

FEATURES OF THE CLINICAL COURSE OF ACUTE OTITIS MEDIA IN PATIENTS WITH IMPAIRED CARBOHYDRATE METABOLISM

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Abstract

The aim of the research: study of the features of the clinical course of acute otitis media (AOM) in patients with impaired carbohydrate metabolism.

Materials and methods. We examined 140 patients with AOM aged 19 to 72 years, of which 75 patients with impaired carbohydrate metabolism constituted the main group and 65 patients were included in the comparison group. Taking into account the peculiarities of the pathogenesis of AOM and disorders of carbohydrate metabolism, patients were randomized into 4 groups: 1 – patients with AOM (36), 2 – patients with AOM on the background of sinusitis (29), 3 – patients with AOM on the background of non-insulin-dependent diabetes mellitus (DM type II) (37), 4 – AOM patients with impaired glucose metabolism (38). The patients underwent a general clinical examination, determination of glycosylated hemoglobin, leukocyte indices of intoxication, audiometry, computed tomography (CT) of the temporal bones (if indicated).

Results. The proportion of patients with impaired carbohydrate metabolism in 2020 was 32.6 %, of which DM type II was diagnosed in 49.3 % earlier. It was shown that a feature of the clinical course of AOM against the background of impaired carbohydrate metabolism is the discrepancy between the duration of the disease history, complaints and objective data to the state of the cellular structure of the mastoid process according to CT data and impaired auditory function mainly by the type of sound perception, which indicates the formation of latent mastoiditis. Clinically significant complaints and objective data for the differential diagnosis of latent mastoiditis in these patients were determined. The absence of statistical significance of differences in indicators in patients with DM type II and against the background of transient hyperglycemia was revealed, and the concept of the latter was characterized. A direct correlation between blood glucose levels and glycated hemoglobin levels was established in patients with DM type II and AOM.

Conclusions. DM type II creates a favorable background for the formation of the clinical course of AOM complicated by latent mastoiditis.

From the general contingent of patients with AOM, patients should be distinguished not only with DM type II, but also with transient hyperglycemia for its timely diagnosis. Significant symptoms: pain and a feeling of «heaviness» in the behind-the-ear region in the absence of reactive phenomena, a feeling of «pulsation» in the ear, dizziness, a cloudy eardrum with a protrusion or perforation in the posterior or posterior-upper section, an asymmetric increase in sound perception thresholds above 25 dB. Such patients should be observed with «early» CT scan of the temporal bones.

Keywords: acute otitis media, non-insulin dependent diabetes mellitus, latent mastoiditis, transient hyperglycemia, audiometry.

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1. Introduction

The choice of the subject of this study is due to our earlier data on the significance of hyperglycemia for the formation of a complicated course of acute otitis media (AOM). We found that for the period 2018–2020, 72.9 % of intracranial complications were secondary otogenic meningitis in patients with acute otitis media against the background of hyperglycemia. Of these, 40.5 % of

patients had previously diagnosed type 2 diabetes mellitus, and in 32.4 %, diabetes mellitus manifested as a complicated course of acute otitis media [1].

According to the literature, acute otitis media is a common pathology in children and adults, accounting for 2.5 % of all diseases of the human body [2]. Among ear diseases, the proportion of AOM increases to 30 % or more [2, 3]. The social significance of AOM lies in the possibility of developing against its background various complications [4, 5] and a negative impact on auditory function [6, 7]. The main etiological factors and pathogenetic links of acute otitis media have been studied and are being studied: tubal dysfunction [8, 9], the role of the microbial factor [10, 11], disorders in the system of general and local immunity [12], pathology of the attic and morphological changes in the tissues of the mastoid process and snails [2, 13]. The data of modern studies indicate the features of the clinical and pathogenetic course of acute otitis media with the threat of sensorineural hearing loss [2], latent mastoiditis [14], which are somewhat different from the classical approach. Methods for diagnosing and treating secretory otitis media are being improved [15].

Clinical and pathogenetic features of ENT diseases, in particular otiatric pathology, in conditions of comorbidity with diabetes mellitus are being actively studied [16, 17]. Variants of the clinical course of inflammatory diseases of soft tissues (furuncle, phlegmon of the neck), pharynx (tonsillitis, paratonsillar and parapharyngeal abscesses) [18, 19], paranasal sinuses [20], features of sensorineural hearing loss in otolaryngological patients on the background of non-insulin-dependent diabetes mellitus (DM type II) are described [17]. The pathogenetic significance of non-insulin dependent diabetes mellitus for the formation of a special form of otitis externa, the so-called malignant otitis externa, has been shown in numerous publications [21, 22]. A feature of the clinical course of the disease is the involvement in the inflammatory process of the bone structures of the middle ear (purulent otitis media and mastoiditis) [23] and the pyramid of the temporal bone with the formation of osteomyelitis [24, 25]. The background effect of diabetes mellitus is manifested by the tendency of patients to develop purulent infections and complications [26], changes in bone structures with a decrease in bone mineral strength [27, 28].

The above theoretical prerequisites and our data on the pathogenetic significance of hyperglycemia for the development of a complicated course of AOM determine the relevance of this study.

The aim of the research: study of the features of the clinical course of AOM in patients with impaired carbohydrate metabolism.

2. Materials and methods of the research

The study was conducted based on a specialized otolaryngological clinical hospital – Municipal non-profit enterprise «City Clinical Hospital No. 30» of the Kharkiv City Council.

