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**OPTIMIZATION OF DIAGNOSTICS OF ACUTE HEMATOGENOGENIC EPIPHYSIS  
OSTEOMYELITIS IN CHILDREN OF EARLY AGE**

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**ЁШ БОЛАЛАРДА ЎТКИР ГЕМАТОГЕН ЭПИФИЗАР ОСТЕОМЕЛИТ ДИАГНОСТИКАСИНИ  
ТАКОМИЛАШТИРИШ**

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**ОПТИМИЗАЦИЯ ДИАГНОСТИКИ ОСТРОГО ГЕМАТОГЕННОГО ЭПИФИЗАРНОГО  
ОСТЕОМИЕЛИТА У ДЕТЕЙ РАННЕГО ВОЗРАСТА**

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**Аннотация.** Ёш болаларда ўткир гематоген эпифизар остеомиелитни даволашнинг муваффақияти, касалликни эрта таъхислаш ва септик асоратларни ривожланишидан олдин амалга ошириладиган оптимал жарроҳлик амалиётидир. Тадқиқотнинг мақсади: ёш болаларда ОГЭОда ултратовуш текширувини ўтказиш имкониятини таҳлил қилиш. Тадқиқот материал ва усуллари. 2011 йилдан бошлаб ОГЭО бўлган беморларда ултратовуш текшируви эрта таъхис қўйиш алгоритмига киритилган. Ушбу тадқиқот ОГЭОга шубҳа қилинган 72 бемор томонидан ўтказилган. Шундай қилиб 72 бемордан ОГЭО фақат 47 да тасдиқланган ва қолган 25 бемор учун таъхис инкор қилинган. Хулосалар. Даволашнинг дастлабки босқичида ОГЭОни таъхислашда танлаш усули ултратовуш текшириш ҳисобланади. Ундан инвазив бўлмаган усул сифатида ОГЭОга шубҳали, ёш болаларни текшириш учун диагностик тадбирлар мажмуасида фойдаланиш мумкин. Ултратовуш текшируви касалликнинг дастлабки босқичида мушаклар ва юмшоқ тўқималарда шийи ва инфилтратив ўзгаришларни, шунингдек бугимларда суюқлик тўпланишини аниқлашга имкон беради. Усул нурли таъсирнинг йўқлиги сабабли хавфсиздир, юқори информатив ва уни тез-тез қўллаш мумкин.

**Калит сўзлар:** ўткир гематоген эпифизал остеомиелит, ёш болалар, ултратовуш текшириш.

**Abstract.** The success of treatment of acute hematogenous epiphyseal osteomyelitis (AHEO) in young children depends on the early diagnosis of the disease and the optimal surgical intervention carried out before the development of threatened conditions and septic complications. The aim of the study is an analysis of the possibility of ultrasound in AHEO in young children. Materials and research methods. Since 2011, an ultrasound study has been included in the algorithm for early diagnosis in patients with AHEO. This study was performed by 72 patients with suspected AHEO. So, from 72 patients, AHEO was confirmed only in 47, and the remaining diagnosis was excluded for the remaining 25 patients. Conclusions. In the diagnosis of AHEO at an early stage of the process (in the early days), the method of choice is ultrasound. It can be used as a non-invasive method in a complex of diagnostic measures for examination of young children with suspected AHEO. Ultrasound allows you to detect edema and infiltrative changes in the muscles and soft tissues, as well as fluid accumulation in the joint at an early stage of the disease. The method is safe due to the absence of radiation exposure, highly informative, its frequent application is possible.

**Key words:** acute hematogenous epiphyseal osteomyelitis, young children, ultrasound.

**Relevance.** According to many scholars, the success of the treatment of acute hematogenous epiphyseal osteomyelitis in young children depends on the early diagnosis of the disease and the optimal surgical intervention carried out before the development of threatened conditions and septic complications [1,7,10, 14]. Clinical observations of a number of authors show that early rehabilitation of the primary lesion (up to three days) can prevent septicopy in many sick children, and subsequent complex treatment leads to recovery in 95% of patients [2, 3, 5, 8, 9].

