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The use of complex radionuclide methods in the detection of metastatic lesions of the skeleton and liver in kidney cancer

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Abstract: *metastasis of kidney cancer occurs to the bones in 30% of cases, and to the liver in 60%. One of the radiation methods for detecting metastatic lesions of the skeleton and liver is radionuclide. Osteoscintigraphy is a specific study in the diagnosis of bone metastases, mainly of the osteoblastic type. For the diagnosis of liver metastases, radionuclide methods are used "in vivo" and "in vitro". Static hepatoscintigraphy, compared to ultrasound, computed tomography and magnetic resonance imaging, is less informative in finding secondary lesions. One of the most sensitive methods for detecting secondary liver damage is radioimmunoassay of specific tumor markers. The main ones are alpha-fetoprotein, carcinoembryonic antigen and carbohydrate antigen 19-9. Their concentration in the blood serum increases tenfold when the malignant process spreads to the liver. In the radionuclide department of the KMCL No. 18, which is located at the Department of Radiology and Radiation Medicine of the O.O. Bogomolets National Medical University, patient S., 62 years old, with right-sided renal cell carcinoma of stage II (T2N0M0), underwent radionuclide studies of the skeleton, liver, function of the single left kidney (after right-sided nephrectomy), and tumor markers. The reason for this was the absence of secondary lesions of these organs on X-ray computed tomograms in the presence of pain syndrome in the lower back and heaviness in the right hypochondrium. Radionuclide examination of the skeleton revealed slight hyperfixation of the radiopharmaceutical (up to 150%) from L1 to L5, which did not confirm the presence of secondary spinal lesions. The functional capacity of the left kidney was reduced. The absence of drug accumulation on hepatoscintigram was not detected, but a diffuse-uneven decrease in its uptake by cells of the reticuloendothelial system was observed, which is characteristic of hepatitis. However, the levels of tumor markers characteristic of focal liver damage significantly exceeded the norm. Based on which a conclusion was made regarding metastatic damage to this organ. Thus, patients with hepatocellular kidney cancer are recommended to undergo a comprehensive radiation examination with the inclusion of radionuclide methods both "in vivo" and "in vitro" to determine tumor markers specific for secondary liver damage.*

Key words: Metastases; Renal Cell Carcinoma; Tumor Markers; Radioimmunoassay; Hepatocellular Cancer; Dynamic Renoscintigraphy; Osteoscintigraphy; Static Hepatoscintigraphy.

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Introduction

One of the most common types of kidney cancer is renal cell carcinoma (RCC) (up to 85%), which arises from the degeneration of epithelial cells of the proximal tubules and collecting ducts. It ranks 10th among all cancers and 3rd among malignant tumors of the genitourinary system. In Ukraine, incidental detection of RCC by ultrasound (US) and X-ray computed tomography (CT) has increased significantly (comparison of data from 1997 and 2021). The incidence rate among women increased from 6.2 per 100 thousand population in 1997 to 8.7 per 100 thousand population in 2021. The mortality rate among the female population in 1997 was 2.7 per 100 thousand population, and in 2021 – 3.1 per 100 thousand population [1]. The diagnosis of RCC is established in healthcare institutions of Ukraine on the basis of the "Unified Clinical Protocol for Primary, Secondary (Specialized) and Tertiary (Highly Specialized) Medical Care" for Kidney Cancer [2]. Before starting specialized treatment, it is necessary to conduct a number of examinations to determine signs of malignant tumor growth and the stage of the disease. This is a package of general laboratory tests and such radiation methods as ultrasound of the abdominal cavity (40-60% of kidney tumors are detected incidentally); CT of the chest and abdominal cavities; dynamic renoscintigraphy (DRSG) to determine the functional state of the kidneys before and after surgery; magnetic resonance imaging (MRI) of the kidneys, urinary tract and brain (in the presence of neurological symptoms), or in case of allergy to X-ray contrast and pregnant women without impaired renal function; osteoscintigraphy (OSG) is mandatory in the presence of pain in the bones of the skeleton and increased alkaline phosphatase (ALP) in the blood serum [3, 4].

RCC is divided into stages:

Stage I – tumor cells differ slightly from normal ones, develop slowly. The tumor is localized in the middle of the kidney and does not protrude beyond the renal capsule.

Stage II – cancer cells have clearly defined differences, grow slowly. The tumor may extend beyond the renal capsule.

Stage III – the tumor affects the lymphatic and circulatory systems. Stage IV – undifferentiated cells are significantly different from healthy ones, metastases are observed in neighboring organs (liver, lungs), distant lymph nodes and organs.

In 30% of cases, RCC spreads to the bones. It most often affects the vertebrae, hip joints, and ribs, causing severe pain, fractures, and cracks [5]. This can lead to induration and growths (in the osteoblastic type of metastasis) or destruction of bone tissue (in the osteolytic type) [6]. In 60% of cases, RCC metastasizes early to the liver, which is manifested by heaviness in the right hypochondrium, bitterness in the mouth, and sometimes jaundice. The main radiological methods for detecting metastatic lesions of the skeleton today remain CT and OSG. However, each of them has its own advantages and disadvantages. CT is more informative in cases of lytic metastases (Mts) and significant bone damage [6]. OSG, on the contrary, is more informative even in small areas of lesion, but mainly osteoblastic type of metastasis. In this case, hyperfixation of the radiopharmaceutical preparation (RPP) is noted above 150% compared to normal bones [7]. To detect secondary liver lesions, ultrasound, CT, MRI and radionuclide methods are used. However, their informativeness directly depends on the size of the lesions, with a diameter of up to 5 mm they may not be visualized. Therefore, if there is a suspicion of the Mts spread of a malignant process to the liver, it is better to study tumor markers (TM), which are specific for its metastatic lesions [8]. One of the mandatory research methods for RCC is DRSG, which is necessary to determine the preoperative function of each kidney to exclude the occurrence of renal failure in the postoperative period, and the function of a single kidney in the postoperative period.

Aim

To investigate the informativeness of radionuclide research methods in detecting secondary skeletal and liver lesions in renal cell carcinoma.