The design of the study (**Fig. 1**) at the first stage involved the study of statistical indicators for the period 2018–2021 for the main diagnosis of acute otitis media (code H 65.0 according to ICD-10), followed by determining the proportion of patients with impaired carbohydrate metabolism. Considering the obtained statistical data, 2020 was chosen as the period for conducting the main array of studies. At the same time, we proceeded from the fact that in the conditions of an unfavorable epidemiological situation, the proportion of «unreasonable» applications is significantly reduced. When selecting patients for the study, we took as a basis, first of all, the number of patients with impaired carbohydrate metabolism, distributing patients with AOM into the comparison group according to the random sampling method upon admission to the hospital in the amount necessary to form representative groups.

Criteria for inclusion of patients in the study: patients with AOM older than 18 years of age with impaired carbohydrate metabolism, patients with AOM older than 18 years without impaired carbohydrate metabolism. When diagnosing AOM, the diagnostic criteria indicated by A. L. Kosakovsky and F. B. Yurochko (2016) were used.

Criteria for exclusion of patients from the study: patients under 18 years, pregnant women, patients with other forms of otitis, including those previously operated on the middle ear, patients with comorbidities (alcoholism, drug addiction, tuberculosis, oncological diseases), which could distort the results of the examination.

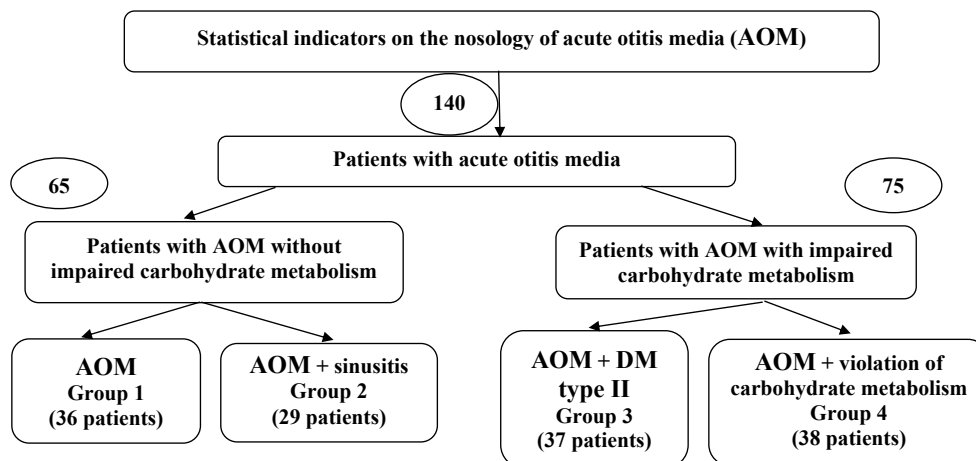


Fig. 1. Study design outline

Considering the pathogenesis of AOM and the characteristics of carbohydrate metabolism disorders, all patients were randomized into 4 groups:

Group 1 – patients with AOM (36 patients).

Group 2 – patients with AOM against the background of acute or exacerbation of chronic sinusitis (29 people).

Group 3 – patients with AOM on the background of non-insulin dependent diabetes mellitus (37 patients).

Group 4 – patients with AOM on the background of carbohydrate metabolism disorders (38 people).

All study participants provided voluntary informed consent. The work was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The Committee of the Commission of the Kharkiv Medical Academy of Postgraduate Education on Bioethics approved and approved protocol No. 4 dated November 18, 2021.

Under the violation of carbohydrate metabolism meant the presence and (or) a combination of several factors: hyperglycemia at admission or during treatment, the presence of glucose in the urine or albuminuria, aggravated anamnesis, the presence of a certain concomitant pathology (hypertension, obesity, fatty hepatosis, dyscirculatory encephalopathy, angiopathy, neuropathy).

All patients underwent a general clinical examination: history taking, general examination and examination of ENT organs, clinical blood and urine tests, determination of blood glucose and glycosylated hemoglobin levels. Leukocyte indices (shift index – SI, leukocyte index of intoxication (LII) Kalf-Kalif and Ostrovsky, reactive neutrophils response (RNR)) according to generally accepted formulas, they were calculated on a leukocyte index calculator. Glycosylated hemoglobin was determined by the ion exchange method using a High Technology reagent kit (HT-G130-80).

According to the indications, a computer study of the pyramids of the temporal bones was performed (in most cases – spiral computed tomography and, in isolated cases, MRI). The study of auditory function (acumetry, audiogram) was performed according to the generally accepted method on the audiometer AD629 No. 098076 (Denmark), certificate No. 22-01/22302.

Statistical processing of the obtained results was carried out using the program Statistica 13/0 (StatSoft, USA license number JPZ8041382130ARCN10-J). Quantitative data are presented as mean (M) and standard deviation (+SD). Student's t-test was used to compare values between groups. Differences were considered significant at $p < 0.05$.

