ENGLISH VERSION: ETIOPATHOGENETIC APPROACH TO MANAGING PATIENTS WITH ACUTE INFLAMMATION OF THE MIDDLE EAR STRUCTURES*

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At present, the signs of transition from the stage of inflammation – antrocellulitis (inflammation of the lining cells of the mastoid process), to mastoiditis (purulent fusion of bone cells of the mastoid process system) are not studied, and clear evidence of the timing and extent of surgery is not identified. The aim of the research is improving the treatment of patients with acute mastoiditis by new scheme of using conservative therapy and modified antromastoidotomy with drainage. Material and methods: the study was conducted in clinical settings: Otolaryngology Department of Poltava Regional Hospital and Otolaryngology Department of the City Hospital No.2 of Poltava. Results in the period from 2009 to 2016 were examined, and 83 patients with acute and middle otitis, complicated with mastoiditis, were treated. All patients were divided into 2 groups: study group – Group 1 (n = 48) and control group – Group 2 (n = 35). Results: in patients of studied groups 1-b and 1-c, we used new developed technique of surgical sanitation of the mastoid process with draining the atticoantral passage with rubber drainage, and postoperative cavity – with teflon tubes with momentary wound suturing. Patients of group 1-b underwent tunnel antrotomy, the aim was to determine the condition of the cells of the mastoid process. In cases when the phenomena of destruction and necrosis were observed, antromastoidotomy was conducted by our own methodology. In conducting surgery, endoscopic techniques was used, air permeability test for atticoantral part was performed. Conclusions. When prescribing the treatment of patients with acute mastoiditis, it is necessary to take into account, in addition to clinical signs of disease, the data of cone-beam CT, the presence of atticoantral connection, which probably depends on the anatomical features of the structure of the middle ear and the severity and prevalence of inflammatory process. Morphological data necessitate the inclusion of antiviral drugs in the scheme of treatment, which significantly increases the effectiveness of treatment of patients with acute mastoiditis.

Key words: acute mastoiditis, mastoid process, morphological studies, immunotherapy, antrotomy, mastoidotomy.

The relevance of managing patients with acute inflammation of the middle ear structures is determined by the serious social and health consequences of the disease: the development of hearing loss, deafness, loss of labor capacity, disability, and even danger to patient's life. Out of all ENT pathologies, ear disorders constitute about 28-35% [1, 14, 22, 32, 34], in which acute otitis media accounts for approximately 33% of patients [17, 23], including 7.8% with lesions of the mastoid process [15].

The frequency of complications of acute otitis media by acute mastoiditis (AM) is about 10.8%, while in 16% of cases of observation, AM ends in development of intracranial complications among which perisinuous abscess, sinusthrombosis, abscesses of the brain and cerebellum are the most common [15, 16, 25].

At the same time, the methods and tactics of treatment of patients with purulent otitis media and its complication – mastoiditis, at present is not sufficiently effective. Obvious is the presence of pathogenic chain that begins with acute inflammation structures of nasal cavity and nasopharynx, auditory tube, with subsequent spread to the tympanic cavity, antrum and the mastoid process.

An important point is that the signs of transition from the initial stage of inflammation – antrocellulitis (inflammation of the lining cells of the mastoid process) to mastoiditis (purulent fusion of bone cells of the mastoid process system) has not yet been studied, and there is no clear evidence of the timing and extent of surgery, whereas antromastoidotomy is often unnecessary.

The role of viral infections in the occurrence of acute otitis media has been studied by numerous scientists [4, 5, 20, 21, 26, 29, 30]. Some viruses are considered the main etiological factors of acute otitis media [4, 5, 27], as evidenced by immunofluorescence or other methods of diagnosis [24, 26], which detect mainly influenza viruses, parainfluenza, adenoviruses. The remaining viruses are assigned the role of trigger mechanisms, followed by additional overlay of bacterial flora [7-9, 11, 12, 33].

