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Practical Significance of Transrectal Doppler Sonography and Ultrasound in Prostate Cancer

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Abstract: Brachytherapy allows most patients to maintain potency and reduces the risk of urinary incontinence. But here too, there are a number of nuances that do not allow brachytherapy to become the “gold standard”, including:

the impossibility of correctly classifying the tumor process and determining the radicality of treatment (no sample of the prostate and lymph nodes is taken);

The method is suitable only for patients with a minimal degree of the tumor process (not even for all cases of local prostate cancer).

Limitations on the size of the prostate – the procedure is not suitable for patients with severe urinary tract diseases (discomfort during urination, slow urine flow, frequent urination, strong urge, repeated nighttime visits to the toilet, urinary incontinence, etc.);

The postoperative period is often complicated by problems such as acute urinary retention, which requires additional therapeutic measures.

Key points: HIFU (High Intensity Focused Ultrasound) – high intensity focused ultrasound.

One of the relatively new methods of local treatment of prostate cancer. The essence of the method is that a sensor located in the patient's rectum exerts a targeted thermal effect on the prostate tissue under ultrasound control, which leads to the death of tumor cells.

Although this approach is “young,” it is widely used around the world. This is because the least invasive (traumatic) of all methods of treating prostate cancer is highly effective (in experienced hands).

It should be noted that HIFU is a very capricious procedure that requires a very careful selection of "suitable" patients. This choice depends largely on whether the intervention is effective (suitable only for patients with very early forms of cancer) and the likelihood of complications, which, unfortunately, are not so low (acute urinary retention, stricture of the prostate, urethra, urinary incontinence, etc.). In any case, the technique is promising, but it is still too early to talk about its role in the treatment of prostate cancer.

Hormone therapy for prostate cancer

Prostate cancer is a disease whose development depends on the level of male sex hormones (androgens) in the blood. The lower their level, the slower the tumor develops. Therefore, another method of treating prostate cancer is hormone therapy, which is a maximum androgen blockade. In local cancer, this approach is used only as an adjunct to the main treatment.

The simplest, most affordable and relatively safe way to reduce the level of sex hormones is bilateral removal of testicular tissue (surgical castration). Today it is the "gold standard" of antiandrogen therapy. It is clear that this approach is very unpleasant for many patients, because, in their opinion, they are "deprived of masculinity." There is another method of treatment - medical

"castration", in which drugs are prescribed that block the production of androgens. Modern drugs of this group are close to the removal of testicular tissue in terms of effectiveness and safety.

Treatment plan for prostate cancer

Locally advanced prostate cancer extends beyond the organ but does not affect neighboring structures and does not metastasize.

Treatment of this form of prostate cancer is a very complex and controversial problem. The decision on the method of treatment should be made strictly individually and on the basis of a comprehensive examination. In any case, the treatment of patients with locally advanced prostate cancer should be comprehensive. In operable patients, this can be followed by radical prostatectomy (adjuvant) with radiotherapy and/or a combination of hormone therapy. Or independent use of radiotherapy, then hormone therapy, etc. The use of modern methods of treating this category of patients allows us to ensure a 5-year survival rate of 70-80%.

Metastatic (common) prostate cancer came to our country a long time ago, despite the 21st century, unfortunately, it is rare. Most often, an advanced malignant tumor of the prostate is the result of the imperfection of the health care system, the illiteracy of a particular doctor and the negligence of the patient. We hear from many patients that they went to the doctor “5 years ago” with symptoms of “prostatitis” or “adenoma” and since then have been receiving constant (and not so frequent) treatment. And if you ask such a patient: “Have you donated blood for PSA?” You will receive the traditional answer: “What is it?” Until the situation changes radically, urological oncologists have to diagnose every fourth patient.

The main feature of common prostate cancer is the presence of metastases in lymph nodes, bones, lungs, liver and other organs. In this form of the disease, it is pointless to remove the prostate or subject it to radiation. A competent doctor can do only two things (without spiritual support):

Slowing down the development of the tumor process and thereby prolonging the patient's life (hormone therapy, in case of ineffectiveness, cytotoxic therapy);

Improving the patient's quality of life and/or combating life-threatening complications of prostate cancer (improving urine flow, stopping bleeding, relieving pain, preventing bone fractures due to metastases, etc.).

Our work was aimed at identifying people with prostate cancer and verifying the diagnosis using both known diagnostic methods (prostate-specific antigen PSA, digital rectal examination, transrectal ultrasound, transrectal Dopplerography of prostate vessels) and a new method - histoscopy. As part of the work, a comparative analysis of standard research methods and diagnostic capabilities of Histoscan for prostate cancer and hyperplasia was carried out. In addition, the diagnostic value of the method in terms of early detection of cancer, the accuracy of staging the process, as well as the impact of the results obtained on planning a polyfocal prostate biopsy and the choice of subsequent treatment tactics were determined.