3. Research results

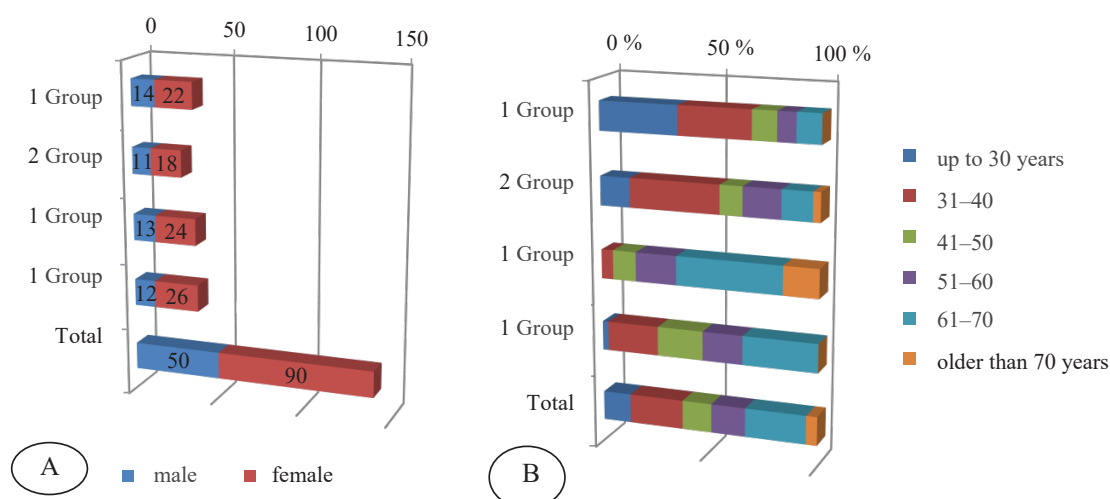
In total, for the period 2018–2021, 19960 patients over 18 years old were treated in the hospital, of which 1328 patients were diagnosed with acute otitis media, which accounted for 6.65 % of all nosological forms of ENT diseases (Table 1).

Table 1
Statistical indicators of acute otitis media

Year of study	Total patients		Patients with acute otitis media			
	Number	% of total	Number	%	% of acute otitis media of the total number of ear diseases	
2018	5890	29.5	360	6.2	27.1	
2019	5549	27.8	402	7.2	30.3	
2020	3614	18.1	230	6.4	17.3	
2021	4907	24.6	336	6.8	25.3	
Total for the study period	19960	100	1328	6.65	100	

It should be noted that against the background of the unfavourable impact of the epidemiological situation in Ukraine and with a decrease in the total number of patients in the ENT hospital in 2020, the proportion of patients with AOM did not decrease, amounting to 6.4 % compared to 6.2 % in 2018. The proportion of acute otitis media among all ear diseases was significantly higher and ranged from 17.3 % to 30.3 %. At the same time, the proportion of patients with impaired carbohydrate metabolism in 2020 was 32.6 %, of which 49.3 % were diagnosed with type 2 diabetes mellitus before the present disease.

The distribution of patients by sex (A) and age (B) is shown in Fig. 2.

**Fig. 2.** Distribution of patients in groups by sex and age

In general, there was a predominance of females (1:1.8) with an equal frequency in the absence of carbohydrate metabolism disorders (1:1.6) in groups 1 and 2 and a maximum predominance in group 4 (1:2.2). Differences were also found in the age composition of patients with an increase in the proportion of younger patients from 19 to 40 years old in the absence of carbohydrate metabolism disorders (63.1 %) in groups 1 and 2 and older patients from 51 to 70 years old in groups 3 and 4.

When determining the history of the disease (Fig. 3), it was found that early treatment (up to 7 days) was characteristic, first of all, for patients of the 2nd group against the background of the main pathogenetic factor in the development of AOM - sinusitis (62.1 %) and for patients with AOM against the background of DM type II (48.6 %).

Patients of the 1st group (30.5 %) and patients of the 4th group (36.8 %) applied with almost equal frequency up to 7 days of illness. In terms of up to 14 days, 52.8 % of patients of the first, 44.7 % of patients of the fourth, 34.5 % of the second and 21.6 % of patients of the third groups applied for specialized care. In some patients with impaired carbohydrate metabolism (27.9 % in the 3rd group and 18.2 % in the 4th group), the history of the disease was longer and ranged from 14 days to 3 months. It should be noted that with an in-depth study of the anamnesis in patients

of the 3rd and 4th groups who applied early (up to 7 days), there were transient episodes of pain – «severity» – hearing loss in the period from 10–14 days to 1–2 months prior to this application. And only in the presence of persistent symptoms, according to patients, «acute», they applied or were referred by a family doctor for specialized care.

It should be noted that an aggravated history (presence of diabetes mellitus in close relatives) was established in 1 patient of the 1st group, 4 patients of the 2nd group, in 13 (35.1 %) and 11 patients (28.9 %) of the 3rd and 4th groups, respectively.

The main complaints of patients are shown in **Fig. 4**.

Similar complaints in patients of all groups were: hearing loss (100 %, 72.2 %, 84.1 %, 94.7 % in the first, second, third and fourth groups, respectively), ear pain (50 %, 65 %, 64.9 %, 68.4 %, respectively, in groups), noise in the ear (30.6 %, 27.6 %, 37.8 % and 34.2 % of patients in the first, second, third and fourth groups, respectively).

