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Research Article

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The Use of Autologous Leucocyte Labelling in Patients With Fever of Unknown Origin

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RELEVANCE Patients with a systemic reaction to inflammation are often observed after adequate surgical intervention and/or treatment of the underlying disease. Laboratory tests indicate the presence of a pronounced inflammatory process, and instrumental diagnostic methods (ultrasound, computed tomography, radiography) do not always help in detecting the source of inflammation.

THE AIM OF THE STUDY is to present the possibilities of radionuclide imaging (RI) using labelled autologous leucocytes to identify the source of infection.

MATERIAL AND METHODS 95 patients with fever of unknown origin were examined by the radionuclide diagnostic method. The data of computed tomography (CT), ultrasound, radiography (RG), laboratory tests (CRP, PCT, IL-6), the results of morphological examination in comparison with the results of RI were analyzed. Clinical examples are presented.

RESULTS With the help of RI, foci of inflammation were identified. Based on the data obtained, the treatment was adjusted, which contributed to the recovery of 80 patients. In 15 patients, because of generalized infection, a systemic inflammatory reaction and sepsis developed, leading to a fatal outcome.

CONCLUSION Radionuclide imaging (RI) using labelled autologous leucocytes in patients with fever of unknown origin allows us to obtain reliable visualization of areas of pathological infiltration and physiological distribution of cells. Based on the data obtained, it is possible to adjust the therapy, which helps increase treatment effectiveness.

Keywords: radionuclide imaging, autologous leucocytes, fever of unknown origin

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BBT — biochemical blood test
CRP — C-reactive protein
CT — computed tomography
DFA — deep femoral artery
EC — endothelial cells
EchoCG — echocardiography
FPB — femoropopliteal bypass
IL — interleukin
LI — leukocyte infiltration
PCT — procalcitonin
RG — radiography
RI — radionuclide imaging
RPP — radiopharmaceutical preparation
SFA — superficial femoral artery
SPECT — single photon emission computed tomography

INTRODUCTION

Inflammatory complications are often observed in patients after adequate surgical intervention and/or treatment of the underlying disease. Fever, asthenia, and impaired reparative processes may signal the development of an inflammatory process or an untreated infection focus. The use of instrumental diagnostic methods (ultrasound examination, computed tomography - CT, radiography - RG) does not always help in detecting the source of inflammation. At the same time, a number of laboratory tests – the number of leukocytes and the leukocyte formula, the level of C-reactive protein (CRP), procalcitonin (PCT), interleukin-6 (IL-6) – may indicate the presence of a pronounced inflammatory processca.

To identify the source of infection, radionuclide imaging (RI) using labeled autoleukocytes is effective [1-3].

Peripheral blood leukocytes are immunocompetent cells – these are neutrophils, monocytes and lymphocytes, which are always present in the area of inflammation.

Neutrophils play a key role in the initiation of inflammation. Neutrophils develop from a common myeloid precursor located in the bone marrow and extramedullary tissues (spleen), and constitute 50–70% of the total pool of leukocytes in human peripheral blood [4, 5]. Neutrophils as effector cells of the innate immune system actively participate in acute and chronic inflammation processes and influence reparative processes. Being the first line of cellular defense against microorganisms, neutrophils overcome the barrier of endothelial cells (EC) and reach the site of infection, accumulate there and participate in the elimination of the pathogen [4, 6]. Neutrophils isolated from the patient's blood retain their functions for up to 3 hours, which allows them to be loaded with a radioactive label and reinfused into the patient [7]. After reinfusion, labeled neutrophils accumulate in inflammation zones for 4–6 hours, constituting the cellular component of inflammatory infiltration. The higher their quantity in the radiopharmaceutical preparation (RPP), the clearer the detection of accumulation zones [1, 2].

MATERIAL AND METHODS

The aim of the study was to present the possibilities of radionuclide imaging (RI) using labeled autoleukocytes to identify the source of infection.

Method of preparing autoleukocytes

300-350 ml of blood are taken from the patient's cubital vein. It is centrifuged (at 200 g) for 20 minutes to precipitate erythrocytes, since by filling the vascular bed they reduce the visualization of the inflammation site. In addition to leukocytes, the cellular concentrate contains platelets, which enhance the visualization of the lesion, nourish the vascular wall, and participate in angiogenesis in the inflammation zone.