Materials and methods

Patient S., aged 62, was diagnosed with stage II RCC (T2N0M0) of the right kidney in 2017

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according to the protocol for managing patients with a diagnosis of RCC and underwent right-sided nephrectomy. In 2024, she underwent the following radionuclide studies: OSG, DRSG, static hepatoscintigraphy (SHSG) and determination of TM by radioimmunoassay (RIA). All studies were performed in the radionuclide diagnostics department of the KNP "KMKL No.18", which is located on the basis of the Department of Radiology and Radiation Medicine of the O.O. Bogomolets National Medical University. OSG, DRSG and SGSH were performed on a gamma camera SPECT-1 "AMCRIS-H Limited" (Ukrainian-American Enterprise), with computer software "Spect Work" (Ukraine). And for RIA, a gamma counter "Gamma-12" was used. OSG and DRSG were performed with one radiopharmaceutical preparation (RPP) of nephro and osteotropic type – methylenediphosphonic acid (MDP) from the company "Polatom" (Poland), labeled with radioactive technetium 99m – Poltech 99mTc-MDP. Technetium was obtained using a molybdenum 99 (Mo99) generator system from the same company directly in the radionuclide department (Fig.1).

The use of one RPP with an activity of 600 MBQ for the study of both the skeleton and the kidneys is due to the fact that phosphate compounds, in addition to osteotropy, also have renal kinetics. The greatest activity in the kidneys is detected within 20 minutes after intravenous bolus administration of the drug, which allows them to be studied at this time. With the help of DRSG, functional parameters such as glomerular filtration rate (GFR), renal plasma flow, and secretory-excretory capacity are determined [9]. The study was performed in the horizontal position of the patient with the gamma camera detector placed under the bed in such a way that its longitudinal diameter was parallel to the spine, and the transverse diameter was at the level of the XII ribs. During the minute, indirect renangiogram (IRNG) data were obtained with a frequency of 1 frame/sec. Subsequently, information collection continued for 20 min with a frequency of 1 frame/min. On the total image of the kidney for the first 10 minutes, its area, size, shape, uniformity of RPP accumulation and time of its excretion into the bladder were assessed. For quantitative computer processing, the following areas of interest were selected: the heart, the “site” of the right kidney, the left kidney, and the urinary bladder. As a result, the kinetic curves of the RPP through the heart (cardiac), the left kidney, and the area of the missing right kidney (renograms) were obtained (Fig. 2).

The glomerular filtration rate (GFR) was calculated from the cardiac curve, and the parameters of the time transport of RPP were calculated from the renograms. The maximum accumulation of RPP for 3-5 min was taken as 100% and the percentage contribution of the left kidney was determined. The analysis of its secretory and excretory function was carried out by a data processing program and consisted in calculating the main parameters:

Gamma camera SPECT-1 Gamma counter "Gamma-12" Mo^{99} generator

Fig. 1. Equipment and generator system for conducting radionuclide research

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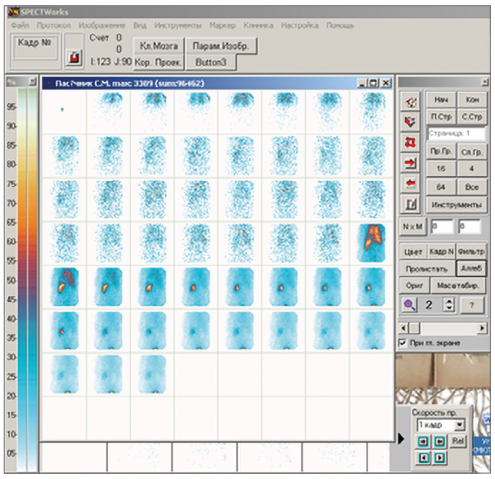
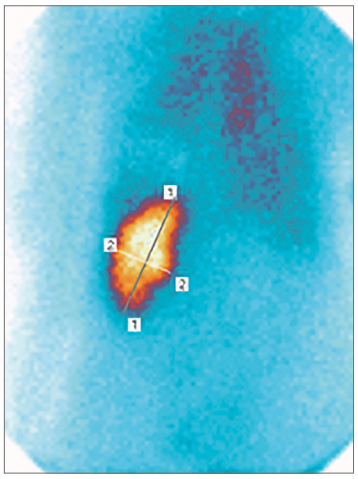
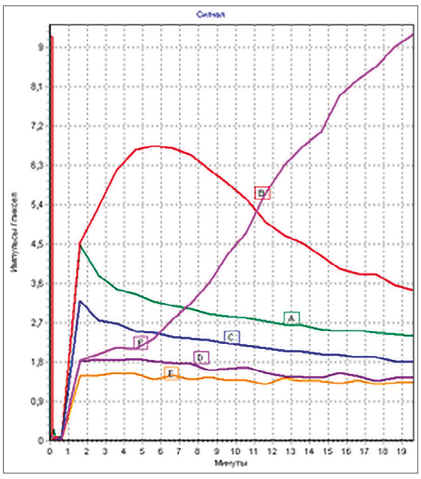


Frame-by-frame image of the dynamics of the RPP over 20 min.



Measurement of the area and size of the left kidney



Graphical representation of the dynamics of RPP: A – heart, B – left kidney zone, C – "place" of the right kidney, D and E – body background, F – urinary bladder.

Fig. 2. DRSG in patient S

– Tmax – time of maximum accumulation of RPP in the kidney (min);
– T1/2max – half-life of RPP from the kidney (min);
– GFR (ml/min) – separate per kidney, total, standardized (by body area);
– E20 – % of RPP elimination from the kidney for 20 min. in relation to the max. accumulation of RPP.

Normally, up to 32% of the total RPP activity is filtered. The data were entered into a standard study protocol developed at the Department of Radiology and Radiation Medicine.

2-3 hours after administration of the RPP, when its absorption in the bones reaches its maximum level, OSG was also performed with the patient lying down. Initially, the study was performed in the "Whole Body" mode (in anterior and posterior projections) with screening of the urinary bladder for simultaneous visualization of all parts of the skeleton. Then we moved on to a polypositional examination (also in the front and back projections). The collection of information on the gamma camera computer continued until 600,000 pulses were obtained from each field. Normally, radioactivity accumulates more in spongy bones – the vault and base of the skull, the facial skeleton, the spine, ribs, angles and edges of the scapulae, the pelvic bones, and the epiphyses of long tubular bones. For quantitative evaluation of osteoscintigrams, hyperfixation zones and normal areas of the bone system were selected. The inclusion of RPP in a suspicious area of bone tissue up to 110-125% was considered the norm. At 130-150% (in the absence of injuries or endoprosthetics), inflammatory or degenerative-dystrophic processes, or secondary lesions of a lytic nature, were suspected. RPP hyperfixation of more than 150% was considered as confirmation of Mts [10, 11] (Fig. 3).

