



Is there the role of ^{18}F -Choline PET/CT in prostate cancer patients?

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SUMMARY

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Prostate cancer is the ninth-most-common cancer in the world and the most common life-threatening cancer affecting men in the western countries. More than 80% of men will develop prostate cancer by the age of 80. Physiologically, choline is a component of cell membranes. It presents a high affinity for malignant prostate tissue. Choline, labeled with ^{11}C or ^{18}F is the essential part of most sensitive nuclear medicine procedure for imaging of spread of prostate cancer today. ^{11}C -choline is preferred due to lower urinary excretion and patient exposure. Due to shorter half-life time of ^{11}C (20 minutes), ^{18}F -choline (half-life time of 110 minutes) is more useful for possible distribution to centers lacking on-site cyclotron. The sensitivity of ^{18}F -choline PET/CT to detect prostate cancer preoperatively is 73%, greater than with 18F-FDG PET/CT (31%). Also, the accuracy is greater with ^{18}F -choline PET/CT (67%) than using ^{18}F -FDG PET/CT (53%). The major goal of pretherapeutic imaging with 18F-choline PET/CT is detection of loco-regional and distant metastases. The exact pretherapeutic diagnosis and staging are mandatory, because the tumor treatment must be selected in strict dependence on the clinical tumor stage and risk profile. In patients with biochemical relapse after the radical prostatectomy or radiotherapy of prostate cancer, ^{18}F -choline PET/CT represents a noninvasive, whole body study that allows disease localization. Detection sensitivity is negatively correlated with serum PSA concentration (ng/ml) and positively correlated with Gleason score. ^{18}F -choline PET/CT is becoming the essential imaging modality in patients with prostate cancer to demonstrate spread of the disease preoperatively and to detect local and distant recurrent disease after radical prostatectomy or radiotherapy.

Key words: Prostatic Neoplasms; Positron-Emission Tomography and Computed Tomography; Choline; Diagnostic Imaging; Neoplasm Recurrence, Local; Prostate-Specific Antigen

Prostate carcinoma is the most common life-threatening cancer affecting men in the Western world. It tends to develop in men over the age of 50 and it is diagnosed in 80% of men who reach age of 80.

^{18}F -FDG PET/CT is nuclear medicine procedure currently most widely used to diagnose primary and metastatic cancers. Unfortunately not all tumors show significant increase of metabolic activity on ^{18}F -FDG PET/CT imaging. This is particularly true for prostate cancer, neuroendocrine tumors and hepatic tumors.

As a component of cell membrane phospholipids, choline is an excellent biomarker for the malignant transformation and increased proliferation of cells.

Choline can be radiolabeled with either ^{11}C or ^{18}F . ^{11}C -Choline has the preference due to lower urinary excretion and patient's exposure, ^{18}F -Choline is more useful for possible distribution to centers lacking in on-site cyclotron. Use of ^{18}F -FDG in prostate cancer is limited to the most aggressive cancers (1).

PATIENT PREPARATION AND ^{18}F -FCH PET/CT ACQUISITION PROTOCOLS

Patients should fast 6-10 hours prior the scan and should drink at least 2 litres of liquid. Up to date, no standardized ^{18}F -FCH PET/CT acquisition protocol has been established for imaging of patients with prostate cancer disease.

Most of the nuclear medicine departments inject 200–300 MBq (app. 2.5 MBq/kg) of ^{18}F -Choline, according to the weight of the patient. Patients rest for approximately one hour and whole body acquisition is performed thereafter, two minutes per bed position on a PET/CT scanner. Late imag-

ing is usually incorporated with early (dynamic) imaging, to avoid interference from bladder accumulation. Early and late whole body images are presented in the usual transaxial, coronal and sagittal planes. Accurate knowledge of the physiologic distribution of ^{18}F -Choline is essential for the correct interpretation of PET/CT imaging.

INDICATIONS FOR ^{18}F -CHOLINE PET/CT

Indications for ^{18}F -Choline PET/CT in evaluation of patients with prostate cancer disease cover a wide spectrum of clinical settings: localization of intraprostatic neoplastic lesions (if PSA level is elevated and multiple biopsies are negative), initial staging, detection of occult recurrences and treatment monitoring in patients with prostate cancer disease.

PRETHERAPEUTIC IMAGING

In 25% of patients with persistent elevated PSA and repeated negative prostate biopsies, ^{18}F -Choline PET/CT allowed the identification of neoplastic prostatic zones (2) (Figure 1).

The major goals of pretherapeutic imaging are to determine the local extent of prostate carcinoma in terms of intraprostatic localization, extracapsular extension, seminal vesicle invasion and detection of loco-regional and distant lymph nodes/bones metastases (Figure 2). Exact pretherapeutic diagnosis and staging are essential, because the tumour treatment must be selected in strict dependence on clinical tumour stage and risk profile (3). Although the role of ^{18}F -Choline PET/CT is still a matter of debate, it is highly efficient in preoperative management once metastatic disease is strongly suspected or documented (4).

