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EFFECTIVENESS OF ULTRASOUND EXAMINATION IN THE DIAGNOSIS OF PATHOLOGICAL PROCESSES OF THE MAXILLOFACIAL AREA IN CHILDREN

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In everyday clinical medical practice, there is a steady increase in the frequency of ultrasound examinations. We determined the effectiveness of its use in diagnosing pathological processes of the maxillofacial region based on the examination of 78 children aged 3 months to 17 years with various head and neck pathologies. The most significant number of ultrasound examinations was performed in patients with various nosological forms of lymphadenitis. As part of this work, 9 Doppler scans were performed. The results allow us to state that ultrasound examination, distinguished by its safety and effectiveness, is quite promising, requiring wider use in diagnosing and diagnosing diseases of the salivary glands, pathology of soft tissues of the maxillofacial region, lymph nodes, and vascular formations. Against its high informativeness, the possibility of some limitations of using diagnostic X-ray techniques and invasive diagnostic interventions and a more rational use of other radiation examination methods – computed tomography and magnetic resonance imaging – seems quite justified.

Key words: children, ultrasound examination, Doppler ultrasonography, maxillofacial region, salivary glands, lymphadenitis, neck cysts.

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ЕФЕКТИВНІСТЬ УЛЬТРАЗВУКОВОГО ДОСЛІДЖЕННЯ В ДІАГНОСТИЦІ ПАТОЛОГІЧНИХ ПРОЦЕСІВ ЩЕЛЕПНО-ЛИЦЕВОЇ ДІЛЯНКИ У ДІТЕЙ

У повсякденній клінічній медичній практиці спостерігається невпинне зростання частоти застосування ультразвукового дослідження. Нами визначено ефективність його використання в діагностиці патологічних процесів щелепно-лицевої ділянки на основі обстеження 78 дітей віком від 3 місяців до 17 років з різною патологією голови та шиї. Найбільше УЗД-обстежень проведено у пацієнтів з різними нозологічними формами лімфаденітів. В рамках вказаної роботи виконано 9 доплерографій. Отримані результати дозволяють стверджувати, що ультразвукове дослідження, відрізняючись безпечністю і результативністю, є досить перспективним, потребуючи більш широкого використання в діагностиці та диференційній діагностиці захворювань слинних залоз, патології м'яких тканин щелепно-лицевої ділянки, лімфатичних вузлів, судинних утворень. На тлі його високої інформативності досить обгрунтованим виглядає можливість деякого обмеження застосування діагностичних рентгенологічних методик й інвазивних діагностичних втручань і більш раціонального застосування інших променевих методів обстеження – комп'ютерної та магнітно-резонансної томографій.

Ключові слова: діти, ультразвукове дослідження, доплерографія, щелепно-лицева ділянка, слинні залози, лімфаденіт, кісти шиї.

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In clinical medical practice, modern research methods are widely used, among which today the most diagnostically significant and informative are, first of all, radiation-computed and magnetic resonance tomography and ultrasound. They usually allow you to determine the volume of the pathological focus, its prevalence, its relationship with adjacent tissues, regional rheological features of the examination area, etc. But in everyday medical work, there is a steady increase in the frequency of use of ultrasound examination (US), which is based on the effect of registering reflected ultrasound radiation and forming a linear (static) or multidimensional (dynamic) image [1, 4, 7].

Effective implementation of ultrasound diagnostics in obstetric practice, including for examination of the maxillofacial area (MFA), makes the monitoring of the stages of embryo development an object of medical interest with the possibility of intrauterine detection of malformations of the fetal head and neck and a number of syndromes with facial features (Down syndrome, Turner syndrome, Goldenhar syndrome, etc.), recognition of the presence of teratomas, vascular tumors, etc. [2, 3, 14].

In some cases, timely identification of these changes forces us to reconsider the tactical approach to pregnancy management, to foresee the need to implement specific organizational, administrative, and therapeutic measures in the perinatal and neonatal periods, in particular, expanding the obstetric team with the involvement of maxillofacial surgeons to provide the earliest possible specialized care at all stages of observation. Sometimes, it is necessary to decide to terminate a pregnancy at the request of relatives or for medical reasons [5, 6, 11].