In the diagnosis of acute hematogenous epiphyseal osteomyelitis, a thorough history, clinical examination of the patient, and modern diagnostic studies are crucial [4, 6, 12].

However, many researchers have noted that the traditional methods for diagnosing osteomyelitis at an early stage of its development are insufficiently informative (Abaev Yu.K. and others, 2004; Bonhoeffer J. and others, 2001). This fact is associated with a variety of clinical manifestations, the “atypical” course of local and generalized forms of the disease, the absence of pathognomonic signs, early radiological manifestations, especially in young children. As a result of this, a large percentage of diagnostic errors are made by doctors of all levels and specialties both in the prehospital and hospital stages of the diagnosis of this formidable disease. A number of studies conducted in this area have made it possible to make some rational suggestions in the early diagnosis of acute hematogenous epiphyseal osteomyelitis in young children [1, 2, 3, 6, 8, 9, 11, 13]. In the early diagnosis of acute hematogenous epiphyseal osteomyelitis in young children, ultrasound is successfully used. Comparative echolocation of the symmetrical segments of the healthy and diseased limbs in young patients reveals the following changes: accumulation of the fluid component in the joint cavity; soft tissue edema in the affected area; compaction and thickening of the joint capsule by 0.15-0.2 mm compared

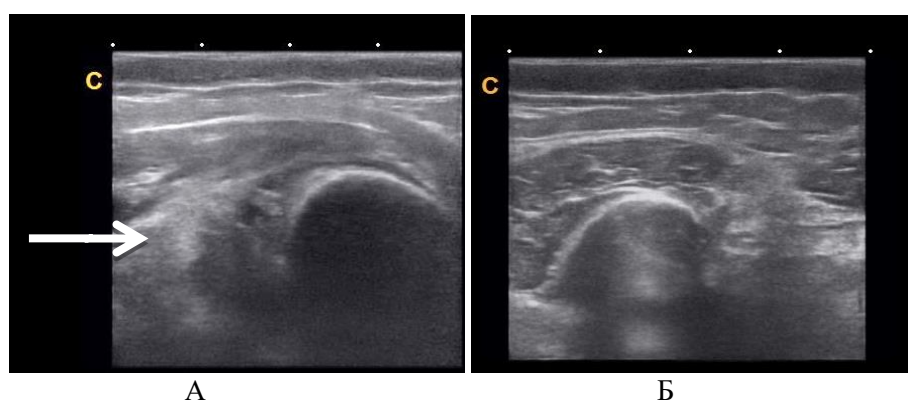
with the contralateral side; thickening of the periosteum by 0.3 mm compared with the healthy side, the appearance of roughness of its contour.

**The aim of the study** is an analysis of the possibility of ultrasound in AHEO in young children.

**Materials and research methods.** Ultrasound has been included in the algorithm for early diagnosis in patients with acute hematogenous epiphyseal osteomyelitis. This study was performed by 72 patients with suspected acute hematogenous epiphyseal osteomyelitis. So, from 72 patients, acute hematogenous epiphyseal osteomyelitis was confirmed only in 47, and the remaining diagnosis was excluded for the remaining 25 patients since 2011. An echographic study of the hip joint (HJ) produced a polypositional study. They were performed on a “DUS-6” ultrasound machine, China, with a 5-10 MHz multifrequency linear transducer in the supine position. Ultrasound was performed immediately upon admission and before surgery.

