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RESULTS AND BENEFITS OF ULTRASOUND EXAMINATION IN ACUTE SCROTAL SYNDROME

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Abstract. The goal of the study was optimization noninvasive methods of diagnosis in acute scrotum syndrome in children. **Material:** the results of treatment of children aged 1 to 18 years with acute scrotal syndrome were studied. Of these, 124 (61.4%) patients had torsion of the testicular hydatid, 57 (28.2%) had testicular torsion, and 21 (10.0%) had inflammation of the testicle and its elements. **Research method:** ultrasound results of patients with acute scrotal syndrome were used. **Result of the study:** in 41% of patients with uncomplicated hydatid torsion, minimal changes in the organs of the scrotum were detected by ultrasound; in 56.1% of patients with testicular torsion, there was a violation of the adjacent skin of the testicular vagina, in the structures of the spermatic cord of its part of the scrotum. **Conclusion:** with testicular torsion, the ultrasound criterion is an increase in blood flow in the internal organs by 2-4 times, an increase in the size of the testicle, heterogeneity of composition, and with hydatid torsion, the blood flow increases to 10% of normal significant (>20%) enlargement of the testicle. An average enlargement of the testicle with a moderate increase in blood flow (up to 10%) is regarded as acute epididymitis, and an increase in testicular size with an increase in blood flow up to 10% of the norm is considered an ultrasound criterion for acute orchitis.

Key words: testicle, hydatid, orchitis, acute scrotum.

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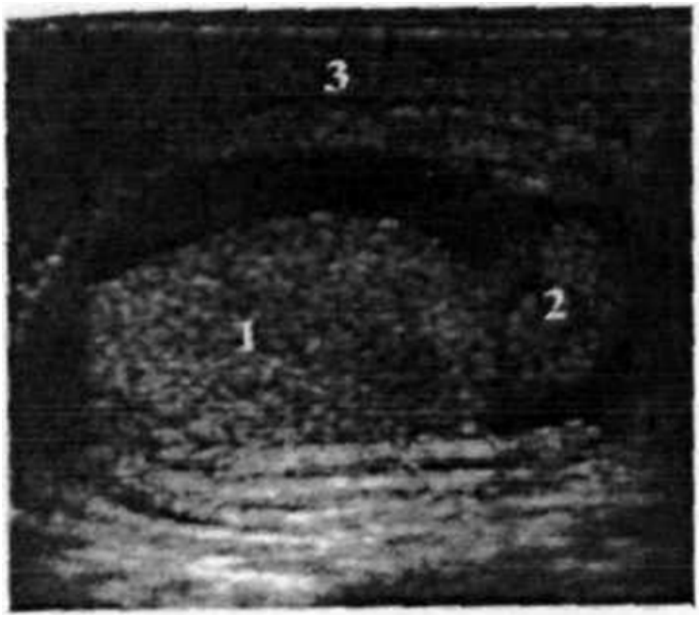
Relevance of the problem: Since the 90s of the last century, almost all pediatric surgeons have switched to active surgical tactics for acute testicular diseases in children, the use of ultrasound and Doppler ultrasound both during the acute disease and in the chronic stage, which has led to more accurate diagnosis and successful treatment of the results[1–3]. However, in the local literature, issues of hormonal and spermatogenic function in adult men who have suffered acute testicular disease (ATD) in early childhood have been practically not studied. Of particular importance are the optimization of surgical treatment and therapeutic and diagnostic measures in the acute period of the disease, as well as the development of pathogenetic approaches to the postoperative treatment of patients in this contingent[2,4–6].

Purpose of the research: Optimization of non-invasive diagnostic methods for acute inflammatory testicular diseases in children.

