% CI 1.74-10.4, p = 0.0017 for tumor-specific survival, RR 1.90, 94 % CI 1.07-3.58, p = 0.03). Conclusion. CT and MRI are mandatory methods of radiation diagnosis in patients with skin cancer of the external auditory canal.

Key words: radiodiagnosis, malignant tumors of the temporal bone, locally advanced skin cancer of the external ear.

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Introduction

Malignant tumors of the external ear are an extremely rare pathology and account for 0.2% of all malignant tumors of the head and neck. About 300 cases of cancer localized in the structures of the ear are registered annually in the United States, and up to 100 cases in Uzbekistan.

Malignant neoplasms of the organ of hearing are distinguished by an aggressive course, spread to the structures of the middle ear, mastoid process, parotid salivary gland, temporomandibular joint, skull bones, meninges and brain. Most patients are admitted to the hospital with a tumor process III (31.1%) and IV (42.2%) stages.

Currently, success in the treatment of patients with tumors of the outer ear with extension to the temporal bone is associated with the achievements of modern methods of radiation diagnostics: computed (CT) and magnetic resonance imaging (MRI), the information content of which is 80-98%. The main tasks of CT and MRI:

- ✓ determining the size of the primary tumor;
- ✓ assessment of the spread of the tumor process to adjacent anatomical structures;
- ✓ determination of the degree of destruction of the underlying bone;
- ✓ assessment of the possibility of radical surgical intervention;
- ✓ assessment of the radicalness of tumor removal;
- ✓ detection of continued growth or tumor recurrence and their differential diagnosis with postoperative changes.

Computed tomography is a method that allows assessing the volume of destruction of bone structures, while MRI (with intravenous contrast) provides a clear definition of the boundaries of the soft tissue component of the tumor. Signs of tumor growth with damage to the cortical layer of the external auditory canal, limiting the lumen, are the abrasion of the contour of the cortical layer, usura , erosion. If the tumor reaches the nerve canals, radiological signs of perineural spread are the destruction and expansion of the bone openings of the nerves, a decrease in the volume of fatty tissue in the bone canal.

When evaluating the possibility of radical surgical intervention, taking into account the data of radiation diagnostics, the system of staging of tumor lesions of the structures of the temporal bone, developed in 1990, was used (University of Pittsburgh), which is based on clinical and radiological data (CT) [6]. This system is used to determine the stages of locally advanced skin cancer of the outer ear with damage to the lateral part of the skull base and allows a detailed assessment of the degree of tumor involvement of anatomically significant structures of the temporal bone.

Stages of skin cancer of the external auditory canal (according to University of Pittsburgh):

- ➢ T1 - the tumor is limited to the external auditory canal, and there is no damage to the bone walls or infiltration of the surrounding soft tissues;
- ➢ T2 Tumor with minimal evidence of bone erosion or infiltration of surrounding soft tissue <0.5 cm thick;
- ➢ T3 - The tumor completely destroys the bony walls of the auditory canal, the infiltration of the surrounding soft tissues is less than <0.5 cm, or the tumor penetrates into the middle ear cavity / mastoid cells;
- ➢ T4 Tumor destroys cochlea, apex of temporal bone, medial wall of middle ear, carotid canal, jugular foramen/dura, surrounding soft tissue infiltration >0.5 cm, or facial nerve involvement.

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Materials and methods

The present study is based on a retro- and prospective analysis of data from a comprehensive examination and treatment of 45 patients with locally advanced skin cancer of the external ear from 1994 to 2021. The follow-up time for patients averaged 30.0 ± 32.3 months (from 0.7 to 117.4 months , median 12.0 months). The study included 16 (35.7%) primary and 29 (64.6%) recurrent patients aged 28 to 88 years (mean age 59.6 ± 13.7 years, median 63 years).

The prevalence of the tumor process was assessed in accordance with the international classification TNM (Tumor , Nodus and Metastasis) of the 8th revision (TNM-8), which does not take into account the features of the spread of the tumor to the anatomical structures of the temporal bone, as well as the staging system University of Pittsburgh (1990), taking into account the data of additional examination methods (CT and MRI).

