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Introducing the PET Centre Bydgoszcz – Poland

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Introduction

Poland is the last country in this part of Europe, where there was no PET unit. Whereas PET centres exist in Czech Republic, Hungary and Slovakia, and several other are in project, PET was not available in Poland, a large country with almost 40 million population. Therefore opening 26th February, 2003 the first PET centre in Regional Centre of Oncology in Bydgoszcz, a city in northern Poland was a festive day for Polish nuclear medicine community.

Department of Nuclear Medicine of Regional Centre of Oncology in Bydgoszcz

The building

Department of Nuclear Medicine of Regional Centre of Oncology (RCO) is located in a separate building together with the Department of Radiology. A large hall together with "cold" waiting room leads to the diagnostic part of Department comprising: consultation room, stress test room, injections room, "hot" waiting room, "hot" lab, two gammacamera rooms plus several other rooms (Fig. 1).

PET laboratory is a separate part of the Department with: "hot" laboratory, computer room, PET camera room plus the rooms of technical maintenance e.g. cooling system, power suppliers etc.

Technical background is localised below, on a ground floor, comprising the rooms directly involved in the synthesis of PET radiopharmaceuticals synthesis: cyclotron room, cyclotron steering room, synthesis laboratory, quality control laboratory, "hot" lab plus rooms of technical and sanitary maintenance.

Figure 1. Main entrance to the NM Department.

Architectural concept and interior design were awarded with the Constructors' Chamber Prize of the year 2002.

The equipment

The Department is equipped with two SPECT gammacameras (Picker): AXIS (dual-head) PRISM 1500 XP combined with a computer system ODYSSEY.

CT/PET station

The pride of the Department is a scanner PET/CT BIOGRAPH (Siemens, Erlangen, Germany). It is a hybrid scanner containing both PET Exact LSO camera and CT scanner Somatom Emotion.

The computer system contains four workstations, two for PET acquisition and processing, two for CT. Platform SYNGO integrates and communicates with the user the whole system.

Image processing is done with use of two separate workstations using ESOFT and FUSION software.

CT scanning parameters

Somatom Emotion is a spiral CT scanner with following parameters (Fig. 2):

— maximal power: 40 kW;
— maximal time of spiral movement: 100 s;
— rotation time: 0.8, 1.0, 1.5 s;
— maximal length of scanning: 145 cm;

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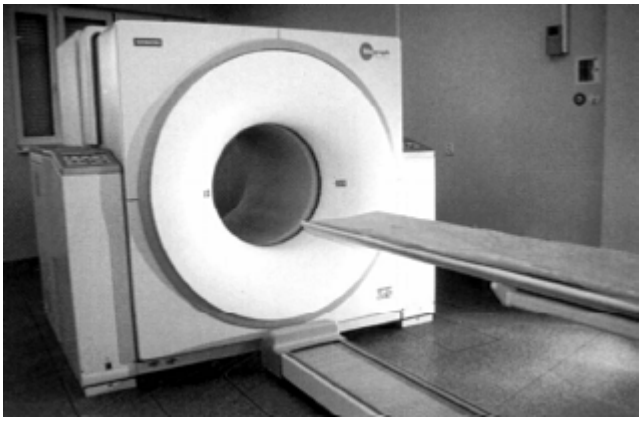

Figure 2. Biograph PET/CT scanner.

Figure 3. The RDS 11 cyclotrone.

— speed of table movement: 1–25 mm;
— slice thickness: 1, 2, 3, 5, 8, 10 mm;
— spatial resolution: 0,32 mm;
— scan field: 50 cm;
— reconstruction field: 5–50 cm;
— reconstruction time: 1 s/slice.

This device can be used independently of PET.

PET scanner parameters

PET scanner is based upon a modern, high-sensitive, detector LCO, utilising a lutetium oxyorthosilicate crystals. Technical data:

— crystal dimensions: 6.45 × 6.45 × 25 mm;
— crystals per detector block: 64;
— no of detector blocks: 144;
— PMTs: 4 per block;
— detector ring diameter: 824 mm;
— detectors per ring: 384;
— no of detector rings: 24;
— transaxial resolution: FWHM at 1 cm 6.3; FWHM at 10 cm 7.4;
— axial resolution: FWHM at 1 cm 5.8; FWHM at 10 cm 7.1;
— sensitivity: 999 kcps/mCi/cc;
— uniformity: < 5%;
— count rate correction: ± 5% at up to 0.81 uCi/cc;
— peak NEC (20 cm): 109 kcps at 0.46 uCi/cc;
— field of vision: axial — 162 mm; transaxial — 585 mm;
— gantry diameter: 70 cm (the same for CT and PET scanner);
— coincidence time resolutionn: ~3 ns;
— coincidence window: 6 ns;
— reconstruction time: < 1 min/bed.

The cyclotrone

The Department is equipped the cyclotron model RDS 11 (CTI) (Fig. 3) with fluorine-18 targetry system. Technical parameters:

— magnet: 4-sector varying field;
— single strip coil: mean field 1.2T;
— valley-to-hill gap ratio: 27:1;
— pole diameter: 90 cm;
— energy: 11 MeV;
— RF system: 4 Dees;
— fundamental mode: 72 MHz;
— single port irradiation: up to 50 mA;
— dual port irradiation 80 mA (40 mA/beam port);
— vacuum:
— base pressure: 1 × 10–6 Torr;
— operating pressure: 1 × 10–5 Torr;
— power consumption: standby < 6 kW; operating 35 kW;
— extraction: multiple carbon foil carousel provides > 99% extraction.

Cyclotron-produced fluorine-18 in a 1.2 ml solution is transported in a capillary to the synthesis lab; a carrier is a pressurised argon. The Department operates with a ^{18}F-FDG synthesiser TRACELab Fx FDG (General Electric) (Fig. 4). Following the synthesis the product undergoes the quality control in a form of fluid, thin-layer and gas chromatography, pH and osmolarity control.

Radiopharmaceuticals, after dispensing to the syringes by Althea dispencer (Comecer-Italy), are delivered from the "hot" lab to the patients using a small lift.

PET scanning

Following registration patient is consulted by the doctor. Then he/she is injected with 500–600 MBq of ^{18}F-FDG and goes to a "hot" waiting room. The time of waiting is approx. 1 hour. Patient is asked to keep a minimal muscular effort activity, including to refrain from reading and to limit talking. In the meantime patient is

Figure 4. F18-FDG synthesis and dispencing unit.

asked to drink 0.5 L of water or pectin solution in order to facilitate urinary bladder emptying and contrast the bowels.

The mean time of average PET/CT whole body scanning (at average patient's height) is 20 min + 5–10 min for patient's positioning.

Hopes, fears and conclusive remarks

February 26th, 2003 has been undoubtedly a festive day for Polish nuclear medicine community. The opening has been attended by a Prime Minister and the Minister of Health, everybody looked happy. Hoewever, we live in a time of bad economic aura and, say, decreased consumers' optimism. It is not fully clear, how this quite expensive diagnostic tool will be financed. Finally only 50 examinations have been performed within first two months since opening ceremony.

On the other hand, this day had to come. PET is no longer a toy in the hands of a limited number of a limited groups of happy scientists in economically and technologically advanced countries. PET people are no longer pet people. This is a diagnostic tool with established position, mostly in diagnostic oncology. This step probably marks future steps in PET diagnostics in Poland.