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Efforts in the Formation and Development of Nuclear Medicine in Vietnam

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Abstract

The foundations of nuclear medicine in Vietnam were established from 1970. Until now, after 48 years of development, in Vietnam, we have some basic equipment including 31 SPECT, 4 SPECT/CT machines, 11 PET/CT scanners, five cyclotrons, and one nuclear reactor. Many nuclear medicine techniques in diagnosis and treatment have been routinely performed at provincial and central level health facilities such as tumor scintigraphy, thyroid scintigraphy, bone scintigraphy, kidney scintigraphy, cardiac scintigraphy, and radio-isotope therapy with I-131 and P-32. Selective internal radiation therapy with Y-90 microsphere and I-125 radioactive seed implantation has been also successfully applied in some big hospitals. However, there are still many difficulties for Vietnam as the lack of new widely used radioisotopes such as Ga-67, Cu-64, Samarium-153, and Lutetium-177 and the lack of nuclear medicine specialists. In the future, we are putting our efforts on the applications of new isotopes in diagnosis and treatment of cancers (theranostic) like Ga-68-DOTATATE, Lutetium-177-DOTATATE, Ga-68-PSMA, and Lutetium-177-PSMA, equipping modern nuclear medicine diagnostic tools, strengthening the human resources training in nuclear medicine. At the same time, we are trying our best to strengthen the cooperation with international nuclear medicine societies in over the world.

Keywords Nuclear medicine · Vietnam · Theranostics · Development

History of the Development of Nuclear Medicine in Vietnam

The foundations of nuclear medicine in Vietnam began in 1970 when the Vietnam Ministry of Health decided to set up the first medical radiology research group in Vietnam at Bach Mai Hospital. In 1971, the first radioactive substances NaI-131 and types of salt of P-32, Cr-51, and Fe-59 were brought to Vietnam and used in medicine [1].

After that, department of nuclear medicine was established at other hospitals such as at the Army Center Hospital 108, the Army Center Hospital 103, Cho Ray Hospital, Da Nang General Hospital.

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In 1987, the Department of Nuclear Medicine of Hanoi Medical University was established to train human resources for nuclear medicine in Vietnam. Since then, the Department of Nuclear Medicine of Hanoi Medical University and the Nuclear Medicine and Oncology Center of Bach Mai Hospital have trained many nuclear medicine doctors working at many provincial hospitals to develop nuclear medicine applications to hospitals nationwide [2]. From 2015, in the central of Vietnam, nuclear medicine has been trained at Da Nang General Hospital and for the South of Vietnam, Ho Chi Minh City Medicine and Pharmacy University has had this responsibility.

In November 2011, recognizing the importance of nuclear medicine, the Prime Minister approved the detailed plan for the development and applications of radiation in medicine to 2020 with the objectives by 2020, over 80% of provinces and municipalities shall have nuclear medicine department; reaching the rate of at least one scintigraphic imaging equipment per million people.

Currently, nuclear medicine techniques in diagnosis and treatment have been routinely performed at provincial and central level health facilities throughout the country. There are currently 28 facilities, departments, and nuclear medicine centers in