The algorithm for preparation for labeling is as follows: taking 300–350 ml of peripheral blood, centrifuging (at 530 g), transferring the leukothrombotic layer to the first Compoplast package and reinfusing autoerythrocytes. Plasma in a volume of 300–350 ml, which is intended for washing off the radioactive label and resuspension of labeled cells, is added to the second package. The two packages — with the leukothrombotic layer and plasma — are transferred to the radioisotope department for labeling. 800–1000 MBq of Tc-99m-

theoxime is added to the package with the leukothrombotic layer (the generator elution is no later than 23 hours) and incubated on a shaker for 10–15 minutes to distribute the radiopharmaceutical preparation (RPP) in the concentrate cells. Then 150–200 ml of plasma are added and centrifugation is performed to wash off unbound activity (at 1162 g, 10 minutes, with cooling). Then the supernatant part of the plasma is removed and non-radioactive plasma is added to resuspend the cellular mass. The time from blood sampling to obtaining the RPP is on average 1.5–2 hours. Upon completion of preparation of the RPP, it is necessary to calculate the cellular composition in 1 ml of the concentrate to account for the cell ratio (leukocytes:platelets:lymphocytes). The finished product - Tc-99m-theoxime-autoleukocytes is reinfused into the patient intravenously by drip, no later than 20-30 minutes from the time of preparation of the RPP.

The first scintigraphic recording in a whole-body scanning mode is performed 15-30 minutes after reinfusion. During these periods, cells are distributed across the small and large circulations and initially enter the foci of inflammation. This involves active visualization of the vascular bed, the blood pool in the heart chambers, and accumulation in the liver and spleen. Recordings in a whole-body scanning mode, single-photon emission computed tomography (SPECT) of the zones of detected or suspected foci of infiltration are performed twice more – after 3–4 and 6–8 hours. SPECT/CT scan is performed once to determine the anatomical region when a zone of pathological accumulation of RPP is detected [3].

Object of the study

At the N.V. Sklifosovsky Research Institute for Emergency Medicine, polypositional scintigraphy with labeled autoleukocytes was performed on 95 patients. Age: from 18 to 90 years. The need to conduct the study was associated with the deterioration of the patients' condition, the appearance of fever within 7 to 35 days from the date of hospitalization. All the patients had increased levels of inflammation markers in the blood: CRP (median - 84 mg/l (min - 3.81; max - 266.0) (normal – 0.00-3.00 mg/l)), PCT (median – 1.1 ng/ml (min - 0.15; max – 50.12) (normal – 0.00-0.10 ng/ml)), leukocytes (median – 13.88×10^9 cells (min – 8.9; max -35.17) (normal - 4.00-9.00×10^9)), an increase in the content of circulating immune complexes in the blood (median - 860 conventional units/ml (min - 444; max - 1363) conventional units/ml (normal 112-230 (conventional units/ml)). To identify the causes of fever, the patients underwent a set of clinical and instrumental examination methods (RG, ultrasound, CT), according to the results of which the cause of fever was not reliably established. All patients received antibacterial therapy before and during RI.

RESULTS OF THE STUDY AND THEIR DISCUSSION

Leukocyte infiltration (LI) zones were detected in 93 examined patients (97.9%). In most cases, the presence of three (in 59 patients, 62%) or two (in 29 patients, 31%) pathological zones of RPP accumulation, localized in various organs and tissues, was noted (Fig. 1).

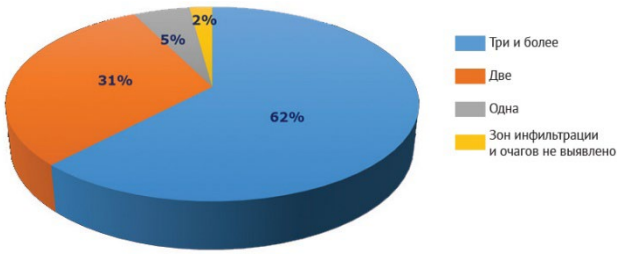

Fig. 1. Diagram of the distribution of the number of identified leukocyte infiltration zones per patient

In terms of frequency of occurrence, accumulation of autoleukocytes was most common in the lungs — in 61 patients (65.6%) and myocardium — in 44 patients (47.3%). LI was visualized in soft tissues, kidneys, intestines, in the projection of venous catheters and trachea (in patients with tracheostomy), areas of fractures and vascular prostheses. In isolated cases, LI was observed in the structures and membranes of the brain (Fig. 2).

