Nuclear medicine in Malaysia – Strengths and challenges for physicians after more than half a century of experience

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ABSTRACT

Nuclear medicine (NM) has been established in Malaysia for almost 60 years. It is a specialty that utilizes radiopharmaceuticals for theranostics, by the assessment of bodily functions to diagnose certain diseases and conditions particularly in oncology, cardiology, and neurology as well as to provide therapeutic solutions in certain instances. The strengths of NM include the establishment of various nuclear medicine centres throughout the country, including in Sabah and Sarawak, particularly for general nuclear medicine, and the mushrooming of positron emission tomography computed tomography (PET/CT) centres along the states in the west coast of Malaysia, the institution of a formal national nuclear medicine physician training programme, and collaboration with international bodies to develop theranostic services. The challenges for NM ahead are namely regulatory and financial constraints for utilizing newer radiopharmaceuticals available in the international market, expansion of accredited training programmes to produce skilled healthcare workforce, optimization of resources at hand and multidisciplinary collaborations to reduce premature mortality of patients caused by non-communicable diseases, particularly cancer.

INTRODUCTION

Nuclear medicine (NM) is a medical specialty that utilizes radioactive tracers known as radiopharmaceuticals to enable the assessment of the functions of the body, especially at a cellular and molecular level, hence facilitating the diagnosis and treatment of diseases. NM has been established for almost 60 years in Malaysia; with doctors (mainly from radiology or internal medicine background training), physicists, nurses, and technologists who have had some training overseas or local parallel training related to the NM field, running the clinical services across various hospitals and centres in the country. At present, there are more than 10 government facilities in Malaysia providing NM services and almost an equal number of facilities in the private sector offering either positron emission tomography computed tomography (PET/CT) or general nuclear medicine services. The mushrooming of these centres, particularly with the utility of PET/CT, has strengthened the role of the NM discipline in the management of oncology cases in Malaysia. Furthermore, a giant step forward was taken in 2007 towards establishing a regular stream of well-trained nuclear medicine physicians, when a formal specialist training programme conferring the Master of Medicine (Nuclear Medicine) was offered by Universiti Sains Malaysia.

Likewise, the Ministry of Health, Malaysia too has been proactively involved in training non-physician personnel such as radio-pharmacists, medical physicists, and nuclear medicine technologists in order to meet the demands of this growing field.

Strengths and challenges in the new millennia

Despite a turf battle with other specialties to claim the 'ownership' of NM practices, many advancements have been made in establishing it as a unique specialty that deals with the diagnosis, staging and treatment of oncology cases, as well as a special role in the diagnosis of cardiology and neurology cases. The perception of this field in the medical community can be further strengthened with designing and initiating a training programme that is broad and comprehensive of complementary imaging and therapy options. A potential option is to adopt a national training programme such as the one started in the United Kingdom of Great Britain that has fortified knowledge on cross-sectional imaging by providing cross training in radiology and internal medicine into the pathway for specialization in NM. A sound understanding of what the specialty has to offer can promote better utility of the resources at hand. Furthermore, due to the COVID-19 pandemic, many continuous medical education programmes have been relegated to the virtual realm. Despite, the challenges wrought by the globally affecting movement control orders, NM physicians are still able to disseminate and share information worldwide through online webinars and conferences. This was stunningly evident in the recently held highly, successful meeting by the Society of Nuclear Medicine and Molecular Imaging (SNMMI) that was fully conducted on a virtual platform. It is believed that the upcoming national nuclear medicine conference by the Malaysian Society of Nuclear Medicine & Molecular Imaging (MSNMMI) in September 2021 will share a similar success.

Moreover, there are three key factors that help in consolidating NM services as having a critical role in disease management in Malaysia. These include the knowledge of the development, production, and validation of radioactive tracers (also known as radiopharmaceuticals), skills in acquisition and interpretation of nuclear diagnostics imaging, along with the formulation, administration, and management of targeted radionuclide therapy. [18F]Fluoro-deoxyglucose, or better known as [18F]FDG, is an example of a widely used radiopharmaceutical in the field of nuclear diagnostics. [18F]FDG has been the workhorse for PET/CT diagnostics since 1994. Although non-specific in activity, it is an indispensable radiopharmaceutical for the diagnosis,

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recurrence for certain oncological indications, including lymphoma, non-small cell lung cancers, and oesophageal cancers; to name a few.

