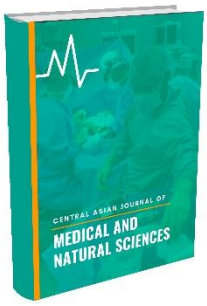
CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES



Volume: 02 Issue: 02 | March-April 2021 ISSN: 2660-4159

www. cajmns.centralasianstudies.org/index.php

Ultrasound diagnosis of urolithiasis

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Received 2th February 2021,
Accepted 27th February 2021,
Online 04th March 2021

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ABSTRACT: Urolithiasis (Urolithiasis) is one of the most common urological diseases and ranks second in the world after inflammatory nonspecific diseases of the kidneys and urinary tract. Its share among all urological diseases is about 40%. In 70% of patients, ICD is diagnosed at the age of 30-60 years, and there is a predominance of males. The increase in morbidity, the severity of complications, the tendency to relapse, the predominant lesion of young and most working age people put forward the diagnosis and treatment of nephrolithiasis among the most important problems of urology.

Key words: urolithiasis, ultrasound examination, dopplerometry, extracorporeal shock wave lithotripsy

Introduction

Urolithiasis (Urolithiasis) is a metabolic disease caused by various exogenous and / or endogenous factors, often hereditary in nature and is determined by the presence of calculus in the urinary system. The causes and mechanism of stone formation remain open in urology. There is still no definitive theory of the development of urolithiasis. The main theories of lithogenesis are reduced to the leading role of the following factors: an increase in the level of lithogenic ions, a deficiency of inhibitors of crystallization and crystal aggregation, the presence of activators of stone formation in the urine, and local changes in the kidneys. In patients with KSD, an increase in the content of L-Y-glutamyl transferase (GGT) and alkaline phosphatase (ALP, EC) in the urine was found, which, apparently, is due to an increase in the permeability of cell membranes. One of the possible mechanisms of stone formation may be aquaporin channels for the transport of ions and water molecules through the cell membrane.

Mortality in ICD has significantly decreased over the past decades due to the widespread introduction into clinical practice of modern methods of treatment: distance lithotripsy (ESWL), contact lithotripsy (CLT), puncture nephrolitholapaxy. However, ESWL is always associated with kidney injury. In severe cases, it is possible to form intraparenchymal, subcapsular or perirenal hematomas, leading to sclerosis of the renal tissue and a decrease in kidney function.

The main symptoms of urolithiasis are pain, hematuria, dysuria, and passage of calculi. One of the manifestations of urolithiasis is renal colic, which is caused by occlusion of the ureter, resulting in increased intracavitary pressure, impaired intrarenal blood flow with severe edema of the renal parenchyma. In the first four hours after the onset of obstruction, there is an increase in renal blood flow as a result of preglomerular vasodilation of the renal vessels. After four hours, blood flow decreases and pressure in the ureter increases due to postglomerular vasoconstriction. The increased pressure in the ureter activates the renin-angiotensin system and increases the level of vasoconstrictors, which is manifested by a decrease in renal blood flow and pressure in the urinary tract due to narrowing of the arterioles that bring them.

Timely and accurate diagnosis of ICD helps to avoid complications of the disease. Radiation diagnostic methods: ultrasound, X-ray, radionucleide, magnetic resonance - allow you to obtain the necessary information about the anatomical and functional state of the urinary system; identify developmental anomalies, carry out differential diagnostics with other diseases and carry out dynamic control over treatment. At present, when distance lithotripsy, contact lithotripsy, nephrolitolapaxy are widely used in urological practice, the question of developing a diagnostic algorithm that allows you to choose the optimal way to remove calculus remains open. The most important role in identifying calculus, determining its localization, size and developing complications is played by ultrasound diagnostics using the B-mode. The use of color and power Doppler imaging makes it possible to assess the violation of uro- and hemodynamics. An important advantage of the method is its non-invasiveness, absence of radiation exposure and the development of allergic reactions. The use of ultrasound research makes it indispensable for studying the dynamics of the early and late postoperative period.

