KAPITEL 8 / *CHAPTER 8* [8]
THE ROLE OF MSCT, DWI, PET/CT, 3D RECONSTRUCTION AND VIRTUAL ENDOSCOPY IN THE DETECTION OF COLON PATHOLOGY AND COLORECTAL CANCER

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Introduction. Cancer of the rectum and colon (colorectal cancer, or CRC) today, without exaggeration, can be designated as a global problem [1,207 p.]. It is known that in the first place in terms of morbidity, among men, is lung cancer, among women - breast cancer, and CRC is gradually coming to second place. The trend towards a continuous increase in the incidence is especially pronounced in industrialized countries. Being the center of the modern globalized world, they involve countries with less developed economies in their orbit, imposing their "industrial" way of life among many factors. One of the characteristics of this lifestyle is nutrition. It is with its features that most scientists associate the rapid increase in morbidity and mortality from colorectal cancer. So, according to the WHO, about one million new cases of patients with colorectal cancer are registered annually in the world [5.976 s]. In the US, mortality from CRC is in third place. In Ukraine, in 2018, the registered incidence rate of CRC is 38 cases per 100 thousand population, which is in line with European and global trends [5,976]. In the CIS countries, over the past 20 years, colon cancer has moved from 6th to 3rd place in women after breast and ovarian cancer and to 3rd place in men, behind only lung and prostate cancer.

To date, such risk factors for colorectal cancer have been identified, such as the age of patients over 50, dietary habits, genetic syndromes (diffuse familial polyposis, Gardner-Turner syndrome, Peitz-Egers syndrome), Turk's disease, the presence of colon adenomas, ulcerative colitis, Crohn's, a history of CRC in relatives, previous breast cancer and / or female genital cancer [12,744p.].

In patients with chronic inflammatory diseases of the rectum, especially with ulcerative colitis, the incidence of rectal cancer is significantly higher than in the general population [13,560 p.].

The duration and clinical course of the disease affect the risk of cancer.

So, according to the literature, the risk of rectal cancer with a disease duration of up to 5 years ranges from 0 to 5%, up to 15 years - 1.4-12%, up to 20 years - 5.4-

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Polyps are more common in men (60%) and less often in women (40%). The sizes at which malignancy of polyps often occurs are as follows: less than 5 mm - 0%, 5-9 mm - 1%, 10-20 mm - 10%, more than 20 mm - 40-50%.

Existing techniques do not always allow us to establish the nature of the changes in the colon. For example, standard barium irrigoscopy can detect only large polyps and, in 80% of cases, colon cancer, most often exophytic, less often endophytic (70-75%).

Conducted tests for occult blood, according to literature data, are characterized by very low sensitivity and low specificity.

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out fibrocolonoscopy to remove polyps identified using virtual colonoscopy. However, the information on this matter is rather contradictory, sometimes based on a small number of observations and is often not interpreted correctly enough.

Virtual colonoscopy (screening of colon cancer using computed tomography) finds 90% of large precancerous polyps [9, pp. 145-150]. The study showed that virtual colonoscopy detected 90% of polyps with a diameter of 10 mm or more (the same accuracy as for colonoscopydetermining the reliability of detecting polyps using MPR, 3D reconstruction and virtual endoscopy; establishing the distinctive features of MSCT images of polyps and polypoid thickening of mucosal folds; establishing criteria for tumor invasion of the intestinal walls; determining the effectiveness of chemoradiation and surgical treatment; determining radiological criteria for tumor recurrence.

The purpose of our research was the following: establishment of MSCT criteria for infiltrating and exophytic colon cancer; establishing the capabilities of DWI and PET / CT in the diagnosis of colon cancer;

determination of the reliability of detecting polyps using the MPR, 3D reconstruction

Materials and methods. When writing the monograph, the data of literature studies were used, the results of our own studies for the period of work from 2006 to 2017 MSCT colonoscopy was performed in 345 patients (240 with suspected cancer, 105 with polyps). Preparation for the study of patients was carried out according to the standard method. The usual radiation dose for MSCT colonoscopy is 6-12 mGy. During screening, it is permissible to reduce the dose to 3-6 mGy ("low dose technique"). The low dose technique should be used to determine the cause of the obstruction of the colonoscope or if the irrigoscopy is not possible. The introduction of contrast is often necessary for the purpose of enveloping the stool lumps. This is especially important for elderly people who cannot perfectly prepare for the examination. Intravenous administration of contrast is performed according to indications, especially if there is a suspicion of a relapse of the tumor process, determination of the transition of the tumor to pericolic fat, to assess the effectiveness of radiation or chemotherapy. When using axial imaging, it is better to use the pulmonary window, which allows better visualization of polyps. The soft tissue window visualizes fat damage better. It is advisable to use all three positions: axial, sagittal and coronary, which demonstrate good resolution (see Fig. 1).