Materials and methods of research: Based on a retrospective analysis, the results of treatment of 202 patients who were treated with a diagnosis of ATD in the emergency surgery and urology departments of the Andijan Regional Children's Multidisciplinary Medical Center for 2015-2022 were studied. The clinical material of the study consisted of children aged from 3 months to 18 years. Patients were divided into 3 groups using modern clinical and statistical classification (ICD-10). According to these data, torsion of the hydatid (epididymitis) of the testicle was observed in 124 (61.4%), testicular torsion - in 57 (28.2%), epididymitis, orchiepididymitis, orchitis - in 21 (10.0%) children. The results of ultrasound and Doppler examination of patients were retrospectively studied. The results of ultrasound examination of 32 scrotums performed for diagnostic purposes at ATD. The echo graphic picture of acute testicular diseases was characterized by a number of signs and was divided into 2 main groups: specific signs and nonspecific or secondary echo symptoms characteristic of each disease. The nonspecific echo graphic criteria for acute testicular disease included the following extra testicular changes: 1. Thickening and layering of the testicular mucosa on the affected side compared with the contralateral side; 2. increased blood flow in testicular tunica albuginea; 3. accumulation of free fluid in the vaginal cavity. **(1-picture)**.

Picture-1

Nonspecific changes in the scrotum: thickening and separation of the testicle, hydrocele. 1) testicle; 2) head of the epididymis; 3) testicular membrane.



Nonspecific ultrasound signs were secondary inflammatory changes against the background of scrotal swelling-hyperemia syndrome. In our study, nonspecific ultrasound symptoms were identified as a clear clinical picture of the disease in complications of hydatid torsion, testicular torsion, epididymitis and epididymorchitis.

In uncomplicated hydatid torsion and subclinical orchitis, no secondary inflammatory changes were detected. Nonspecific echo symptoms in traumatic injuries were found only in the case of hematoma of the testicular tunica albuginea and testicular rupture. Ultrasound data of 15 patients with hydatid torsion were studied. When the testicle or epididymis is tyrosinated, the duration of the echo graphic picture in children depended on the severity of clinical changes in the organs of the scrotum.

Depending on the picture of ultrasound changes, patients with hydatid torsion can be divided into 2 groups: 1) uncomplicated; 2) with complications. In patients of the first group, the testicular tunica albuginea membrane of the testicle is symmetrical, not thickened, the size, contours, echo structure of the testicle are not changed on both sides, the linear dimensions of the head of the epididymis are increased slightly, the blood flow in its parenchyma has increased slightly. In patients of the second group (complicated course of the disease), there is an accumulation of free fluid in the mucous membranes of the testicles, their thickening on the affected side compared to the contralateral side (nonspecific, secondary extra testicular echo symptoms). An increase in the linear dimensions of the head of the epididymis and a heterogeneous echo structure were noted. Ultrasound revealed increased blood flow in the epididymis and mucous membrane. In all patients, an additional echogenic formation of a round or oval shape was observed between the upper pole of the testicle and the head of the epididymis. The location, shape, and size of the hydatid varied with some changes. In some patients, hydatid was detected as a heterogeneous oval-shaped hyperechoic formation against the background of the epididymis. Polypositional scanning of the upper half of the scrotum when visualizing the hydatid is difficult makes it possible to determine the “pocket depth” between the upper pole of the testicle and the epididymis. Large-sized cystic-changed hydatids were very clearly visible against the background of free fluid accumulated in the cavity of the vaginal mucous membrane of the testicle. Polypositional scanning of the upper half of the scrotum at complications with visualization of hydatid allows to determine the “pocket depth” between the upper pole of the testicle and the epididymis. Large-sized cystic-changed hydatides were very clearly visible against the background of free fluid accumulated in the cavity of the vaginal mucous membrane of the testicle. Cystic-changed hydatid was defined as a hyperechoic flange, hypoechoic or anechoic round formation. The technical characteristics of diagnostic equipment have become of great importance in the diagnosis of hydatid. Although the echostructure of the epididymis was heterogeneous when using 5 MHz sensors, in the same patient it was possible to see an additional hyperechoic round formation against the background of the head of the epididymis when examined with 13 MHz sensors. Hypersensitivity has also been noted with Doppler’s sensor in torsion of hydatid.