Recent studies confirm the detection of herpes virus type I and II in acute otitis media in 40% of patients, adenoviral infection – in 24%, and in diseases of paranasal sinuses – Epstein-Barr virus – in 56.7%, adenoviral infection – 40 % [10, 13]. In defining acute otitis media it becomes clear that inflammatory lesion of the mucous membranes occurs both in the auditory tube, tympanic cavity and in the mucosa of antrum and the mastoid process. Therefore, if acute otitis media of viral etiology is complicated by AM, the latter should be considered from the standpoint of the same etiological cause [26, 28]. Studying the causative factor of acute otitis media, M.K. Drahneva [8] concluded that bacterial factor is not the leading one in the etiology of mastoiditis, and AM is considered a surgical disease.

Since the times of Schwartz, who is considered the ancestor of antromastoidotomy, the surgical technology has not virtually changed after many decades. So far, in most cases the trephine wound remains open after antromastoidotomy.

Since the traditional antromastoidotomy is a rather traumatic surgery, many authors note that it is not appropriate to apply it in the form in which it was proposed 150 years ago. Currently, the organ preserving surgery methods on the mastoid process are actively implemented: antrodrainage, transmastoid bypass surgery, organ preserving microsurgical operations. In the context of organ-saving techniques in the treatment of acute inflammation of middle ear structures, it is needed to search for new effective etiopathogenetic approaches.

The aim of the research is to increase the effectiveness of treatment of patients with acute mastoiditis by using the new scheme using of conservative therapy and modified antromastoidotomy with drainage.

Materials and methods

In accordance with the aim and the tasks of the research, the study was conducted in clinical settings: Otolaryngology Department of Poltava Regional Hospital and Otolaryngology Department of the City Hospital

* *To cite this English version: Bezeha M.I. Etiopathogenetic approach to managing patients with acute inflammation of the middle ear structures // Problemy ekologii ta medytsyny. - 2016. - Vol 20, № 3-4. - P. 9–13.*

No.2 of Poltava, which are the bases of the Department of Otorhinolaryngology with Ophthalmology of Higher State Educational Establishment of Ukraine "Ukrainian Medical Stomatological Academy". Results in the period from 2009 to 2016 were examined, and 83 patients with acute and middle otitis, complicated with mastoiditis, were treated.

The criteria for exclusion from the study were as follows:

1. Age under 18.
2. Pregnancy and lactation.
3. Patients with intracranial otogenic complications (meningitis, brain abscesses and cerebellum).
4. Patients with atypical forms of mastoiditis.
5. The presence of comorbidities (diabetes, HIV positive).
6. Patients with chronic suppurative middle ear disease (mesotympanitis or attic disease).

All patients were divided into 2 groups: the study Group 1 (n = 48) and the control Group 2 (n = 35) (Table. 1).

Table 1.
The distribution of patients by age and gender

Age	Total:		Total in groups:		Men		Women	
	abs.	%	Group 1	Group 2	abs.	%	abs.	%
18-25	19	22.9	11	8	9	10.8	10	10.8
26-35	22	26.5	11	11	11	13.3	11	13.3
36-45	20	24.1	12	8	8	9.6	12	9.6
45-65	22	26.5	14	8	12	14.5	10	14.5
Total	83	100.0	48	35	40	48.2	43	48.2

According to the data presented in Table, groups were statistically homogeneous by age and gender. Patients of the 1st, (study) group were administered antiviral therapy in addition to the conventional comprehensive therapy of acute mastoiditis. Moreover, all these patients underwent eardrum bypass in the first day of hospitalization. Some of them underwent surgery on the 1st day of hospitalization.

Depending on the type of medical care, patients within the groups were divided into subgroups:

1-a – the study group – treatment without surgery was performed on the mastoid process. Patients in this group underwent topical paracentesis with eardrum bypass. The feature of the overall treatment was the prescription of antiviral drugs.

1-b – the study group – tunnel antrotomy + antiviral therapy;

1-c – the study group – modified antromastoidotomy + antiviral therapy;

2-a – the control group – patients of this group received conservative treatment. Local traditional paracentesis of eardrum and auripuncture were performed.