At the same time, the modern version of ultrasound examination of soft tissues of the face and neck is performed on equipment designed for the examination of peripheral structures without the use of any special devices (the use of linear sensors with a vibration frequency of 5.0–7.5–9.0 MHz is sufficient), which makes it quite widespread in the clinic of maxillofacial surgery and surgical dentistry, including in pediatric practice [8, 10, 12, 13].

Color Doppler imaging is based on the Doppler effect – the reflection of ultrasonic waves with a changed frequency from moving objects. Ultrasound examination using Doppler techniques is, in most cases, the only possible diagnostic choice for pediatric patients. Using modern specialized sensors during scanning allows for improved visualization and more accurate diagnosis. In addition, Doppler imaging allows for the differentiation of types of vascular anomalies with fast and slow flow [9, 15].

Despite the above, available literature sources contain only scattered data on the effectiveness of ultrasound examination and the practical significance of its results in the clinic of surgical dentistry and maxillofacial surgery, especially in children.

The purpose of the study was to determine the effectiveness of using ultrasound in the diagnosis of pathological processes of the maxillofacial area in children.

Materials and methods. Considering that ultrasound does not require special patient preparation and has no age restrictions, over 3 years we examined 78 children aged 3 months to 17 years who were undergoing treatment at the clinic of the Department of Pediatric Surgical Dentistry of Poltava State Medical University, located based on the multidisciplinary surgical department of the municipal enterprise “Children's City Clinical Hospital” of the Poltava City Council with various pathologies of the maxillofacial area. There were 43 boys and 35 girls.

The examination was performed on a Samsung Medison RS85 device with a linear sensor LA3-16A. The maximum penetration into the tissue depth was 8.3 cm, and the oscillation frequency was 3–16 MHz.

Ultrasound was used not only for diagnostic purposes but also with an already-established diagnosis to identify individual features of the dynamics of the disease, which could be important in planning treatment.

Examination of the child and planning of treatment measures were carried out without harm to his health, after parental consent, and with the permission of the ethics committee. At the same time, we followed the recommendations of the Helsinki World Medical Association and the Geneva supplements.

Patients' personal data and any identifying information were excluded from the analysis to ensure confidentiality and protection. This data is securely stored in an electronic format with limited access.

Results of the study and their discussion. All examined children were divided according to the identified clinical diagnoses.

Table 1 presents the quantitative structure of the examined patients, which shows that the most significant number of ultrasound examinations were performed in children with various nosological forms of lymphadenitis.

Table 1

Quantitative structure of the examined pathology

Pathological process	Number of observations	
	abs.	%
Lymphadenitis	42	53.9
Adenophlegmona	10	12.8
Hemangioma	9	11.5
Thyroglossal duct cyst	7	9
Chronic parenchymal mumps (CPM)	6	7.7
Lymphangioma	4	5.1

During the examination, ultrasound characteristics of the formations were determined in all cases:

– A – quantity (singular, multiple, exact number);

– B – sizes (small, medium, large, exact sizes);

– C – shape and proportions (round, oval, etc.);

– D – nature of the contours (clear, fuzzy, even, uneven);

– E – structure (uniform or non-uniform);

– F – degree of echogenicity (ability to reflect ultrasound waves) (hyper-, hypo- or anechoic) and density;

– G – the presence or absence of inclusions and their distribution in the formation.

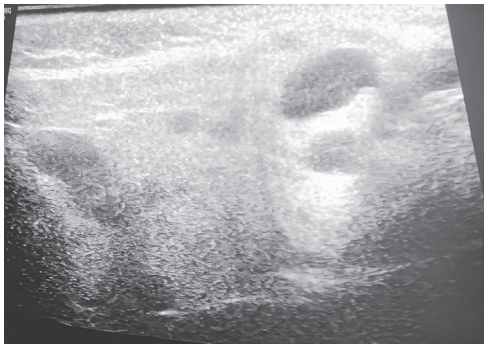
We consider it appropriate to summarize the most significant, in our opinion, ultrasound results obtained in this study.

Ultrasound examination of diseases of the major salivary glands has significantly contributed to the diagnosis of various forms, allowing for effective differential diagnosis of chronic sialadenitis and reactive changes in the major salivary glands and distinguishing surgical from non-surgical pathology.