In the treatment of recurrence, the classification of the recurrent tumor was used, the stage of rTNM was determined based on the data obtained as a result of the study of the relapse process. When using the TNM-8 system, the size of a recurrent tumor was estimated, and when using the University of Pittsburgh, the features of the spread of a recurrent tumor to the structures of the temporal bone were taken into account based on CT and MRI data.

This study did not include patients with a skin tumor limited to the auricle. The main criterion for the minimum prevalence of the tumor process was the lesion of the external auditory canal.

The study included 33 patients who received surgical treatment in various volumes (subtotal, lateral or incomplete lateral resection of the temporal bone). The distribution of patients, taking into account the prevalence of the tumor, is presented in Table. 1. PT criterion in pathomorphological classifications (TNM-8, University of Pittsburgh) is presented only for operated patients.

There was a decrease in the incidence of stage T2 tumors (TNM-8) in the pathomorphological classification (pT2 — 9.1%) compared with the data of the clinical classification (stT2 — 31.1%), which is associated with the detection during histological examination in this group patients with tumor invasion into deep structures (muscle, cartilage). This made it possible to classify such patients as pT3.

An increase in the incidence of pT3 tumors was observed (University of Pittsburgh) (33.3%) compared with the incidence of stage cT3 tumor in the clinical classification (University of Pittsburgh) (20%), which is associated with the detection of destruction of the middle ear components during the operation. In this study, CT was performed in 36 patients, MRI - in 3, CT and MRI - in 6 (Table 2). CT and MRI data were interpreted according to the staging system university of Pittsburgh .

results

In order to select the optimal radiodiagnosis algorithm for patients with locally advanced outer ear skin cancer, we analyzed cases of stage mismatch according to the University of Pittsburgh before and after surgery. The main reasons for such discrepancies are: intraoperative detection of lesions in the components of the middle ear and facial nerve. Therefore, we calculated the sensitivity, specificity, and accuracy for these parameters.

In our study, patients who underwent surgical interventions of various sizes (n = 33) underwent only 30 CT examinations (false results were obtained in 5 (16.7 %) cases) and 8 MRI examinations (of which 1 (12.5%) case, a false result was obtained). The accuracy of the methods was comparable. Using one-way regression analysis according to Cox, we assessed the predictive value of the prevalence of the tumor process according to the University system of Pittsburgh in clinical and pathological classifications. According to the results of our studies, the stage determined by this

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system, both in clinical and pathomorphological classifications, affects the prognosis for all types of survival: taking into account data before surgery (cT1-4) (for relapse-free survival - the risk ratio (RR) 4.76, 95% confidence interval (CI) 1.93–11.73, p = 0.00069, for tumor-specific survival RR 4.25, 95% CI 1.74–10.39, p = 0.0015; for overall survival, RR 1.96, 95% CI 1.07–3.58, p = 0.029); taking into account the pathomorphological classification (pT1-4) (for relapse-free survival — RR 8.32, 95% CI 2.49–27.84, p = 0.00058; for tumor-specific survival, RR 7.26, 95% CI 2.21–23.8, p = 0.0011; for overall survival, RR 2.09, 95% CI 1.06–4.11, p = 0.033).

Since the staging system university of Pittsburgh , which takes into account CT and MRI signs of damage to the temporal bone and adjacent anatomical structures, is a factor that significantly affects the long-term results of treatment; to obtain a more complete diagnostic picture, we recommend using both CT and MRI studies.

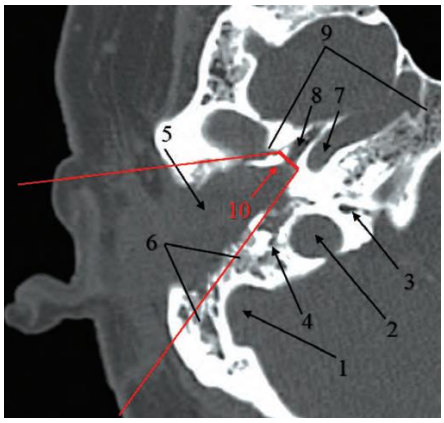
We analyzed the features of X-ray semiotics in patients with a tumor lesion of the temporal bone pyramid. We present clinical observations, which, in our opinion, most clearly demonstrate radiological criteria that should be taken into account when assessing the possibility of surgical intervention, and on the basis of which indications for surgery are formulated.

