WHAT IS THE DIFFERENCE IN THE HYBRID IMAGING TECHNIQUES- SPECT/CT AND PET-CT AND IS THERE ANY ADVANTAGE OF THEIR APPLICATION?

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Abstract

The hybrid imaging methods- Single photon Emission Tomography-Computer Tomography / SPECT-CT / and Positron Emission Tomography-Computer Tomography / PET-CT/ allow receiving of combined image of two different techniques. In such a way it is possible to superimpose detailed anatomical image of the multislice spiral computer tomography with specific and sensitive molecular images of the SPECT and PET in a single study, allowing utilization of the full possibilities of the both techniques. They have advantages and disadvantages, which basically stem from the differences in the used radiopharmaceuticals and their physical properties. In PET-CT – positron emitters are applied, most often 18F and 11C, while in SPECT-CT – single photon emitters, most often 99mTc and 131I. A disadvantage of PET is a high cost, which is produced in cyclotron and its logistics is complicated. The great advantage of PET is its better spatial resolution, compared to SPECT, because of the possibility for simultaneous detection of pared photons and better registration. These techniques, especially PET-CT are nowadays the most increasing imaging methods in the world in making diagnosis, staging and following the effect of treatment in patients with oncological, neurological, cardiological, orthopedic diseases and infections. Recently, they are applied for the purposes of radiotherapy planning on the basis of the metabolically active tumor. As a final result, compared to the conventional techniques- rentgenography, CT and MRI, it is possible in many cases to make an early and more precise diagnosis, saving patients’ time and using most appropriate treatment. As a conclusion it is clear, that the hybrid imaging has future and its application will increase.

The subject of nuclear medicine / NM / is the clinical application of the radiopharmaceuticals for diagnosis and therapy of the patients. Using diagnostic methods, objectively organ

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function could be visualized and evaluated. The therapeutic methods can be applied in diseases, refractory to other treatment methods.

Using NM methods makes it possible:

- to diagnose the disease in the earliest stages before morphological changes have occurred, which could be detected using computer tomography / CT/ or magnetic resonance imaging / MRI /
- to make whole body investigation and to see the spread of the disease
- to give qualitative information for the organ’s function

Nowadays the most often used instrumentation in NM are gamma cameras / planar-for a two dimensional or tomographic-for a three dimensional functional image / and hybrid scanners-SPECT-CT / single photon emission computed tomography, combined with computer tomography, using gamma emitted radiopharmaceuticals / and PET-CT / Positron Emission Tomography, combined with Computer Tomography, using positron emitted radiopharmaceuticals.

Worldwide the application of NM diagnostic and therapeutic procedures are increasing thanks to the quick development of the multimodal diagnostics SPECT/CT and PET/CT for making diagnosis, staging and therapeutic control of the number of oncological and non-oncological diseases / 1 /. 

**Advantages of the hybrid imaging**, using PET/CT and SPECT/CT are as follows:

- They give complex information for the structure and function of the organs
- They shorten the time for making diagnosis and consequently the initiation of therapy
- The scintigraphic images are with a higher quality because of a correction of the attenuated gamma rays through CT
- A precise localization of the pathological changes is possible and absolutely necessary for surgery and radiotherapy
- Receiving whole body imaging it is possible to give very important information for making diagnosis, spread of the disease, for determination of the most adequate therapy and to follow its effect.

**The differences** between SPECT/CT and PET/CT are:
They use different emitters: SPECT-only gamma emitted radioisotopes and PET-positron emitted.

Most often used isotopes for SPECT are 99mTc and 131I and for PET- 18F and 11C.

The most common use of CT in both techniques is for a higher quality and a higher specificity of the scintigraphic image, because of the correction of the attenuated gamma rays and a possibility for a precise localization.

SPECT/CT is ten times less expensive than PET/CT

SPECT/CT gives less radiation burden to the patient than PET/CT

PET has better spatial resolution / around 5mm / compared to SPECT / around 10mm /, because of the possibility for a simultaneous detection of paired photons and better registration

The final result of the use of the hybrid scanners is the higher diagnostic accuracy.

Principal application of SPECT/CT are in the field of cardiology, oncology and orthopedics, but nowadays its application is expanding for the visualization of thyroid masses, parathyroid glands, brain pathology, inflammatory processes and recently also for the radiotherapy planning in order to irradiate only tumor volume and sparing neighboring healthy tissue /Fig.1/. The literature data show that nearly 35% of SPECT-investigations have to be combined with CT for an increase of the specificity. As a final result- the interpretation has changed in 56% of the patients and in 26% of them there are principal mismatches /2/.
Nowadays **PET/CT**, which is a new hope in oncology, is considered as “One-stop oncology shop”, as it gives except metabolic / functional /, but also morphological / anatomical / organ changes, as well as blood flow and perfusion, using contrast enhanced images. The most often used radiopharmaceutical is $^{18}$F]-FDGq, which is a glucose analog and a precise information for the cells glucose metabolism is achieved /4/. In the tumor cells it is highly upstaged.

**The main applications of PET/CT are /5/:**

- **In diagnosis for** differentiation of benign from malignant tumors of the lungs and pancreas/ Fig.2 / and for searching of a tumor with unknown localization, as well.

- **For staging of tumors**, using the possibility of whole body imaging for visualization of local recurrence and distant metastases of breast, lung, gastrointestinal tract, head and neck cancers, lymphoma, melanoma.
For determination of the type of therapy, for following its effectiveness and determination of patient’s prognosis

For radiotherapy planning

Often with PET/CT are visualized metastasis that are not diagnosed with the other imaging methods, which changes the therapy and prognosis of the patient. As a whole, this technology changes the therapy in 40% of the patients and quit surgery in 30% of them. Nowadays it is the most quickly developing imaging method. As a final result, compared to the conventional techniques- rentgenography, CT and MRI, it is possible in many cases to make an early and more precise diagnosis, saving patients’ time and using most appropriate treatment. As a conclusion it is clear, that the hybrid imaging has future and its application will increase.

References

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