The obtained indicators, along with the doctor's comments, were entered into a standardized research protocol developed at the Department of Radiology and Radiation Medicine (Fig. 4).

Radionuclide studies of the liver were performed using "in vivo" and "in vitro" methods, namely – HSG and RIA. Scintigraphic methods are divided into dynamic (to determine the function of the hepatobiliary system) and static (to assess the position of the organ, its relationship with other organs; size, shape, contours; nature of the lesion; detection of portal hypertension syndrome; prevalence of focal lesions). Their use depends on the indications and objectives of the study. In order to detect Mts liver damage, SGHS was performed 2 weeks after DRSG and OSG. The study was performed 20 minutes after intravenous administration of a colloidal solution of technetium with an activity of 1 MBq/kg of

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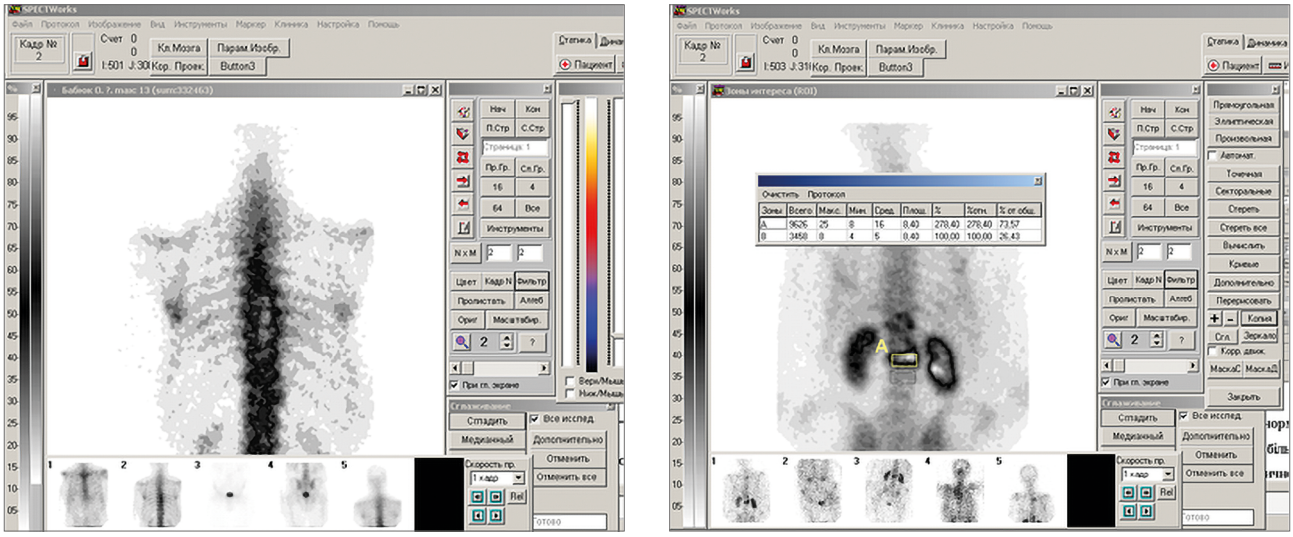


Polypositional research Quantitative processing of polypositional OSG results

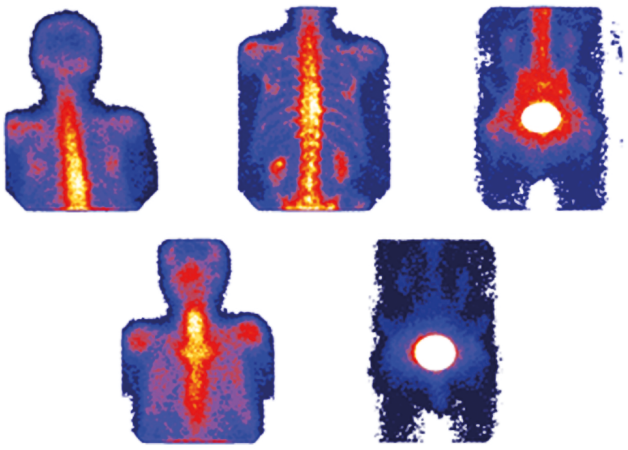
Fig. 3. Computer processing of OSG results

КОМУНАЛЬНЕ НЕКОМЕРЦІЙНЕ ПІДПРИЄМСТВО"КИЇВСЬКА МІСЬКА КЛІНІЧНА ЛІКАРНЯ № 18"ВИКОНАВЧОГО ОРГАНУ КИЇВСЬКОЇ МІСЬКОЇ РАДИ (КИЇВСЬКОЇ МІСЬКОЇ ДЕРЖАВНОЇ АДМІНІСТРАЦІЇ)
Кафедра радіології та радіаційної медицини НМУ ім. О.О.Богомольця

м. Київ, пр-т Перемоги, 34. м.т. 096-491-02-93

Клінічне дослідження: Остеосцинтиграфія

Пацієнт: _____
Рік народження: 1950
Дата обстеження: 15-03-23
Радіофармпрепарат(РФП): Tc-99м-MDP
Введена активність: 500 МБк
Променеве навантаження: 2.95 мЗв



Сцинтиграфічно визначається помірно підвищена фіксація РФП в ділянках грудного і поперекового відділів хребта – до 125%. Інші симетричні ділянки кісткової системи препарат накопичують відносно рівномірно.

Висновок: Сцинтиграфічно достовірних даних про Mts-ураження кісткової системи не отримано. Ознаки дегенеративно-дистрофічних змін хребта.

