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Combined Positron-Emission and Computed Tomography in the Study of the Kidneys Energy Metabolism

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Relevance- Biochemical reactions that provide the process of urine secretion and excretion are well studied, and they are based on the energy-dependent transmembrane movement of molecules on both sides of the nephron. This unique machine is designed in such a way that not only the physiological processes of its activity, but also pathological destructive reactions require the use of biological energy carriers. So a fast source of energy is a glucose molecule built into the membrane ATP-ASE, the long-term carrier of energy potential are lipids, or rather membrane phospholipids containing a molecule of choline. These energy "swings" are the essence of the entropy of living matter [1-6].

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Relevance- **Biochemical reactions that provide the process of urine secretion and excretion are well studied, and they are based on the energy-dependent transmembrane movement of molecules on both sides of the nephron. This unique machine is designed in such a way that not only the physiological processes of its activity, but also pathological destructive reactions require the use of biological energy carriers. So a fast source of energy is a glucose molecule built into the membrane ATP-ASE, the long-term carrier of energy potential are lipids, or rather membrane phospholipids containing a molecule of choline. These energy "swings" are the essence of the entropy of living matter [1-6].**

I. The Purpose of Research

The purpose of research was to study the possibility of use of positron-emission and computed tomography (PET/CT) with the isotope (18F-FDG) of glucose and 11c-choline in the study of the energy balance of the kidney parenchyma in the process of physiological urine formation.

II. Materials and Methods

To achieve this goal, a retrospective analysis of 60 PET/CT findings of the entire human body was conducted. In 30 cases with the isotope (18F-FDG) of glucose and in 30 cases with the isotope 11c-choline in patients with melanoma examined for the possible presence of metastases. These were young people aged 25-35 years old without any concomitant nephrological pathologies. The combined positron emission and computer tomography were performed according to the standard method on the PET device | CT (Siemens Biograph) production of Germany. Any functional changes in the kidney parenchyma in the regions of increased 18F-FDG glucose or 11c methionine metabolism in the process of physiological urinary formation were studied. The zones of interest were analysed by a semi-quantitative measure and the bar-line was mapped. In these zones, the value of the standard capture level (Suv max) was calculated. The calculation was performed automatically by the program complex. As the normal range, in the digital value, the indicators were in the range of 3.5-6.5 conditional units.

III. The Results of the Study

In the process of retrospective analysis of the results of PET/CT kidney parenchyma scans, we were interested in the metabolism of 18F-FDG glucose, as a fast source of energy, providing glomerular filtration and tubular reabsorption. The results are presented on the Tomogram 1.

From the presented data it is visible, that glucose metabolism has special characteristics independent from morphological localization in the nephron region (renal medulla or cortex) and, apparently, reflects the phase process of urinary formation in the mode of real time.

The results of the analysis of long-term carrier metabolism of energy potential in the composition of membrane phospholipids containing the molecule of marked 11c-choline and providing physiological fluidity of the kidney membrane filter are presented on Tomogram 2.