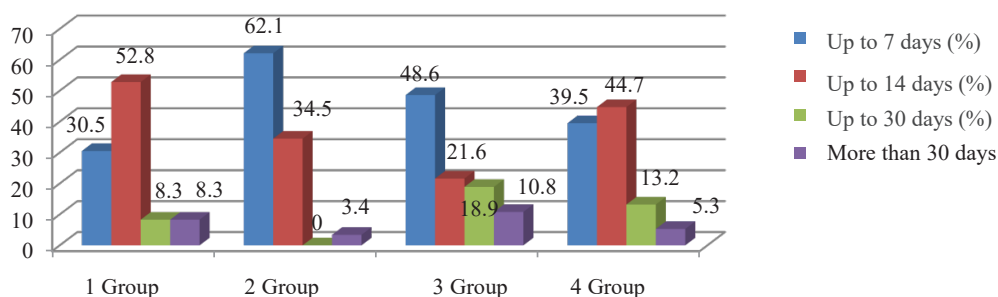


Fig. 3. Duration of medical history in patients with AOM

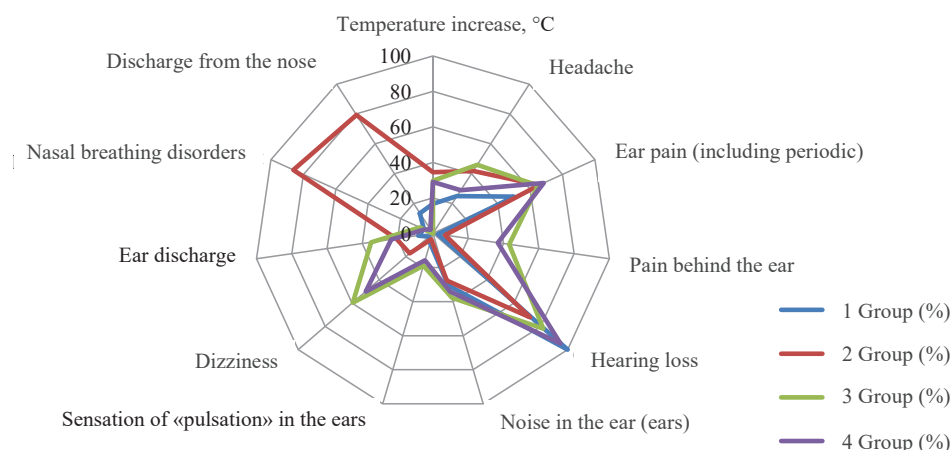


Fig. 4. The structure of the main complaints in patients with AOM

A large proportion of complaints about nasal breathing disorders (86.2 %) and nasal discharge (73.9 %) in patients of the second group is due to the main pathogenetic factor of AOM – sinusitis. In patients with impaired glucose metabolism, the proportion of complaints of pain in the behind the ear (including periodic), a feeling of «heaviness» in the behind the ear in 43.2 % of patients in the third and in 36.8 % of patients in the fourth group versus 2.8 % and 6.95 in the 1st and 2nd groups, respectively. The significance of complaints about «pulsation» in the ear also increased (18.9 % and 15.8 % in the 3rd and 4th groups versus 5.6 % and 3.4 % in the 1st and 2nd groups), dizziness (59.5 % and 50 % in patients with DM type II and in group 4 versus 2.8 % and 17.2 % in groups 1 and 2). Characteristically, 44.7 % (17 patients) of patients of the 4th group on the eve of admission had a single «unmotivated» increase in body temperature up to 38–39 °C.

When performing otoscopy (**Fig. 5**) as the main criterion for AOM in patients with impaired carbohydrate metabolism, hyperemia and infiltration of the tympanic membrane were visualized with almost equal frequency (unlike patients of the 1st and 2nd groups) with virtually no identifying

contours (45.8 % and 44.7 % against the background of DM type II and in groups 4-1), thickened cloudy eardrum with fuzzy identification contours (48.5 % and 47.4 % in groups, respectively). Different from patients of the 1st and 2nd groups was «atypical» bulging of the tympanic membrane in the posterior or postero-superior sections (A, C) in 44.4 % and 36.8 % of cases in patients of the third and fourth groups, which is against the background of an increase in body temperature during referral to inpatient treatment was erroneously interpreted as a manifestation of viral (bullos) otitis media. In 18.9 % of patients with DM type II, who noted the appearance of discharge in the ear canal, the presence of perforation of the tympanic membrane of atypical localization in the posterior or posterior-upper section was diagnosed (B, C, D).

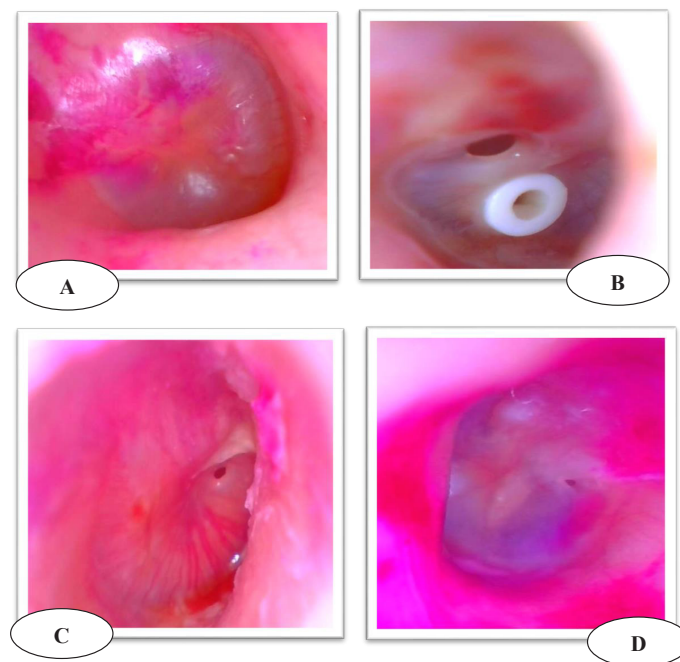


Fig. 5. Features of the otoscopic picture

Concomitant pathology in the examined group of patients was a certain comorbid background, different in patients in groups. So, in the first group, comorbid pathology was established in 33.3 % of cases and consisted mainly in manifestations of angiodystonia and asthenic syndrome. In the second group, the comorbid background was detected in 48.3 % of patients, and against the background of impaired carbohydrate metabolism, it was significantly higher and concomitant pathology was diagnosed in 63.2 % of patients in the fourth group, and in 75.7 % of patients with DM type II. Among the comorbid pathologies in patients with impaired carbohydrate metabolism, the following were noted: dyscirculatory encephalopathy, retinal angiopathy, hypertension, coronary heart disease, cardiosclerosis, polyneuropathy, osteochondrosis, vestibulo-atactic and cerebros-thenic syndrome, obesity.