Clinical observation 1

Patient Z., 53 years old. Referral due to continued growth of skin cancer of the external auditory canal (stage T3N0M0 according to the staging system University of Pittsburgh). Previously received surgical and radiation treatment at the place of residence.

From the anamnesis: in November 2013, purulent and sanious discharge from the right external auditory canal appeared. She was treated by an ENT doctor at the place of residence for otitis externa. Due to the ineffectiveness of conservative therapy in December 2013, the tumor of the external auditory canal was removed, histologically - squamous cell carcinoma. Further, the patient was observed in the oncological dispensary at the place of residence. The patient underwent external beam radiation therapy up to a total focal dose (SOD) of 60 Gy (completed in May 2021). Due to the continued growth of the tumor, the patient was referred for a consultation.

According to CT data from 05.11.2021: in the right external auditory canal, a soft tissue substrate measuring 2.4 x 2.1 cm is detected, filling the middle ear cavity (Fig. 1). The cortical layer along the anterior and posterior walls of the external auditory meatus is usurated . The tympanic cavity is filled with a tumor component, auditory



Rice. 1. Computed tomography of patient Z. with skin cancer of the right external auditory canal. Condition after combined treatment in the community: continued tumor growth, T3N0M0 (University of Pittsburgh). 1 - sigmoid sinus, which serves as a reference point for the posterior border of the subtotal resection of the pyramid of the temporal bone;

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2 - internal jugular vein, the bulb of which serves as a guide for the lower border of the subtotal resection of the pyramid of the temporal bone;

3 - snail plumbing; 4 - mastoid part of the canal of the facial nerve (data confirming bone destruction, no); 5 - the area of the tympanic cavity, filled with soft tissue tumor component (tympanic membrane is not visible); 6 - mastoid process, part of the cells is not determined due to involvement in the tumor process and bone destruction, in the remaining cells - the substrate; 7 - petrous part of the internal carotid artery, which serves as a landmark of the anterior border of the subtotal resection of the pyramid of the temporal bone; 8 - bone mouth of the Eustachian tube; 9 - the area of the apex of the pyramid of the temporal bone (there are no radiographic signs of damage); 10 — resection border adjacent to the mouth of the Eustachian tube. The red color indicates the boundaries of the bone resection, while they are not visualized. The cells of the mastoid process on the right are airless, with a violation of normal aeration. The stony part of the internal carotid artery is intact . The Eustachian tube is not involved in the tumor process, its walls as part of the bone part (closest to the middle ear) are not usurated .

Taking into account the prevalence of the tumor process (see Fig. 1) involving the tympanic cavity and lesions of the cells of the mastoid process, the patient underwent a surgical intervention in the amount of subtotal resection of the pyramid of the temporal bone with the removal of part of the mastoid cells to the border with the bone groove of the sigmoid sinus. In this case, the absence of damage to the sigmoid sinus and the canal of the facial nerve throughout is a prognostically favorable radiological criterion. There were no contraindications to surgical intervention in the form of bone destruction of the apex of the pyramid and the canal of the internal carotid artery.

Clinical observation 2

Patient A., aged 73, applied to oncology due to widespread recurrence of skin cancer of the right auricle (T4N0M0 according to the staging system university of Pittsburgh). From the anamnesis: in December 2008, an ulcerative tumor formation appeared on the skin of the right auricle with spread to the skin of the temporal region. Basal cell carcinoma was diagnosed in the oncological dispensary at the place of residence, for which in March-April 2009 the patient received a course of radiation therapy up to SOD 50 Gy with a positive effect. In 2010, a tumor recurrence with spread to the right parotid salivary gland was diagnosed at the oncological dispensary at the place of residence. On December 6, 2010, a surgical intervention was performed in oncology in the amount of subtotal resection of the right parotid salivary gland, fascial-case excision of the tissue of the neck on the right. In May 2011, a follow-up examination revealed a relapse (Fig. 2). From 05/13/2011 to 06/23/2011 the patient received 2 courses of TPF polychemotherapy at the place of residence , and from 05/27/2011 to 07/08/2011 - a palliative course of proton beam therapy up to SOD 42 Gy.

