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Original Article

Role of positron emission tomography computed tomography in screening metastasis of renal cell carcinoma

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ABSTRACT

Purpose: To demonstrate role of PET-CT (positron emission tomography-computed tomography) in screening for local and distant metastatic deposits from primary renal cell carcinoma and enhancing its advantages over other imaging modalities.

Materials and methods: Twenty patients were evaluated as post nephrectomy screening for renal malignancy. Positive cases were interpreted whenever a focal area of FDG uptake more than the surrounding tissue whether in or outside abdominal cavity. Final diagnosis after correlation with other conventional radiological modalities as CT, MRI with the gold standard was histopathological diagnosis.

Results: In current study, there were different sites of distant metastasis of renal cell carcinoma as follow: lung was the commonest (8 patients = 40%), followed with bones (7 patients = 35%), lymph nodes (6 patients = 30%), liver (4 patients = 20%), suprarenal gland (4 patients = 20%) and last were peritoneal deposits (2 patients = 10%).

Conclusion: PET-CT had limitations in evaluating RCC metastasis due to its inability for adequate characterization of small metastatic lesions, however positive PET-CT results as a good predictive for evaluating metastatic deposits. PET-CT acts mainly as a complementary anatomy-based imaging modality and hence it may decrease or exclude the need for biopsy in some situations.

1. Introduction

Renal cell carcinoma (RCC) comprising 3% of whole malignancies in adults and constitutes more than 90% of kidney malignancies [1]. RCC occurs predominantly in 6th to 8th decades of life with male: female ratio is 1.5:1 [2]. According to WHO (world health organization) classification 2004 that included four subtypes (mainly divided as clear and non clear cell carcinoma) including clear cell (commonest one), papillary, chromophobe and the last is medullary carcinoma [3].

Staging is the most important factor in determining the outcome of RCC as it defines the anatomic extent of disease and thus influencing the choice of therapy. Contrast enhanced computed tomography (CECT) is the most accurate corner stone tool for pre-operative staging using TNM 2009 staging system. Two main systems used to assess the risk of progression of localized tumor namely stage, size, grade and necrosis (SSIGN) score [4], and University of Los Angeles integrated Staging System (UISS) [5] (see Figs. 1–6).

Several factors affect patient prognosis such as size of the tumor, degree of infiltration, distant metastasis, histopathological type, as well as nuclear grading [6]. While in post radical nephrectomy in stage I RCC; 5-year survival rate is more than 90%, on the other hand, stage II lesions having survival rate of less than 80% [7].

Documented common sites for metastasis from primary RCC are the lungs (75%) followed with regional lymph adenopathy (65%), bone (40%), liver (40%) and brain (5%). In 20–50% of localized RCC patients presented with post surgery relapse [8].

18F-fluorodeoxyglucose (FDG) is a glucose analog that gives important data about the glucose metabolism within either normal or abnormal tissues; it preferred to accumulate more in malignant cells compared with non-malignant cells [9]. FDG PET (positron emission tomography) alone is hindered by lack of anatomical and morphological information due to low resolution [10]. So fusion of PET and CT images while patient at same position provides coupling of high anatomical and functional information for lesions in an informative single session [11].

