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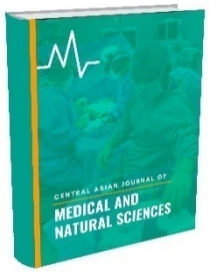

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# Modern Application of Computer Tomography in Urology

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**ABSTRACT**: Modern computed tomography is an important diagnostic method that has undergone significant evolution over 49 years of its existence. In view of the obvious advantages of the study, computed tomography has become a standard method used in the diagnosis and determination of treatment tactics in many urological diseases. In this regard, we set the task to summarize the capabilities of computed tomography in modern urology.

**Keyword**: multiline computed tomography, modeling, kidney cancer, nephrolithiasis, pyelonephritis, hydronephrosis, bladder cancer.

One of the most common urological sufferings is urolithiasis. Its diagnosis has been significantly simplified with the introduction of multislice computed tomography, with the help of which, even with a native study (i.e., without the use of an X-ray contrast agent), it is possible to visualize urinary calculi in a matter of minutes, regardless of their size, localization and chemical composition. To a large extent, this is achieved due to visual multiplanar constructions that help to make a virtual slice of the patient's body in any plane of interest.

Multispiral computed tomography combines the ability to determine the X-ray density of the calculus, which is important when choosing a treatment strategy.

When using contrasting, the method provides information about the state of the upper urinary tract. The so-called CT urography, especially in 3-dimensional execution, allows you to determine the optimal percutaneous access to the stones of the calyceral system. When planning percutaneous interventions, it is necessary to represent the intraorgan location of large renal vessels to prevent severe intraoperative bleeding. Relatively visual information about the angioarchitectonics of the kidney helps to obtain 3-dimensional angiograms, with multislice computed tomography with contrast.

However, with coral stones, taking into account the planning of their percutaneous removal, the information obtained in this study is not enough, due to the fragmentation of information on the phases of visualization. Thanks to the close cooperation of the departments of urology and radiation diagnostics of SamMI, over the past year, the use of software methods for processing primary axial tomograms obtained during multispiral research has been mastered and introduced into clinical practice. Postprocessing computer modeling allows to obtain an exact alignment of coral calculus, calyx-pelvic system, parenchyma and large intrarenal vessels in one image. At the same time,

depending on the tasks, instant subtraction or addition of the corresponding visualization phase is available with the creation of the necessary intensity of the transparency effect of the structures surrounding the stone. As a result, it is possible to calculate the truly optimal percutaneous access to the coral calculus, at which the smallest thickness of the renal parenchyma will be passed without affecting the large intrarenal vessels.

A serious complication of urolithiasis is the addition of an acute inflammatory process in the kidneys. The most important point in acute pyelonephritis is the differentiation of the obstructive or non-obstructive nature of the disease and the severity of the lesion of the renal parenchyma. Multispiral computed tomography with contrast can detect not only the presence of upper urinary tract obstruction, but, which is especially important, reliably diagnose local circulatory disorders in the kidney tissue, and at later stages of the process - purulent destructive changes in the parenchyma. It is the computed tomography data that are decisive in the choice of treatment tactics. The absence of obvious carbuncles or kidney abscesses suggests a serous phase of acute pyelonephritis and the patient should be prescribed adequate conservative therapy against the background of mandatory urinary tract drainage. The presence of the formed foci of destruction of the parenchyma is an indication for surgical treatment - decapsulation of the kidney, dissection or excision of purulent-destructive tissues and drainage of the calyx-pelvic system.

In case of kidney tumor, multispiral computed tomography with contrast is the "gold standard" of clarifying diagnostics. Its application makes it possible to obtain informative multiplanar and 3-dimensional constructions, based on which it is possible to judge the exact size, location and prevalence of the tumor, mono- or multifocality of the latter, the state of the great and renal vessels, while it is also possible to assess the state of regional lymph nodes ...

Perhaps the only but very significant drawback of this method is the acquisition of disjointed information on the arterial, perchymal, venous and excretory phases of imaging. When trying to obtain a combined image using standard computer tomography software, the the need for repeated administration of an expensive X-ray contrast agent with additional radiation exposure to the patient's body. At the same time, it is usually not possible to combine more than 2 phases, which makes the use of this method in clinical practice unprofitable and impractical.