The use of the B-mode of ultrasound examination allows to evaluate both direct and indirect signs of renal obstruction. So, according to A.I. Gromov pyelocaliectasia is detected in 90.9%. The sensitivity and specificity of ultrasound is 90.9 and 93.0%, respectively; In the diagnosis of ureteroectasia, the frequency of visualization of a dilated ureter depends on the level of obstruction. Dilation of the ureter in the parochal region and in the upper third is visualized in 74.6% of cases, in the middle third - in 46.6%, in the lower third - in 12.3%, in the intramural region - in 81.4%. To study the latter, transvaginal scanning in women and transrectal scanning in men is used. The sensitivity and specificity of ultrasound is 55.9 and 77.8%, respectively. Indirect signs of ureterol Itiasis also includes local thickening of the

ureteral wall, periureteral edema, impaired ureteral emissions, thickening of the pelvis wall, and edema of the renal parenchyma.

According to Yu.Yu. Migushova and V.M. Kitaeva, ureteroectasia is found in 97.8% of cases, pyelectasis is detected in 30.1%, and hydronephrosis is found in 51.5% of cases.

Evaluation of indirect signs showed that the degree of dilatation in ureteroectasia was in direct proportion to the duration of the calculus stay and the concomitant inflammatory process. Difficulties in diagnosing ultrasound signs of obstruction arise when examining obese patients and when conducting a study after stopping an attack of renal colic.

A direct ultrasound sign of nephro- and ureterolithiasis is an echo-positive structure in the cavity system of the kidney and / or in the lumen of the ureter with an acoustic shadow. In the studies of Yu.Yu. In a flash, the appearance of an acoustic shadow depended on the size of the stone. So, the acoustic shadow was confidently detected with a stone size of 4 mm and more. At smaller sizes, the acoustic shadow, as a rule, was not detected. To visualize it, a clarifying ultrasound scan was used with an intracorporeal sensor, and in the presence of calculus, an acoustic shadow, as a rule, was detected, which made it possible to carry out differential diagnostics between the stone, strictures and other pathologies. The diagnostic capabilities of ultrasound for calculi of the lower ureter were the highest.

Ultrasonography can be considered an informative method in assessing renal colic. In some cases, with a "dumb" kidney, it becomes the only acceptable way of interpreting the situation. If obstruction of the upper urinary tract is suspected, it should be the primary diagnostic technique in the clinical program, and its data can justify the whole complex of further examination and determination of treatment tactics.

Color Doppler mapping (CDC) is a competitive method of contrast angiography, its accuracy compared to the latter, according to various authors, ranges from 85% to 100%. With regard to angiography, the CDC has an undeniable advantage - the method is non-invasive. Improvement of ultrasound technology, as well as the use of ultrasound contrasts (levovist, sonovist, etc.) allows tracing the branching of the renal artery up to the subcapsular sections. With the help of intravenously administered echocontrast drugs, it is possible to study the true perfusion of an organ, to identify areas of ischemia or destruction at the earliest manifestations.

The analysis of the spectral Doppler curve is carried out taking into account the qualitative and quantitative indicators, which, in turn, are divided into angle-dependent and angle-independent. The borderline values of hemodynamic parameters in the diagnosis of obstructive uropathy according to a number of authors: resistance index (^)> 0.7, pulsation index (P1)> 1.2, parenchyma thickness in the middle segment <0.9 cm, the difference in minimum velocities in healthy and the affected kidney> 2 cm / s, the difference between the kidney with acute obstruction and the contralateral kidney is> 0.08. In the absence of impaired urodynamics, the values of the indices of resistance and pulsation are close to normal.

Thus, according to A. Iagiop, the resistance index (Purselo index) in renal colic and complete ureteral obstruction is 0.7 ± 0.06, and the difference in resistance indices on the obstruction side and on the healthy side is 0.09 ± 0.02. In patients with partial obstruction, the resistance index on the obstruction side is 0.64 ± 0.06 and the difference in the indices is 0.03 ± 0.05, and in healthy volunteers, the Purselo index is 0.59 ± 0.05 and the difference between the indices is 0.03 ± 0.01.