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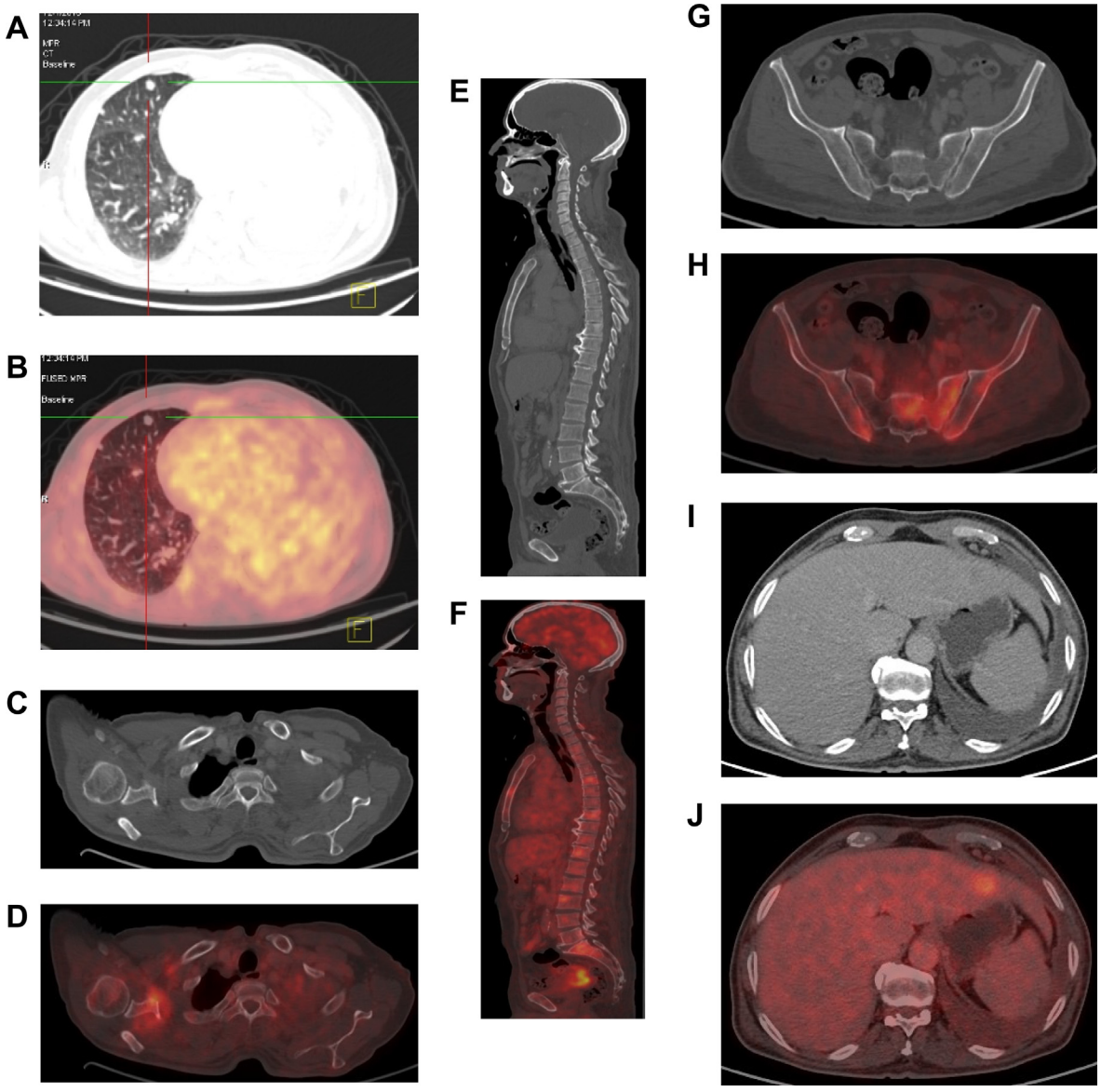

Fig. 1. 65 years male with pathologically proved right RCC underwent right radical nephrectomy with adjuvant chemotherapy and referred to PET –CT for FU. (a, b) Axial CECT and corresponding PET/CT images lung window showed left lung apex totally replaced by metastatic mass infiltrating the left pleural surfaces of heterogeneous FDG uptake, SUVmax up to 7, the mass is seen inseparable from left hilum, mediastinum and pericardium with multiple right pulmonary deposits. (c, d) CT and corresponding PET/CT bone window images showed FDG over-metabolism at the right scapula with SUVmax 5.6 while axial bone window CT showed no appreciable abnormality. (e, f) Sagittal CT and PET CT bone window image showed FDG uptake in DV6 (SUVmax 5.3), DV9 (SUVmax 4.8), DV12 (SUVmax 5.9), LV3 (SUVmax 6.2) and sacrum (SUVmax 6.5) and sagittal CECT showed no appreciable changes. (g, h) Axial CECT and corresponding PET/CT images showed FDG uptake in both iliac bones (SUVmax 5.2 and 6.1 respectively) with no anatomical changes at CECT. (i, j) Axial CECT and corresponding PET/CT images showed 2 cm hepatic deposit segment II (SUVmax 5.8).

As PET/CT is applied in assessment and staging of primary RCC, still it has not greatly improving detection of primary lesions due to less sensitivity and specificity compared with data supplied with contrast enhanced CT [12].

Other factor attributed to the excretion of FDG through the urinary tract with variable FDG uptake by RCC. However, it can give help in restaging and in detection of metastatic sites [13,14].

PET/CT is particularly helpful in assessing local recurrence, bony and nodal metastasis where the later could demonstrate false negative results when applying CT size criteria only [15].

2. Methods

The current prospective study included 20 patients that were studied along time interval from May 2015 to April 2016, with pathologically proved diagnosis of renal cell carcinoma. All patients subjected to full history taking, relevant laboratory tests, initial screening imaging modalities as ultrasound or contrast enhanced computed tomography followed with PET/CT. Data were obtained using Siemens Bio-graph true point PET/CT scanner using MDCT 164 slices. These integrated system of both PET with MDCT scanners allowing acquisition of co-registered CT and PET images in single session. The study subjected to the rules of ethics committee and informed consent was obtained from every patient after informing patient about the indications, steps and remote complications of the technique.

2.1. Imaging protocol

2.1.1. Patient preparation

Before scanning, patients being fasting for six hours, all metallic items were removed and patients were given gowns to wear.