Comparative characteristics of the morphological composition of peripheral blood are shown in **Table 2**.

Although, in general, the indicators are within acceptable limits, a statistically significant increase in the content of leukocytes in patients of the 4th group was determined in comparison with patients with DM type II ($p < 0.05$). In patients of the 3rd and 4th groups, a decrease in the content of eosinophils was found compared to that of patients in the 1st and 2nd groups, which was statistically significant in patients with DM type II ($p < 0.05$). At the same time, against the background of impaired glucose metabolism in patients of the 4th group, the content of monocytes decreased statistically significantly compared with the 3rd ($p < 0.001$) and 2nd ($p < 0.05$) groups.

Selectively, in patients of all four groups, the content of glycated hemoglobin in the blood was determined (**Table 3**).

Table 2
Morphological composition of peripheral blood in patients with AOM

Group	Red blood cells (x10 ¹² /l)	Hemoglobin (g/l)	Leukocytes (10 ⁹ /l)	P/nuclear (%)	C/nuclear (%)	Eosinophils (%)	Lymphocytes (%)	Mono-cytes (%)	ESR (mm/h)	Blood glucose (mmol/l)
Group 1 (n = 36)	4.2±0.07 (3.1–4.9)	132.2±2.5 (101–165)	8.4±0.6 (4–17.2)	5.2±0.35 (1–10)	62.2±1.6 (40–91)	2.7±0.3 (0–6)**	22.76±1.5 (5–51)	7.32±0.5 (2–12)	14.9±2 (2–46)	4.9±0.1 (3.4–6)****
Group 2 (n = 29)	4.3±0.06 (3.6–5)	133.3±2.2 (108–158)	7.8±0.5 (4–14.6)	4.9±0.5 (1–11)	63.03±1.2 (47–78)	2.6±0.3 (1–6)**	22.14±0.97 (13–34)	7.8±0.5 (2–12)***	17.±2.03 (3–45)	5.1±0.1 (3.9–5.9)****
Group 3 (n = 37)	4.4±0.09 (3–5.5)	134±2.9 (100–174)	7.3±0.43* (3.4±14.2)	5.7±0.4 (1–9)	61.5±1.3 (45–79)	1.7±0.2 (0–5)**	22.57±1.2 (10–36)	8.7±0.43 (3–15)***	18.03±2.5 (2–55)	8.8±0.6 (3.4–19)****
Group 4 (n = 38)	4.2±0.07 (3.2–5.4)	127.2±2.9 (100–159)	8.9±0.5 * (4.4–16.5)	6.2±0.6 (1–18)	65.5±1.5 (46–86)	1.9±0.3 (0–9)	19.9±0.9 (7–33)	6.3±0.5 (1–14)***	18.8±2.5 (2–64)	6.7±0.09 (5.9–8.2)****

Note: * – reliability of differences in indicators of 3–4 groups ($p < 0.05$); ** – reliability of differences in indicators of 1–3 and 2–3 groups ($p < 0.05$); *** – reliability of differences in indicators of 2–4 and 3–4 groups ($p < 0.05$); **** – reliability of differences in indicators of 1–4, 2–4 groups ($p < 0.001$) and 3–4 groups ($p < 0.01$)

Table 3
The content of glycosylated hemoglobin in the blood serum of patients with AOM

Indicator	Group 1 (n = 17)	Group 2 (n = 15)	Group 3 (n = 20)	Group 4 (n = 21)
Blood glucose (mmol/l)	4.8±0.2 (3.4–6.0)* **	5.0±0.18 (3.9–6.0)*** ****	10.7±0.8 (4.2–15.6)*****	6.8±0.15 (5.2–8.2)
Glycosylated hemoglobin (%)	4.9±0.2 (3–6.3)* **	4.8±0.2 (3.8–6.0)*** ****	9.8±0.5 (6.9–13.1)*****	8.01±0.2 (6.8–9.5)

Note: * – reliability of differences in indicators of groups 1–3 ($p < 0.001$); ** – reliability of differences in indicators of groups 1–4 ($p < 0.001$); *** – reliability of differences in indicators of groups 2–3 ($p < 0.001$); **** – reliability of differences in indicators of groups 2–4 ($p < 0.001$); ***** – reliability of differences in indicators of groups 3–4 ($p < 0.05$)

As in the groups as a whole (**Table 2**), there was a significant difference in blood glucose levels in groups 1–3, 1–4, 2–3, 2–4, in the absence of a statistical difference between groups 1 and 2, which indicates the correct choice of patient population. The content of glycosylated hemoglobin corresponded to the glucose values in the groups with the same reliability. The study of the correlation established the presence of a strong correlation between the level of glucose in the blood serum and the content of glycosylated hemoglobin ($R = 0.8$) in patients with DM type II and a weak correlation between the indicators in patients of the 4th group ($R = 0.33$).