According to CT data from October 26, 2011: the residual tumor in the soft tissues of the parotid region is closely adjacent to the mastoid process of the right temporal bone with destruction of its cortical layer in the area of 2.6 x 1.0 cm (Fig. 3). The destruction also extends to the large wing of the sphenoid bone, the temporomandibular joint, and the initial sections of the zygomatic arch. The spread of the tumor into the external auditory meatus was noted. Bone erosion is more clearly seen in the axial view.

1.5 months after surgical treatment, the patient underwent a control CT scan (Fig. 4).

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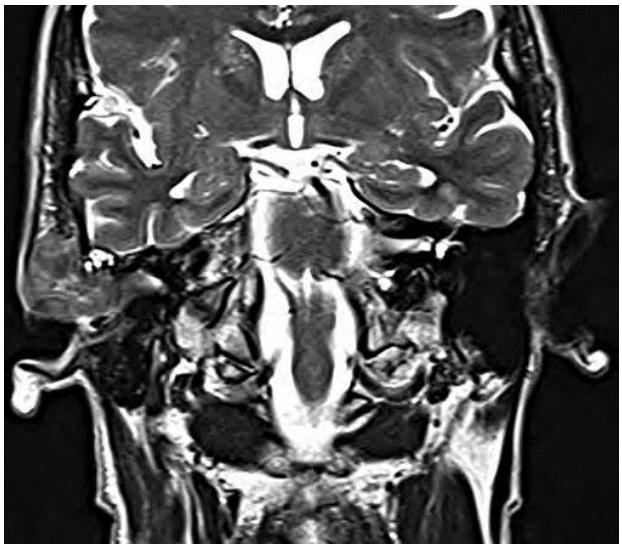
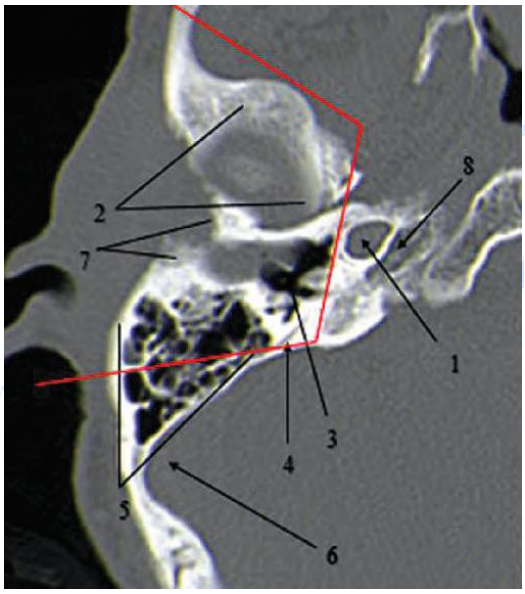


Rice. 2. Magnetic resonance imaging of patient A. with skin cancer of the right temporal region dated 04.05.2011. Condition after radiation therapy (2009) and surgical treatment (2010). Relapse. T4N0M0 by staging system University of Pittsburgh



Rice. 3. Computed tomography of patient A. with skin cancer of the right temporal region T4N0M0 (University of Pittsburgh) dated 10/26/2011. Residual tumor after previous chemoradiotherapy. 1 - channel of the internal carotid artery, the bone contours are clear, there are no signs of destruction; 2 - mandibular fossa, the contour is worn out, which indicates radiological signs of bone destruction; 3 - the middle ear cavity, the aeration of the tympanic cavity is not disturbed, the bone structures of the middle ear are visualized; 4 - posterior semicircular canal; 5 — a mastoid process, cells are contoured completely, their pneumatization is not broken; 6 - sigmoid sinus;

7 - the area of the external auditory canal, the obliteration of the contour of the auditory canal is determined; 8 - the area of the top of the pyramid, there are no signs of bone destruction. The red line marks the boundaries of the subtotal resection of the temporal bone pyramid. The operation was accompanied by resection of the zygomatic arch, the articular process of the lower jaw, part of the cells of the mastoid process with the inclusion of the tympanomastoid part of the facial nerve canal