Лікар-радіолог: Анатолій МАКАРЕНКО

Fig. 4. Sample standardized OSG protocol

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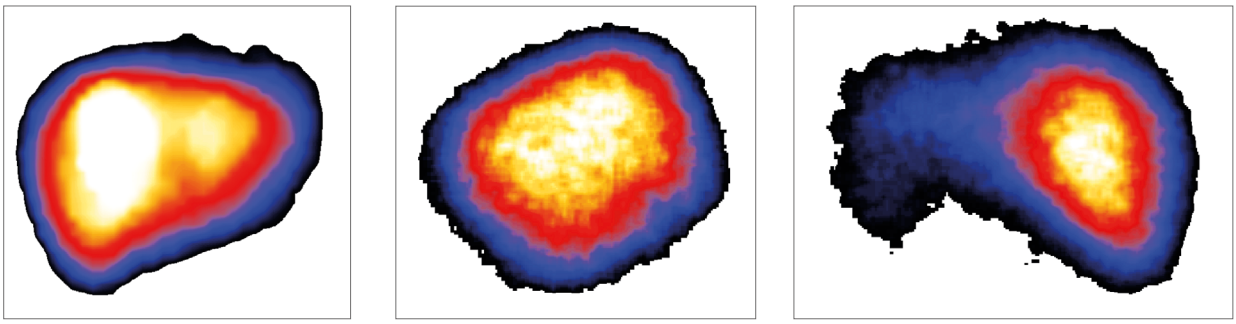


a – front projection | b – right lateral projection | c – rear projection

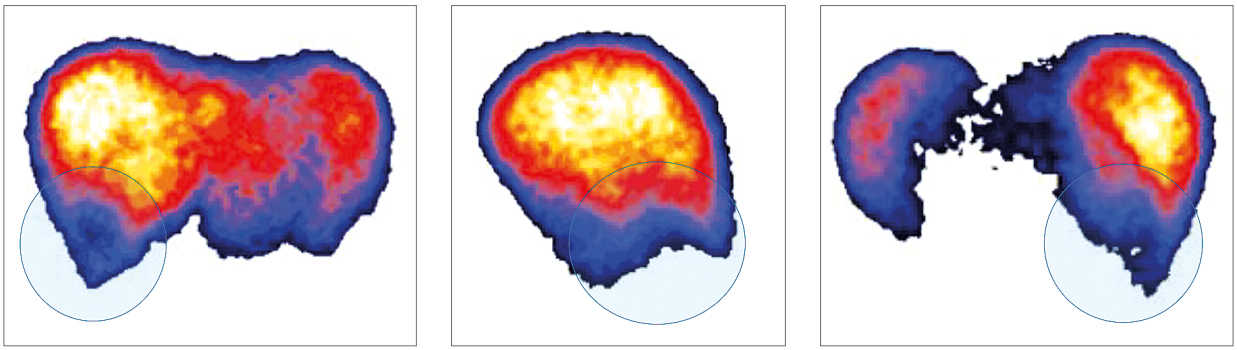
Fig. 5. Liver scintigrams are normal (data from our own archive).

weight in the patient's "standing" position from the abdomen, right side and back. This RPP has hepatotropic properties and accumulates in the mononuclear phagocyte system of the liver and in other organs of the reticuloendothelial system (RES). In a healthy person, all the blood passes through the liver in 10-12 minutes, so it is during this time that the maximum concentration of RPP in the organ is reached. Normally, the liver captures approximately 90% of the injected RPP and on scintigrams has clear, even contours without depressions and protrusions, with a smooth transition of colors from maximum to minimum shade, which is displayed on the color scale. In the direct projection, its shape resembles a triangle with the hypotenuse along the edge of the right costal arch. In the right lateral projection, it has the shape of an oval, and in the posterior projection, its left lobe is shielded by the spine. The assessment of parameters in SGHS is carried out in the direct projection (Fig. 5).

In the direct projection, the spleen is not visualized, but may be visible in the posterior projection. Its appearance on the scintigram in the direct projection indicates significant liver damage. In cysts, abscesses, liver tumors, the colloidal solution of radioactive technetium is not taken up by the PEC cells and looks like "accumulation defects" of RPP. Primary tumors appear as single "defects" of varying sizes. Sometimes they may appear as a "shothole" or the absence of part of the liver [12] (Fig. 6).

In Mts liver damage, foci of hypofixation (or absence) of RPP accumulation can be either single or multiple (more often) (Fig. 7).

For RIA on TM content, blood was taken during multi-target scintigraphy of the skeleton and a single kidney. TM are specific molecules that are produced directly by tumor cells or normal cells in response to the growth of a malignant neoplasm. They can be primary, secondary, and additional. The primary TM has high sensitivity and specificity for the corresponding tumor [13]. In this case, it is alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), and carbohydrate antigen (CA 19-9). These tumor



a – "defect" accumulation of radiopaque material 3.8x2.7cm in 6 and 5 segments – direct projection | b – right lateral projection | c – rear projection

Fig. 6. Liver scintigrams in hepatocellular carcinoma (data from our own archive)

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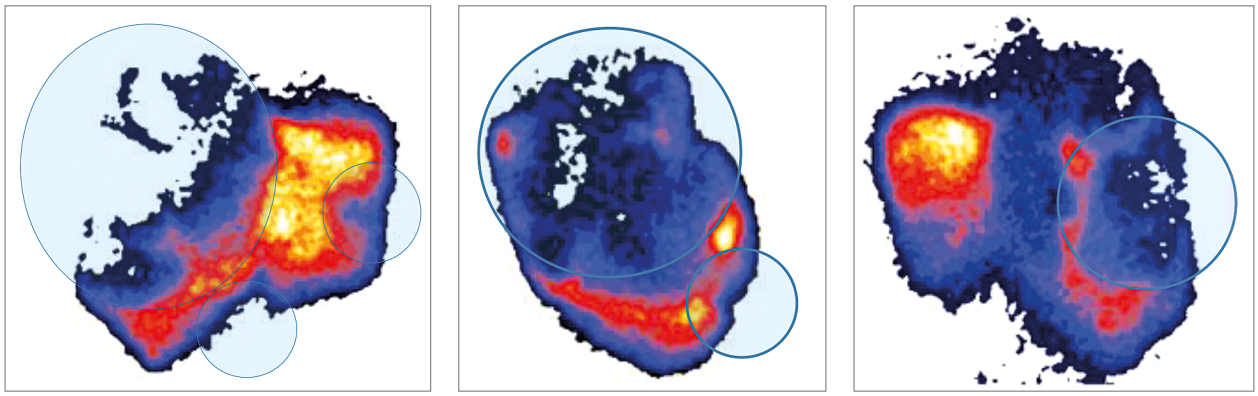

a – "defects" of RPP accumulation in the left lobe 2.5x3cm; in the right – 22.5x15.5cm – direct projection

b – right lateral projection

c – rear projection

Fig. 7. Liver scintigrams with Mts lesion (data from our own archive)

markers are not specific for renal cell carcinoma. But it is their level that increases significantly precisely with metastatic damage to the liver by any malignant tumor. Secondary is less sensitive and specific for a particular neoplasm, but in combination with the main TM significantly increases the probability of tumor detection. It includes thymidine kinase (TK) in Mts in the liver. Additional TM are even less sensitive, but may have a certain organ specificity and are significantly increased with tumor recurrence. The main TMs characteristic of metastatic liver lesions were determined using appropriate kits from the company "Immunotech" (Czech Republic) [14].