Obviously, the disunity of information on the 4 phases of the contrast computer study does not allow us to judge the true intraorgan anatomy of the tumor process, since when considering standard multispiral tomograms, we cannot draw a final conclusion about the relationship of the tumor with large segmental vessels and elements of the calyceal-pelvic system. This information is of particular importance for organ-preserving benefits. At the same time, both when planning a kidney resection and nephrectomy, even before the operation, it is important for the surgeon to study in detail the features of the renal blood supply in order to prevent fatal bleeding during the operation. As a result of a large-scale study, we have found that anomalies of the renal vessels are very common in the human population. Based on the foregoing, the urgency of developing new methods of visualization and post-processing processing of the graphic data obtained by tomography has become quite obvious to us.

As already noted, as a result of the joint work of the departments of urology and radiation diagnostics of SamMI, an innovative method of computer modeling has been introduced into clinical practice. When studying the pathological process and planning the course of the operation for a kidney tumor, it allows without distortions to effectively combine all the imaging phases in one image, which provides comprehensive information about the anatomical features of the organ affected by the tumor process. At the same time, it additionally becomes possible to create the effect of layer-by-layer tissue transparency, which provides the operating surgeon with unique data on the relationship of the neoplasm with large intrarenal vessels and elements of the pyelocaliceal system. When planning an organ-preserving intervention, a technique for virtual removal of the tumor has been developed, which allows you to see what the bottom of the resection plane is. This method helps to predict damage to the

segmental vessel or the calyx-pelvis system. Thus, computer modeling provides the operating surgeon with information that helps prevent life-threatening bleeding and eliminate the risk of developing a urinary fistula.

The resulting images can be presented in the form of two-dimensional constructions in an arbitrary plane of the virtual slice, as well as in static or dynamically rotated 3D models. It should be noted that the intraoperative situations observed by us are completely identical with the data of modeling the pathological process in a kidney tumor.

It should be emphasized that the above possibilities of computer modeling of the pathological process in renal neoplasms are not limited to this. Recently, when planning organ-sparing interventions for kidney tumors, we have been using a unique technique. With the help of laser stereolithography, it is possible to produce polymer individual templates, which are used intraoperatively and make it possible to clearly outline the resection zone within healthy tissues. The prepared template is superimposed on the kidney tumor to accurately observe the distance of the incision from the edges of the neoplasm. As the resection proceeds, the edges of the template penetrate into the kidney parenchyma until the tumor node completely fills it. Then the final stage of the operation is carried out using scissors.

Previously, invasive angiography was often performed to identify an accessory vessel in hydronephrosis, but recently, multispiral computed tomography with contrast has been successfully used for this purpose. The method allows a detailed assessment of the preservation of the renal parenchyma and the state of the calyx-pelvic system. In addition, using virtual endoscopy, it is possible to examine the pelvic-ureteric segment from the inside with an accurate measurement of its lumen.

In especially difficult diagnostic situations, when there are multiple renal vessels, the most valuable information is provided by the new method of computer modeling of the pathological process, introduced as a result of joint scientific work of the departments of urology and radiation diagnostics of SamMI. The possibility of obtaining an integral image of the kidney together with the calyceral system and all vascular structures makes it possible to have comprehensive information about the anatomy of the hydronephrotic altered organ at the preoperative stage. This, in turn, helps to plan the operation in detail with a forecast of possible intraoperative bleeding and measures to prevent it.

For papillary tumors of the pelvis, ureter or bladder, multispiral tomography with contrast is the best diagnostic method. The use of virtual endoscopy provides clear visibility alization of neoplasms of the urothelium. While axial images and multiplanar constructions help to very accurately stage the process at the preoperative stage.

Prostatic hyperplasia is one of the most common causes of bladder outlet obstruction. In most clinical situations, its diagnosis is not difficult. But in everyday practice, difficult diagnostic situations are not so rare when, in addition to prostatic hyperplasia, there is an additional cause of bladder obstruction. In such cases, a completely new and non-invasive method of mixing multispiral cystourethrography comes to the rescue. It was also developed as a result of close cooperation of the departments of urology and radiation diagnostics of SamMI. This method allows you to obtain an image of the entire urethra in a section, present it in three-dimensional form and, if necessary, even perform a virtual urethroscopy. With the advent of multispiral cystourethrography, the problem of hidden causes of urinary disorders in patients with prostate adenoma was removed. In addition, this method allowed for the first time to see and prove the existence of urethroprostatic reflux. The latter is known to be important in the onset of chronic prostatitis.

In conclusion, summarizing all of the above, I would like to admit that modern urology would not be like this in the absence of computed tomography diagnostic tools in the arsenal. This method has significantly advanced us not only in solving complex diagnostic problems, but also in planning

therapeutic interventions. But it should be remembered that effective recognition of urological diseases is possible only with a well-established interaction between the urologist and the radiation diagnostician. The well-coordinated work of these specialists is the key to the successful treatment of the patient, which is a priority professional task for all of us.

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