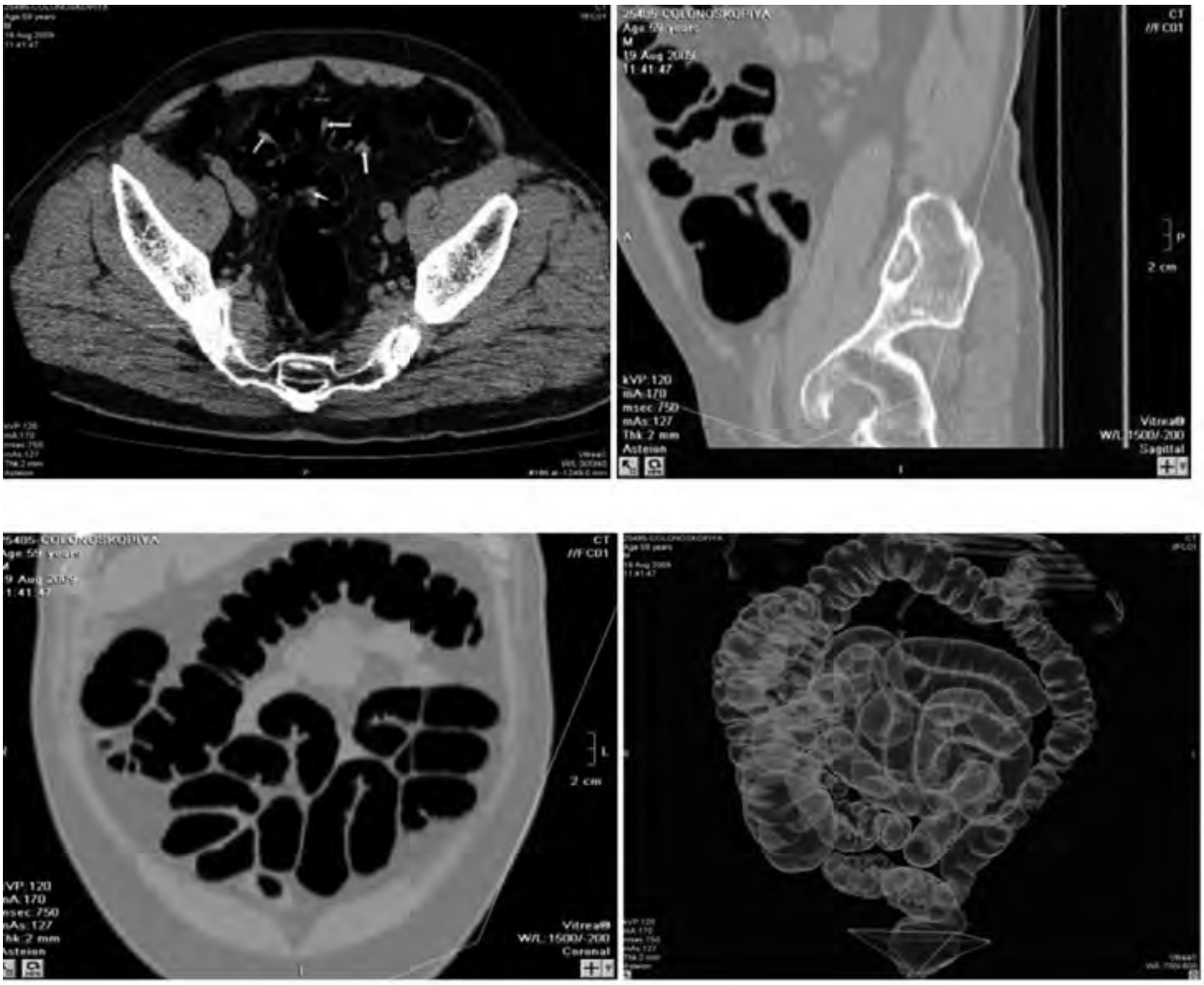

Figure 1 - shows MSCT colonography of the normal colon.

When using a 3D view, we clearly visualize invisible lesions located behind the haustral folds. Sometimes difficulties arise when there is a lot of fluid or stool. In these cases, it is necessary to examine patients on the back and abdomen. With the help of targeted navigation, it was possible to inspect the large intestine both from the outside and to view the object from the inside [9, p.145-150].

We used standard abdominal radiography, MSCT (multislice computed tomography), MRI (magnetic resonance imaging), DWI (diffusion-weighted images).

MSCT studies were carried out on 4 and 64-slice Toshiba devices. MRI examinations were performed with a field strength of 1.5 T. PET / CT was performed using labeled 18F-FDG (2-fluorodioxyglucose).

Results and discussion. Malignant tumors are subdivided into endophytic or infiltrative, exophytic and mixed tumors. In infiltrative tumors, thickening of the colon walls over 12-13 mm was determined with a norm of 2-3 mm. The latter circularly narrow the intestinal lumen.

The virtual colonoscopy clearly reveals the tumor formation. MSCT examination of the colon was carried out in cases of suspicion of a tumor and difficulty in performing standard methods of examination of the colon, due to severe pain, pronounced dolichosigma, enema incontinence, the impossibility of examining the right sections of the colon, post-radiation changes, with suspicion of early postoperative complications, in cases of massive extraorganic growth to assess the prevalence of the process and identify extraorganic tumor recurrence.

Exophytic cancer was found in 90, endophytic in 86 and mixed in 74 patients. With exophytic tumors, a cancerous tumor has a bumpy surface and, as it were, consists of several nodes. The use of CT colonography helps to identify tumor invasion of the intestinal wall and the surrounding fatty tissue or mesentery.

Virtual colonoscopy clearly demonstrates individual tumor nodes that grow into the adjacent fatty tissue, often put pressure on the outer wall of the intestine, determine the defeat of the lymph nodes in the abdominal cavity. The virtual colonoscopy clearly reveals the tumor formation. MSCT examination of the colon was carried out in cases of suspicion of a tumor and difficulty in performing standard methods of examination of the colon, due to severe pain, pronounced dolichosigma, enema incontinence, the impossibility of examining the right sections of the colon, post-radiation changes, with suspicion of early postoperative complications, in cases of massive extraorganic growth to assess the prevalence of the process and identify extraorganic tumor recurrence.