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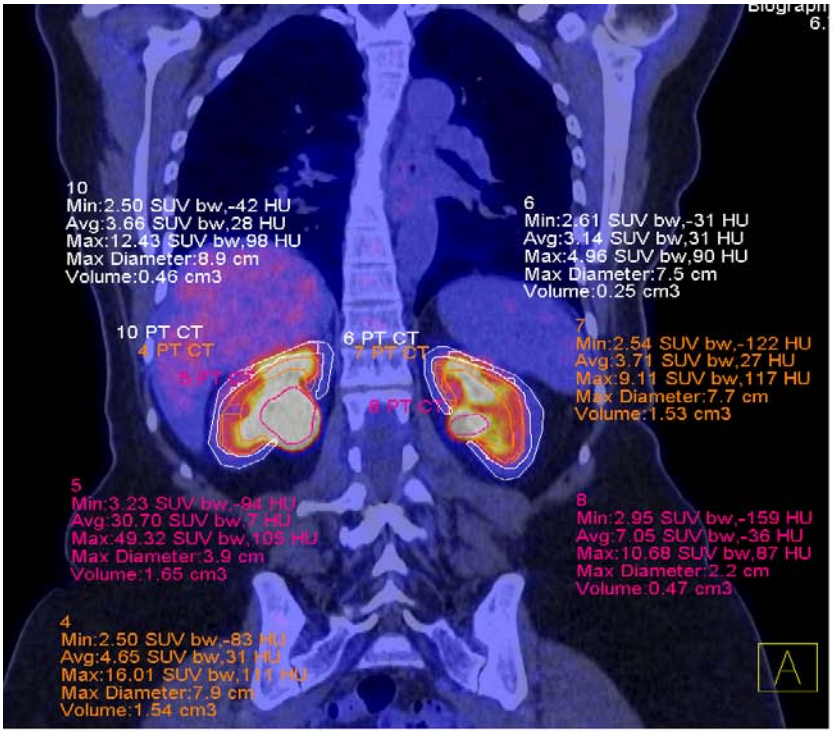
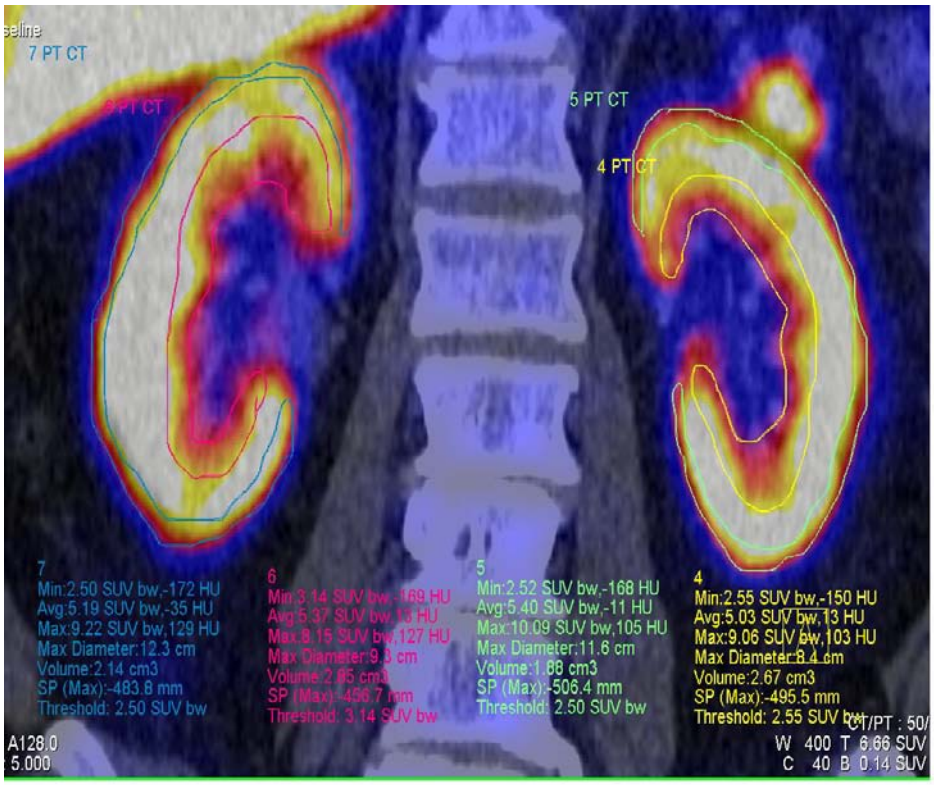


Tomogram 1: Kidney PET/CT with 18F-FDG glucose



Tomogram 2: Kidney PET/CT with 11c-choline

The presented Tomograms visualize clear regional distribution of the intensity of fixation of choline indicating its deficit, first of all at the level of the medulla layer of the kidney, and then the cortex. We can assume that the medulla layer of the kidney in the long-term mode is more energy-dependent and it requires special research. The mathematical analysis of the presented data (SUV max) can be one of the confirmations of the stated assumptions.

IV. Conclusions

As a result of the conducted research the possibility of investigation of the energy metabolism of kidneys by the method of PET/CT with isotopes 18F-FDG and 11c-choline in the process of physiological urinary formation is established.

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