New PET Tracers in Oncology

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Positron emission tomography with computed tomography (PET/CT) is being increasingly utilized in diagnostic nuclear oncology for the evaluation of patients with known or suspected cancer disease in diagnosis, staging and therapy monitoring. The majority of PET/(CT) investigations are performed by using [^{18}F]-fluorodeoxyglucose ([18F]-FDG), the glucose analogue, the marker of glycolytic activity. Although [^{18}F]-FDG, with its high sensitivity and specificity for the assessment of the presence and extent of the disease, is probably the molecule of the century, it shows poor sensitivity for well-differentiated tumours with low metabolic activity and slow progression such as neuroendocrine tumours (NETs)[1] and prostate cancer (PCa).

The majority of well differentiated NETs overexpress somatostatin receptors (SSTR). In nuclear oncology receptor targeting with radiolabeled peptides has gain an important role. SSTR imaging constitute the backbone of nuclear imaging in NET. For many years SSTR imaging was performed with gamma camera technique (using ^{111}In-DTPA-octreotide). Within last few years, when several [^{68}Ga]-labeled somatostatin receptor ligands have been introduced, it increasingly moved towards PET. [^{68}Ga]-DOTATOC, [^{68}Ga]-DOTATATE and [^{68}Ga]-DOTANOC are most commonly used [^{68}Ga]-labeled tracers in diagnosis, staging and restaging of NETs[2]. [^{68}Ga] can be obtained from generator, so there is no need for having cyclotron on site.

^{18}F-DOPA, a dopamine precursor and PET tracer is taken up by NET cells by L-type large neutral amino acid transport system and metabolized into dopamine. With the PET-based, 68Ga-labelled tracers, it is not obvious that ^{18}F-DOPA adds to imaging of NETs, since the studies show much higher sensitivity for the three ^{68}Ga-labelled somatostatin analogues[3]. [^{18}F]-FDG can be used when SSTR imaging is negative, in highly proliferating NETs.

PCa is the most common type of cancer in men worldwide. At present, imaging of PCa is indicated for diagnosis, staging, restaging and for the detection of recurrent disease. Large fraction of PCa is not amenable for ^{18}F-FDG imaging as the neoplasm is well-differentiated. ^{11}C or ^{18}F radiolabeled choline represents more suitable alternative and is currently used in clinics as PET tracer for staging and restaging of PCa. While choline-based PET/CT can be used for the evaluation of high-risk patients with high prostate specific antigen (PSA) levels and Gleason scores, it has limited sensitivity at low PSA levels.

The prostate-specific membrane antigen (PSMA) is overexpressed in most local PCa lesions, cancerous lymph nodes and bone metastases. Several studies indicate that [^{68}Ga]-HBED-CC-PSMA, PSMA inhibitor, is superior in tumour lesion detection as compared to [^{1}8F]-flourocholine[4].

In direct comparison, the radiopharmaceutical was shown to be superior to [^{18}F]-fluorocholine, especially at low PSA levels. Among the clinically tested PSMA inhibitors [^{18}F]-DCFPyL represents another promising tracer for PET imaging of PCa patients[5].

Although ^{18}F-FDG has the merit for the rapid development of PET there are new PET-based radiopharmaceuticals filling the gaps in patient management in nuclear oncology.

References

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