AFP is a glycoprotein produced in the embryonic yolk sac, liver, and intestinal epithelium of the fetus. Molecular weight 70,000 daltons, half-life 5-7 days. In adults, it is normally absent or detected in minimal amounts, therefore it is a tumor marker. A moderate increase in its level can be caused by liver pathology, and a significant one by hepatocellular carcinoma or its metastatic lesion [15]. This is due to the acquisition of some cancerous neoplasms of the properties of embryonic tissues and the ability to synthesize proteins, which are characteristic of the early stages of the body's development. In primary liver tumors, its increase in 95% of patients can be detected 1-3 months earlier than the clinical manifestations of the disease. The size and intensity of tumor growth, the stage of the process and the degree of malignancy are not proportional to the amount of this TM in the blood [16, 17]. The main indications for the determination of AFP in serum are:

- detection of hepatocellular carcinoma;
- diagnosis of metastases of tumors of various localizations in the liver;
- detection of testicular teratoblastoma;
- differential diagnosis of tumors of other localizations;
- assessment of treatment effectiveness.

Values in international units (IU) per ml: normal 0-5.0 IU/ml; borderline 5.0-10.0 IU/ml; pathological ≥10.0 IU/ml.

CEA is also a glycoprotein that is produced in very small amounts in the cells of the digestive system in healthy people. Its determination is used for early diagnosis, monitoring of the course of the disease and treatment, primarily in colon and rectal cancer. The initial values of CEA in these diseases are very high. In addition, CEA can be significantly increased in liver metastases. Sometimes high levels of this TM are also observed in various inflammatory, autoimmune, benign diseases of internal organs, in smoking and alcohol consumption. CEA concentration: normally 0-5.0 ng/ml; limit values: 5.0-8.0 ng/ml; in pathology ≥8.0 ng/ml; in oncopathology >20 ng/ml. In somatic pathology, the CEA level rarely exceeds 10 ng/ml and normalizes with clinical improvement. In malignant processes, its level steadily increases throughout the entire period of the disease [18].

CA19-9 is a mucin-type glycoprotein similar to Lewis antigen with a molecular weight of 500,000 daltons. It is produced by epithelial

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cells of the fetal digestive tract. In adults, it is present in minimal concentrations in the blood and other fluids. The biological half-life is 5 days. When a tumor occurs in the liver, pancreas or stomach, CA19-9 is produced by their cells. But it is most often used to monitor the effectiveness of treatment. The ability to produce CA19-9 is associated with a person's blood group: in patients with the rare Lewis group (a-/b-), it is not produced. CA19-9 is excreted exclusively with bile, and therefore even minor cholestasis can cause its significant increase. High concentrations of CA19-9 are also observed in cholelithiasis, cystic fibrosis, cholecystitis or pancreatitis, as well as in hepatitis and cirrhosis of the liver. Its highest levels are determined in pancreatic cancer [19]. In primary liver cancer and in metastases to it from tumors of other localizations, a significant increase in the level of CA 19-9 is also observed [20]. In practically healthy people with normal bilirubin levels, the concentration of CA19-9 in the blood serum is 0-30 IU/ml. With increased bilirubin and alkaline phosphatase levels, its level increases to 100 IU/ml. The values considered to be borderline are: 30.0-40.0 IU/ml, and pathological values are ≥40.0 IU/ml. Almost all patients with very high levels of CA 19-9 (over 10,000 IU/ml) have distant metastases, including to the liver [13].

Description of a clinical case

Patient S., 62 years old, was diagnosed with stage II RCC (T2aN0M0) in 2017. No clinical manifestations were observed, except for the presence of a small amount of blood in the urine. In the same year, a right-sided nephrectomy was performed, followed by targeted therapy. The patient underwent repeated courses of chemotherapy and annual control CT scans, which did not reveal metastatic lesions of other organs and systems. When a slight pain syndrome in the lower back and heaviness in the right hypochondrium appeared in 2023, the next CT scan was performed, the results of which did not reveal pathological changes in the skeleton and other organs. The content of alkaline phosphatase and ionized calcium did not exceed the norm. Given the persistent pain syndrome in the spine and heaviness in the right hypochondrium, it was decided to conduct a comprehensive radionuclide study on the patient. OSG, which is more sensitive in detecting metastatic lesions; DRSG to assess the functional status of the single left kidney; SHSG and determination of AFP, REA and CA19-9 PM by RIA to determine the presence of secondary focal liver damage. OSG and DRSG were performed on 02/16/2024. Immediately after bolus IV administration of RPP, DRSG was performed. Its results revealed a slight slowdown in the filtration and excretory abilities of the single left kidney. Its arterial and venous circulation, according to indirect renangiogram, were not impaired. The accumulation and distribution of radiopaque substance in it is uniform, indicating the absence of areas of sclerosis and focal lesions. The right kidney was not visualized due to its removal (Fig. 8).

2 hours after the injection of RPP, an OSG was performed, the results of which revealed a slight hyperfixation of RPP in the spine up to 150%: Th XII-L1 up to 150%, and from L3 to L5 up to 135%. This did not allow us to conclude that there was a reliable secondary bone lesion (Fig. 9).

Alkaline phosphatase and ionized calcium levels were normal. Two weeks later (March 4, 2024) after a multi-target radionuclide study of the skeleton and kidneys, the patient underwent SHSG to detect focal lesions (Fig. 10).

Scintigraphically, the liver is enlarged due to both lobes (16.5x13.2x11x22cm). Its shape is unchanged, the contours are clear and even throughout. The accumulation of radiopharmaceuticals is diffuse and uneven. The spleen is not enlarged (6x3cm) with the accumulation of the drug up to 5% (0). The bone marrow did not accumulate RPP (0). A conclusion was made of moderate diffuse changes in the liver.What are the scintigraphic signs of hepatitis.