Very obvious inflammatory changes in the scrotal organs were detected when the hydatid was torsionated to a large extent. Damage to the hydatid with a diameter of 8–10–12 mm caused reactive inflammation of not only the epididymis, the testicular membrane, but also the testicle itself. At this time, the rounded shape of the testicle, an increase in the size of the epididymis, and visualization of the body of the epididymis and its tail were noted. Obvious secondary nonspecific echo symptoms were revealed. According to ultrasound data, increased blood flow in the projection of the testicle, epididymis, and testicular membrane was accompanied by a lack of blood flow in the hydatid itself. Echo graphic images of significant torsion of the hydatid resemble those of testicular torsion. The ultrasound mode allowed us to differentiate this disease. In contrast to the sharp decrease in blood flow with testicular torsion, hydatid torsion was accompanied by a marked increase in blood flow in the membrane, epididymis and testicle. The echo graphic picture of hydatid torsion in different subgroups is presented **in table-1**

Table-1

Echosymptoms of hydatid torsion

Structural unit	Echomarks	Uncomplicated course	Complicated coure
Stromas	thickness	Not accelerated	enlarged
	Blood flow on ultrasound	Not accelerated	increased
Testicles	Dimensions	Age appropriate	Age appropriate
	Echo structure	Usual	Usual
	Blood flow on ultrasound	Not changed	Not changed
Epididymis	Dimensions	raising2≤	raising4≤
	Echo structure	Usual	different
	Blood flow on ultrasound	Slightly accelerated	increased
Additional formation (hydatid)	Dimensions	4–6 mm	8–12 mm
	Echo structure	same	different
	Blood flow on ultrasound	Not identified	Not identified

The table shows that the main difference between the complicated and uncomplicated course of the disease is noted in the identification of secondary inflammatory changes in the membrane of the testicle and epididymis. It is worth noting that the complicated course of the disease was determined mainly in small torsion of hydatid 4–6 mm in size. Thus, during ultrasound examination of patients with uncomplicated hydatid torsion, minimal changes in the scrotal organs were observed. In patients with a complicated course of the disease, very pronounced echo graphic symptoms were characterized by secondary inflammatory changes in the scrotum.

Considering that clinical signs of testicular torsion indicated urgent surgical intervention and in some cases (during the evening and night shifts) it was not possible to perform ultrasound, 27 (47.3%) patients in the main observation group for testicular torsion underwent ultrasound before surgery. In case of testicular torsion, regardless of the duration of the disease, nonspecific ultrasound signs of acute testicular disease were detected in all cases. When testicular torsion lasts 24 hours or more, ultrasound reveals thickening and layering of the testicular membrane, increased blood flow in the stroma. The echographic picture of testicular torsion was clearly differentiated **(Table 2).**

Table-2

Echosymptoms at testicular torsion

Structural Unit	Echomarks	Testicular torsion
Stroma	Thickness	enlarged
	Blood flow on ultrasound	increased
free fluid	accumulation	identified
	Dispers suspensions	identified
Testicular	Dimensions	increased
	Echogenicity	decreased
	Blood flow on ultrasound	Decreased or not
Epididymis,head	Dimensions	increased
	Echogenicity	decreased
	Blood flow on ultrasound	Decreased or not

Seminal system	Linear process	impaired
	Blood flow on ultrasound	separately, raised up

In 32 (56.1%) boys aged 11-18 years, disturbances were detected in the vaginal stroma of the testicle and in the scrotum, in the structure of the seminal system. In them it was not possible to observe linear processes in the structure of the seminal system from the distal surface to the inguinal ring. At the same time, the flow in the inguinal canal of the elements of the spermatic cord did not change. From the data presented in the table, we can conclude that obvious echographic changes during testicular torsion were detected in all elements of the scrotum. When characterizing the testicles, changes were found in all echo marks. Also, if it is possible to see this formation due to the normal relative position of the scrotal organs, changes in the epididymis, in the hydatid, are detected. All patients showed an average amount of free fluid accumulation in the intrinsic vaginal stroma, while in all cases there was a diffuse solution in the fluid. This characteristic of free fluid distinguishes testicular torsion from other acute conditions (with the exception of the collection of blood seen with hematoceles in some traumatic scrotal injuries).Against the background of accumulation of free fluid with a dispersed solution, a round-shaped testicle with a clear flat contour and slightly enlarged dimensions was revealed. The echogenicity of the testicular parenchyma is reduced, the exostructure is homogeneous or diffusely heterogeneous during long periods of the disease.

There was a disturbance in the functioning of the scrotal organs - the testicle was torsionated, the head of the epididymis could not be determined in its place. Polypositional scanning revealed a significant increase in the linear dimensions of the testicles. The echogenicity of the epididymis was very low compared to the echogenicity of the testicular parenchyma with a heterogeneous echostructure.