According to E.V. Olshanskaya, an increase in peripheral resistance in acute obstruction is associated with an increase in pressure in the wall of the pyelocaliceal system (PCS), provoking an increase in the level of prostaglandins that cause vasoconstriction, which explains the increase in J.

In the works of V.A. Fokas investigated changes in intrarenal hemodynamics in obstructive uropathies. The author points out that the compression of the kidney parenchyma by expanding cavities is accompanied by an increase in intraparenchymal pressure, atrophy of the pyramids of the medulla and their further obliteration. This leads to interstitial inflammation and an even greater increase in vascular resistance in the arteries of the medulla. The interlobar arteries become thinner and longer. There is a redistribution of blood from the cortex to the brain. Arteriovenous shunts develop, and later the death of the renal glomeruli occurs.

As a result of intracavitary hypertension, edema of the renal parenchyma develops, and venous outflow from the kidney becomes difficult. In the literature, this situation has been little studied and it seems appropriate to conduct a special study of this problem. According to some authors, the most valuable data comes from a comparative assessment of blood flow in the affected and healthy kidney.

In the work of E.V. Olshanskaya showed a statistically significant increase in the index of resistance on the side of colic and the difference in the index of resistance and are a "risk group" in terms of the severity of changes in blood flow, since initially there are conditions for impaired urodynamics. In the presence of pyeloectasia, initially high values of F and P1 were noted, which, after the EBRT session, reached the highest possible values regardless of the structure of the pelvis-pelvic system (PCS): N - 0.81 ± 0.03 ($p < 0.05$) and P1 - 1.59 ± 0.06 ($p < 0.01$).

SOUTH. Alyaev investigated the relationship between F at different levels of the renal vascular system and the degree of enlargement of the pelvis. The correlation coefficient between F at the level of the renal artery and the dilatation of the renal pelvis was 0.02 ($p = 0.9$), in the segmental arteries 0.03 ($p = 0.8$), at the level of the arcuate arteries 0.11 ($p = 0, 6$). There is a tendency to an increase in F at the level of the renal artery with an increase in the dilatation of the PCS and a decrease in F at the level of segmental and parenchymal vessels against the background of prolonged expansion of the cavity system.

In the work of S.V. Vykhodtsev's main hemodynamic characteristics according to the USDG data were P1, maximum systolic velocity (V max), minimum diastolic velocity (V

mm). ^ is more useful than P1, in view of the fact that it has a lower coefficient of variation, which is no more than 5%, at the same time, P1 is a more sensitive parameter, since the envelope of the Doppler frequency shift spectrum is taken into account when calculating W and the blood flow is estimated throughout cardiac cycle. Thus, the change in renal blood flow in patients with ICD depends on the nature of the urodynamic disorder, the localization and size of the calculus, the duration of the disease, the presence of complications, and the patient's age. The inflammatory process accompanying the above factors, in varying degrees of activity, also affects the state of blood flow.

Urodynamics of the upper urinary tract (UMT) is impaired in urolithiasis. To diagnose urinary passage disorders, a fine understanding of urodynamic processes is required. However, until now, there is no consensus on the regulation of the physiological activity of the upper urinary tract and, in this regard, several different theories remain relevant. In 1931, Fuchs proposed a cystoid theory. In this theory, the ureter was considered as an organ consisting of sphincters capable of holding portions of urine and evacuating them. But the circular course of smooth muscle was not found. Cavernous vascular formations were identified in the wall of the ureter in the area of the pelvic ureteric segment, in the middle and lower third of the ureters and in its intramural region. Portional accumulation and emptying is carried out by baroreception. In functional polyuria, the ureter is rapidly rearranged and represents one cystoid. One of the latest theories of the functioning of the upper urinary tract was put forward by Yu.A. Pytel and V.V. Borisov. The authors assign the main role to the electrochemical potential, under the influence of which the smooth muscles of the renal pelvis contract. With the accumulation of urine and overstretching of the wall of the pelvis, the permeability of the urothelium increases, especially for sodium ions. A potential difference is generated between the lumen of the urinary tract filled with urine and the muscular wall. As a result, muscle contraction occurs. Thus, the functioning of the upper urinary tract appears to be a complex multi-level process.