2-b – the control group – patients of this group underwent traditional antromastoidotomy in different periods.

The number of patients included in each group is presented in Table 2.

Table 2
The quantitative composition of the studied groups of patients

Group of patients:	Subgroup	Number of patients		Total
		Abs.	%	
1 – study group	a	26	54.2	48
	b	17	35.4	
	c	5	10.4	
2 – control group	a	11	31.4	35
	b	24	68.6	

In patients of study groups 1-b and 1-c, a new method, developed by us, was applied: surgical sanitation of the mastoid process with draining the atticoantral passage by rubber drainage and the postoperative cavity – by teflon tubes with momentary suturing of surgical wounds.

All patients of study group 1-b underwent tunnel antrotomy, whose aim was to determine the state of the cells of the mastoid. In case when the phenomena of destruction and necrosis, the presence of viscous purulent exudates were observed, antromastoidotomy was conducted by our own method, and these patients were transferred to the study group 1-c in. In addition, during the tunnel antrotomy, endoscopy of antro-tympanic anastomosis was conducted. It expanded to the extent of air when in samples air or liquid began to flow freely through it. In endoscopic study, endoscopes with a diameter of 4 mm with an angle of 0° – 30° were used. Through its use, it has become possible to recover the atticoantral communication more carefully, to avoid dangerous traumas of important anatomical structures.

Emergency surgery in the early hours after treatment of patients with AM was conducted only in patients with severe clinical course of the disease, complications or the presence of radiological data of destruction in the partitions between the cells of the mastoid process.

In the standard scheme of patients' examination, audiometry and computed tomography of the mastoid process were included. Preference was given to cone-beam imaging, in which a patient receives almost 10 times less radiation exposure (less than 50 mSv). In this context, only the area of interest is scanned – the mastoid process, and the radiation exposure is accordingly reduced, which allows the control radiological research along with treatment and minimal damage to the health of the patient. The advantage of cone-beam tomography is also high quality imaging of bone structures, so that the thickness of CT slices ranges from 0.125 mm, which is signifi-

cantly less than conventional computed tomography (0.5 mm).

When choosing an integrated approach to the treatment of AM, we have developed indications for conservative tactics of their management as well as clinical, radiological and temporal aspects or the need to move to surgery. In this case, we considered the following combination of data that influence the choice of treatment strategy: clinical (local and general), X-ray, laboratory, and presence of complications. Clinical symptoms include pain, hyperthermia, general intoxication manifestations, deterioration of auditory function, local manifestations (data of otoscopy, changes in the postaural area).

For morphological study, material after extracting were fixed in 10% neutral formalin solution, condensed in paraffin by conventional method [18], and histological sections were made, 3-5 microns thick. Slices after staining with hematoxylin and eosin, were put in the polystyrene coating under the lenses and after polymerization were examined in the light microscope Biorex – VM3 – of 500T with digital photomicrographic attachment DCM 900.

Results and discussion

Analyzing the results of histological examination of the removed mastoid mucosa during antromastoidotomy, we observed the changes characteristic for viral lesions of the mucous membranes. In the study of sections stained with hematoxylin and eosin, we revealed that in the cells of epithelial plate the phenomena of hydropic dystrophy were visualized. In the cytoplasm numerous vacuoles were defined containing optically transparent liquid, nucleus was shifted to the periphery.

In the surface layers of the lamina propria mucosa of the cells of mastoid process against the background of hydration events in amorphous substances lymphocytic infiltrates are identified, sometimes merging (Fig. 1). In vessels of surface networks, plethora was determined; locally – the phenomena of stasis.