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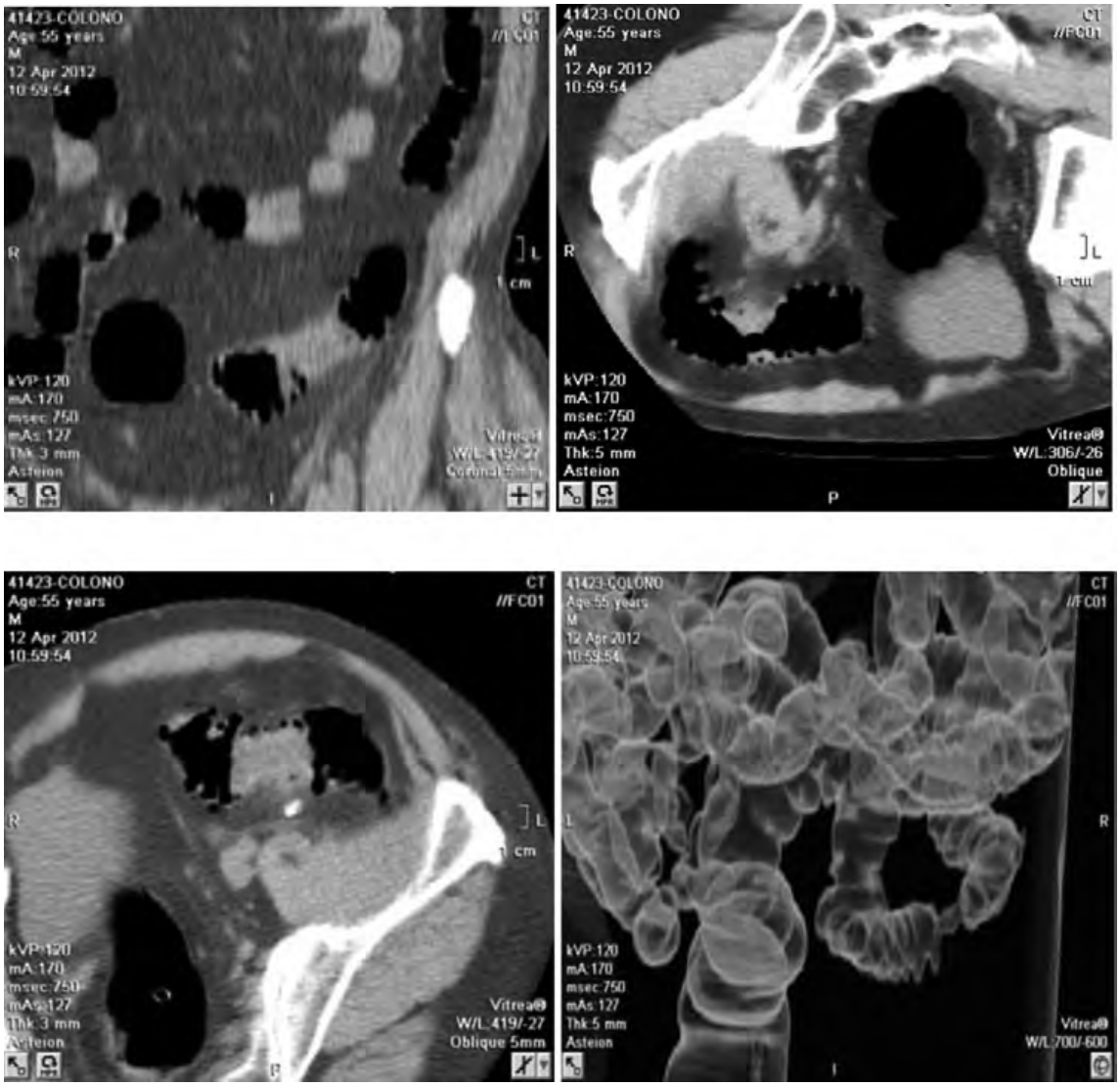

Figure 2 - shows an infiltrative tumor with concentric narrowing of the intestine.

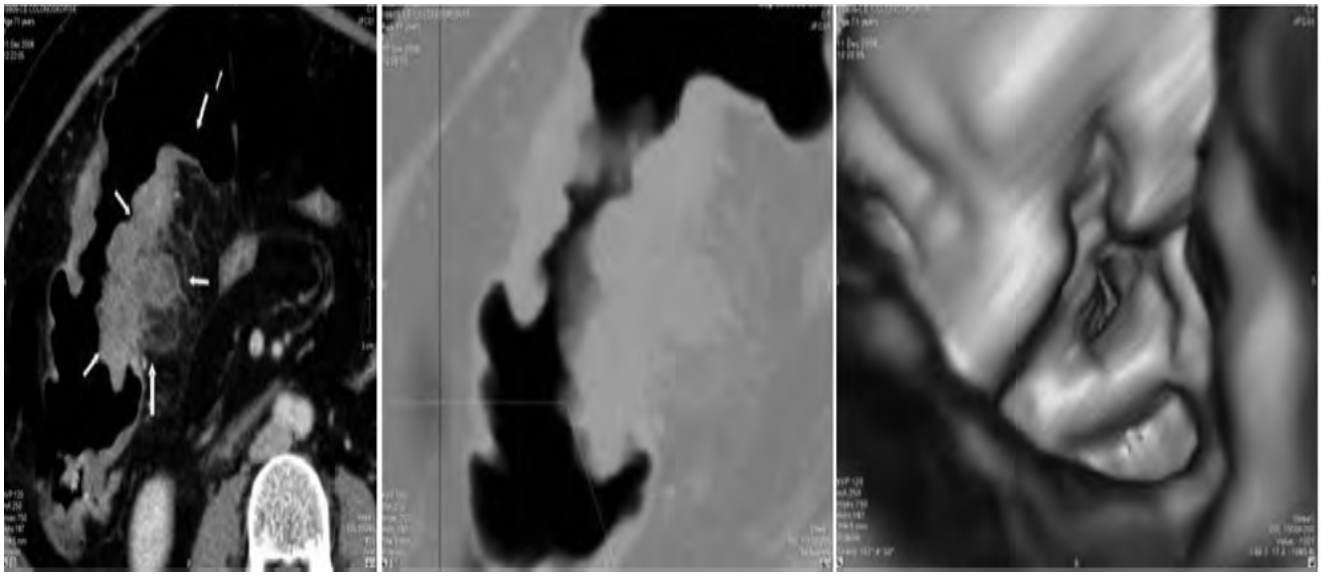

Figure 3 - MSCT and spiral colonography show an exophytic colon tumor (see arrows).

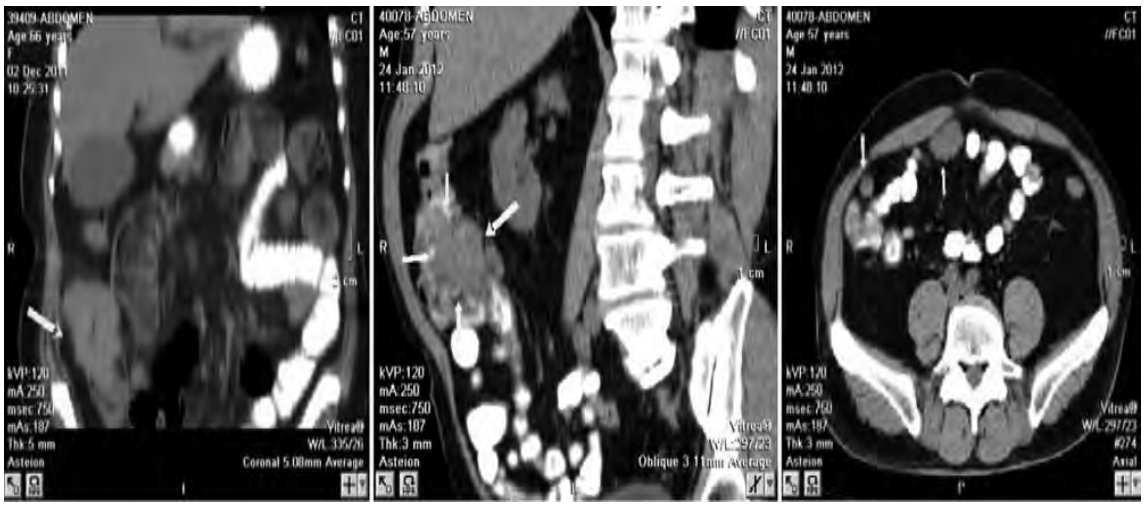

Figure 4 - MSCT. Tumor of the cecum with metastases in the abdominal cavity

To date, the risk factors for colorectal cancer have been identified. These are: 1. the age of patients over 50; 2.features of power supply; 3. genetic syndromes (diffuse familial polyposis, Gardner-Turner syndrome, Peitz-Egers syndrome), Turk's disease; 4.the presence of adenomas of the colon; 5. ulcerative colitis; 6. Crohn's disease; 7. A history of colorectal cancer in relatives, previous breast cancer and / or female genital cancer.