Initially, a retrospective group of patients (hereinafter referred to as the first group) was identified and studied - 67 patients with suspected prostate cancer underwent a prostate biopsy from 2009 to 2011. He conducted a standard diagnostic complex for a patient with suspected prostate cancer, consisting of clinical and biochemical blood tests, detection of prostate-specific antigen (total and free according to the instructions (PSA total > 4 ng / ml) and PSA density), general urinalysis, 3-cup test, uroflowmetry, transabdominal and transrectal ultrasound of the prostate, as well as Doppler ultrasound of the veins of the prostate, then transrectal polyfocal biopsy was performed.

To directly address the objectives of our study, we subsequently examined 701 patients with the Histoscan device. All of these patients underwent the standard diagnostic complex mentioned above. The distribution of prostate-specific antigen levels in them was between 1.09 and 209 ng/ml.

Patients with high PSA levels who underwent histoscopy were divided into three groups based on the degree of increase. Thus, 67 patients (to compare the results of prostate biopsy with and without histoscopy) and two control groups were identified.

In the first four groups (patients with suspected prostate cancer), all patients underwent a prostate biopsy.

With the introduction of Histoscan, every patient who came to our clinic with a high PSA level (or with a normal PSA level, but other examination methods suspected prostate cancer) was assigned to one of the above groups. Then the patients were examined according to the scheme developed for this study, which was a classic examination of a patient with suspected prostate cancer. The first step was a digital rectal examination (DRE). Seven (1.5%) of the 456 patients in the second group had suspicious areas for prostate cancer. In the third group of 112 patients, 17 (15.3%) DREs were suspicious for cancer. In the fourth group, during the DRE, 63 out of 70 patients had suspicious areas, that is, 87.5% of the patients in this group. In the fifth group - a conditional control group - none of the 20 patients had suspicious areas during the digital rectal examination. In the sixth group, none of the subjects had suspicious areas during the DRE.

In the first group of 67 patients, 15 (22.3%) had areas suspected of prostate cancer on digital rectal examination (Table 2).

Identification of suspicious areas during DRE in patients of research groups.

After that, a classic gray ultrasound examination - transabdominal and transrectal examination - was performed, followed by a Doppler examination. According to the examination data, the presence or absence of suspicious foci for prostate cancer was recorded (Figure 6). It should be noted here that we did not take into account the changes characteristic of prostatitis and prostate adenoma according to TRUS and Doppler data.

In none of the 456 patients in the second group did we find any changes characteristic of prostate cancer according to TRUS and Doppler examination of blood flow in the prostate vessels. In the third group, with PSA threshold values of 10-20 ng/ml, no ultrasound signs of prostate cancer were found in any of the patients, as was the case in the second group. In the fourth group, 30 of 70 patients, or 43.8%, had ultrasound signs characteristic of prostate cancer. In the fifth group, TRUS and Doppler ultrasound examinations of the prostate did not reveal any specific changes for prostate adenocarcinoma in any of the patients. No changes were found in the adolescents in the sixth (control) group.

In the first group of 67 patients, 11 had classic hypoechoic areas suggestive of prostate cancer, representing 16.4% of all patients in the group.

The second phase of the study consisted of performing a histoscopy with mapping of the prostate for biopsy. The histoscopy begins with a transrectal ultrasound examination.

The transrectal ultrasound examination is performed in two projections: the prostate is visualized in a transverse projection, then in a sagittal projection. The prostate is then scanned in the sagittal plane. This is possible because the sensor is mounted on a special magnetic coil that rotates 180° in the rectum.

The ultrasound data of the prostate is then processed by the HistoScan device. During processing, Histoscan creates three projections of the prostate. The first two: sagittal and transverse - are obtained by ultrasound examination.

Prostate with construction of a 3D model in 3 projections.

Prostate in 3 projections and 3D model with histoscopy tissue (suspicious for prostate cancer), shown in green.

In the 3D model, histoscan tissue (suspicious for prostate cancer) is shown in green.

Then, based on this data, the HistoScan device (hereinafter referred to as Histoscan) independently constructs the third, virtual plane of the prostate - frontal (cranial). Based on the information obtained from the three projections, the Histoscan creates a 3D model of the prostate, which the researcher can orient in space as required.

After all the projections of the prostate have been created and a 3D model has been created, the researcher further defines the boundaries of the prostate, which he initially defines independently. The ultrasound data of the prostate is then processed by the Histoscan device. This is how we identified suspicious areas for prostate cancer in the 3D model. A map of the prostate was then created for biopsy, on which suspicious areas for prostate cancer were also marked.

In the third phase of the study, some patients at high risk of cancer, i.e. some patients in groups 3 and 4, underwent an MRI with an endorectal coil, and some of them also underwent a CT scan of the pelvic organs.

