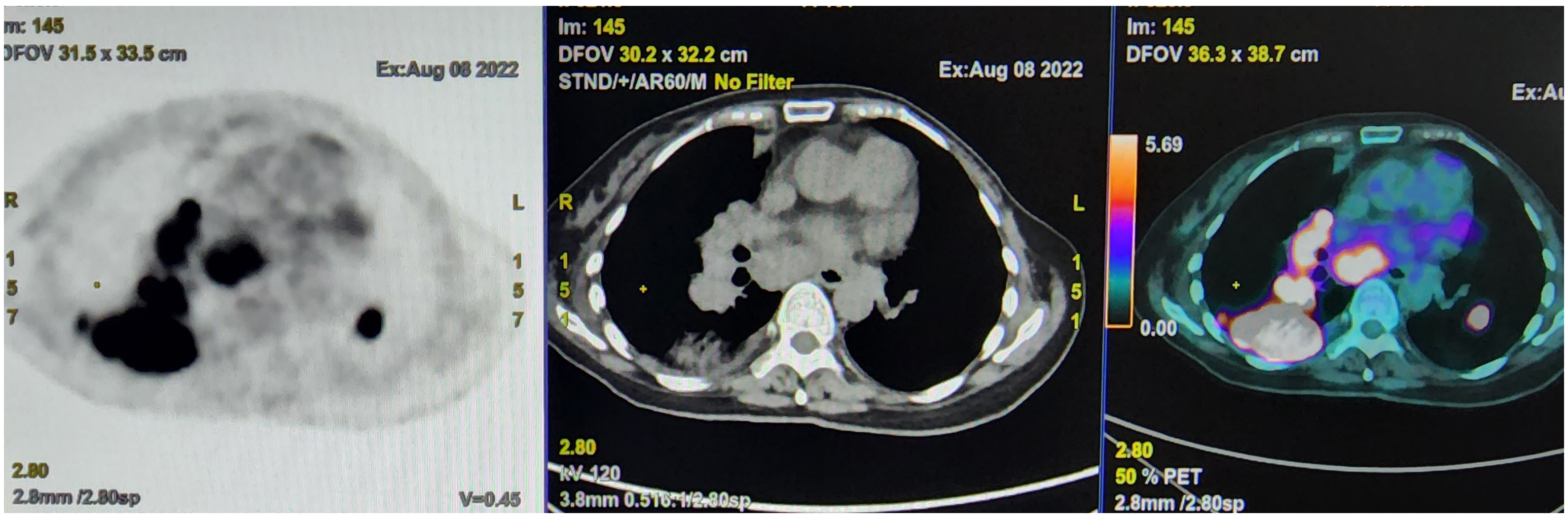
Advancements in the field of nuclear medicine



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THERE are plenty of reasons patients may be deterred from seeking a specific treatment or undergoing a particular diagnostic test in medicine. Any kind of treatment or diagnostic procedure that is rare or not widely used may cause anxiety to any patient and the word 'nuclear' is not the most compelling in trying to remove their hesitance. While nuclear medicine is not a new speciality and has been around for about 100 years thanks to the discovery of radium by Marie Curie, it is not an option that is frequently used in the medical field. Nuclear medicine has a unique niche in medicine in that its utility is meant for very specific indications.

Nuclear medicine can be defined as a specialty in medicine that uses radioisotopes to diagnose and treat diseases and medical conditions. Though most of the workload in nuclear medicine is diagnostic scans, it is also used in treating several medical conditions, especially in certain cancers at a therapeutic capacity.

There are two reasons radioisotopes are used in nuclear medicine. First, radioisotopes emit ionising radiation that can be detected at minute amounts, and at higher levels of radiation is able to destroy cancer cells and diseased tissues. The second reason is that radioisotopes have identical chemical characteristics as non-radioactive isotopes and therefore can be attached with the appropriate chemicals that have specific characteristics in the human body. This combined molecule of radioisotopes and a particular chemical or pharmaceutical compound is known as a radiopharmaceutical.

The properties of the radioisotopes and radiopharmaceuticals as mentioned allows for early detection of specific conditions and the ability to treat certain cancers while minimising the effects on healthy tissue.

Technology playing a vital role

Among the latest developments in nuclear medicine is theranostics, short form for therapeutic diagnostics, that utilises the same or similar pharmaceuticals. By attaching it to a particular radioisotope, doctors can diagnose a particular cancer and determine if it will respond to nuclear medicine therapy by employing another radioisotope to initiate the annihilation of those cancer cells.

At present, theranostics are used mainly in the treatment of Neuroendocrine tumours and prostate cancer but may be employed in other cancers as new pharmaceuticals are developed.

Positron emission tomography (PET) scanner and a computed tomography (CT) are highly utilised scanners in nuclear medicine. They are used as a pair for better imaging outcome.