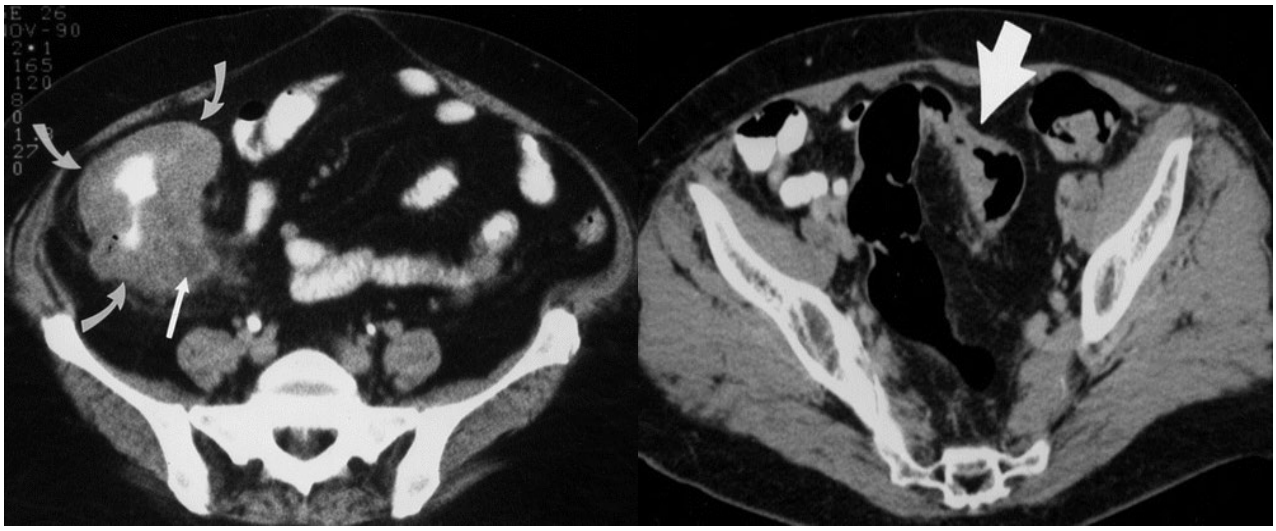

Figure 5 - MSCT of colon cancer (cecum, transverse colon - arrows).

In patients with chronic inflammatory diseases of the rectum, especially with ulcerative colitis, the incidence of rectal cancer is significantly higher than in the general population. Cancer risk is influenced by the duration and clinical course of the disease (Fig. 6).

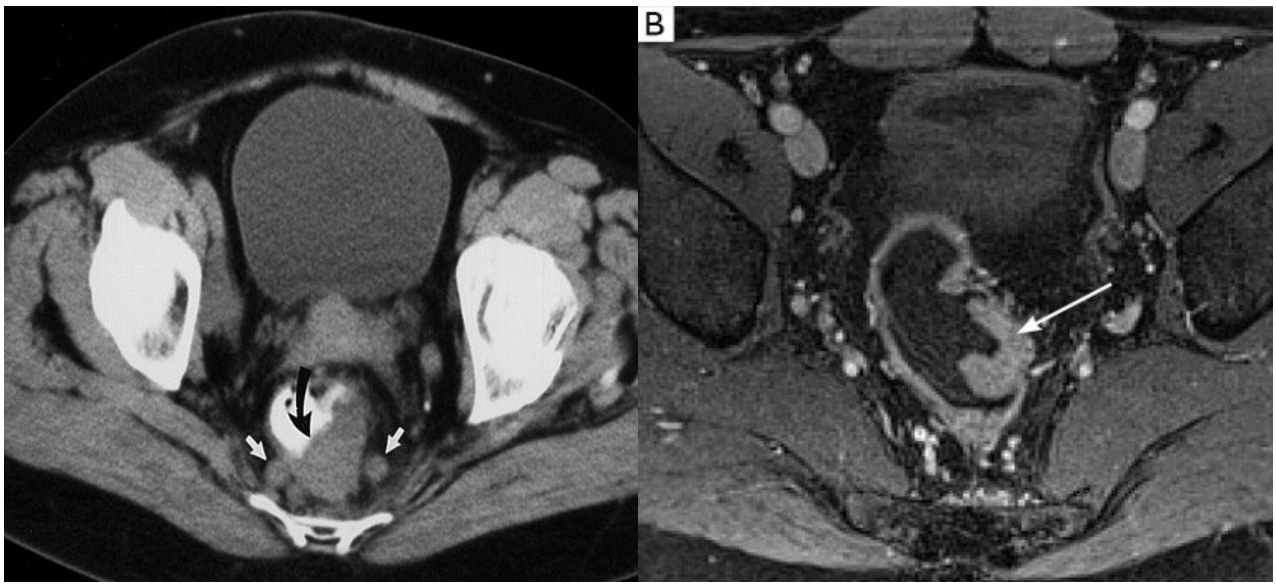

Figure 6 - (a) MSCT of rectal cancer (b) MRI of rectal cancer

According to the literature, the risk of rectal cancer with a disease duration of up to 5 years ranges from 0 to 5%, up to 15 years - 1.4-12%, up to 20 years - 5.4-20%, up to 30 years - 50% ...

The accuracy of MSCT varies significantly and depends on the extent of the process. Here you should pay attention to the fact that with the progression of the process, tumor growth can be observed not only in the area of the anastomosis, but also in the adjacent areas, while the tumor significantly accumulates contrast. You should also pay attention to the condition of the regional lymph nodes.