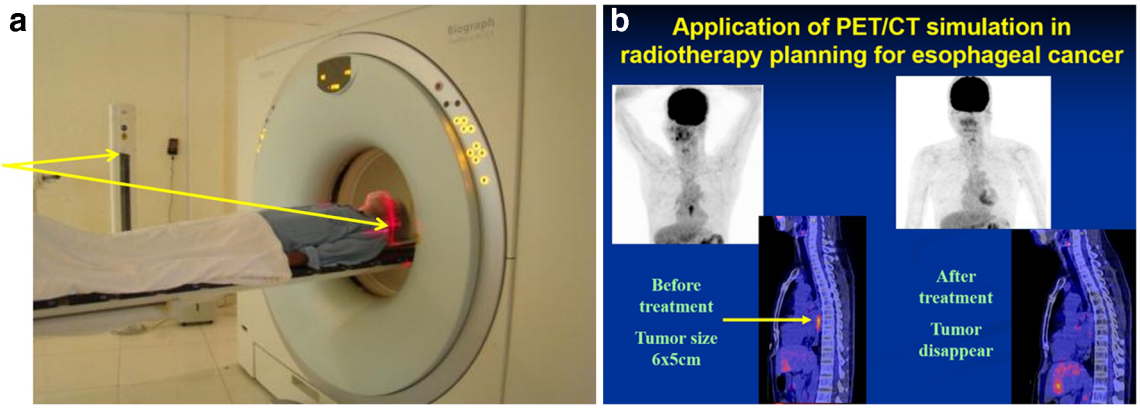

Fig. 1 PET/CT simulation in radiotherapy. **a** Simulation by PET/CT with 3-dimensional laser positioning system; **b** PET/CT simulation in radiotherapy planning for esophageal cancer

the country. Regarding the equipment, there were 31 Single Photon Emission Computed Tomography (SPECT), 4 Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT) machines, 11 Positron Emission Tomography/Computed Tomography (PET/CT) scanners, five cyclotrons, and one nuclear reactor in Da Lat providing radioactive drugs (Tc-99m, I-131, P-32) for nuclear medicine units nationwide. About human resources, we have had about 200 trained and experienced staff (including doctors, engineers, technicians, and nurses) in nuclear medicine. The leading professors in nuclear medicine as Prof. Phan Van Duyet, Prof. Phan Sy An, and Prof. Mai Trong Khoa are the representatives and coordinators of IAEA's regional cooperation programs in Vietnam.

Nuclear Medicine Techniques Are Being Applied in Vietnam

In Vietnam, there are modern laboratories for radioimmunoassay (RIA), genetic and molecular biology testing to study the applications of nuclear medicine and molecular biology in clinical practice. At these laboratories, radioimmunoassay (RIA) is routinely performed to measure thyroid hormone (Free triiodothyronine (FT3), Free Thyroxine (FT4), Thyroid- Stimulating Hormone (TSH)), and tumor indications (thyroglobulin (Tg), anti-thyroglobulin (anti-Tg), carcinoembryonic antigen (CEA), Alpha-fetoprotein (AFP) ...).

Nuclear medicine techniques for diagnosis such as tumor scintigraphy, thyroid scintigraphy, bone scintigraphy, kidney scintigraphy, cardiac scintigraphy, and ^{18}F-FDG PET/CT scan in the diagnosis of cancer and Alzheimer are routinely performed at the Nuclear Medicine and Oncology Center [3] (Fig. 1).

For treatment, many nuclear medicine techniques have been applied successfully. For example, radio-isotope therapy with I-131 has been given for thousands of patients with hyperthyroidism and differentiated thyroid cancer; patients with primary polyarthritis or cancer patients with bone metastases have been treated by P-32; more than 200 liver cancer patients were successfully treated with selective internal radiation therapy with Y-90 microsphere (Fig. 2). In addition to that, I-125 radioactive seed implantation was applied in the treatment of early-stage prostate cancer with 8 out of 8 successful cases [4, 5] (Fig. 3).

Difficulties in the Clinical Practice of Nuclear Medicine in Vietnam and the Future Development

Currently, with great efforts to apply nuclear medicine in diagnosis and treatment, certain achievements have been

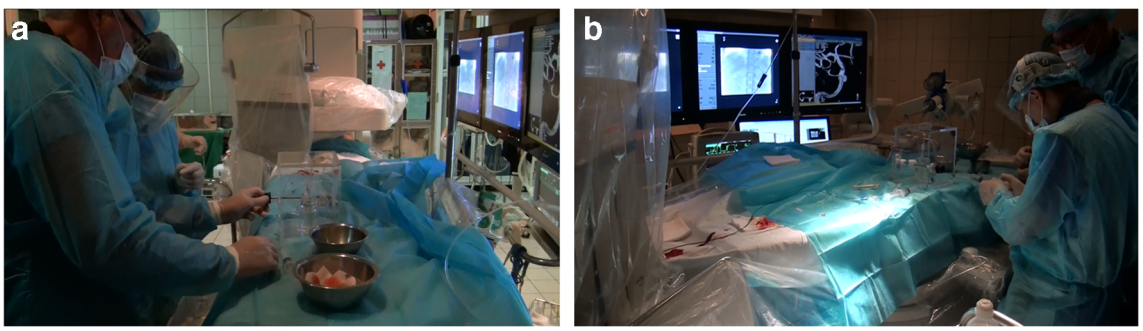

Fig. 2 Selective internal radiation therapy with Y-90 microspheres. **a** Injecting Y-90 microspheres to artery supplying to the tumor; **b** checking after injecting Y-90 microspheres