Since then, many more radiopharmaceuticals have been approved by the Food and Drug Administration (FDA) in the United States of America once they comply with the national drug quality standards compendiums, such as the U.S. Pharmacopeia (USP).[1] Whereas, in Europe, recommendations by the European Pharmacopeia (EP) is enforced by the European Medicines Agency (EMA). To date, there are more than twenty approved radiopharmaceuticals in the market that are utilized for oncology, cardiology, or neurology indications. Recently, a novel radiopharmaceutical called [18F] fibroblast activation protein inhibitor ([18F]FAPI) has been developed, and this shows great promise to be a strong contender for mainstream oncology imaging agent compared to [18F]FDG. The advantage of [18F]FAPI is that it provides good sensitivity for the detection of malignancy, improved target-to-background radio for a wide range of cancers including brain tumours, and can be tagged with either [18F], [68Ga], and even [99mTc] radio-isotopes.[2] Apart from the high contrast resolution provided by this novel radiopharmaceutical due to its low uptake in normal tissues, it has also a potential to be used in theranostics applications for the treatment of certain cancers such as prostate cancer.[3] In neurology imaging, particularly for the management of Alzheimer's disease by quantifying the cerebral amyloid burden, novel amyloid-β imaging compounds have been utilized for PET/CT diagnostics,[4,5] but have yet to reach the shores of Malaysia. Despite, the regulatory and financial challenges, efforts have been taken to aid in the management of Alzheimer's disease and other neurological conditions such as epilepsy, at various centres in Malaysia, by utilizing [18F]FDG PET/CT diagnostics.[6]

The administration of targeted radionuclide therapy by NM physicians in Malaysia has also been gaining acceptance among the medical fraternity. Currently, target-specific somatostatin analogs i.e., DOTA-peptide molecules, and prostate-specific membrane antigen (PSMA) molecules, tagged with beta emitting radioisotopes, are being utilized as alternative therapies in patients with neuroendocrine tumours (NETs) and prostate cancers, respectively. At present, these therapeutic radiopharmaceuticals hold promise as a life-prolonging alternative treatment in patients with advanced NETs and prostate cancers, respectively who have previously undergone multiple lines of systemic chemotherapy. The NETTER clinical trial using [177Lu]DOTATE for metastatic neuroendocrine tumour patients, as well as the VISION and TheraP phase III clinical trials utilising [177Lu]PSMA for castrate resistant metastatic prostate carcinoma patients; have demonstrated significant improvements in the progression free survival of these patients.[7-9] The impressive results have enabled these treatment options to gain acceptance among clinicians in the oncology and surgery disciplines and have paved the way for certification by the FDA. The challenge for physicians now is on the timing for the institution of such therapies, which is usually decided in a multidisciplinary specialist setting.

Another challenge for NM physicians in Malaysia is the adequate optimization of resources at hand and multidisciplinary collaborations to reduce premature mortality caused by non-communicable diseases, particularly cancer. Currently, there are several installations of hybrid imaging technology in Malaysia such as PET/CT and single photon emission tomography computed tomography (SPECT/CT). The advantage of PET/CT is in its versatile ability to detect and quantify cancers at a molecular level, thus enabling the diagnosis, staging and follow-up of oncology cases. By using the value of radiopharmaceutical uptake in the liver as a background baseline uptake, NM physicians can quantify the tumour burden as well as assess the metabolic response of the tumour towards therapy.[10] Overall, SPECT/CT is relatively cheaper to maintain with lower costs of the radiopharmaceuticals and maintenance of the equipment, which may be an important consideration for installation in developing regions within the country.[11] Efforts are being taken to improve this modality in its ability to quantify tumour burden such as in the evaluation of bone metastasis.[12] Furthermore, in future if the production of [99mTc]-based radiopharmaceuticals are developed using FAPI, this would enable SPECT/CT to perform a wider range of diagnostics in cancer management.

Future considerations and the way forward

The Malaysian NM arena is rapidly changing since its inception, and we have come along way in recent decades. A proactive stance is needed among NM physicians in this country in order to build strong networks among clinicians from other disciplines. Incorporation of wider clinical skills prior to joining the specialty, enforcement of accredited structured training programmes, keeping abreast with international developments and promoting subspecialty interests in a system or disease-orientated division, as well as adoption of the know-how of artificial intelligence into the field are among the key approaches to ensure that the specialty remains viable in years to come.

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