Colon polyps

In Figure 7, two polyps are found in the shadow projection option. One of them is located in the hepatic corner of the large intestine, the other on the lateral wall of the rectum. The size of the first polyp is 1.6 cm, the second is 1.5 cm.

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In addition to polyps, hyperplastic folds, which resemble adenomatous polyps, are false in the differential diagnostic plan.

With adenomatous polyps, virtual colonography gives a clear idea of the presence of an adenomatous polyp by maintaining a normal internal pattern of the intestine, haustration (Fig. 7).

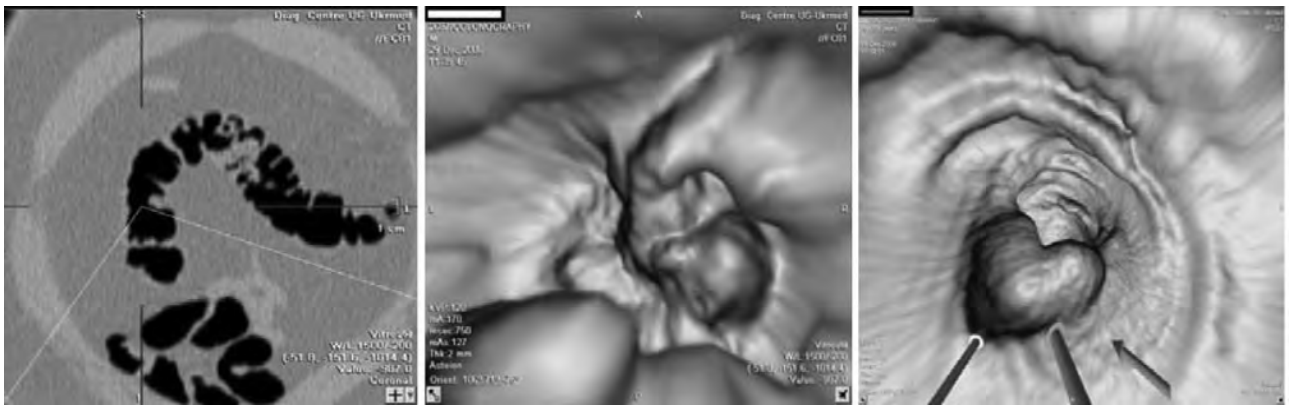

Figure 7 - shows two adenomatous polyps of different sizes: 1.6 cm and 1.5 cm. The patient was asked to remove them.

Tumor formations larger than 1 cm and hyperplastic masses in 10-25% may be carcinomas.

On an axial tomogram, the changes are no different from the image of cecum cancer with invasion of pericolic fatty tissue. Virtual colonography indicates an inflammatory process with preservation of gaustration.

Patients with these processes must necessarily be examined using fibrocolonoscopy to take a biopsy.

Fatty polyps, especially pedunculated polyps, are highly mobile and can make them difficult to interpret. Figure 8 shows an image of a large fatty polyp with a long stem, up to 1.8 cm in size. The polyp was removed during a subsequent colonoscopy.

The sensitivity of MSCT in the diagnosis of polyps measuring 6 mm is 90% and 99% during colonoscopy. With tumors larger than 1 cm, the sensitivity of both methods reaches 100%, but it should be borne in mind that not all patients will be able to undergo colonoscopy.

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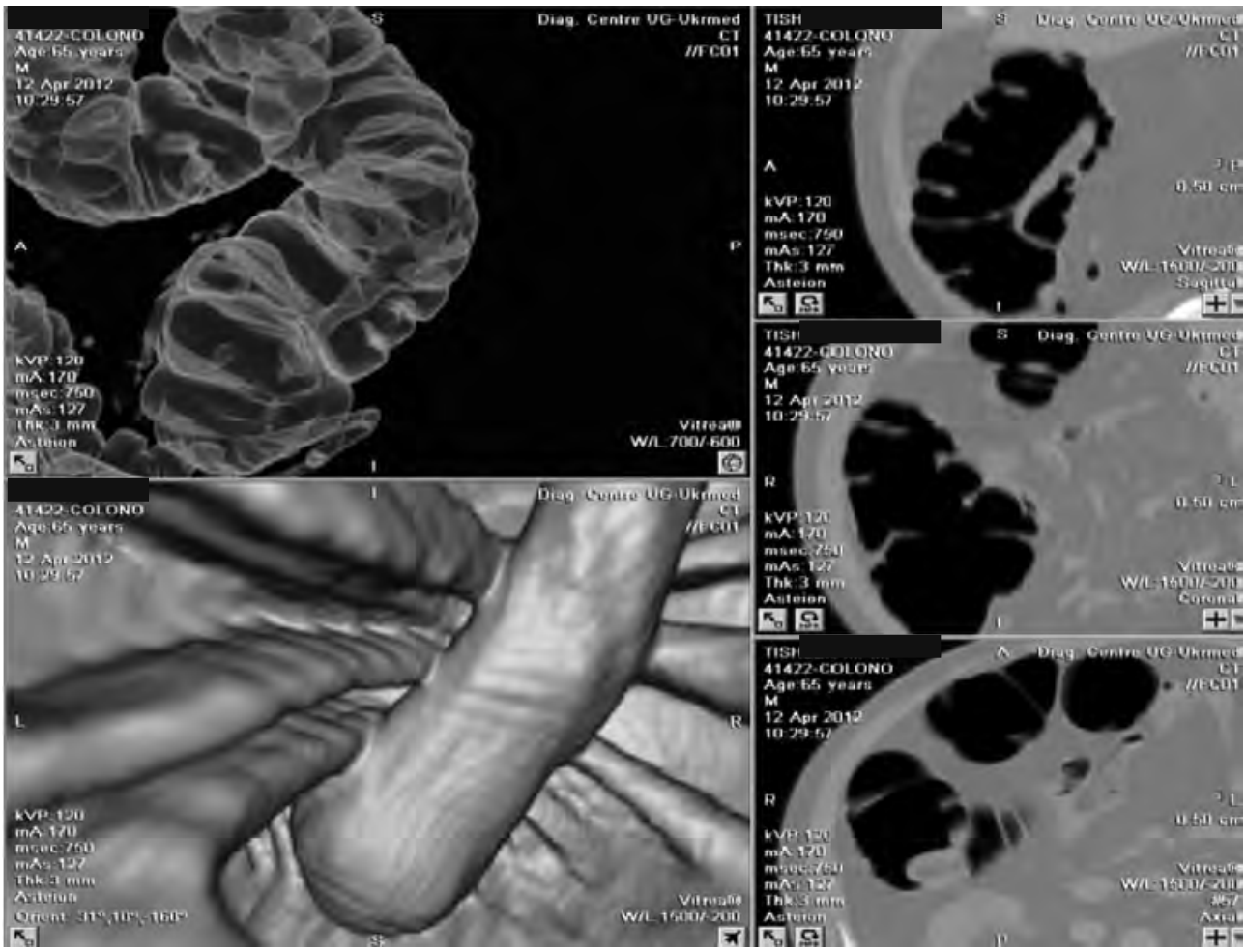


Figure 8 - Virtual colonography. Large pedunculated fatty polyp.