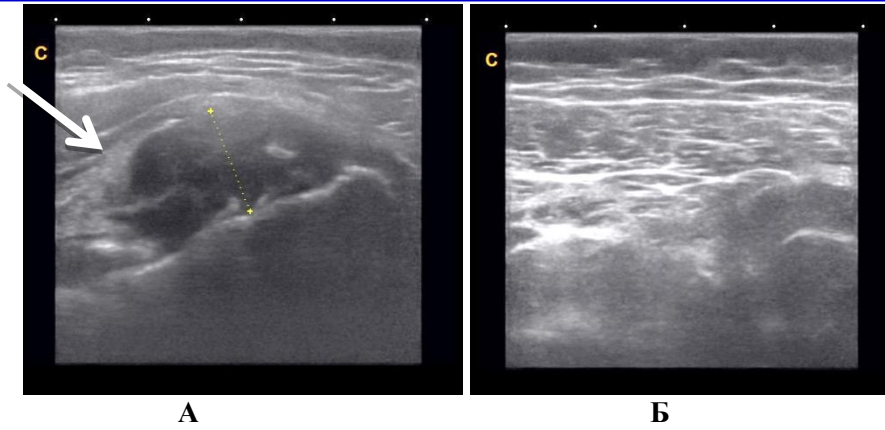
Ultrasound, the following anatomical structures were evaluated: soft tissues (skin, subcutaneous fat, muscles), joint and condition of the joint capsule (thickness, density, integrity), articular surfaces of bones, volume and consistency of joint fluid, periosteum (thickness and density, subperiosteal fluid accumulation). At the same time, an ultrasound was performed on a symmetric section of a healthy limb to compare the revealed pathological changes in tissues with similar structures.

**Results.** When ultrasound was performed in patients with acute hematogenous epiphyseal osteomyelitis 1–3 days after the onset of the disease (16 patients), pronounced edema of the soft tissues surrounding the affected joint was observed, which manifested itself in their “blurred” borders between the anatomical layers and a decrease in echogenicity. Soft tissues were enlarged in comparison with the healthy side, a thickening of the hip joint capsule was observed, and the fluid component was determined in the joint without pathological inclusions (fig. 1.).

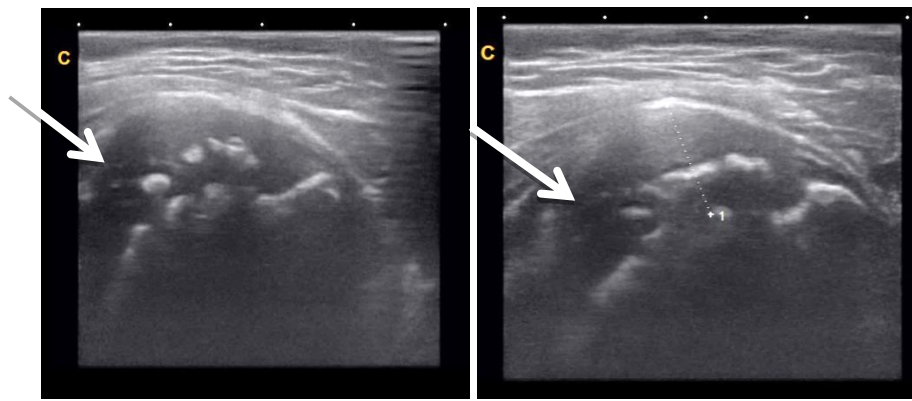


**Fig. 1.** An echogram of the right hip joint, with acute hematogenous epiphyseal osteomyelitis, 2 days of illness.

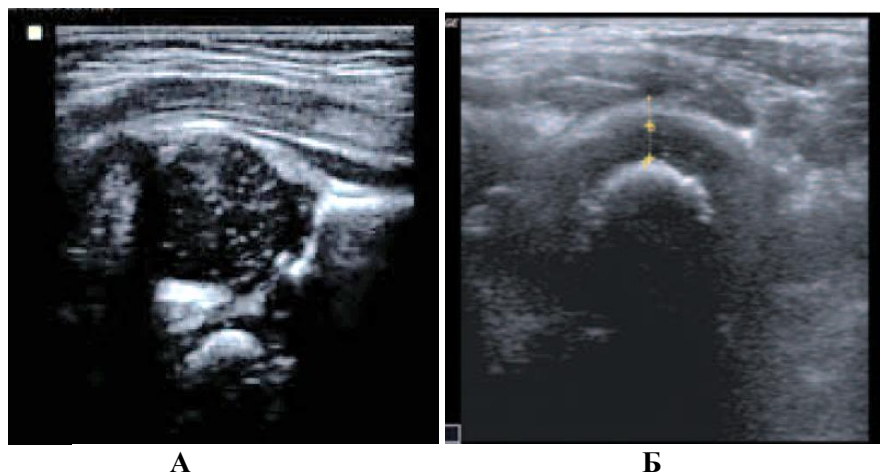
In the picture, pronounced edema of the soft tissues surrounding the hip joint and “lubrication” between the layers of soft tissues (a) are determined. On the echogram of a healthy joint, soft tissues are structural, all layers are clearly visualized (b).