When determining the TM AFP, CEA and CA-19-9, the results of a significant increase in their levels were obtained: AFP – 67 IU/ml (with a normal value of up to 5 IU/ml), CEA – 32 ng/ml (with a normal value of up to 5 ng/ml), CA19-9 – 301 IU/ml (with a normal value of up to 30 IU/ml). Taking into account the anamnesis, clinical, laboratory and radionuclide data, it was concluded that patient had possible secondary

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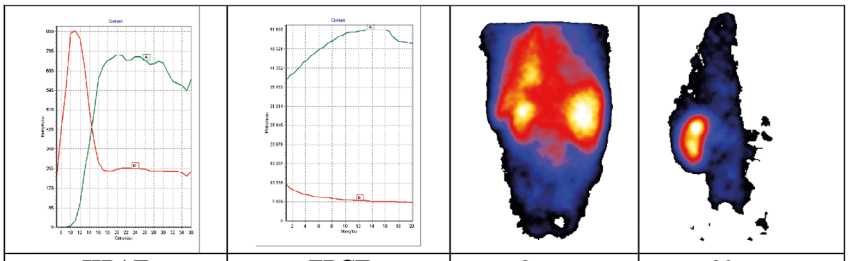
"КИЇВСЬКА МІСЬКА КЛІНІЧНАЛІКАРНЯ №18"
Кафедра радіології та радіаційної медицини НМУ ім. О.О.Богомольця
м. Київ, пр-т Берестейський, 34. т. 096-491-02-93
Клінічне дослідження: Динамічна реносцинтіграфія

Прізвище І.П.: С.М. Рік нар: 1962 Зріст: 177 Вага: 61 Стать: ж
Дата дослідження: 16.02.2024 Номер дослідження: 2169 Положення пацієнта: лежачи

Модель гамма-камери: ОФЭКТ-1 Програмне забезпечення: SW
Тип коліматора: загального призначення
РФП : 99мТс-MDP Активність (МБк): 400
Ефективна доза опромінення (мЗв): 2,36 Категорія пацієнта: АД



НРАГ	ДРСГ	3 хв.	20 хв.

	Ліва нирка	Права нирка
Розташування	типове	
Нирка ощущена на (см)	ні	
Нирка ротована	ні	
Форма	бобоподібна	
Контури	чіткі	
Розміри (см)	11 x 6	
Площа (см^2)	63	
Розподілення РФП	рівномірне	
Візуалізація розширеної миски	ні	
Візуалізація сечоводу	ні	
МСР (хв.)	ні	
Візуалізація сечового міхура (хв.)	2	

Параметр НРАГ

	Ліва нирка	Права нирка
Час артеріального притоку (сек)	10	
Час венозного відтоку (сек)	10	
Асиметрія (л.н./п.н.)	1,0	

Параметри ДРСГ

Клубочкові	Ліва нирка	Права нирка
ШКФ загальна (мл/хв.)	57	
ШКФ окр. (мл/хв.)	57	
ШКФ стандартизована (мл/хв.)		
ШКФ належна (мл/хв.)	31	
Tmax (хв.)	16	
T ½ max (хв.)	-	
Відсоток виведення до 20 хв.	5	
Коефіцієнт асиметрії (л.н/п.н.)		
Миска:		
Tmax (хв.)	15	
T ½ max (хв.)	не має	
Відсоток виведення до 20 хв.	8	

Висновок

	Ліва нирка	Права нирка
Час артеріального кровотоку	не порушено	
Час венозного відтоку	не порушено	
Фільтраційна здатність нирки	декілька знижена	
Екскреторна здатність нирки	виражено уповільнена	

Заключення:

За даними ЕВМ аналізу фільтраційна здатність єдиної лівої нирки декілька знижена. Видільна здатність лівої нирки виражено уповільнена. По даним НРАГ час артеріального і венозного кровотоку лівої нирки не порушено. За час дослідження права нирка не візуалізується.

Лікар-радіолог: **Анатолій М.**

Fig. 8. Results of DRSG of patient S

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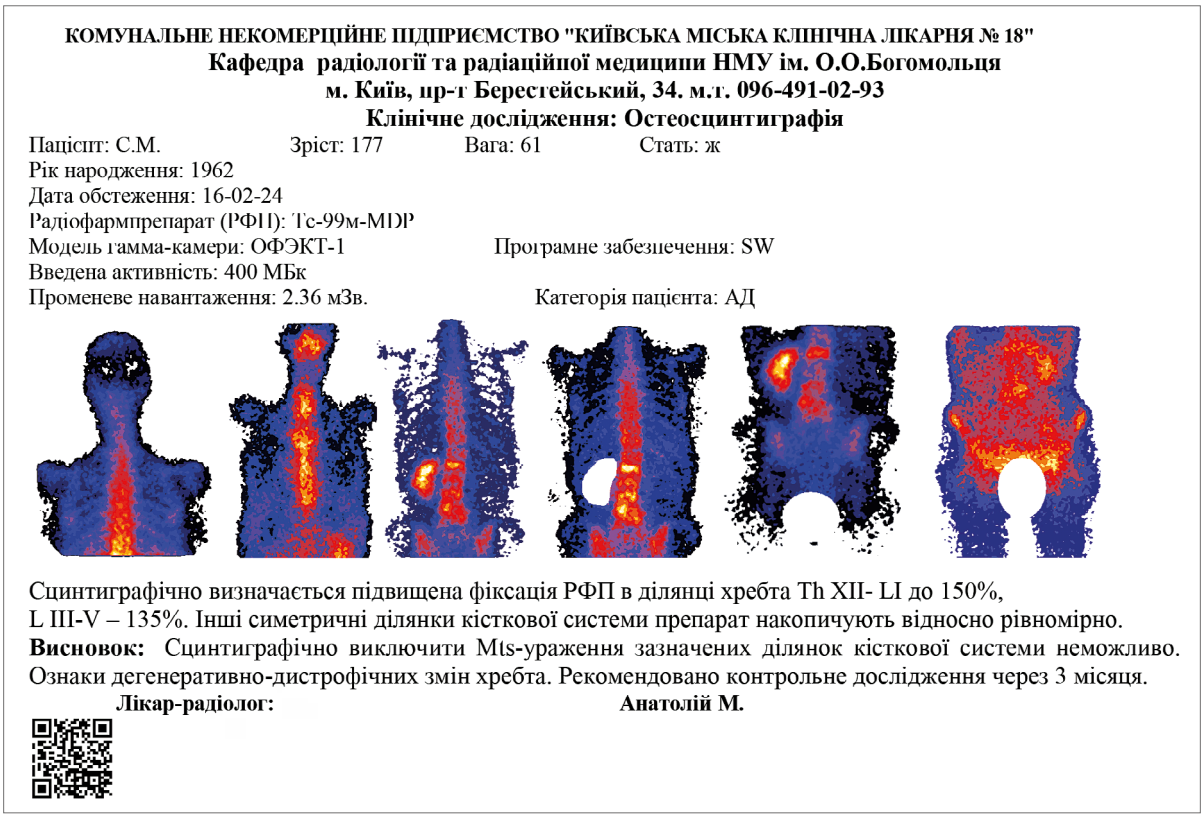
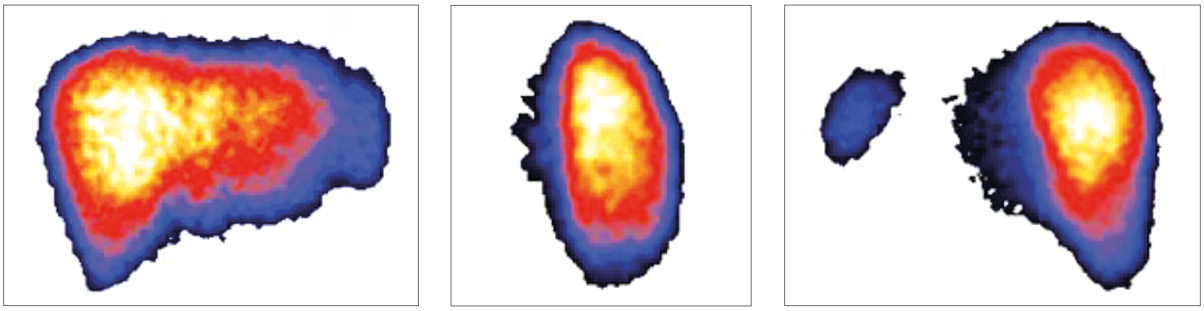