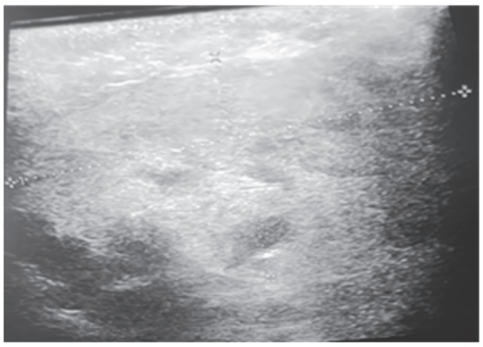
The study was often conducted with an exacerbation of chronic parenchymal mumps. In addition to the primary signs listed above, the presence of areas of sclerosis and the condition of the capsule (normal or thickened) were determined in the parotid salivary gland. Attention was paid to the size of hypo- or hyperechoic areas, the condition of the ducts (presence of dilation or narrowing and their degree), the presence of concrements in the parenchyma or the duct ("acoustic track"), and the size of intraglandular lymph nodes was determined.

Usually, the condition of not only "causal" but also symmetrical or other unilateral salivary glands was examined.

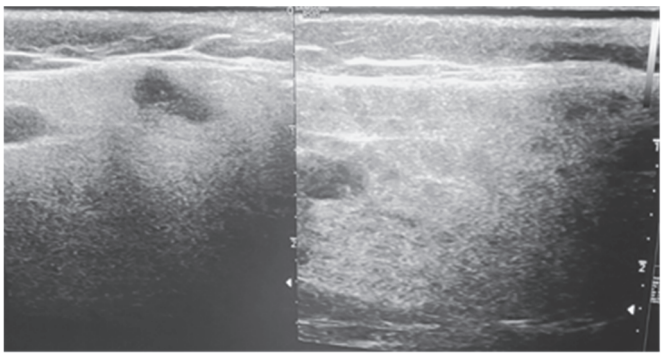
It is generalized that in the presence of mild clinical manifestations of exacerbation of CPM, mainly changes presented on the ultrasound scan occurred (Fig. 1).



A



B



C

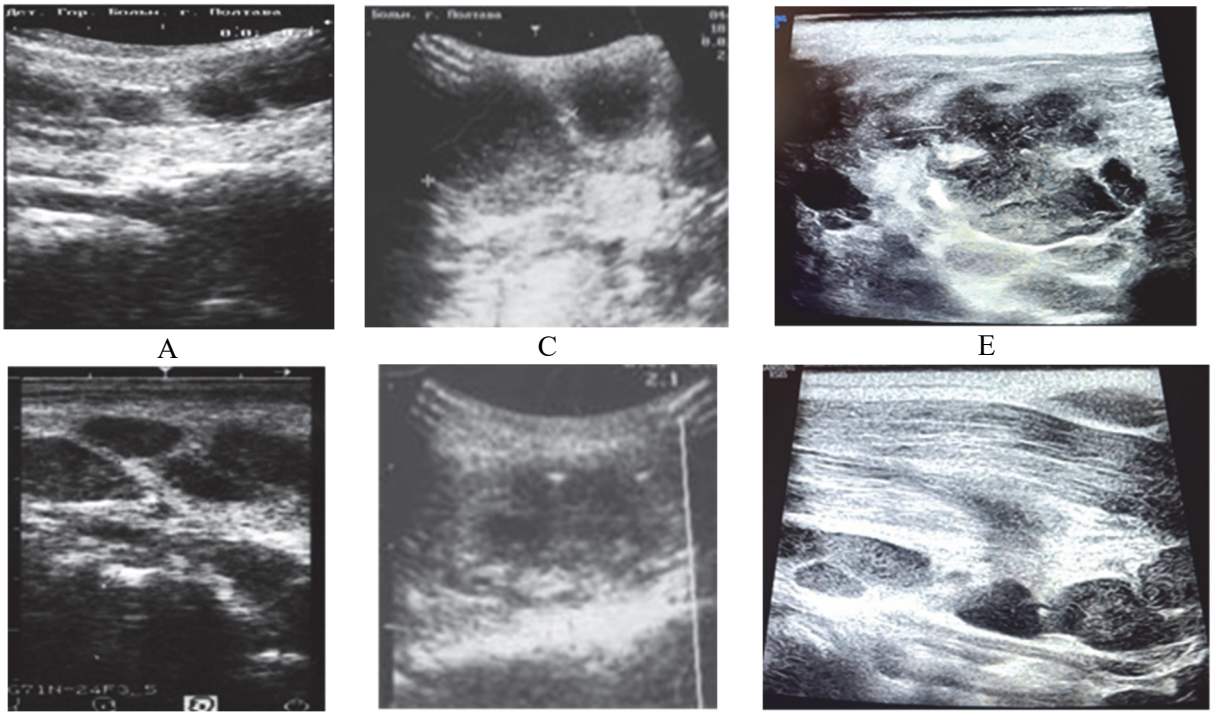
Fig. 1. Ultrasound images of a patient exacerbating chronic parenchymal mumps on the left. A, B – heterogeneous hyperechoic structure of the parotid salivary gland with slight anechoic inclusions and oval hypoechoic areas (according to the location of the lymph nodes); C – comparison of the structures of the right (healthy) and left (inflamed) parotid salivary glands.