Data comparing the diagnostic value of the main clinical and ultrasound symptoms depending on the presence or absence of inflammatory changes in the scrotal organs are presented in **Table 3.**

Table-3

Sensitivity and specificity of the main clinical and ultrasound symptoms of acute testicular diseases at different stages of the disease.

		Sensitivity(Se)		Specificity (Sp)	
		No	yes	no	yes
Testicular torsion					
Clinics	Prehn symptom	100%	12%	94%	90%
	Horizontal position of the testicle	100%	4%	100%	100%
Ultrasound	Testicle enlargement >20%	0	66,6%	85,7%	75%
	Heterogeneity of the testis and epididymis	100%	100%	83,3%	85,7%
Hydatid torsion					
Clinics	Pain in the epididymis	100%	38%	64%	96%
	Detection of formation by palpation at the upper pole	100%	13%	73%	96%
Ultrasound	Epididymal enlargement >20%	66,6%	66,6%	80%	80%
	Isolated testicular heterogeneity	100%	100%	75%	100%

In diseases of testicular torsion and of hydatid, as can be seen from the table, the sensitivity of clinical symptoms before the onset of swollen and hyperemic scrotum syndrome is high (100%), ultrasound symptoms show slightly less sensitivity (66.6–100%). However, with the appearance of local inflammatory reactions, the sensitivity of clinical symptoms decreases dramatically (4-38%), while the diagnostic value of ultrasound signs remains unchanged (Se = 66.6-100%). The specificity of clinical and ultrasound

symptoms remains highly stable regardless of the stage of the disease.

We could not see the hydatid separately from the epididymis. However, indirect signs, such as testicular enlargement by more than 20% and its unequal composition, indicate obvious damage to the epididymis. Significant (>20%) enlargement of the epididymis on ultrasound is due to a combination of the size of the epididymis itself and the damaged, sharply enlarged scrotum. To visualize the hydatid and epididymis separately, a 10.51–4.5 MHz sensor is required. The heterogeneity of the testicles on ultrasound, in our opinion, is associated with the visualization of a disrupted hydatid. The average increase in arterial and venous blood flow (up to 10%) reflects secondary inflammatory processes in the epididymis. Acute epididymitis is characterized by a moderate increase in the size of the epididymis and homogeneity of its composition. A moderate increase (up to 10%) in arterial and venous blood flow in the vessels of the internal organs of the testicle indicates inflammation.

It should be noted that during this study, ultrasound criteria for acute orchitis were divided. These included: an increase in the size of the testicles, homogeneity of the echo structure of the gonads with normal blood flow in the internal organs. Clinically (without surgical exploration) it was not possible to differentiate between orchitis and epididymitis. We encountered certain difficulties in the ultrasound diagnosis of testicular torsion.

In all children with torsion of the gonads, we found that the size of the damaged testicle was increased, the echo structure was heterogeneous, and its contours were unclear compared to the contralateral organs. Most patients experienced a sharp decrease in blood flow to the internal organs (up to its disappearance). In observations during this study, with testicular torsion, the linear velocity of arterial blood flow increased by 2 times, and venous blood flow by 5 times. According to the law of hydraulics, fluid flow (volume) depends on flow speed and area. It follows that without changing other parameters, a decrease in the diameter of the vessel leads to an increase in the fluid flow rate. The increase in arterial and venous blood flow velocity observed in this study may indicate a sharp obstructive incomplete reduction in vascular diameter during testicular torsion. An increase in venous linear blood flow velocity is a sign of indirect compression on the outside of a vessel significantly larger than the artery. The reason for this phenomenon is in the anatomical structure of the walls of arterial and venous vessels.

Thus, when the testicle is twisted, the blood flow in the internal organs sharply decreases (even disappearing) or increases 2-4 times along with an increase in the size of the testicle and the heterogeneity of its composition. Ultrasound examination criteria were calculated. Ultrasound criteria for hydatid torsion were significant (>20%) enlargement of the epididymis with an increase in blood flow to 10% of normal and its heterogeneity. Ultrasound criteria for acute epididymitis are a moderate increase in blood flow (up to 10%) and testicular homogeneity. Ultrasound criteria for acute orchitis include an increase in testicular size, heterogeneity of its composition and disturbance of blood flow up to 10% above normal.

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