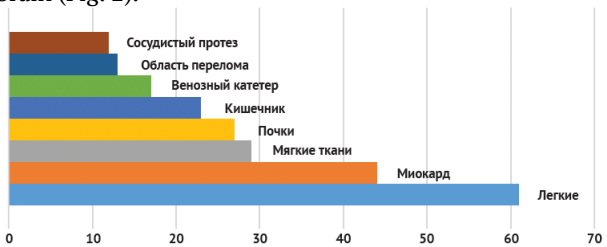

Fig. 2. Frequency of detection of leukocyte infiltration zones by localization

Clinical examples

Female patient G., 64 years old, was treated for cerebral infarction with the formation of an ischemic focus in the right hemisphere of the cerebellum with spread to the vermis. Unspecified pathogenetic variant according to the TOAST classification.

Underlying illness: stage 3 arterial hypertension, risk of cardiovascular complications 4.

Comorbidity: type 2 diabetes mellitus, insulin-dependent. Ischemic heart disease. Class 2 angina pectoris. Grade 2 aortic valve stenosis.

Treatment of the underlying disease for 13 days was accompanied by positive dynamics, which was confirmed by a control X-ray examination: CT signs of ischemic changes in the right cerebellar hemisphere in the stage of regression (total volume up to 5 cm3, initially 25 cm3). Clinical manifestations of hypostatic pneumonia developed in the following 24 hours. Monitoring of clinical and laboratory data revealed an increase in signs of a systemic inflammatory reaction: hyperthermia up to 37.6° C; in the general blood test leukocytosis up to 14.47×109/l, an increase in the level of inflammation markers - CRP up to 288 mg/l, an increase in the content of nitrogenous bases in urine tests. The following studies were performed:

— Chest X-ray: Pulmonary pattern with signs of pneumosclerosis. The roots of the lungs are structural. The heart shadow is unremarkable. The aorta is thickened. The diaphragm is clear, normally located on both sides. Sinuses are free. No gas or fluid in the pleural cavities. Central venous catheter is on the right.

— Ultrasound of the abdominal cavity and retroperitoneal space: In areas accessible to the location, no echo signs of free fluid in the abdominal cavity were detected. Echo signs of diffuse changes in the liver and pancreas. Echo signs of diffuse changes in the renal parenchyma.

— Transesophageal echocardiography: 2nd degree spontaneous echocardiographic contrast in the left atrial appendage.

— Echocardiography: Visualization is sharply reduced due to the constitutional features of the patient, and the study being performed during tachycardia.

The cardiac chambers are not dilated. Global and regional systolic function of the left ventricular myocardium is preserved: ejection fraction is 66% (Simpson).

Atherosclerotic changes in the aortic and mitral valve leaflets. Mild aortic insufficiency: grade 0–1 aortic regurgitation. Severe calcification of the posterior mitral valve leaflet. Mild mitral stenosis and moderate mitral regurgitation: grade 2 mitral regurgitation. Moderate tricuspid insufficiency: grade 1-2 tricuspid regurgitation. No signs of pulmonary hypertension - systolic pressure in the pulmonary artery is 27 mm Hg. Moderate concentric hypertrophy of the left ventricular myocardium. Minor amount of fluid in the pericardial cavity.

— CT scan of the chest organs (Chest CT): signs of changes in the posterobasal parts of both lungs, most likely of hypoventilation and gravitational genesis.

Esophagogastroduodenoscopy (EGDS): ulcer of the antral part of the stomach (biopsy result). Axial cardiac hernia of the esophageal opening of the diaphragm; during morphological examination of the submitted material, the fragment was represented by attributively damaged gastric mucosa with the presence of a separately located fragment of purulent-necrotic detritus.

A consultation with a clinical pharmacologist was scheduled to resolve the issue of antibacterial therapy. Taking into account the results of chest CT, the presence of changes in the posterobasal parts of both lungs, most likely due to hypoventilation, the development of bacterial pneumonia in the patient could not be ruled out. Despite the length of hospital treatment from the moment of hospitalization, the inflammation was most likely caused by gram-positive flora; the patient was recommended empirical antibacterial therapy.