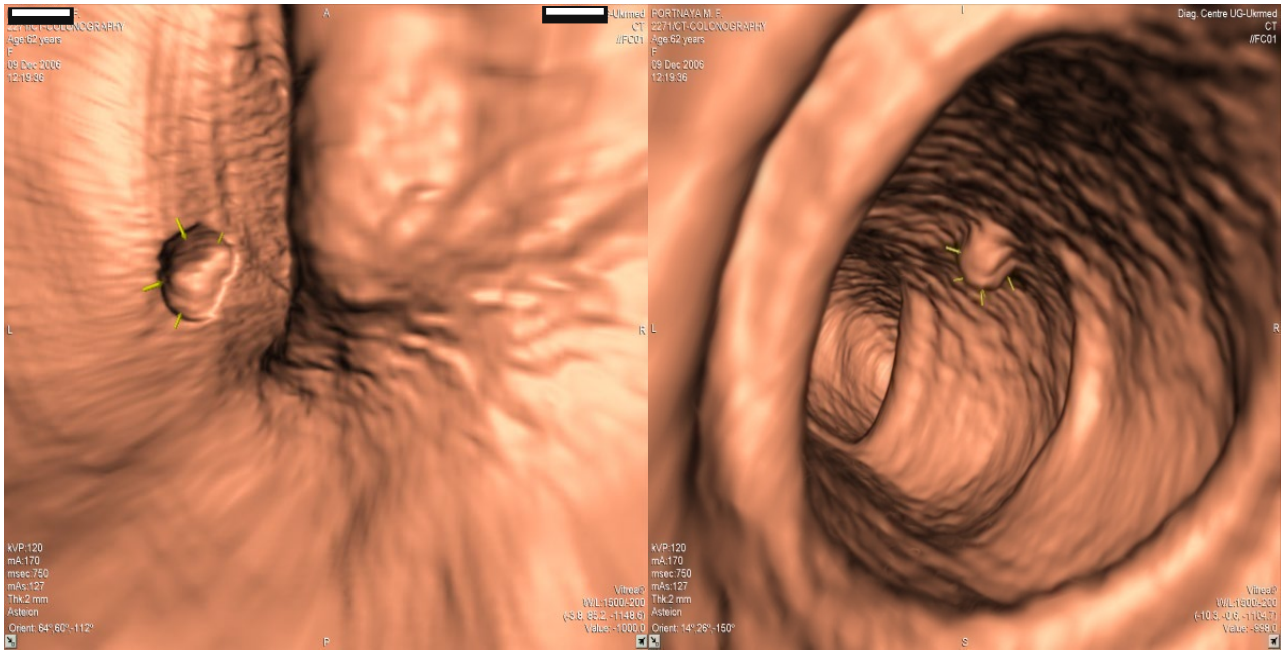


Figure 9 - Virtual colonoscopy of a piece of stool and polyp.

When performing radiation therapy, we paid attention to the features of the contrast distribution in the tumor and surrounding tissues (during and after) irradiation). A pronounced decrease in the accumulation of contrast by the tumor indicated a good effect of the radiation therapy.

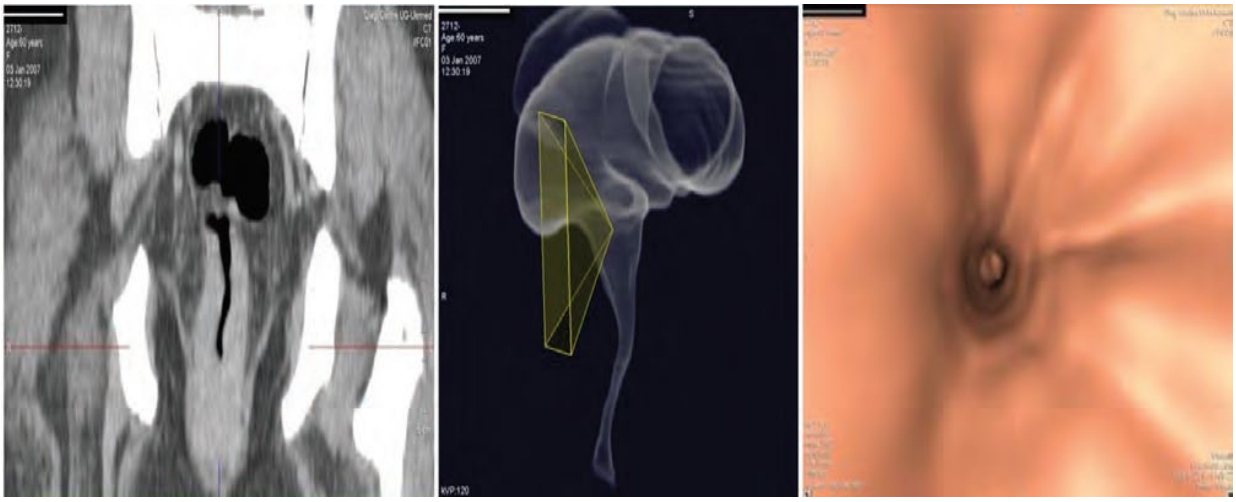


Figure 10 - MSCT and virtual colonography of rectal cancer after radiation therapy.

The following are the results of examining patients using DWI and PET / CT.

DWI is based on the registration of changes in the nature of the Brownian motion of water molecules in various pathological processes. We measured the signal intensity in a series of DWI images and calculated the diffusion coefficient (DTC) values. The ICD is a gradient curve that is plotted by comparing the values of b on the x-axis and the logarithm of the tissue signal on the y-axis. ICD values were determined automatically by entering the area of interest on the map. ICD is expressed in μm2 / s. We used the values b = 50s / mm2, 400s / mm2, 800s / mm2. For each focus, the diffusion coefficient of ICD was determined on special ICD maps (Fig. 11 and Fig12).