Severe hydronephrosis, ureteral strictures are risk factors contributing to a complicated course after SWL. Analysis of the nearest results of extracorporeal lithotripsy revealed a relationship between the effectiveness of this treatment and the initial degree of expansion of the upper urinary tract and their tone, and the contractile activity of the ureter is important for the discharge of fragmented fragments only with unexpressed dilatation.

With the introduction of color Doppler imaging techniques, it became possible to non-invasively assess the contractility of the upper urinary tract. I.H. Cox, E. Thomas, H.Y. Burge investigated the characteristics of urine discharge in the ureter. Using this method, the nature of the obstruction (complete or incomplete), the maximum, minimum and average flow rates, the amount of emissions on both sides were identified. Using this method, it is possible to obtain qualitative and quantitative differences in the curves of ureteral emissions in healthy individuals, depending on the level of urine output and the degree of filling of the bladder. The method non-invasively allows you to determine the separate diuresis of each kidney.

Registration of ureteral emissions can be carried out both using external and using a transvaginal or transrectal sensor.

According to a number of authors, only the speed and frequency of the ejection are informative for the diagnosis of urodynamic disorders.

Considering the role of individual factors in compensating for urodynamic disorders, it should be noted that the pressure in the renal pelvis with localization of the obstructive factor in the upper third of the ureter increases in proportion to the degree of obstruction and in accordance with its compensation by intrarenal mechanisms. Such mechanisms are the calyx-pelvic reabsorption, pyelorenal, pyelovenous, pyelolymphatic refluxes. Compensation of increased pressure can also occur as a result of dilatation of the calyceal system and the ureter.
Thus, according to a number of authors, in patients with calculus in the ureter, the maximum number of emissions did not exceed 3 per minute. (normal 4-7), the absence of emissions or their significant asymmetry relative to the opposite side is highly likely to indicate obstruction of the upper urinary tract. The flow spectrum in the presence of a stone in the ureter differs significantly from the normal flow spectrum: the curve is devoid of characteristic peaks and is represented by a monophase low-amplitude curve with low flow acceleration, the so-called "venous spectrum". In the work of A.G. Dybunov, this was not reflected, which the author associates with different age composition and considers it possible to obtain a "venous spectrum" with obstruction in the lower third of the ureter.

The phenomenon of urine stream visualization is based on the difference in the density of urine in the bladder and urine entering it. After water loading and subsequent urination, the density of urine in the bladder and the density of urine in the ureter gradually equalize, which leads to a sharp decrease in the possibility of receiving ultrasound signals [25]. Indicators of CDC and pulsed Doppler ultrasonography are normal at various degrees of filling of the bladder and a certain level of urine output, which are quite stable and reproducible, which allows us to offer a certain method of research and preparation of the patient, to differentiate the norm and pathology by analyzing Doppler images of ureteral emissions.
Thus, the algorithm for studying the urodynamics of the upper urinary tract should begin with an ultrasound scan in parallel with an ultrasound scan. Comprehensive ultrasound examination of patients with obstructive uropathy, taking into account the state of hemo- and urodynamics, allows not only to establish the presence of obstruction and its nature (complete or incomplete), but also to assess the functional state of the kidney and upper urinary tract, which is necessary for choosing an adequate tactics of therapeutic measures. Scanning must be carried out polypositional, which allows you to get a complete picture of all parts of the kidneys and upper urinary tract.

Before endoscopic interventions, KLT and ESWL, excretory urography is performed with the execution of an excretory urogram in an upright position of the patient to study the

orthostatic reaction of the upper urinary tract, multispiral computed tomography, and magnetic resonance imaging.

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