To identify the source of inflammation, polypositional scintigraphy with labeled autoleukocytes was recommended. The study was performed after 30 minutes and 5 hours in the whole-body mode with SPECT of the head, chest and abdominal cavities, and pelvic cavity.

Results of the study. Physiological accumulation of the RPP in the spleen, liver, kidneys, and urinary bladder is visualized. Elimination of the RPP is noted along the loops of the small and large intestines. In the early and late frames, an increased accumulation of labeled autoleukocytes is determined in the following locations:

– diffuse accumulation in both lungs, mainly in the posterior segments (Fig. 3);

– diffuse accumulation in the myocardium of the left ventricle of the heart (Fig. 4).

In later frames, moderate diffuse infiltration is determined in the parenchyma of both kidneys (Fig. 5).

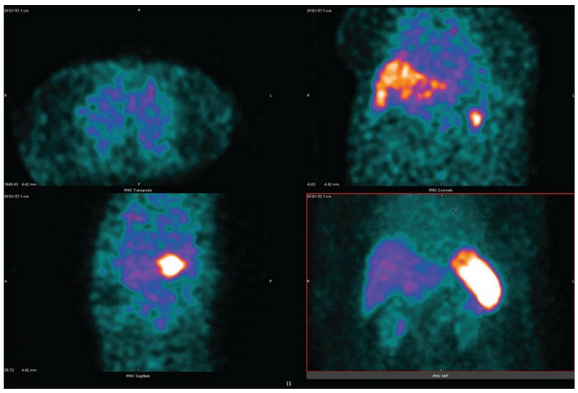

Fig. 3. Thoracic cavity SPECT of patient G.

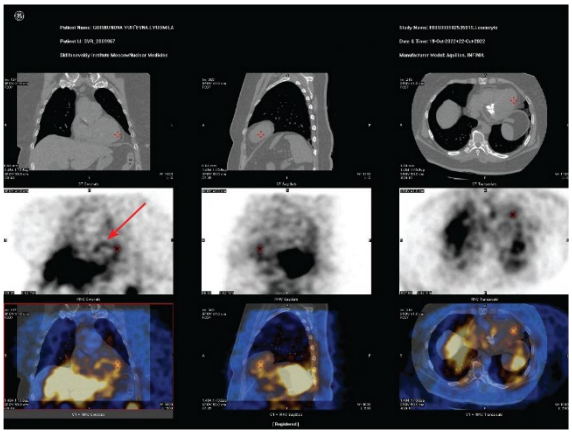

Fig. 4. Hybrid images of patient G. confirming accumulation of RPP in the myocardial region (indicated by the cursor and arrow)

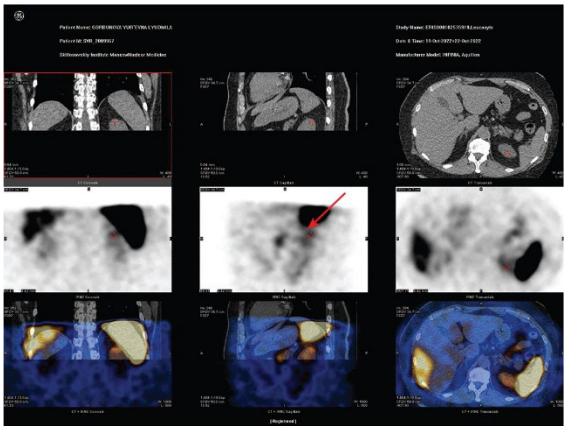

Fig. 5. Hybrid images of patient G. confirming accumulation of RPP in the area of the renal parenchyma (indicated by the cursor and arrow)

When combining SPECT images with chest CT, confirmation of the accumulation of the RPP in the area of the left ventricular myocardium was obtained.

Thus, the patient showed scintigraphic signs of leukocyte infiltration (LI) in both lungs (mainly in the posterior segments), the myocardium of the left ventricle of the heart, and moderate LI in the renal parenchyma.