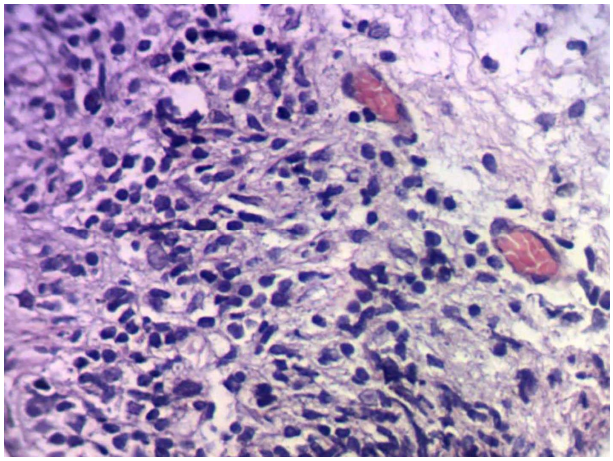

Fig. 1. Photomicrograph of lymphocytic infiltrates in the lamina propria of mucosa cells of the mastoid in patients with secondary acute mastoiditis. Staining: hematoxylin-eosin. Magnification: Ob.: 40, R.: 10.

In the deep layers of the lamina propria morphological features of hydration are identified that are manifested in the dissection of collagen fibers. Perivascularly, leukocyte cells number are – macrophages, lymphocytes, plasmocytes. In venous vessels, the phenomena of plethora and stasis were observed. Sometimes – diapedetic hemorrhages (Fig. 2).

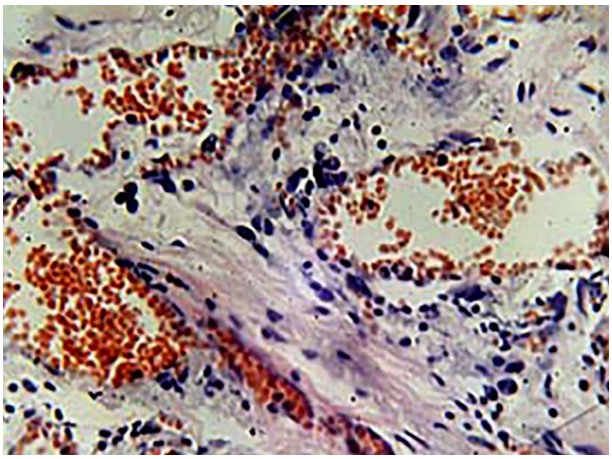

Fig. 2. Photomicrograph of the venous congestion in the deep layers of the lamina propria in the mucosa cells of the mastoid in patients with acute mastoiditis. Staining: hematoxylin-eosin. Increase: Ob.: 40, R.: 10.

The conducted histological study of the established changes in the mucosa cells of the mastoid (hydropic degeneration of epithelial cells, lymphocytic infiltrates, and diapedetic hemorrhage and venous plethora in the lamina propria) suggests the viral etiology of inflammation in this group of patients.

The results of this study became the basis for inclusion of antiviral drugs in the treatment. In the search for effective antiviral agents, we used "Proteflazidum" for standard basic scheme and used it for irrigation, compresses and as phonophoresis. "Proteflazidum" is of domestic production, of plant origin, with pronounced adaptogenic, immunomodulating and antiviral properties; it is non-toxic, and has virtually no side effects. The liquid drug solution can be used in both systemic and local therapy for AM.

All patients were prescribed conservative treatment, which included the standard pattern: antibacterials (combination of 2-3 antibiotics of broad-spectrum), anti-inflammatory, dehydration agents, antihistamines and local (early paracentesis, irrigation of tympanic cavity with antiseptics, anematizing the nasal mucosa, etc.). In the presence of inhomogeneous darkening at CT-images in the system of mastoid process cells, even with the presence of 1-2 intact cells in obtaining serous content with paracentesis, the prescribed therapy was carried out for 2-3 days, then cone-beam tomography was re-conducted. With the improvement of clinical and laboratory data, and with positive radiologic dynamics, which was manifested in the increased number of air cells, and most importantly – in restoring the mastoid-tympanic conjunction, the conservative treatment continued up to recovery.