The fourth stage of the examination was a transrectal polyfocal prostate biopsy under ultrasound guidance for patients in groups 2, 3 and 4 (groups 1, 5 and 6 – control).

It should be noted that, unlike the patients in the first group, in this case the prostate biopsy was performed using the maps of the prostate obtained by histoscanning. To better evaluate the results of the technique, each examined prostate is divided into 6 zones - sextants. Histoscan provides information in cubic centimeters about the volume of each of these sextants, as well as the volume of pathological tissue in a particular sextant. The device then adds up and displays the total volume of the gland, as well as the total volume of lesions suspicious of prostate cancer in the examined prostate gland. This information, due to computer processing, is more accurate than the size of the gland measured during ultrasound examination.

It should be noted that the number of sextants for each patient is constant and is 6 (Figure 2). However, the number of sites taken during biopsy varied and depended on the size and number of suspicious spots according to histoscopy. Biopsies from these areas were considered suspicious. We assessed the presence or absence of a suspicious lesion based on the histoscopic data in a particular sextant and then the morphological picture of this area - this is the first way to compare the histological examination data and the morphological conclusion. The morphological results of the study were the gold standard for detecting prostate cancer. Then the data of all studies were compared with each other.

Sextants in the prostate.

Prostate sextants – left sagittal projection, right cranial (tissue suspected of prostate cancer is shown in pink)

Left sagittal projection of the prostate, right cranial projection. Pink in both projections indicates tissue suspicious for prostate cancer. Arrows in the cranial projection of the prostate indicate sextants.

In addition, to optimize and simplify the calculation of patient examination results using Histoscan, a second method was developed to evaluate the sensitivity and specificity of Histoscan. First, for each patient, we counted the number of tissue cores taken from suspicious areas during polyfocal prostate biopsy and summed their number. These were standard sutures of tissue from suspicious areas and additional sutures from suspicious areas. For example, the total number of suspicious prostate tissue columns in the second group of patients was 2684.

Second, in the same way, for each of these patients, we calculated the number of tissue columns obtained in polyfocal prostate biopsies from areas that were not altered according to histoscan. The number of these prostate tissue columns was 3700. That is, the number of columns containing non-suspicious prostate tissue was 3700. This number represents the standard column of prostate tissue.

Sampling scheme for tissue columns for prostate biopsy.

Sampling scheme for tissue columns for prostate biopsy

Map of the prostate, arrows indicate sites for additional tissue sampling during prostate biopsy. Thus, a total of 16 prostate tissue columns were obtained from this patient: 12 standard and 4 from suspicious sites.

Histoscan map.

Histoscan map – locations of additional column collections are indicated by arrows

Grid positions for additional posts are indicated by arrows.

Next, we evaluated the morphological image in all columns of the prostate tissue and compared it with the results of the histoscan.

After obtaining these data, we calculated the sensitivity and specificity of the method for detecting prostate cancer using the Histoscan device.

In addition, we have developed a third method for assessing the morphological picture in suspicious areas based on histoscopic data, which consists in conducting an additional postoperative biopsy after radical prostatectomy, during which both suspicious areas and unchanged tissue are taken according to histoscopic data. For this purpose, the removed gland is specially marked in quadrants of 5 × 5 mm in size. This feature made it possible to spatially correctly project suspicious areas from histoscopy data into the prostate. After numbering the tissue columns, we sent them for morphological examination, which was carried out blindly, that is, the morphologists did not know which areas of the prostate they were examining (Figure 3).

Comparison of prostate mapping for blinded postoperative biopsy.

Left photo of the removed prostate, right histoscopy map

On the left is a photo of the removed prostate gland (specially marked 5x5 mm), on the right is a map from a histoscan (also marked 5x5 mm).

Then the morphological study data were compared with the histoscopy data. This comparison was carried out together with experienced morphologists after radical prostatectomy. It should be noted here that there are several methods for postoperative assessment of the prostate. We used the following method: first, the entire prostate was cut by a morphologist like an “open book”: sections of the organ were made from the base to the apex with a cut 2-3 mm thick and were incomplete. End, that is, in comparison with an open book, the zone became the “cover of this book”. The results of the morphological study fully confirm the histoscan data: according to the histoscan data, macroscopically the node is located in the right lobe, and during the morphological study the node is adjacent to the prostate capsule in the right lobe (Fig. 5).); .

Macroscopic specimen and prostate map.

A macroscopic sample of the prostate - part of the tumor tissue is surrounded by red color

A. Macroscopic preparation of the prostate in the view of an open book, with some tumor tissue circled in red.

Schematic map of the prostate – blue arrow indicates dashed line

B. Prostate map with dashed line indicated by a blue arrow.

Using histoscan data, 638 prostate biopsies were performed and their morphological findings were compared with the data of 67 prostate biopsies without histoscopic data and with the data of 53 morphological studies after prostatectomy.

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