Combined PET/CT with Iodine-124 in Diagnosis of Mediastinal Micrometastases in Thyroid Carcinoma

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Citation

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Abstract

Iodine-124 PET is an useful 3-dimensional imaging technique for diagnosis and management of thyroid diseases. The difficulty in interpretation of the PET scans with highly selective tracers like iodine-124, is the lack of identifiable anatomical structures, so an accurate anatomical localization of foci presenting abnormal uptake is problematic. Consequently, a combined PET/CT scanner can resolve these difficulties by co-registering PET and CT data in a single session allowing a correlation of functional and morphologic imaging.

A case is presented where iodine-124 produced by a clinical cyclotron was used with a combined PET/CT scanner for clinical staging of a patient with thyroid carcinoma.

BRIEF REPORT

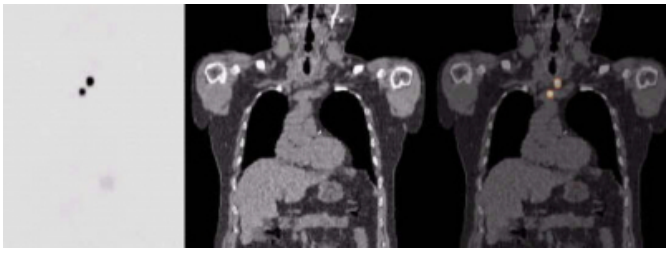
A 54-year-old male with a history of an well differentiated (G1) follicular thyroid carcinoma (1cm in diameter penetration of the thyroid capsule; pT4 pN0 MX) was referred to the Department of Nuclear Medicine for radioiodine therapy. The medical history was inconspicuous. The physical examination showed a patient in good general condition. On admission time the following pathologic laboratory values were seen: Thyreoglobulin: 1.8 ng/ml, recovery test: 68%, thyroid stimulating hormone: 68 mU/l, fT3 <2.9 ng/ml and fT4 2.8 ng/ml. Cervical ultrasonography showed no pathological structures. Prior to further treatment, an accurate staging was desired.

IODINE-124 PET/CT

24 hours after the oral administration of 85 MBq of the positron-emitting radionuclide [iodine-124]-sodium-iodide [1] images on a combined PET/CT system were acquired (biograph, Siemens Medical Solutions Erlangen, Germany manufactured by CPS, Knoxville, USA). Projections from head to pelvis were obtained. The biograph consists of a single slice spiral CT (Somaton Emotion) and a dedicated full-ring PET scanner (ECAT HR+). The CT data are also used for PET attenuation correction in a 3D mode [2,3]. The PET scan alone showed pathologically increased tracer uptake in two cervically or mediastinal foci (Fig. 1, left).

Figure 1

Fig. 1: Iodine-PET (left), CT (middle), and fused image of fully co-registrated PET and CT (right) acquired 24h after oral administration of 85 MBq of the positron-emitting radionuclide [iodine-124] sodium iodide showing pathologic tracer uptake mediastinally



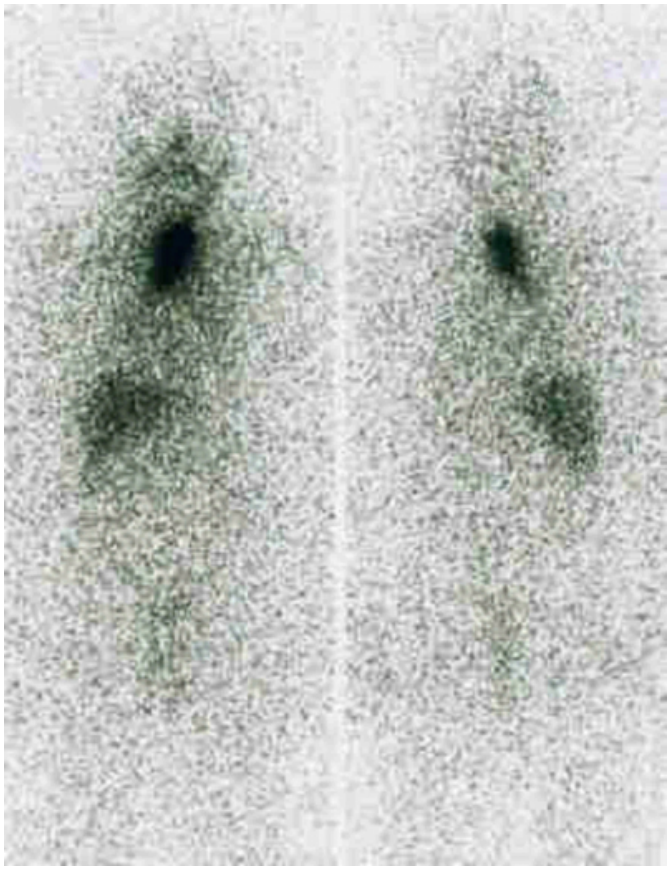
An accurate anatomical localization of these foci was not completely possible as the tracer is highly specific. The CT scan alone showed no pathology. Image fusion of PET and the co-registrated CT enabled to attribute the pathological tracer uptake to an area close to the aorta representing mediastinal micrometastases.

IODINE-131 SCAN

Iodine-131 Scan; Eight days after the oral administration of the therapeutic dose of 3,000 MBq Iodine-131 a whole body scan was acquired (Bodyscan, Siemens Erlangen, Germany) using a high energy collimator. Pathological tracer uptake was documented cervically and mediastinally

Figure 2

Fig. 2: Whole body scan eight days after the oral administration of 3,000 MBq Iodine-131 showing mediastinal metastases



DISCUSSION

Patients with well-differentiated thyroid cancer (WDTC) regularly have an excellent prognosis. However, staging is crucial for appropriate surgical treatment, radioiodine therapy, and, in advanced disease, external beam radiotherapy [4]. Besides whole-body iodine-131 scintigraphy, ultrasonography, fluorine-18 fluordeoxyglucose Positron Emission Tomography (FDG-PET) is an established diagnostic tool in the follow-up of thyreoidectomized patients with WDTC [4,5,6,7,8]. Another positron emitter suitable for PET imaging is iodine-124 with a half-life of 4.2 days. It has not been widely used because of a complex decay scheme including several high energy gamma rays [1, 9,10,11,12]. This 3-dimensional imaging technique has been shown to be an useful imaging technique for diagnosis and management of thyroid diseases [11]. However, the difficulty in interpretation of the PET scans with highly selective tracers like iodine-124, is the lack of identifiable anatomical structures [2]. The low anatomical resolution of the presented PET scan is insufficient for an accurate anatomical localization of foci with abnormal uptake (Fig. 1, right). In our case, the use of a combined PET/CT system provided accurately fused PET and CT images in a single session [2-3]. Fused images revealed mediastinal micrometastases of the thyroid carcinoma. Accurate metabolical and anatomical staging was therefore accomplished. Compared to iodine-131 whole body scan, iodine-124 PET/CT has shown to be superior in exact localisation of metastases.

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