**Fig. 2.** An echogram of the right hip joint, with acute hematogenous epiphyseal osteomyelitis, day 6 of the disease. In the picture, pronounced edema of the joint capsule with hyperechoic fluid is determined; soft tissue differentiation is reduced (a). On the echogram of a healthy joint, soft tissues are structural, all layers are clearly visualized (b).



**Fig. 3.** An echogram of the left hip joint, with acute hematogenous epiphyseal osteomyelitis. The picture shows hyperechoic fluid in the soft layers surrounding the affected joint. In the joint cavity, exudate, a heterogeneous structure with pathological inclusions, the lumen of the joint cavity is narrowed. The joint surfaces of the bones forming the vehicle are fuzzy, rough (indicated by arrows), the femoral head loses its sphericity and is fragmented.



**Fig. 4.** Echogram of the hip joint, with RK, 2 and 6 days of illness. The picture shows a slight swelling of the soft tissues over the affected joint and the “smearing” of their structure. The capsule of the affected joint is somewhat thickened, the contours are clear and continuous, in the joint cavity there is an accumulation of transparent (hypoechoic, without inclusions) effusion. On the echogram of a healthy joint, soft tissues are structural, all layers are clearly visualized.

On 3-7 days from the onset of the disease (15 patients), marked swelling of the joint capsule was noted, the cavity of the affected joint was expanded,

the fluid in it became heterogeneous. The articular surfaces of the bones were clear, without roughness. Violation of the structure and thickening of the soft



tissues surrounding the joint increased in dynamics (fig. 2).

On the 7th day (16 patients), with the progression of inflammation, an increase in the thickness of soft tissues was observed, while their echogenicity increased, and the differentiation of tissues decreased. There was also hyperechoic fluid in the soft layers surrounding the affected joint. The contours of the vehicle became fuzzy, intermittent. Exudate was visualized in the joint cavity, heterogeneous structure with pathological inclusions in the form of hyperechoic structures, the lumen of the joint cavity narrowed. The joint surfaces of the bones of the forming vehicles became rough, fragmented and "blurred" (fig. 3).

The remaining 25 patients with acute hematogenous osteomyelitis of the bones of the hip joint were excluded and diagnosed with reactive coxitis, of which 18 children underwent ultrasound imaging in the first three days from the onset of the disease, and in 7 at a later date.

During the examination, the following changes were revealed: slight swelling of the soft tissues over the affected joint and the "lubrication" of their structure. Changes in the capsule of the affected joint were noted in 15 patients, the latter was thickened, but its contour remained clear and continuous, in the joint cavity there was an accumulation of transparent (hypoechoic, without inclusions) effusion. Inflammation stopped in 1-3 days against the background of the conservative treatment (fig. 4).

Returning to the above, the ultrasound diagnosis was performed by 72 patients who were suspected of having acute hematogenous epiphyseal osteomyelitis who were included in our study. So, out of 72 patients, Acute hematogenous osteomyelitis of the bones of the hip joint was confirmed only in 47 (65.3%) children (true positive result), and the remaining 25 (34.7%) patients were excluded from the above diagnosis and exposed to reactive coxite (i.e. false-positive result of ultrasound diagnostics). In order to calculate the sensitivity and specificity of ultrasound in identifying acute hematogenous epiphyseal osteomyelitis, we traced the fate of 56 children who underwent ultrasound at the place of residence and were sent to the clinic with suspected osteomyelitis. Moreover, further during the operation, out of this number, only 7 (2.4%) children were identified with acute hematogenous osteomyelitis of the bones of the hip joint (false-negative ultrasound result).