A day later, the patient developed an infarction of the right occipital lobe (cardioembolic pathogenetic variant according to the TOAST classification). The underlying disease was bacterial endocarditis. The patient's condition progressively worsened, and complications developed within 6 days: bilateral hypostatic pneumonia, secondary bacterial meningitis, sepsis, splenic infarction, cerebral edema and dislocation. The patient died as the above disorders progressed.

At pathological examination, the presence of infectious thromboendocarditis of the mitral valve with multiple septic complications was confirmed, as shown in Figs. 6–9.

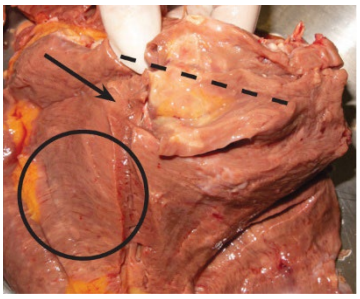

Fig. 6. Subclavian abscess (arrow), valve base (dotted line), diffuse focal subacute myocarditis (circle)

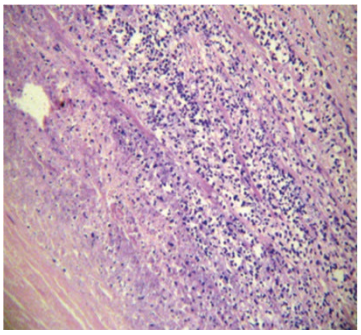

Fig. 7. Myocardial abscess with purulent infiltration and necrosis of cardiomyocytes. Hematoxylin and eosin staining (×100)

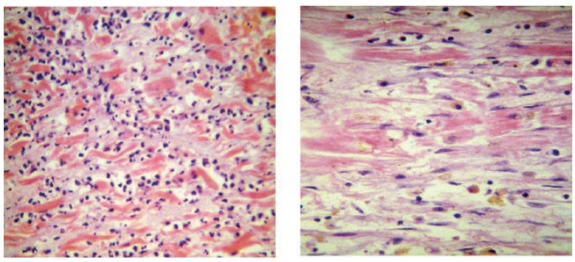

Fig. 8. Subacute diffuse focal interstitial myocarditis. Hematoxylin and eosin staining (×200)

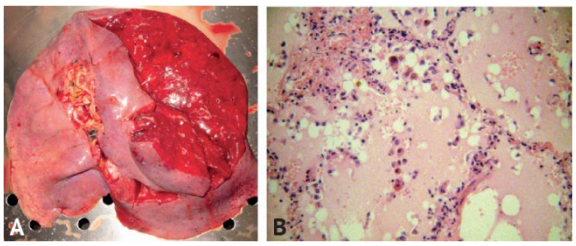

Fig. 9. Prosoid whitish inclusions (apostemes) in the thickness of the cerebral layer of the kidney (A). Abscess in the parenchyma of the kidney (B). Hematoxylin and eosin staining (×200)

When comparing the data of pathological and morphological examination and radiological examination using labeled autoleukocytes, a coincidence in the localization of inflammatory changes was revealed.

Patient S., 65 years old. Diagnosis upon admission: "Thrombosis of the common right femoral artery, acute ischemia of the right lower limb, grade 2B. Condition after right femoropopliteal bypass grafting".

Local status: The left lower limb is of normal color and temperature, the subcutaneous veins on the foot are filled satisfactorily. Sensitivity and movement are preserved. The gastrocnemius muscles are soft, not tense, and not painful on palpation. Pulsation is not determined at all levels. The right lower limb is pale-cyanotic and cold from the level of the upper third of the shin, the subcutaneous veins on the foot are collapsed. Sensitivity is reduced in the foot, movement is somewhat limited in the ankle joint and toes, the foot and lower leg are swollen. The gastrocnemius muscles are dense, somewhat tense, painful on palpation. There is no pulsation in the common femoral artery and femoropopliteal prosthesis.

According to the results of Doppler ultrasonography of the iliac arteries and arteries of the lower extremities: the condition after multiple grafting of the arteries of the lower extremities. Echo signs of shunt occlusion with restoration of blood flow in the distal sections and signs of interfascial hematoma of the lower leg in the organization stage. Attention is drawn to the middle and upper third of the leg along the inner surface; heterogeneous hypoechoic circumscribed fluid accumulation measuring approximately 19.6×2.9 cm, heterogeneous with finely dispersed suspension is localized interfascially. Color Doppler mapping does not detect blood flow.

