ble and decays through annihilation which results in the emission of two 0.511 MeV photons in opposite directions. If the kinetic energy of the positron is close to zero, then two 511-keV annihilation photons scatter isotropically strictly at the angle of 180º to each other.

In a positron emission tomography, two 511-keV annihilation photons are detected within each other's coincidence window by two opposite detectors along a straight line called a line-of-response. In full ring systems data is collected simultaneously within 360º.

In modern PET scanners, BGO and LSO crystals are installed. These crystals are not hygroscopic, and therefore they do not require hermetic packaging. Both detectors have high density and a linear attenuation coefficient.

In a PET scanner, each detector is connected in a coincidence chain to a series of opposing detectors. The number of opposing elements can vary from one to a maximum equal to a half of the total number of detectors located on the ring. Therefore, each detector element can be connected to coincide with a maximum of a half the total number of opposite elements. Each detector element has a number of projections, depending on the number of opposite detectors connected to it. The angle of "coincidence" of the detector element formed in this case is called an acceptance angle. The multiple acceptance angles of all detectors on the scanner ring create a transaxial field of view.

The purpose of this work is to describe the main stages of the process of visualizing the internal structures of a body when performing positron emission tomography and to determine the basic principles for registering photons with detector elements of a PET scanner.

BIBLIOGRAPHY

1. Saha, G. B. Basic of PET Imaging: Physics, Chemistry and Regulations / G. B. Saha. – 2nd Edition. – Cleveland: Springer, 2010. – 213 p.

2. International Atomic Energy Agency. Quality Assurance Programme for Computed Tomography: Diagnostic and Therapy Applications. Human Health Series. – Vienna: IAEA, 2012. – № 19. – 171 p.

CHARACTERISTICS TO BE MONITORED ON PET/CT

O. Popchenya

Belarusian State University, ISEI BSU,
Minsk, Republic of Belarus
ledi.popchenya@gmail.com

The characteristics to be monitored on X-ray computed tomographs, positron emission tomographs, and on a positron emission tomography apparatus combined with an X-ray computed tomography are listed to ensure the correct operation of the apparatus.

Keywords: positron emission tomography, computed tomography, PET/CT scanners, quality of PET / CT images, quality assurance program, radiation safety, dosimetric characteristics, characteristics of the scanner.

The following groups of characteristics are tested on x-ray computed tomographs:
– radiation safety system;
– electromechanical characteristics of the scanner;
– image quality;
– dosimetric characteristics.

Radiation safety system.

The following devices incorporated into X-ray computed tomographs are monitored for radiation safety:
– information boards and signal lights;
– loud speaker communication;
– emergency radiation switches.

Electromechanical characteristics of a scanner.

The following electromechanical characteristics of X-ray computed tomographs are checked:
– light localization system;
– table incrementation accuracy.

Image quality.

The following image quality parameters of X-ray computed tomographs are checked:
– CT number, uniformity and noise in a homogeneous environment;
– spatial resolution and contrast resolution;
– slice thickness and distance measurements.

Dosimetric characteristics.

In X-ray computed tomography, two dosimetric characteristics are of the greatest practical importance:

– Computed Tomography Dose Index (CTDI) and Dose Length Product (DLP).

The following characteristics are monitored on positron emission tomographs:

– image uniformity;

– spatial resolution;

– signal-to-noise ratio;

– stability of the detector system;

– cross calibration factor.

The following characteristics of positron emission tomographs combined with X-ray computed tomographs are monitored:

– cross-calibration coefficient and a comprehensive verification of a system in the clinical trial mode;

– a shift of the observation zone.

As a result of this work, we have established a list of characteristics that have to be periodically monitored. This list is sufficient for optimal control and ensuring the correct operation of the device.

BIBLIOGRAPHY

1. International Atomic Energy Agency. Quality Assurance Programme for Computed Tomography: Diagnostic and Therapy Applications. Human Health Series. – Vienna, 2012. – № 19. – 171 p.

REQUIREMENTS FOR THE POSITRON-EMISSION TOMOGRAPHY COMBINED WITH THE X-RAY COMPUTER TOMOGRAPH

O. Popchenya

Belarusian State University, ISEI BSU,
Minsk, Republic of Belarus
ledi.popchenya@gmail.com

The requirements for positron emission tomography equipment combined with an X-ray computer tomograph to ensure accurate apparatus operation are presented. The substantiation of the need for creating clinically acceptable quality assurance programs in a particular PET department is given, which allows the control of the basic scanner characteristics.

Keywords: positron emission tomography, computed tomography, PET department, PET/CT scanners, quality of PET / CT images, oncology, quality control, quality assurance program, IEC standards, NEMA, IAEA.

Positron emission tomography (PET) is used in neurology, cardiology and oncology. The combination of PET and computed tomography (CT) has significantly increased the diagnostic value of medical images, because CT images carry anatomical information, and PET carries metabolic information. The applying of PET onto CT images allows localization of the radiopharmaceutical accumulation centers with a high degree of accuracy.

To ensure high diagnostic quality of PET / CT images, constant monitoring of the scanner characteristics is required to timely detect their deviations from the values declared by the manufacturer and to take appropriate measures.

Modern medical diagnostics imposes strict requirements on the information content of images, so the issue of quality assurance is quite urgent. Often, manufacturers recommend a rather reduced set of measurements that do not provide a quality assurance in accordance with international and national standards. In addition, not all measurements included in these standards can be performed on a particular scanner due to the lack of necessary phantoms and the features of its software. Thus, there is a need to develop a quality assurance program adapted to the conditions of a particular PET department.

There are various standards for the acceptance and routine testing of PET/CT scanners. The standards governing acceptance tests can also be used for routine measurements, if necessary.

Of particular note is the lack of official standards governing the comprehensive testing of combined PET / CT scanners. In this regard, there are only recommendations from the IAEA and manufacturers of such scanners.

Thus, a program should be drawn up to guarantee the operation quality of the apparatus based on an analysis of international IEC standards, state IEC GOST R, NEMA standards, IAEA and manufacturer recommendations, and taking into account the presence of necessary phantoms.