According to the morphological composition of peripheral blood, the level of endogenous intoxication was studied by the value of leukocyte indices (**Table 4**).

Table 4
Leukocyte indices in patients with AOM

Group	Shift index	LII Kalf-Kalif	LII Ostrovsky	Reactive neutrophil response
Group 1 (n = 36)	0.083±0.006 (0.011–0.143)	1.07±0.19 (0.24–6.64)*	2.46±0.3 (0.69–11.5)	6.7±0.9 (0.69–17.25)**
Group 2 (n = 29)	0.079±0.008 (0.014–0.167)	0.93±0.1 (0.22–2.16)*	2.27±0.14 (1.06–4)	7.37±1.48 (0.29–33)***
Group 3 (n = 37)	0.094±0.007 (0.01–0.18)	1.2±0.1 (0.33–2.63)	2.29±0.14 (1.02–4.05)	11.91±1.5 (0.67–33.63)** **
Group 4 (n = 38)	0.1±0.01 (0.01–0.31)	1.45±0.15 (0.23–3.67)*	2.88±0.2 (1.09–6.69)	12.95±1.8 (1.28–45.39)** **

Note: * – reliability of differences in indicators of 1–4 and 2–4 groups ($p < 0.05$); ** – reliability of differences in indicators of 1–3 and 1–4 groups ($p < 0.001$); *** – reliability of differences in indicators of 2–3 and 2–4 groups ($p < 0.01$)

A relative increase in LII Kalf-Kalif was found in the 3rd and 4th groups, which, although it did not indicate significant intoxication, was still significantly higher in patients of the 4th group ($p < 0.05$). Disturbance of carbohydrate metabolism in patients with AOM was accompanied by a significant ($p < 0.001$) increase in RNR in the 3rd and 4th groups compared with the 1st and with the indicators of patients of the 2nd group ($p < 0.01$), despite the fact that there was no significant difference between the indicators of groups 1–2 and 3–4.

The analysis of auditory function in patients with AOM was performed according to the results of an audiometric study. The sound conduction function was evaluated by the level of air conduction in decibels at standard frequencies (Table 5).

Table 5
Air conduction in patients with AOM

Group	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Group 1 (n = 36)	33.1±1.9 (10–60)* **	32.72±1.75 (10–60)* **	33.3±1.5 (20–55)* **	37.2±1.9 (20–70)* **	35±2.2 (20–80)* **	43.06±2.5 (10–90)* **	47.57±2.5 (10–80)* **
Group 2 (n = 29)	32.9±2.9 (5–80)*** ****	35.7±2.9 (5–80)*** ****	38.3±3.18 (5–80)****	40.3±3.7 (5–90)****	38.2±3.7 (5–90)*** ****	48.5±4.1 (5–90)***	48±4.1 (10–90)****
Group 3 (n = 37)	43.25±2.6 (10–80)	42.7±2.5 (10–75)	43.65±2.8 (10–80)	47.9±2.9 (10–90)	49.46±3.2 (20–90)	57.36±3.4 (20–90)	58.3±3.7 (25–95)
Group 4 (n = 38)	47.9±2.6 (20–80)	46.58±2.7 (15–30)	48.7±2.7 (20–100)	52.8±3.1 (25–110)	51.45±3.2 (20–110)	58.66±3.4 (5–100)	64.6±3.1 (30–95)

Note: * – reliability of differences in indicators of groups 1–3 ($p < 0.05$); ** – reliability of differences in indicators of groups 1–4 ($p < 0.05$); *** – reliability of differences in indicators of groups 2–3 ($p < 0.05$); **** – reliability of differences in indicators of groups 2–4 ($p < 0.05$)

A significant ($p < 0.05$) increase in air sound perception thresholds was found in patients of the 3rd and 4th groups compared to patients without carbohydrate metabolism disorders. The exception is the absence of a statistically significant difference in sound conduction parameters at frequencies of 500, 1000 and 8000 Hz in patients of the 2nd and 3rd groups and at a frequency of 4000 Hz in patients of the 2nd and 4th groups ($p < 0.05$), which clearly shown in Fig. 6.

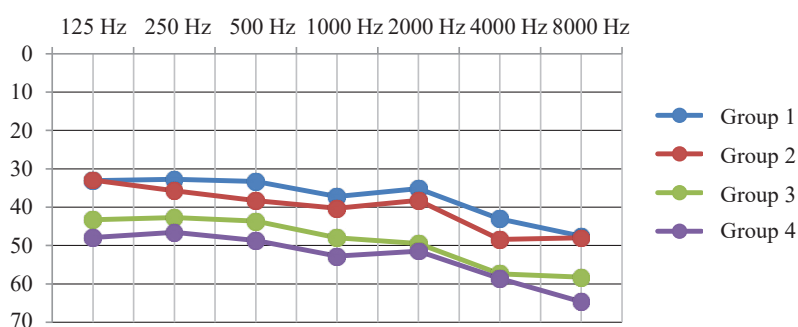


Fig. 6. Air conduction thresholds in patients with AOM

Sound perception was assessed by the level of bone conduction sound thresholds (Table 6).

A sharp deterioration in sound perception was noted against the background of a significant increase in the thresholds of bone conduction sounds ($p < 0.001$) at all frequencies in the 3rd and, especially, in the 4th groups compared with patients without impaired carbohydrate metabolism (groups 1 and 2). At the same time, there was no significant difference in the thresholds of bone- and air-conducted sounds in patients of groups 1–2 and 3–4 ($p > 0.05$). Differences in indicators are illustrated in Fig. 7.

