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Editorial

Can Choline PET Tackle the Challenge of Imaging Prostate Cancer?

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Abstract

Positron emission tompography with radiolabeled (with 11C- or 18F-) choline has received much attention, particularly in Europe and Japan, over the past several years. While monitoring cellular membrane lipogenesis with radiolabeled choline is nonspecific for cancer, the malignancy-induced increased demand for cellular membrane synthesis can be a useful feature for imaging-based diagnosis and treatment evaluation. Many choline PET(/CT) studies have focused on prostate cancer given that 18F-flurodeoxyglucose appears to be primarily useful in progressive metastatic disease and is overall limited in the initial staging of disease or for evaluation of men with biochemical recurrence. The current evidence suggests that choline PET(/CT), particularly the 18F- label, may become routinely available, initially in many European countries, for the clinical imaging evaluation of men with prostate cancer.

Key words: Prostate, Cancer, PET, Choline

Prostate cancer is a growing public health problem. Accurate imaging evaluation of this clinically heterogeneous disease can pave the way for more optimal care of men with prostate cancer which may include a spectrum from active surveillance to active treatment. Evidence derived from imaging studies over the past many years suggest that use of different imaging modalities may need to be aligned with the clinical phase of the disease.

There has been a plethora of research activity in recent years toward development of multimodality imaging techniques that can provide non-invasive interrogation of the complex biology of prostate cancer. These efforts have been fueled by continuous advances in our fundamental understanding of the pathophysiology of prostate cancer and the many currently unmet clinical needs that have been partly brought forward into spotlight because of new therapeutic approaches that are becoming rapidly available for castration-resistant prostate cancer. In order to be able to compare the available therapeutic options, there is an urgent need for objective assessment of disease status to guide appropriate treatment with anticipated higher success rate and to be able to evaluate response to treatment accurately. This strategy also needs to be aligned with the paradigm shift in cancer therapy that calls for continuation of therapy as long as the disease manifestations are controlled and/or new manifestations are prevented or delayed (1).

Positron emission tomography (PET) combined with computed tomography (CT) or with magnetic resonance imaging (MRI) can provide powerful hybrid anatomic and functional imaging evaluation of prostate cancer. CT provides means for attenuation correction of PET emission data and for precise local-

ization of findings on PET. Multiparametric MRI including techniques such as diffusion-weighted imaging (DWI), dynamic contrast enhancement (DCE) and magnetic resonance spectrospcopy (MRS) are now being actively investigated in prostate cancer (2). Imaging evaluation of prostate cancer may in fact develop into an appropriate indication for the recently developed integarted PET/MRI imaging systems (3).

The power of PET is its ability to provide biodistribution map of the biologically relevant radiotracers. In case of prostate cancer, many candidate radiotracers have been designed and evaluated in the pre-clinical and pilot clinical arenas. These tracers include those that interrogate glucose metabolism, fatty acid metabolism, amino acid metabolism, salvage pathway of DNA synthesis, hypoxia, angiogenesis, receptors (e.g. androgen receptor, gastrin releasing peptide receptor), prostate-specific membrane antigen, prostate stem cell antigen, as well as reporter gene-reporter probe techniques (4). While much more work needs to be done for deciphering the exact comparative utility of these tracers in specific clinical phases of prostate cancer, it is fairly clear that PET will play a major role in the imaging evaluation of prostate cancer.

There has been considerable interest in the potential diagnostic utility of PET with radiolabeled (11C- or 18F-) choline in prostate cancer (5). The biologic basis for radiolabeled choline uptake in tumors is the malignancy-induced upregulation of choline kinase, which leads to the incorporation and trapping of choline in the form of phosphatidylcholine in the tumor cell membrane. The investigations on radiolabeled choline in this arena have been most intense in the Europe and Japan. Recently these investigations have reached a perceived critical mass that consensus guideline articles have been published (6). In this issue of Theranostics, two European groups of investigators with substantial experience with choline PET in the imaging evaluation of prostate cancer summarize their findings as well as those of others in the initial diagnosis and staging of prostate cancer and also in men with biochemical recurrence of prostate cancer (7, 8). Based on these summaries, it is expected that choline PET will, at least initially, play a significant role in the imaging evaluation of men with biochemical failure after definitive treatment for primary prostate cancer. Exciting work remains ahead to determine the exact role of choline and other promising PET radiotracers in prostate cancer.

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