PET / CT in combination with MSCT with high accuracy allows diagnosing both small colon tumors and metastases, including tumor dissemination along the peritoneum [15, p.92-103] (Fig.13 and Fig.14).

Spiral tomography clearly shows tumor growths in the cecum (b), MSCT shows a tumor lesion of the cecum (arrow (a)), which was confirmed by 18F- FDG(c).

Rectal cancer recurrence 6 months after resection and radiation therapy (arrows). The accumulation of FDG over the tumor indicated insufficient effectiveness of the radiation therapy.

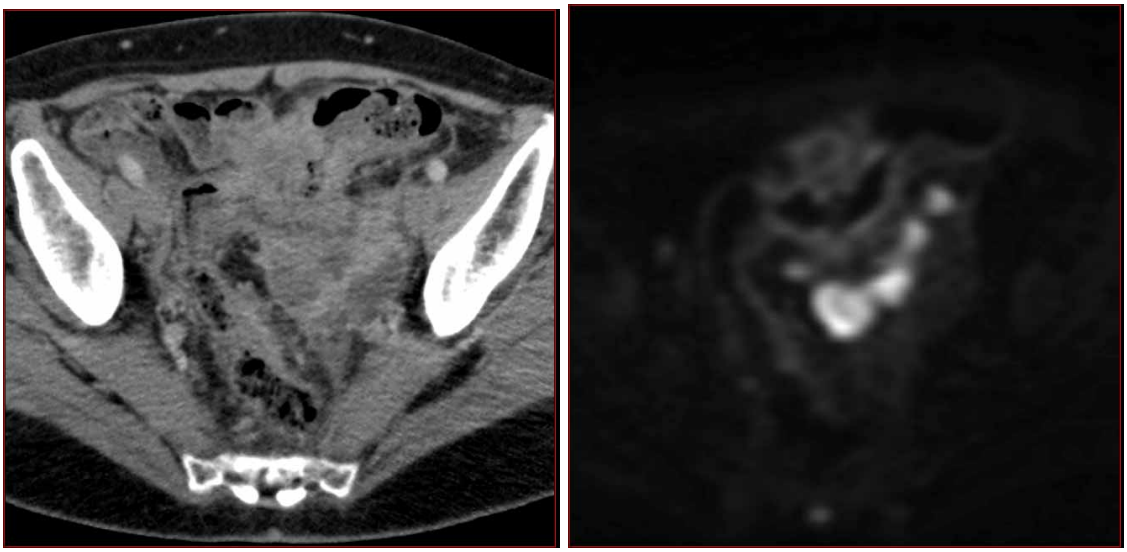


Figure 11 - MSCT tumor of the sigmoid colon. T2-weighted images show a well-defined lesion in the perisigmoid space. DWI was obtained at b = 750 and shows a high signal.

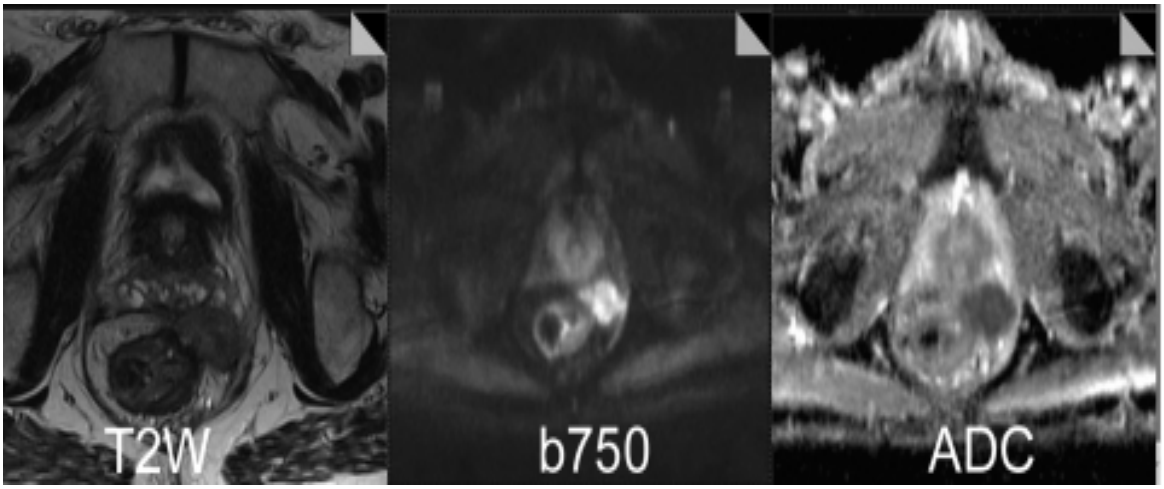


Figure 12 - T2-weighted images show a well-defined lesion in the perirectal space. DWI was obtained at b = 750 and shows a high signal.