CT scan of the abdominal aorta and iliac vessels with contrast enhancement on the right revealed occlusion of the external iliac artery, common femoral artery (CFA), deep femoral artery (DFA), superficial femoral artery (SFA), and the initial section of the popliteal artery with distal restoration of contrast; occlusion of the femoropopliteal bypass with signs of infection. Paraprosthetic partially delimited fluid accumulation, spreading along the walls of the prosthesis in the distal section, to the popliteal fossa area and soft tissues of the leg subfascially along the internal head of the gastrocnemius muscle (total volume up to 400 cm^3), most likely a partially lysed hematoma with signs of infection (Fig. 10). Stenosis of the popliteal artery, anterior tibial artery (ATA), tibioperoneal trunk, and the orifice of the peroneal artery.

Biochemical blood test (BBT): CRP level 227.00 (normal less than 3.00) mg/l; PCT — 0.48 (normal less than 0.05) ng/ml.

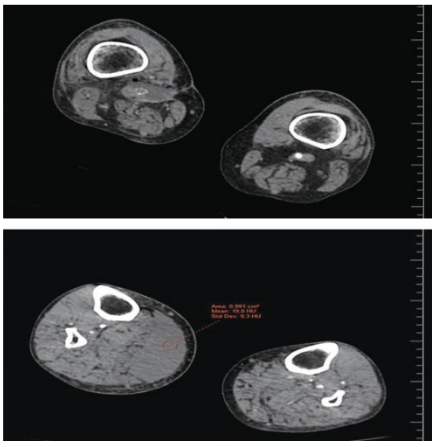

Fig. 10. Computer tomograms of patient C. at the level of the popliteal artery and the prosthesis

According to the RI data, pronounced LI was detected in the area of the middle and lower third of the right thigh laterally, and in the soft tissues of the anteromedial surface, as well as paraprosthetically with distribution along the prosthesis, mainly in the middle and lower third of the thigh. In the later frames,

an increase in the intensity of the LI in the soft tissues and interfascially in the right thigh was determined. The area of absence of RPP inclusion in the medial region of the gastrocnemius muscle of the right leg is noteworthy - the area of impaired microcirculation (hematoma) (Fig. 11).

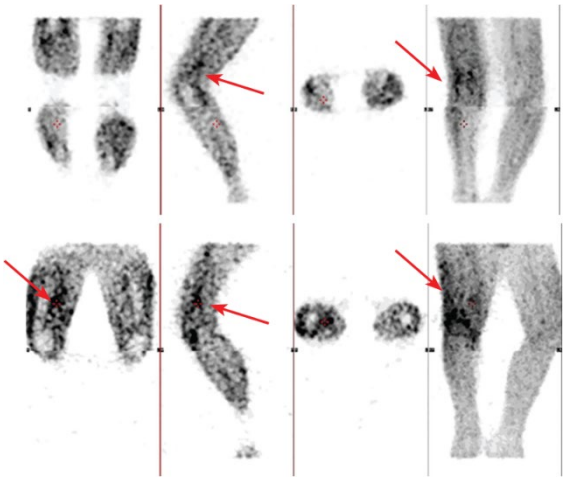

Fig. 11. Scintigrams of patient C. at the level of the lower extremities. The spread of leukocyte infiltration is indicated by arrows

The patient has diffuse atherosclerosis of the aorta, occlusion of both iliac arteries and multiple stenoses of the arteries of the lower extremities, thrombosis of the right FPB with signs of infection against the background of chronic critical ischemia of the right lower limb, infection of the paraprosthetic partially lysed hematoma. Taking into account the history of the disease, the absence of a receptive arterial bed, scintigraphy and CT data, there are no conditions for performing reconstructive vascular surgery. Conservative therapy was performed in the department without positive dynamics. The patient has clinically and according to examination data (CT, scintigraphy) developing ischemic gangrene of the right lower limb, infected FPB. The patient was transferred to the purulent surgery department (A.K. Yeramishantsev City Clinical Hospital No. 20), where amputation of the right lower limb at the level of the upper third of the thigh was performed. It is known from the protocol of pathological and anatomical examination of biopsy (surgical) material (registration number: 003462_23):

In the soft tissues of the right lower limb (in the adipose tissue, fibrous tissue and striated muscles) - diffuse dense inflammatory leukocyte infiltration with purulent exudate; muscles with dystrophic necrotic changes; in the lumen of the artery - a mixed thrombus of the arterial wall with fibrous plaques.