The calculation of the sensitivity (Se) of an ultrasound scan was performed according to the formula:

$$Se = \frac{TP}{TP + FN} \times 100\%,$$

where TP - truly positive results of the study, FN - false negative results of the study.

When determining the specificity (Sp) of the method, the formula was used:

$$Sp = \frac{TN}{TN + FP} \times 100\%,$$

where TN is the truly negative results of the study, FP is the number of false positive results.

In this case, the diagnostic accuracy (Ac) for the detection of acute hematogenous osteomyelitis of the bones of the hip joint was calculated by the formula:

$$Ac = \frac{TP + TN}{TP + TN + FP + FN} \times 100\%$$

So, the sensitivity of ultrasound in the detection of acute hematogenous osteomyelitis of the bones of the hip joint in our observations was

$$Se = \frac{47}{47+25} \times 100\% = 65,3\%, \quad \text{specificity} -$$

$$Sp = \frac{49}{49+7} \times 100\% = 87,5\% \text{ and diagnostic accuracy of the method} -$$

$$Ac = \frac{47+49}{47+7+49+25} \times 100\% = 75,0\%.$$

Thus, using ultrasound, the following signs of epiphyseal osteomyelitis can be identified: heteroechogenicity of hyaline epiphyseal cartilage, including anechogenic inclusions; deformation; fragmentation deformation and heterogeneity of the metaepiphyseal zone with the presence of anechogenic inclusions in the pineal gland; changes in the periosteum and cortical layer of the bone. Ultrasound allows you to establish a diagnosis of acute hematogenous osteomyelitis in the first 2-3 days of the disease. In this case, the sensitivity of ultrasound in the diagnosis of epiphyseal osteomyelitis is 65.3%, and specificity is 87.5% and diagnostic accuracy is 75%.

**Conclusions.** In the diagnosis of acute epiphyseal osteomyelitis at an early stage of the process (in the early days), ultrasound is the method of choice. The method can be used as a non-invasive method in a complex of diagnostic measures during examination of young children with suspected acute hematogenous epiphyseal osteomyelitis. Ultrasound allows you to detect edema and infiltrative changes in the muscles and soft tissues, as well as fluid accumulation in the joint at an early stage of the disease. The method is safe due to the absence of radiation exposure, highly informative, its frequent application is possible.

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# ОПТИМИЗАЦИЯ ДИАГНОСТИКИ ОСТРОГО ГЕМАТОГЕННОГО ЭПИФИЗАРНОГО ОСТЕОМИЕЛИТА У ДЕТЕЙ РАННЕГО ВОЗРАСТА

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Махмудов З.М.

**Аннотация.** Успех лечения острого гематогенного эпифизарного остеомиелита (ОГЭО) у детей младшего возраста зависит от ранней диагностики заболевания и оптимального хирургического вмешательства, осуществляемого еще до развития угрожаемых состояний и септических осложнений. Целью исследования является проведение анализа возможности ультразвукового исследования при ОГЭО у детей раннего возраста. Материалы и методы исследования. В алгоритм ранней диагностики у больных с ОГЭО с 2011 года включили ультразвуковое исследование. Это исследования произведены 72 больным, поступившим с подозрением на ОГЭО. Так, из 72 больных, ОГЭО подтвердился только у 47, а остальным 25 пациентам вышеуказанный диагноз был исключен. Выводы. В диагностике ОГЭО на ранней стадии процесса (в первые дни) методом выбора является УЗИ. Может быть использован как неинвазивный метод в комплексе диагностических мероприятий при обследовании детей младшего возраста с подозрением на ОГЭО. УЗИ позволяет на ранней стадии заболевания выявить отек и инфильтративные изменения в мышцах и мягких тканях, а также скопления жидкости в суставе. Метод безопасен в связи с отсутствием лучевой нагрузки, высоко информативен, возможно его частое применение.

**Ключевые слова:** острый гематогенный эпифизарный остеомиелит, дети раннего возраста, ультразвуковое исследование.