Thus, an increase in the size of the salivary glands and heterogeneity of the structure of their parenchyma with a moderately pronounced decrease in echogenicity were observed; sometimes – single echogenic inclusions in the parenchyma corresponding to protein clots in the large ducts of the glands. They were formed due to impaired production and evacuation of secret ons, visualization of the capsule as a thin echo-dense line, and usually no dilation of ducts of various calibers. A small number of small anechoic inclusions measuring 2–3 mm in size could be detected in the gland parenchyma, corresponding to the presence of sialectasis.

With pronounced manifestations of inflammation, changes in the parenchyma were more pronounced: an increase in the size of the glands, decreased echogenicity, characteristic of sialectasis, anechoic inclusions in the parenchyma of the gland measuring 3–4 mm due to their filling with secretion. The gland capsule is thickened and compacted. Sometimes linear echogenic inclusions were identified as reflecting the compacted connective tissue stroma, vessel walls, and gland ducts. Reactively enlarged lymph nodes could be identified in the parenchyma.

In 2 (2.6 %) patients, a clinically latent inflammatory process was detected in the symmetrical gland, as evidenced by a decrease in the echogenicity of the parenchyma and anechoic inclusions.

A lymph node without pathological changes during ultrasound examination has reduced echogenicity by the surrounding tissues, which in a comparative aspect allowed us to visualize the changed lymph nodes according to the above-mentioned number of main signs and with high reliability to reconstruct the structural changes occurring in them depending on the nosological form of the disease (Fig. 2).