Conventional medical scans such as CT scan, X-rays, ultrasound and MRI detect anatomical or structural changes in the human body to detect disease and to assess treatment response.

The main difference with PET/CT is that it attempts to detect physiological or functional changes to diagnose a condition and evaluate treatment response. As physiological changes occur earlier in the development of a particular disease, it stands to reason that diseases are able to be detected earlier before there are any significant anatomical changes that can be detected on conventional scans.

To put it in simpler terms, consultant nuclear medicine physician at Subang Jaya Medical Centre (SJMC) Dr Yogendren Letchumanasamy says, "The difference between a PET/CT and a traditional CT scan is that a traditional CT scan can only show you the form of the abnormalities. It can neither tell you the function nor the aggressiveness of the abnormalities. However, with a PET/CT, you can determine the form and the function of the abnormal cells, thus allowing doctors to come up with a better course of treatment."

Dr Dharmendra Harichandra.

Dr Yogendren Letchumanasamy.

Dr Yogendren continues to explain that earlier treatment means improving the chances of patient recovery and survival. For a cancer patient, the treatment response to a particular regime can be assessed earlier to determine the effectiveness of the treatment, allowing oncologists to modify the treatment earlier and thus improving the overall outcome for the patient.

Precise treatment can save lives

Nuclear medicine is now in the era of precision medicine where treatments are tailored according to the patient's cancer and condition. Another consultant nuclear medicine physician at SJMC Dr Dharmendra Harichandra says, "Nuclear medicine technology allows not only the early detection of cancer and the extent of the cancer in a person, but it allows for a continuous assessment of the patient's response to a particular treatment regimen."

He explains the practice of using a standardised treatment plan for all patients of a particular cancer is slowly dying out. In the future, every patient's treatment will be tailored specifically to each case, with nuclear medicine scans playing an important role in fulfilling this objective.

Besides this, nuclear medicine allows for a semiquantitative analysis of the disease state, and this allows for a more precise and objective evaluation of the disease and the treatment response. For instance, prior to treatment, a tumour will pick up FDG, a radioactive glucose according to its metabolic activity. The more active the tumour is, the higher the glucose uptake. This glucose avid disease focus has a greater potential to grow and spread. This activity can be measured on the PET CT scan.

After the course of treatment, the cancer can be evaluated again. A drop in the glucose uptake or complete resolution of the metabolic activity indicates the treatment is effective and can be continued to kill the cancer cells.

> ***"While cancer is the main workload for nuclear medicine, there is a growing role for nuclear medicine in non-oncologic conditions such as epilepsy, dementia and other neurological conditions"***

Future expectations in the advancement of nuclear medicine in Malaysia

Both doctors express that part of their future expectations has been fulfilled with the acquisition of the Digital PET/CT scanner. Dr Dharmendra says, "A digital PET/CT scanner allows for faster scans, reduces dosage radioisotopes use and improves lesion detection compared to the older analogue PET/CT scanners. This allows for more patient comfort as the scanning time is effectively halved. The reduced dose of radioisotopes reduces radiation exposure to the patient and improved lesion detection allows for a more precise diagnosis. All these features will also ultimately reduce the cost for the patient."

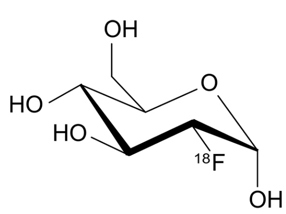
While cancer is the main workload for nuclear medicine, there is a growing role for nuclear medicine in non-oncologic conditions. A particular field that both doctors agree they would like to see nuclear medicine grow is in the field of neurology, with the management of epilepsy, dementia and other neurological conditions.

■ For more information, call 03-5639 1212/1818.

What are radiopharmaceuticals?

Radiopharmaceuticals or radiotracers, as defined by National Cancer Institute, is a drug that contains a radioactive substance and is used to diagnose or treat diseases including cancer. It is also called a radioactive drug. By using radiopharmaceuticals during a PET CT scan, the physician is able to separate regular cells from the active tumour.

FDG: Fluorodeoxyglucose



F18 is a radiotracer used to detect glucose accumulation in the cells with increased metabolism. Glucose accumulation is a tell-tale sign of abnormal and possibly cancerous cells as cancer cells tend to consume glucose at a faster rate.

Ga 68 PSMA: Prostate-specific membrane antigen or PSMA is a unique cell surface marker expressed by almost all prostate cancers. When PSMA is used with Gallium Ga 68 (a form of radioisotope) and is injected into the body, this radiotracer will attach itself to where the prostate cancer is located.

Ga 68 DOTATATE: Ga 68 DOTATATE is used to detect a neuroendocrine tumour in both adults and children. Tyrosine-3-octreotate (TATE) is a type of protein commonly found on the surface of neuroendocrine tumours. By binding this to the dodecane tetraacetic acid (DOTA) to become a somatostatin receptor, the radiotracer attaches itself to neuroendocrine tumour cells in the body.