КОМУНАЛЬНЕ НЕКОМЕРЦІЙНЕ ПІДПРИЄМСТВО "КИЇВСЬКА МІСЬКА КЛІНІЧНА ЛІКАРНЯ № 18"
Кафедра радіології та радіаційної медицини НМУ ім. О.О.Богомольця
м. Київ, пр-т Берестейський, 34. м.т. 096-491-02-93
Клінічне дослідження: Остеосцинтиграфія

Пацієнт: С.М. Зріст: 177 Вага: 61 Стать: ж
Рік народження: 1962
Дата обстеження: 16-02-24
Радіофармпрепарат (РФП): Tc-99м-MDP
Модель гамма-камери: ОФЭКТ-1 Програмне забезпечення: SW
Введена активність: 400 МБк
Променеве навантаження: 2.36 мЗв. Категорія пацієнта: АД

Сцинтиграфічно визначається підвищена фіксація РФП в ділянці хребта Th XII- LI до 150%, L III-V – 135%. Інші симетричні ділянки кісткової системи препарат накопичують відносно рівномірно.
Висновок: Сцинтиграфічно виключити Mts-ураження зазначених ділянок кісткової системи неможливо. Ознаки дегенеративно-дистрофічних змін хребта. Рекомендовано контрольне дослідження через 3 місяця.
Лікар-радіолог: **Анатолій М.**

Fig. 9. Results of polypositional OSG of patient S



a – direct projection – "defect" of accumulation in the IV segment

b – right lateral projection

c – posterior projection

Fig. 10. Static hepatoscintigram of patient S.

damage to the spine from Th-12 to L-5, most likely of a lytic nature, Mts to the liver. On the control CT scan after six months, rapid spread of the process to almost all organs was observed, despite constant courses of targeted therapy. Pathological compression of L1, L2 and L4 was revealed from the spine (Fig. 11).

Thus, patients with RCC should regularly undergo comprehensive radiation examinations: ultrasound, CT and radionuclide, in order to timely establish the spread of the process to various organs and systems for correction of therapeutic interventions. Determination of the content of relevant TM can detect metastatic lesions at the preclinical stage.

Discussion of results

When diagnosing RCC according to the "Unified Clinical Protocol for Primary, Secondary and Tertiary Medical Care for Kidney Cancer", a whole range of studies, including radiation, is used. This is necessary to determine the stage and extent of the process in order to decide on the patient's further treatment. As a rule, these are ultrasound, CT, MRI and

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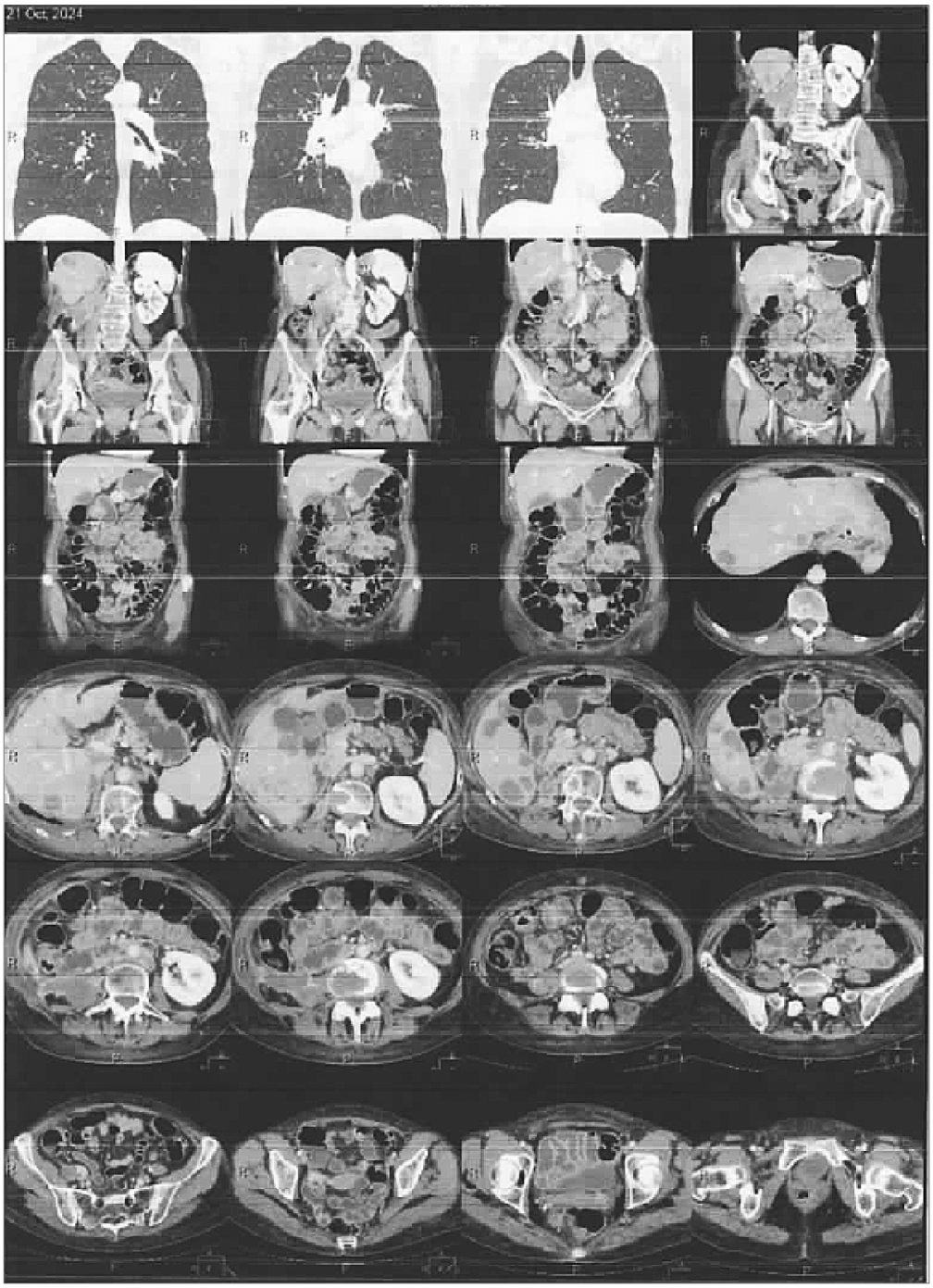