When performing a «routine» clinical diagnostic algorithm in patients with AOM, CT examination of the temporal bone pyramids is not mandatory and is performed taking into account individual indications. These include increased pain syndrome, the appearance of reactive phenomena,

the ineffectiveness of conservative therapy, the absence or insufficient positive dynamics of the restoration of auditory function, the patient's refusal to perform diagnostic tympanopuncture. Considering these indications, the need for CT examination of the pyramids of the temporal bones arose in 48.6 % of patients with DM type II and in 57.9 % of patients with impaired carbohydrate metabolism of the 4th group, while CT was performed only in 2.7 % of cases in patients of the 1st and in 17.2 % of patients of the 2nd group. There were no destructive changes in the mastoid process in patients with impaired carbohydrate metabolism in any case. However, in all patients, a decrease in pneumatization of mastoid cells was found: filling of cells with a soft tissue component (inflammatory content) in the periantral (20 %), periantral and angular zones (30 %), total and subtotal filling of mastoid cells in 50 % of cases (**Fig. 8 A, B**) with horizontal liquid levels in 25 % of them.

Table 6
Bone conduction thresholds in patients with AOM

Group	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Group 1 (n = 36)	6.67±0.7 (0-20)* **	8.3±0.6 (0-15)* **	9.6±0.98 (0-35)* **	11.1±0.87 (0-20)* **	15.8±1.3 (0-40)* **	18.75±1.7 (5-50)* **	18.7±1.4 (5-40)* **
Group 2 (n = 29)	9.5±1.3 (0-30)*** ****	10.7±1.4 (0-40)*** ****	11±1.5 (0-40)*** ****	12.8±1.8 (0-50)*** ****	17.6±2.5 (0-60)*** ****	20±2.7 (0-60)*** ****	17.05±2.3 (5-40)*** ****
Group 3 (n = 37)	19.97±1.6 (5-40)	18.65±1.7 (0-40)	22.3±2 (0-50)	27.03±2.5 (5-60)	38.1±2.7 (10-70)	38.14±2.2 (20-70)	37.4±1.9 (20-60)
Group 4 (n = 38)	19.6±1.6 (10-50)	18.9±1.9 (5-50)	20.9±2.1 (10-65)	23.3±2.27 (10-70)	31.3±2.2 (10-65)	35.5±2.1 (5-60)	33.2±2.1 (10-60)

Note: * – reliability of differences in indicators of groups 1-3 ($p < 0.001$); ** – reliability of differences in indicators of groups 1-4 ($p < 0.001$); *** – reliability of differences in indicators of groups 2-3 ($p < 0.001$); **** – reliability of differences in indicators of groups 2-4 ($p < 0.001$)

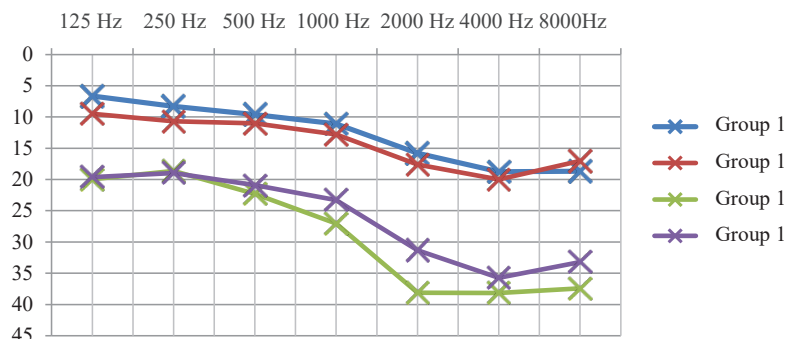


Fig. 7. Bone conduction thresholds in patients with AOM

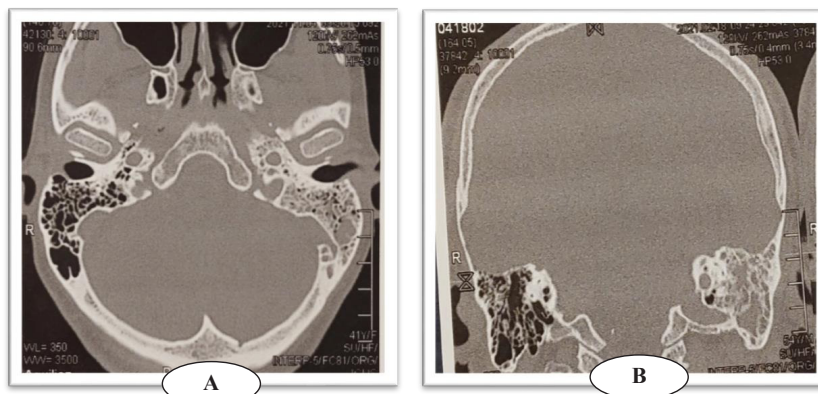


Fig. 8. Spiral computed tomography of patients with AOM against the background of impaired glucose metabolism in axial (A) and coronal (B) projections

According to the results of CT examination of the temporal bones in patients with impaired carbohydrate metabolism, tympanopuncture and paracentesis were performed in 40.5 % of cases in group 3 and in 44.7 % of patients in group 4. Shunting of the tympanic membrane was performed in 26.3 % of cases against the background of impaired glucose metabolism and in 21.6 % of patients with DM type II. 10.8 % of patients with DM type II underwent surgical treatment – antromastoidotomy. At the same time, before the operation, tomograms showed no signs of destruction of bone trabeculae, and intraoperatively, softening of the bone was found in the absence of abundant purulent contents.

