

Editorial

Integrated Fusion Imaging Modalities: Single Photon Emission Computed Tomography /Computed Tomography (SPECT/CT) and Positron Emission Tomography/ Computed Tomography (PET/CT)

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PET/CT and SPECT/CT are integrated functional and morphological diagnostic imaging modalities. Acquisition of images during a functional study of PET and SPECT are fused with images acquired during a morphological CT study using an integrated protocol resulting in highly improved image resolution. This facilitates improvements in diagnostic accuracy thus eliminating the need for prolonged hospital stay or repeated visits by patients.

At microscopic level, during a pathological event, functional abnormality often precedes time consuming morphological changes. Therefore, hypothetically at imaging, demonstration of functional abnormality is evident earlier using both techniques even without morphological changes taking place. Concurrent anatomical abnormalities detectable with increased metabolic activity are almost always an indication for ongoing pathological processes during SPECT and PET/CT acquisition.

Both techniques are widely utilised in oncology depending on imaging characteristics. In general, both protocols are found very useful if the tumours show avidity to FDG or gamma isotopes.^[1-3] The basis of these integrated techniques in clinical imaging is utilised to assess the nature of primary tumours and demonstration of metastases for surveillance after therapy. Both non-invasive techniques have the ability to evaluate the whole body in one single seating. This is one of the advantages over any other conventional imaging techniques. In the management of tumours having bony involvement like leukemia, their potential in detecting medullary and extra-medullary extensions make them important tools in predicting prognosis and outcome.^[4- 10]

Although both are found to be very useful in guiding clinicians to better management of oncology patients, interpretation of results from the techniques must be done with caution as high metabolic activities are not exclusively confined to malignant lesions.^[11] Bacterial and parasitic infections like toxoplasmosis have been reported to demonstrate high uptake at imaging using PET/CT and SPECT/CT.^[12] These modalities have also been reported to be useful in differentiating the aetiology of cerebral mass lesions in AIDS patients. In such conditions, cerebral lymphoma and toxoplasmosis are common complications. The latter is an important contributor towards high mortality and morbidity when treatment is delayed. Both techniques have been proven to increase the diagnostic accuracy to 85%.^[13-16] Other than infection, physiological and inflammatory conditions like sterile arteritis also demonstrate increase in FDG uptake due to high metabolic activities.

Knowledge of this non-malignant uptake is vital for physicians to avoid false positive interpretation in the imaging results.^[17-19]

Medical imaging is also known to play a leading role in the intervention programme of coronary artery diseases (CAD). This is accomplished by early detection and evaluation of signs for atherosclerosis through imaging of cardiac coronary circulation.^[20] Recent technology advancements tend to provide greater clinical clarity over anatomical imaging modalities like CT and MRI for better patient management which has resulted in the growing utilisation of SPECT and PET in coronary artery imaging. By allowing direct fusion of morphologic and functional information in PET/CT and SPECT/CT, diagnosis can be achieved with high diagnostic confidence.^[21] Of late, these techniques have been found to be valuable tools in stratifying patients with different grading in risk for developing myocardial infarction even when coronary arteries are found to be normal at cross-sectional morphological imaging using conventional imaging methods.^[22] High spatial resolution of fused coronary PET/CT images have also been reported to have enabled smaller perfusion defects to be visualised with significant improvement in sensitivity, specificity and accuracy. However, tracer production for PET imaging remains the major drawback factor limiting wide multi-centric utilisation of this modality. Lack of large multi-centre trials of these modalities deny justification for wider and routine use, hence, they are unlikely to replace SPECT in the management of CAD patients.^[23] Recent developments have witnessed research activities in clinical cardiology focussing on the potential of PET/CT in the field of molecular imaging in inflammation, vulnerable plaques, gene and stem cell therapies.^[24-26]

Apart from imaging oncology, infection and cardiology, SPECT and PET protocols have been repeatedly utilised in the study of schizophrenia starting from late 1980s. To date, multiple studies have been carried out using these functional imaging tools in search of a better understanding of the patho-physiology of schizophrenia.^[27,28] PET and SPECT enable researchers to measure the regional cerebral blood flow to the brain.^[28,29] However, the use of brain SPECT imaging as a diagnostic tool in psychiatry is extremely controversial. The patterns of cerebral SPECT uptake on 99m-Tc HMPAO scintigraphy of schizophrenic patients are not specific and merely a suggestion of disturbed circulation to the affected area of the brain.^[30,31] On the other hand, PET imaging had been utilised more comprehensively to demonstrate the role of Dopamine D1, D2 and serotonin 5HT₂ receptors in schizophrenia using F-FDG and F-DOPA.^[32] Apart from 18-Fluorine, short lived isotopes like 11-Carbon has also been utilised. Considering the fact that brain imaging using PET in schizophrenia almost persistently gives an inconstant finding, they are therefore unsuitable for a major role in diagnosis or treatment. In the near future, the role of integrated PET/CT and PET/MR in demonstrating concurrent abnormalities to the receptor binding sites and anatomical disturbances at imaging should be looked into. Much of these integrated imaging modalities will be expected to contribute most in the research for drug development. This should be the frontier in the goal for improving the outcome in the management of this devastating illness.

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