Fig. 11. Results of RCT from 10/21/2024 of patient S

radionuclide methods. Each of them has its own informativeness, advantages and disadvantages. CT is performed annually to preventing the spread of disease to other organs and systems. In case of musculoskeletal pain, patients are recommended to undergo radionuclide examination of the skeleton to detect Mts skeletal lesions. For the detection of secondary skeletal lesions of predominantly blast nature, OSG remains the most informative. Patients with RCC belong to the AD category with the maximum permissible radiation dose per year in Ukraine is 100 mSv. For example, a single CT scan of the chest or abdomen can expose a patient to up to 10 mSv, and if it is performed several times a year, the dose is significant. And the administration of radiation therapy to areas of bone damage significantly increases the radiation exposure to the patient.

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Ago, when using radiation examination methods with ionizing radiation (CT and OSG), attempts are made to reduce the radiation exposure to the patient by combining some examinations, for example, of the skeleton and the urinary system (multi-target osteoscintigraphy).

Conclusions

1. The multipurpose scintigraphy technique with a phosphate compound labeled with Tc99m should be included in the examination protocols of patients with RCC for simultaneous assessment of the skeletal status and renal/kidney function at all stages of diagnosis and treatment. Sequentially performing DRSG and OSG on one X-ray allows for reduced radiation exposure to the patient, unlike two separate examinations of the kidneys and skeleton.
2. The dynamics of radioactivity growth in individual areas of the skeleton (exceeding the limit of 150%) allows Mts to detect lesions of predominanly blast nature earlier than other radiation methods or clinical manifestations.
3. Simultaneously conducting two methods of radionuclide research has an economic benefit when using funds from the National Health Service of Ukraine (NHSU).
4. Scintigraphic examination of the liver to exclude Mts lesions is not a specific method, but can provide information about its functional state and the degree of parenchymal damage.
5. It is recommended to constantly analyze the levels of AFP, CEA, and CA19-9, which are the main markers of Mts in the liver, for their timely detection and the appointment of appropriate treatment.

Financing

This research did not receive external funding.

Conflict of interests

This publication does not cause any conflict between the authors, has not been and will not be the subject of commercial interest or remuneration in any form.

Consent to publication

All authors have read the text of the article and gave consent to its publication.

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Значущість комплексного радіонуклідного дослідження в виявленні метастатичного ураження скелету і печінки при нирковоклітинному раку нирки

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Анотація: *метастазування раку нирки в 30% випадків припадає на кістки, а в 60% – на печінку. Одним з променевих методів виявлення метастатичного ураження скелету і печінки є радіонуклідний. Остеосцинтиграфія є специфічним дослідженням в діагностиці метастазів в кістки, переважно остеобластичного типу. Для діагностики метастазів у печінку використовуються радіонуклідні методи «in vivo» та «in vitro». Гепатосцинтиграфія в порівнянні з УЗД, комп,ютерними рентгенівською та магнітно-резонансними томографіями є менш інформативною в виявленні вторинного ураження цього органу. Але метод радіоімунного аналізу пухлинних маркерів характерних для цього процесу є більш чутливим і достовірним. Головними з них є альфа-фетопротеін, раково-ембріональний антиген та карбогідратний антиген 19-9. Їх концентрація в сироватці крові збільшується у десятки разів при поширенні злоякісного процесу на печінку. У радіонуклідному відділенні КМКЛ №18, яке розташоване на кафедрі радіології та радіаційної медицини НМУ ім. О.О. Богомольця, пацієнтці С. 62 років з правобічним нирковоклітинним раком II стадії (T2aN0M0), були проведені радіонуклідні дослідження скелету, печінки, функції єдиної лівої нирки (після правобічної нефректомії) і пухлинних маркерів. Приводом для цього була відсутність на рентгенівських комп'ютерних томограмах вторинних уражень цих органів при наявності больового синдрому в попереку і важкості в правому підребер'ї. При радіонуклідному дослідженні скелету була виявлена незначна гіперфіксація радіофармпрепарату (до 150%) від L1 до L5, що не підтверджувало наявність вторинного ураження хребта. Функціональна здатність лівої нирки була зменшена. Відсутність накопичення препарату на гепатосцинтиграмі не було виявлено, але спостерігалось дифузно-нерівномірне зниження його захоплення клітинами ретикуло-ендотеліальної системи притаманне гепатиту. Але рівні пухлинних маркерів, характерних для вогнищевого ураження печінки значно перевищували норму. На підставі чого був зроблений висновок щодо метастатичного ураження цього органу. Таким чином, хворим на гепатоцелюлярнийрак нирки, рекомендовано проходити комплексне променеве дослідження з включенням радіонуклідних методів як "ін віво" та і "ін вітро" для визначення пухлинних маркерів, специфічних для вторинного ураження печінки.*

Ключові слова: динамічна реносцинтиграфія, метастази, нирковоклітинний рак, остеосцинтиграфія, пухлинні маркери, радіоімунний аналіз, статична гепатосцинтиграфія.

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