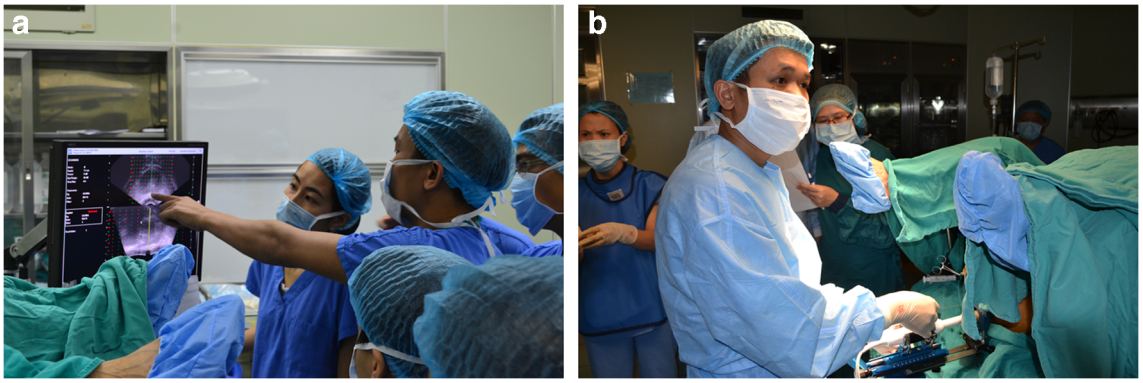

Fig. 3 Treating patients with early-stage prostate cancer with I-125 radioactive seed implantation. **a** Checking the tumor under ultrasound before treatment; **b** implant radioactive seeds to the tumor

recorded. However, there are still many difficulties for Vietnam as the lack of new widely used radioisotopes such as Ga-67, Cu-64, Samarium-153, and Lutetium-177. Another difficulty is the lack of nuclear medicine specialists.

In the future, we are putting our efforts on the applications of new isotopes in diagnosis and treatment of cancers (theranostics), combining the role of molecular biology and nuclear medicine in clinical practice, equipping modern nuclear medicine diagnostic tools such as Positron Emission Tomography/Magnetic Resonance Imaging (PET/MRI) scan, and strengthening the human resources training in nuclear medicine. In detail, PET/MRI scan will be installed at the Nuclear Medicine and Oncology Center, Bach Mai Hospital in the near future; the application of radiation therapy for peptide receptors in patients with neuroendocrine tumors and prostate cancer will be performed. Importing and applying new radioactive drugs such as Ga-68- dodecanetetraacetic acid (Tyr3)-octreotate (Ga-68-DOTATATE), Lutetium-177-DOTATATE, Ga-68- Prostate-Specific Membrane Antigen (Ga-68-PSMA), and Lutetium-177-PSMA will be imported and ^{18}F-Na will be synthesized and used for bone scintigraphy. At the same time, we are trying our best to strengthen the cooperation with international nuclear medicine facilities in Korea and Japan in exchanging and training nuclear medicine specialists.

Conclusion

Now in Vietnam, nuclear medicine is developing strongly and planned by the government. Many modern nuclear medicine techniques in diagnosis and treatment are successfully and routinely implemented in Vietnam. We are still developing and cooperating with nuclear medicine organizations in the world to update advanced diagnosis and treatment techniques, train human resources, and equip modern facilities.

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Compliance with Ethical Standards

Conflict of Interest Mai Trong Khoa, Pham Cam Phuong, Bui Tien Cong, Tran Hai Binh, Pham Van Thai, Dao Manh Phuong, and sTran Dinh Ha declare that they have no conflict of interest. There is no source of funding.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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