Thus, as a result of RI using autoleukocytes, it was demonstrated that the patient's inflammatory changes in the lower limb were more extensive than it seemed before RI. The study was of decisive importance in deciding on the patient's further treatment plan.

Female patient H., 36 years old, diagnosis upon admission: "Mine-blast injury". Deep shrapnel wound of the 2nd zone of the neck on the right, wound of the internal jugular vein, common carotid artery. Comminuted penetrating wounds (2) of the abdominal cavity. Penetrating wound of the small intestine. Penetrating wound of the sigmoid colon. Wound of the ascending colon. Hemoperitoneum. Wound of the right kidney with damage to the segmental arteries of the right kidney. Perinephric hematoma on the right. Traumatic shock.

The patient's vascular integrity was restored, resection of the small and sigmoid colon with the formation of enteroenteroanastomosis and sigmo-sigmoidoanastomosis was performed, and an ileostomy was created. The internal jugular vein was ligated, and the defect of the common carotid artery was sutured. Embolization of the branches of the renal arteries on the right was performed, the capsule of the right kidney and paranephrium were sutured.

According to CT data, the formation of a pseudoaneurysm of the branches of the right renal artery was established; in this connection, ultraselective embolization of the branches of the right renal artery was performed. The postoperative period was uneventful: there was no macrohematuria or signs of ongoing bleeding. On the 7th day, evening fever up to 38.6°C with chills without any additional complaints was noted. The patient was reexamined by the urologist, and a CT scan of the kidneys with contrast enhancement was recommended, according to which the presence of a paranephric hematoma of the previous size (80 cm^3) was determined, as well as the presence of foci of ischemia (conditions after injury and ultraselective embolization), satisfactory secretory and evacuation function of the remaining parenchyma of the right kidney, absence of contrast leaks in the arterial and excretory phases, absence of ongoing bleeding and urinary leaks.

Ultrasound results: Examination of the soft tissues of the right lateral surface of the neck in the area of the operation revealed signs of infiltrative changes in the tissue along the postoperative suture. Signs of

decreased blood circulation in the upper pole of the right kidney, edema of its parenchyma, hematoma of the paranephric tissue on the right, infected hematoma of the right kidney.

CT scan revealed signs of hypoventilation of the lower lobes of both lungs, an area of peribronchial infiltration in S3 of the right lung, bilateral hydrothorax (on the right – 40 cm^3, on the left – 60 cm^3), occlusion of the right internal jugular vein. Edema of the vascular space of the neck on the right, minimal emphysema of the soft tissues of the chest on the right. CT signs of damage (penetrating wound) to the parenchyma of the right kidney with perinephric hematoma (80 cm^3) and hemorrhagic impregnation of the paranephric tissue, infarction of the right kidney (8 cm^3), moderate infiltrative changes in the greater omentum, minimal hemoperitoneum and edema of the soft tissues of the right lateral abdominal wall.

BBT: interleukin-6 content — 15 (normal <7 pg/ml), CRP — 84 mg/l, leukocytes — $7×10^9$/l

Radionuclide examination was performed 2, 6 and 19 hours after the introduction of labeled autoleukocytes in the whole-body mode with SPECT of the chest, abdomen and pelvis. Elimination of the RPP was noted through the loops of the small and large intestines with the movement of feces, the RPP actively enters the stoma into the colostomy bag. The following areas attracted attention:

1. The area of diffuse focal leukocyte infiltration of the soft tissues of the neck (on the right in the supraclavicular region), when compared with CT data, corresponds to a small area of compaction of the tissue around the sternocleidomastoid muscle, the adjacent thrombosed right internal jugular vein and the tissue around the sternal end of the clavicle (Fig. 12).