4. Discussion of the results

The study, systematization and analysis of the available clinical indicators revealed the presence of features of the course of acute otitis media in patients with impaired carbohydrate metabolism.

The main clinical feature is the discrepancy between the duration of the disease history, complaints and objective data on the state of the cellular structure of the mastoid process and auditory function, primarily the increase in the thresholds of perception of bone conduction sounds. The presence and nature of changes in the mastoid process according to CT examination of the pyramids of the temporal bones, a deeper lesion of sound perception with an intact, often cloudy tympanic membrane with fuzzy contours, indicate the likelihood of the formation of latent mastoiditis, taking into account the characteristics of bone metabolism inherent in diabetes mellitus. Against this background, complaints about a feeling of «heaviness» and periodic short-term pain in the behind-the-ear region acquire clinical significance, which, in the absence of reactive phenomena, are often regarded as neuralgia, especially in older patients, which includes most patients with impaired carbohydrate metabolism.

It has been established that objective symptoms of protrusion of the posterior and posterior-upper parts of the tympanic membrane, the presence of perforation in these quadrants, which often indicate the state of the cellular system of the mastoid process, and which should be taken into account in the differential diagnosis of latent mastoiditis, have diagnostic value.

The absence of statistically significant differences in laboratory parameters and audiometry data in patients of groups 1 and 2, as well as groups 3 and 4, testifies in favor of the pathogenetic significance of carbohydrate metabolism disorders for the formation of AOM course features. At the same time, the unreliability of the difference in the indices of patients in the 3rd and 4th groups indicates the significance of transient hyperglycemia even in the absence of diabetic complaints and a confirmed diagnosis of diabetes mellitus. This fact is confirmed by a statistically significant increase in the content of glucose and glycosylated hemoglobin in the blood in patients of the 4th group compared with patients of the 1st and 2nd groups ($p < 0.05$). The established strong correlation between blood glucose and glycated hemoglobin against the background of inflammation of the middle ear structures in patients with DM type II and the presence of a correlation (albeit weak) in patients with transient hyperglycemia allow us to consider the determination of glycated hemoglobin as an informative criterion for diagnosing a complicated course of AOM.

Since the presence of type 1 diabetes mellitus was not detected in any of the cases, we can speak about the significance of DM type II in the pathogenesis of AOM.

The adverse effect of the comorbid background in patients with impaired carbohydrate metabolism is manifested by significant changes in individual (leukocytes, eosinophils, monocytes) indicators of the morphological composition of peripheral blood against the background of an increase in the level of endogenous intoxication, in particular RNR and LII Kalf-Kalif in the fourth group.

Study limitations. The study is limited to a certain specific time interval (2020), during which the main sample array was conducted and reliable results were obtained. The limitation of the study is the exclusion of a certain category of patients from it due to the presence of contraindications for CT examination, diagnostic measures.

Prospects for further research is to study the features of bone metabolism in patients with impaired carbohydrate metabolism and to identify diagnostically and clinically significant markers. It is also promising to develop a clinical diagnostic algorithm for determining an effec-

tive AOM treatment strategy, taking into account the possibility of developing latent mastoiditis in patients with impaired carbohydrate metabolism and the previously studied clinical portrait of patients with DM type II [29].

5. Conclusions

Taking into account the obtained statistical data, patients over 18 years of age with AOM as the main diagnosis make up 6.2–7.2 % of all nosological forms of ENT diseases in the hospital, while the proportion of acute otitis media among all ear diseases was significantly higher and ranged from 17.3 % to 30.3 %. At the same time, patients with AOM in 16.1 % of cases were previously diagnosed with DM type II.

In patients with AOM, 2 types of carbohydrate metabolism disorders can be distinguished: DM type II and transient hyperglycemia without diabetic complaints and anamnesis. Clinically and pathogenetically significant is not only persistent disorders of carbohydrate metabolism (established diagnosis of DM type II), but also transient hyperglycemia, therefore, such patients should be isolated from the contingent of patients with AOM for examination and treatment. Significant signs of transient hyperglycemia in patients with AOM should include even a single increase in peripheral blood glucose, the presence of glucose and (or) protein in the urine, an increase in the level of glycated hemoglobin, and a burdened endocrinological history.

Disturbance of carbohydrate metabolism contributes to the emergence and maintenance of a certain premorbid background, which forms the prerequisites for the development of latent mastoiditis, which is indicated, among other things, by changes in the composition of peripheral blood, leukocyte indices, and a deterioration in the function of sound perception in AOM against the background of impaired glucose metabolism.

Diagnostic significance in patients with AOM against the background of carbohydrate metabolism disorders are complaints of pain and a feeling of «heaviness» in the behind-the-ear region in the absence of reactive phenomena, complaints of a feeling of «pulsation» in the ear, dizziness, the presence of a cloudy tympanic membrane with protrusion or perforation in the posterior or posterior-upper sections, asymmetric increase in the thresholds of perception of bone conduction sounds above 25 dB.

«Early» CT examination, taking into account diagnostically significant symptoms, will allow choosing an effective individually directed tactics for the treatment and rehabilitation of patients.

Conflict of interests

The authors declare that they have no conflicts of interest.

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