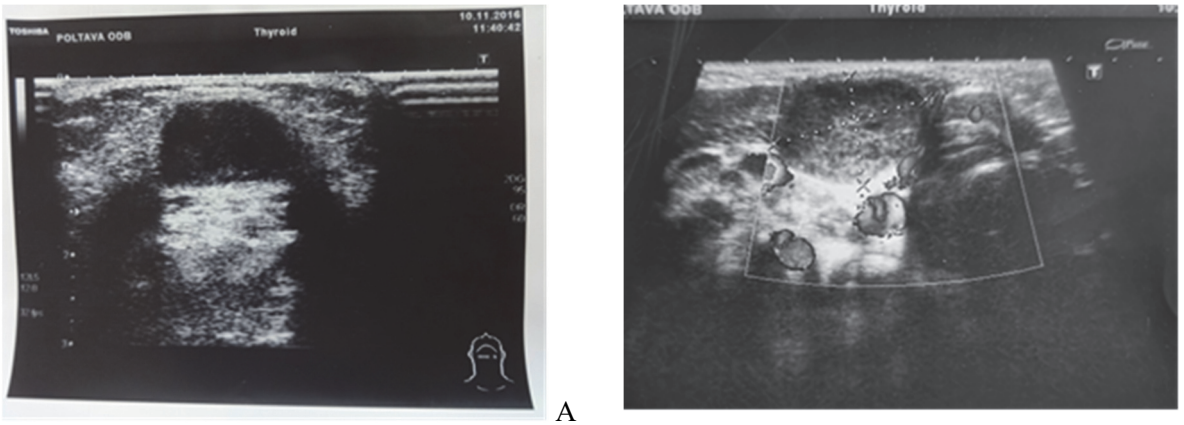
A C E

B D F

Fig. 2. Ultrasound results of patients with acute serous lymphadenitis (A, B), acute purulent lymphadenitis (C, D), and adenophlegmon of the neck (E, F). A – lateral surface of the neck on the left (hypoechoic areas of ovoid shape with clear boundaries up to 1.5 cm in diameter, limited by echogenic surrounding tissues); B – right parotid-masticatory area (subcapsular – four lymph nodes with hypoechoic structure, different in size, with clear contours). C, D – enlarged lymph nodes with anechoic and hypoechoic structures. E – non-contoured purulent focus with no clear structure; F – reactively enlarged adjacent lymph nodes of varying echogenicity with clear boundaries, compaction of adjacent soft tissues of the neck).

Ultrasound examination of congenital cysts of the head, neck, and oral cavity, which constitute a significant proportion of maxillofacial diseases, allows for their visualization, clarification of the structure and organotopic characteristics, based on which basic measures for determining the scope and stage of surgical intervention are formed and planned.

Recognizing the species of congenital cysts was necessary for us, considering their requirement for mandatory surgical treatment and the potential for radical removal to prevent recurrence. Thus, if dermoid, epidermoid, or retention cysts of the sublingual salivary gland are clearly demarcated formations and mostly do not have fistulas, then thyroglossal cysts (Fig. 3) are usually associated with the hyoid bone or the root of the tongue. Branchiogenic cysts often have fistulas in the lateral wall of the pharynx, which determine the tactical and technical features of surgical intervention in this pathology.



A B

Fig. 3. Ultrasound images of patients with median neck cysts (A, B).

We often had to differentiate congenital MFA cysts from the cystic form of lymphangioma, a malformation of the lymphatic vessels. Its cystic form was typically characterized by multi-chambered cavities or multiple cyst-like formations, with a significant prevalence, clear boundaries, and a homogeneous hypoechoic structure (Fig. 4 A, B). In the case of suppuration, the clarity of the contours disappeared, and the structure became heterogeneously hyperechoic (Fig. 4 C, D).