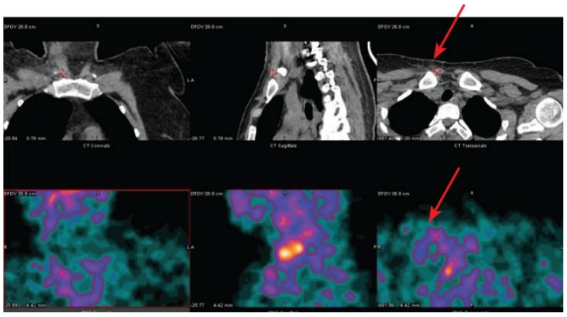

Fig. 12. Tomograms of the neck area of patient X. (according to CT and SPECT), the area of leukocyte infiltration is indicated by an arrow

2. The flow of the radiotracer through the drainage installed in the retroperitoneal space on the right is determined after 19 hours in an insignificant amount.

3. In the projection of the middle segment of the right kidney, a defect in the accumulation of the RPP is determined, corresponding to the defect on CT; active accumulation of labeled autoleukocytes in the retroperitoneal space behind the contours of the kidney is not noted (Fig. 13).

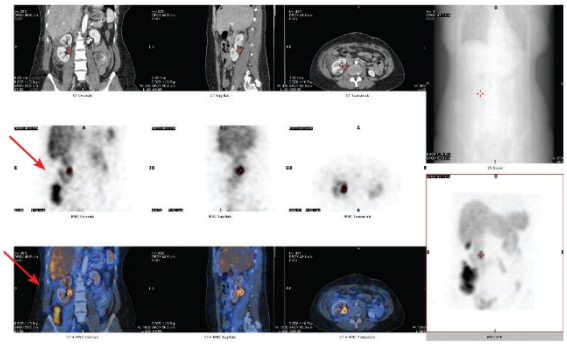

Fig. 13. Hybrid image of the abdominal cavity and retroperitoneal space of patient X., the arrow indicates moderate renal impairment without signs of leukocyte infiltrationThus, at the time of the examination, the patient was found to have a zone of moderate leukocyte infiltration of the soft tissues of the neck on the right in the supraclavicular region in the projection of the lower part of the postoperative suture. Due to an unconfirmed suspicion of an infected hematoma of the right kidney, the drainage was removed.

Control chest CT, angiography of vessels and soft tissues of the neck with contrast revealed signs of hypoventilation of the lower lobe of the left lung, area of peribronchial infiltration in S3 of the right lung (with a tendency to resolve), left-sided hydrothorax (37 cm^3, was 60 cm^3), occlusion of the right internal jugular vein and edema of infiltration of the vascular space of the neck on the right, marginal fracture of the 11th rib on the right.

CT of the abdominal cavity and pelvic organs with contrast revealed signs of damage (penetrating wound) to the parenchyma of the right kidney with a perinephric hematoma with signs of encapsulation (23 cm^3) and hemorrhagic impregnation of the paranephric tissue 20 cm^3 (there was a total volume of 80 cm^3); infarction of the right kidney (3.5 cm^3, there was 8 cm^3), moderate infiltrative changes in the greater omentum; minimal amount of free fluid; edema of the soft tissues of the right lateral abdominal wall.

According to laboratory tests, a decrease in the level of inflammation markers in the blood was noted (Table).

Table

Laboratory monitoring

Indicators, reference interval	Date of performing				
	25.03.24	26.03.24	29.03.24	01.04.24	08.04.24
CRP (0–3 mg/l)	153.0	91.5	87.8	84.2	62.1
PCT (0–0.1 ng/ml)	8.78	4.74		0,55	
IL-6 (0–20 pg/ml)			41.4	15.0	11.0

Notes: IL-6 – interleukin-6; PCT – procalcitonin; CRP – C-reactive protein

Against the background of the treatment, positive dynamics were noted, and the patient was discharged in a satisfactory condition under outpatient supervision of specialists.

CONCLUSION

Based on the data obtained during the radionuclide examination, the treatment was adjusted, which contributed to the recovery of 80 patients. Unfortunately, due to generalization of the infection, 15 patients developed a systemic inflammatory reaction and sepsis, which led to death.

FINDINGS

1. The use of radionuclide imaging with labeled autoleukocytes in patients with fever of unknown genesis allows for reliable visualization of areas of pathological infiltration and physiological distribution of cells.
2. Based on the data obtained, it is possible to adjust the therapy being carried out, which helps increase the effectiveness of the treatment.

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