Complications of AM were divided into two groups: complications within the system of the middle ear and complications that went beyond that are of practical importance in choosing treatment. Complications within the middle ear were: bullous myringitis, herpetic otitis and facial nerve paresis, as the latter had the character of peripheral lesions. Complications that came out of the middle ear, were primarily the intracranial complications (meningitis, meningoencephalitis, sinusthrombosis, brain abscess) and subperiostal abscess, zygomatic abscess, petrositis and others.

It should be noted that we did not rely on the time aspects, i.e., the need for surgery on the 7th-9th day of otitis media or on the 3rd-4th day of mastoiditis, as the history of each patient differed in the process intensity and

composition of means in the previous treatment, especially various antibiotics. In this regard, we have taken a decision to delay surgery only in the absence of positive clinical effect, negative laboratory dynamics, and especially – in the absence of air cells in the mastoid process with repeated CT and availability of air tympanic cavity, which we considered as a blockade of antro-attico-tympanic drainage system.

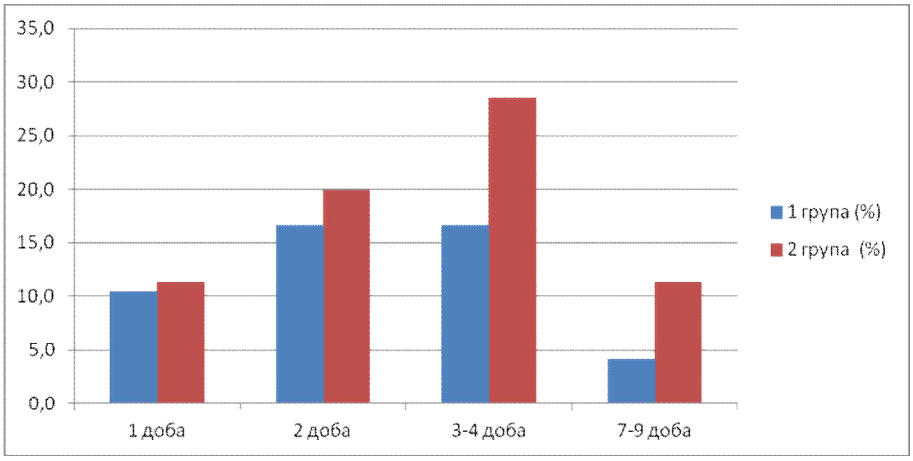

Fig. 3. Timing of surgery in patients of the study group and the control group.

The number of patients of the study group which needed surgery, was significantly different from the control group (Figure 3.). In the dynamics in patients in the 1st study group, the number of surgeries tends to reduce, as compared to the control group on the 3rd-4th and especially – on the 7th-9th days of treatment. In our opinion, this is due to a more efficient recovery in the functioning of atticoantral communication, both through the antiviral therapy and efficiency of the tympanic cavity bypass. Due to this, in the study group, the amount of delayed surgery was significantly lower (P <0.05) than in patients in the control group. In general, conservative treatment ended in recovery in 26 patients of the study and in 11 – of the control group that is 52.1% and 28.6%, respectively.

Thus, in the prescription of treatment for patients with acute mastoiditis it is necessary to take into account, in addition to clinical signs of disease, the data of cone-beam CT, the presence of preserved atticoantral communication, which probably depends on the anatomical features of the structure of the middle ear (the width of the hole between the attic and antrum) and the prevalence and severity of inflammation. This treatment should be comprehensive and aimed at all levels of pathogenic course of inflammation – from the nasal cavity and auditory tube to the mastoid bone structures. Since admitting the patient, one should pay special attention to the restoration of the drainage system of the middle ear. This may help to avoid traumatic surgery and lead to recovery, and our proposed method of operation reduces the patient's stay in hospital, which has significant economic value. The obtained morphological data necessitate the inclusion of antiviral drugs (Proteflazidum) in the scheme of treatment, which significantly increases the effectiveness of treatment of patients with acute mastoiditis.

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Матеріал надійшов до редакції 27.01.2017