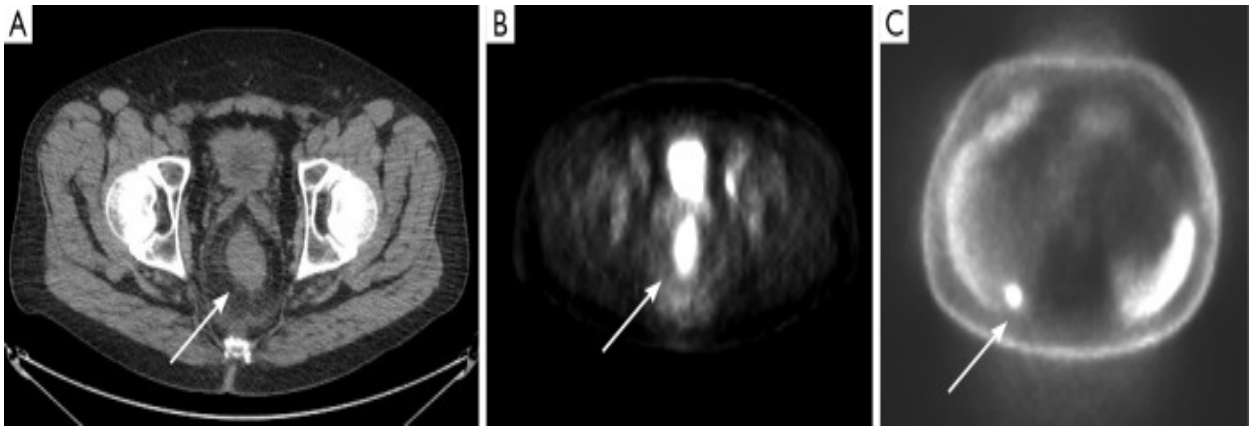
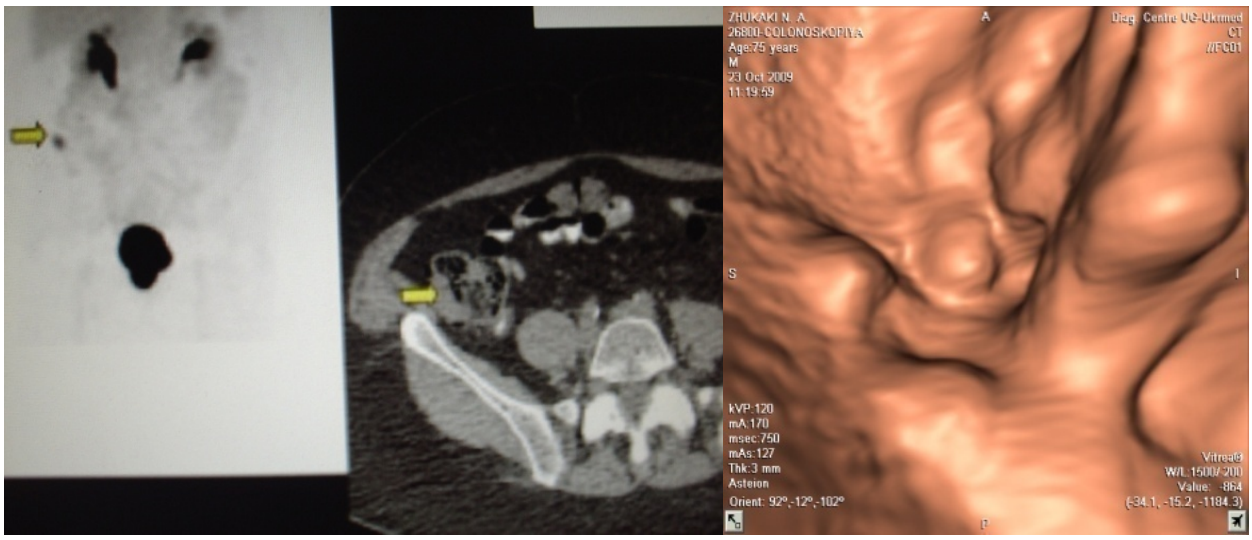


Figure 13 - PET / CT of rectal tumor with liver metastasis (arrows).



(c) (a) (б)

Figure 14-MSCT(a), spiral tomography (b) and PET/CT of the cecum tumor (c).

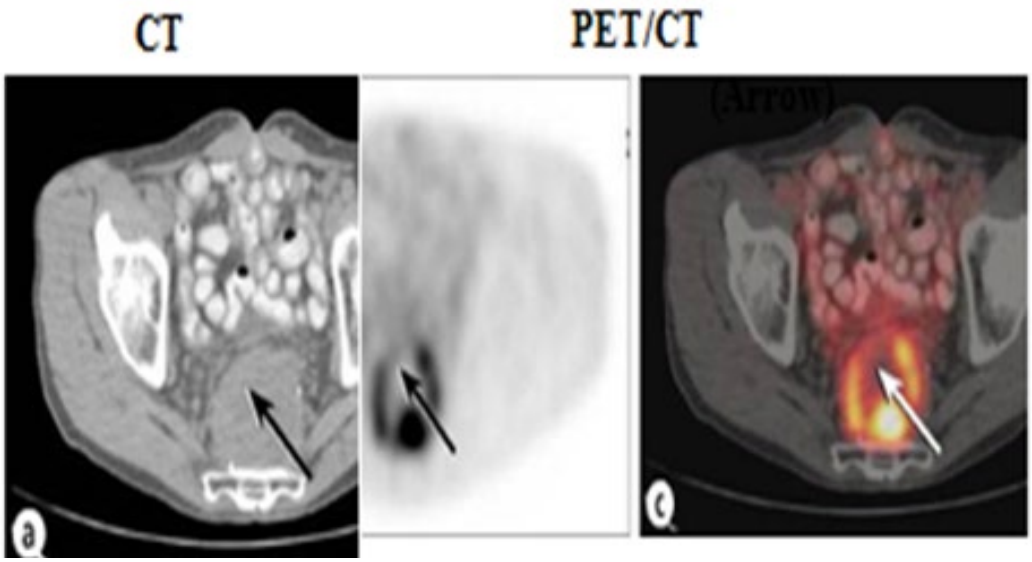


Figure 15 MSCT and PET / CT Recurrent rectal cancer. (a) MSCT shows a large pre-sacral mass that showed negative biopsy. *The negative result was obtained because during the puncture the needle passed through necrotic changes in the tumor. (b) The arrow shows the progress of the biopsy image of a fused active tumor with a discontinuous rim surrounding the necrotic center. (c) Repeated biopsy based on PET / CT imaging confirmed tumor recurrence*

Conclusions.

MSCT, including MSCT endoscopy, is a highly informative method for detecting invasive colon cancer, showing sensitivity and specificity indicators approaching 100%, which cannot be said about the diagnosis of colon polyps (76%). The use of MSCT can increase the accuracy of preoperative detection of a colon tumor, clarify the stage of the disease, detect tumor recurrence, and determine the effectiveness of radiation therapy. The sensitivity of MSCT for detecting polyps of 5-6 mm in size was 59%, with optical colonoscopy - 76%, the sensitivity of MSCT for detecting polyps of 10 mm was 91%, with optical colonoscopy - 95%.

The advantage of virtual colonoscopy is that it does not require complex preparation of the patient for the study and does not injure him, since the research technique, in fact, is a variant of computed tomography.

This technique is well suited for screening patients from risk groups, especially in the presence of polyps, because they often undergo malignant transformation.

Methods MSCT, DWI, MRI are useful in the diagnosis and definition of the metastatic focus of education.

18F-FDG PET / CT can provide effective prognosis information after surgical resection of colon cancer. PET / CT provides a significant advantage in improving diagnosis and therapeutic monitoring of patients, monitoring treatment responses.