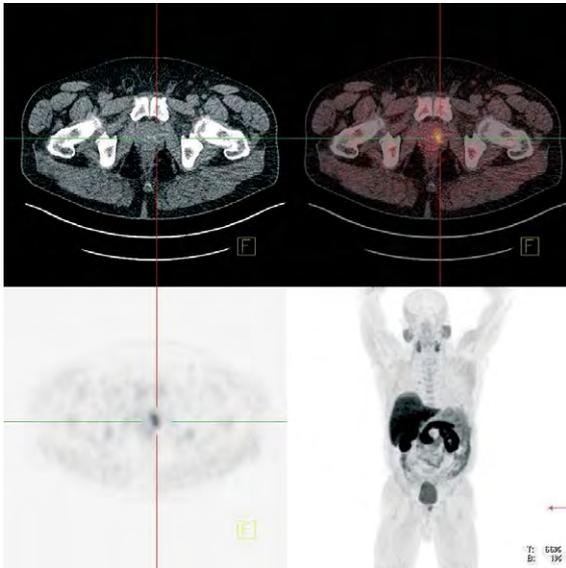


Figure 1. Pathological ^{18}F -Choline uptake in left lobe of prostate due to prostate cancer

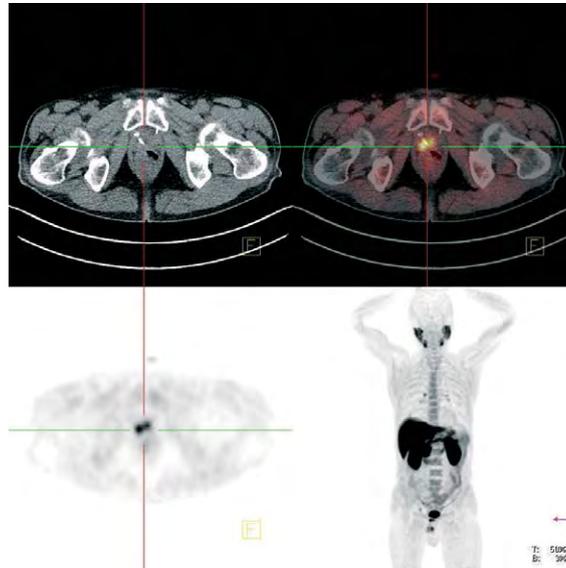


Figure 3. ^{18}F -Choline uptake in prostatic bed due to local recurrence

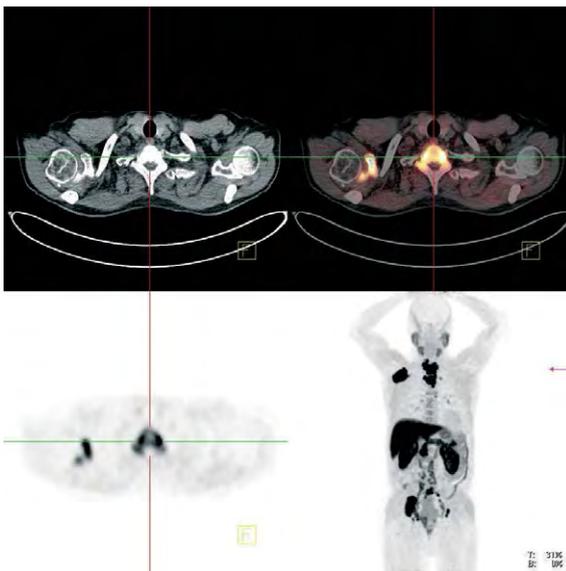


Figure 2. Multiple regions of ^{18}F -Choline uptake in axial skeleton and paraaortic as well as iliac lymph nodes

POSTTHERAPEUTIC IMAGING

15-23% of patients with carcinoma of the prostate undergoing therapeutic procedures will ultimately relapse. 50% of relapsing patients will have local recurrence and 50% will have systemic disease with or without local recurrence. Therefore, localization of recurrent prostate cancer is critical for selecting a local or systemic therapeutic strategy. Imaging with ^{18}F -Choline PET/CT possesses a high potential for early localization of recurrent prostate carcinoma (5) (Figure 3). ^{18}F -Choline PET/CT represents a single step, whole-body, noninvasive study that allows recurrent disease detection and localization. Detection sensitivity is probably negatively correlated with serum PSA concentration. Doubling time of serum PSA increase is more important as PSA level itself.

In patients with antiandrogen treatment conventional imaging modalities very often do not show any morphological changes. In these patients ^{18}F -Choline PET/CT has potential role to demonstrate metabolic response to antiandrogen therapy.

In all of these indications this modality seems to be of high priority.

Conflict of interest

We declare no conflicts of interest.

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