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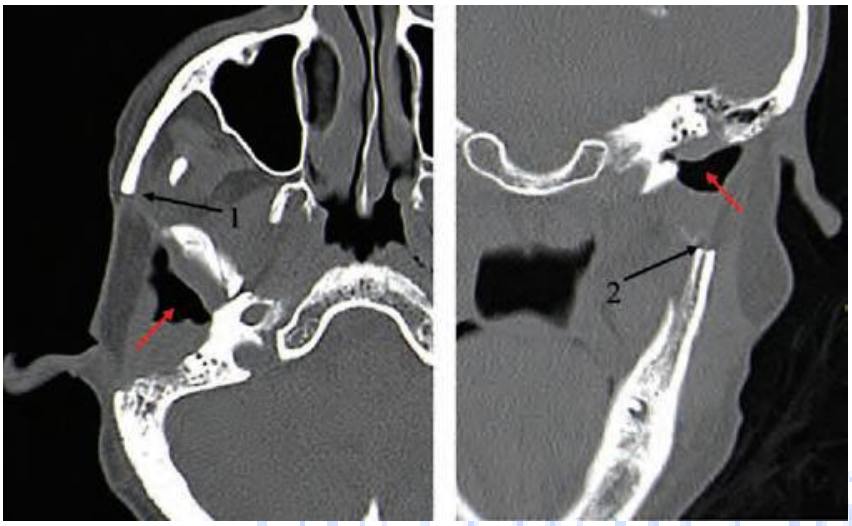
Discussion

When analyzing the results of CT and MRI studies in patients with malignant tumors localized in the ear structures, attention should be paid to the following aspects:

- the presence of areas of usuration along the bone walls of the external auditory canal;
- the presence of areas of usuration of the cortical layer of the auditory canal and impaired pneumatization of the cells of the mastoid process, which are not determined



Rice. 4. Computed tomography (control) of patient A with skin cancer of the right temporal region dated February 1, 2012. Condition after surgical treatment on 12/13/2011 in the amount of subtotal resection of the pyramid of the temporal bone on the right, resection of the articular process of the lower jaw, auricle, soft tissues of the parotid region. 1 - zygomatic arch, part of it is resected; 2 - branch of the lower jaw, partially resected, looks intermittent in the picture. The red arrow indicates the postoperative cavity. Destruction of the bone structures of the lateral part of the skull base was not revealed. There is no evidence for recurrence. The area of the postoperative defect occupies a musculocutaneous flap with the inclusion of the pectoralis major muscle completely, in combination with a violation of the structure of the trabeculae;

- the presence of a volumetric formation in the tympanic cavity, which has the density of soft tissues. The tumor has reduced signal intensity on the T1-weighted MRI image; its moderate strengthening is noted after administration of gadolinium. Differential diagnosis should be carried out with cholesterol granuloma, in which there is no violation of the trabecular structure, there is a high signal intensity on T1- and T2-weighted MRI images; there is no enhancement after contrast injection.

Of great importance is the assessment of damage to the facial nerve in its canal. The presence of destruction or mass formation in the internal auditory canal, the pyramid of the temporal bone, the spread of the tumor process to the parotid salivary gland, according to CT data, can only indirectly judge a possible lesion of the facial nerve. Destruction and expansion of the stylomastoid foramen, a decrease in the volume of fatty tissue in the bone canal are significant signs of perineural spread of the tumor. Evaluation and identification of foci of destruction in the form of contour wear along the entire length of the bone canal of the facial nerve in its labyrinth (pyramidal), tympanic and mastoid parts are required.

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However, the above changes are not always unambiguously determined during a CT scan. In this case, an MRI scan is required. Damage to the facial nerve after the introduction of gadolinium on MRI is visualized as a pronounced increase in the external knee of the facial nerve or its mastoid part.

Conclusion

The prevalence of the tumor process in skin cancer of the external auditory canal in accordance with the University system of Pittsburgh , which takes into account CT and MRI signs of damage to the temporal bone and adjacent anatomical structures, is a factor that significantly affects long-term results of treatment. In this regard, CT and MRI are mandatory methods of radiation diagnosis of such patients.

For tumors that affect the structures of the middle ear, mastoid cells and canal of the facial nerve (stages T3 and T4 according to the University system of Pittsburgh), a more aggressive surgical approach is required in the form of subtotal resection of the temporal bone. Bone destruction of the apex of the pyramid according to CT data, as well as signs of involvement in the tumor process of the dura mater according to MRI data, in our opinion, serve as contraindications for surgery.

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