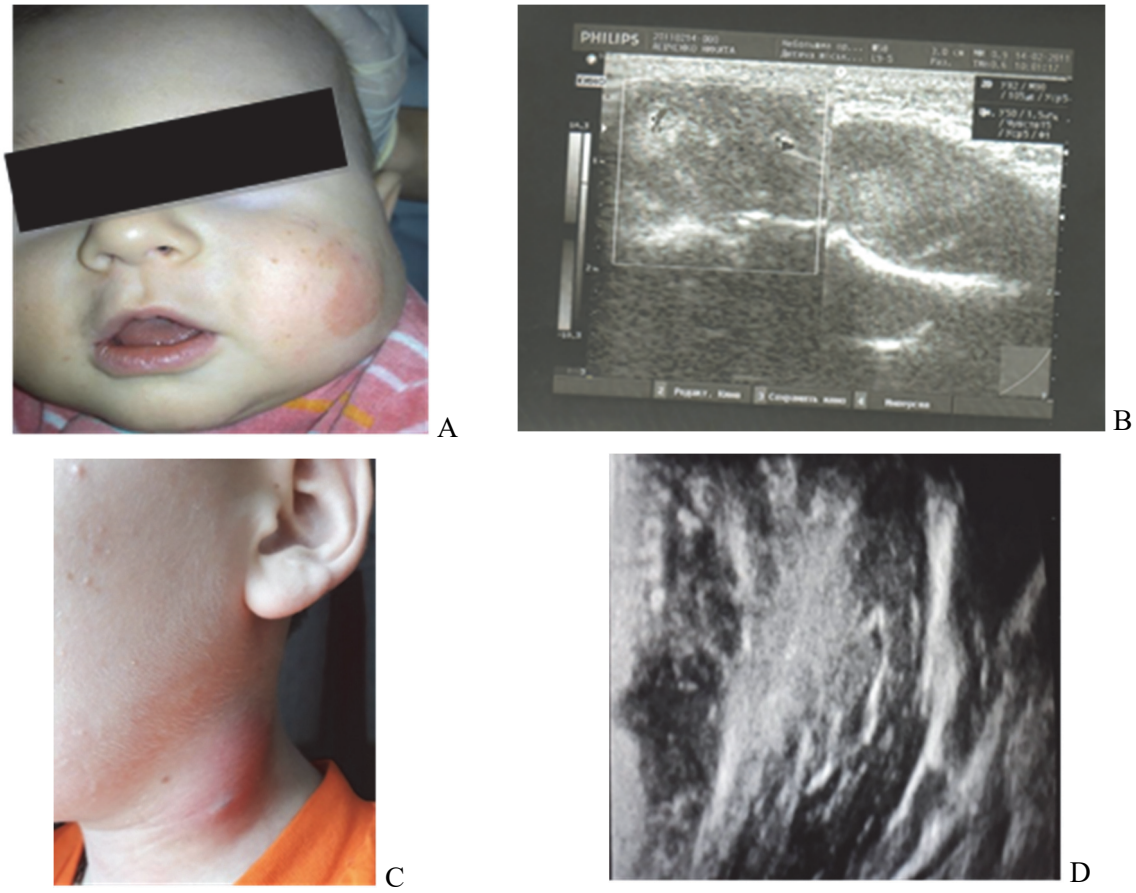


Fig. 4. Appearance of children with lymphangioma of the left cheek (A) and suppurating lymphangioma of the left neck (C) and their ultrasound images, respectively. B – oval hypo- and hyperechoic areas with clear boundaries and smooth contours, D – non-contoured purulent focus with no clear structure.

Differential diagnosis was significantly difficult in cases of a single-cell tumor with limited spread.

If necessary, Doppler imaging was used to determine the nature of blood flow. Such research was primarily conducted in cases of lymphatic system pathology. A total of 9 Doppler scans were performed within the scope of this work.

Ultrasound examination of maxillofacial tissues is quite informative. In most cases, it satisfies clinical needs and requirements: almost all parts of the maxillofacial region and neck, including the body and root of the tongue, are accessible for examination with external sensors. The only exceptions are the upper parts of the peripharynx and the pterygomandibular space, which are shielded by the branch of the mandible [2, 4].

For an ultrasound diagnostician, the maxillofacial region and neck are of great professional interest, as the development of diseases from various nosological groups (inflammatory, autoimmune, degenerative-dystrophic, tumors, and tumor-like formations) and the presence of various embryological defects (angiomas, lymphadenopathy, congenital cysts, etc.) are possible here. The differential diagnostic process is complicated because the maxillofacial region is a zone of massive infection and inflammatory processes, with all the varied and pronounced clinical symptoms that can overlap with primarily non-inflammatory diseases [6, 11].

Additional difficulties in interpreting ultrasound results are created by the complex anatomical structure of the maxillary sinus and its topographic-anatomical relationships with other structures. However, it is the anatomical detailing that is of great importance, as it determines the organ of the pathological process by clarifying the topographic and anatomical features of its distribution. This, in turn, along with determining the nosological form of the disease, is one of the most critical tasks of diagnosis. This is especially relevant considering the location of the intervention. During operations in the maxillofacial region, surgeons face a particularly challenging task of finding a compromise between optimal access for the most radical intervention possible and minimizing aesthetic defects [5, 7].

Conclusions

1. Ultrasound examination, distinguished by its safety and effectiveness, is considered quite promising and is recommended for broader use in the diagnosis and differential diagnosis of diseases of

the salivary glands, soft tissue pathology in the maxillofacial region, lymph node involvement, and vascular formations.

2. Against the background of the high informativeness of ultrasound examination, the possibility of some limitations of diagnostic X-ray techniques and invasive diagnostic interventions and more rational use of computed and magnetic resonance tomography seems entirely justified.

3. The ease of performance, non-invasiveness, and harmlessness of ultrasound examination allow its repeated use in patients to monitor the dynamics of the pathological process and assess the effectiveness of therapeutic measures.

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