Role of fluorine-18 fluorodeoxyglucose positron emission tomography in a case of renal cell carcinoma to differentiate tumor thrombus from bland thrombus

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ABSTRACT

Tumor thrombus is a rare complication of many solid tumors. We present a case of renal cell carcinoma whose baseline contrast-enhanced computerized tomography (CT) revealed an heterogeneously enhancing mass in the upper half of right kidney with tumor thrombus in the right renal vein extending to suprarenal inferior vena cava (IVC), crossing the cavoatrial junction and reaching up to the right atrium (Grade IV). Fluorine-18 fluorodeoxyglucose (18F-FDG) positron emission tomography (PET)/CT imaging revealed large irregular right renal mass, hypermetabolic tumor thrombus extending from the right renal vein to suprarenal IVC reaching up to the right atrium. There was no FDG uptake noted in the infrarenal IVC and bilateral iliofemoral venous thrombi. Thus, 18F-FDG PET/CT was not only helpful in the staging, but was also helpful in differentiating tumor thrombus from bland thrombus in our patient.

Keywords: 18F-fluorodeoxyglucose positron emission tomography/computerized tomography, bland thrombus, renal cell carcinoma, tumor thrombus

A 61-year-old male patient presented with below knee swelling in lower limbs, weakness and right sided hydrocele since 1 month. Ultrasonography of kidney-urinary bladder revealed 6.3 cm × 10.3 cm × 6.3 cm sized irregular heterogenous lesion arising from upper pole of right kidney, having few echogenic areas within, with increased internal vascularity and not causing any pressure effect. Later computerized tomography (CT) abdomen showed 10 cm × 7 cm × 6 cm heterogeneously enhancing mass with areas of necrosis and foci of calcification in the upper half of right kidney with tumor thrombus in the right renal vein and suprarenal inferior vena cava (IVC), crossing the cavoatrial junction, reaching up to the right atrium (Grade IV) [Figure 2a]. The suprarenal IVC thrombus shows similar enhancement on the renal mass [Figure 2a]. The thrombosis of the infrarenal IVC and bilateral iliofemoral veins is observed, this thrombus is not enhancing like tumor thrombus [Figure 2a].

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F-18 fluorodeoxyglucose (18F-FDG) positron emission tomography (PET)/CT was done after ensuring at least 6 h fasting and blood glucose levels <150 mg/dl prior to intravenous injection of 259 MBq of radiotracer. Data acquisitions by an integrated PET/CT system (Philips GEMINI TF, 16 slice CT) were performed within 60 min after the injection. Data acquisition was performed as follows: CT scanning was performed first, from skull base to proximal thighs, with 120 kV, 50 mA, a tube rotation time of 5 mm section thickness, which was matched to the PET section thickness. Immediately after CT scanning, a PET emission scan that covered an identical transverse field of view was obtained. Acquisition time was 1 min per table position. PET image data sets were reconstructed iteratively by applying the CT data for attenuation correction, and co-registered images were interpreted. 18F-FDG PET/CT was performed for

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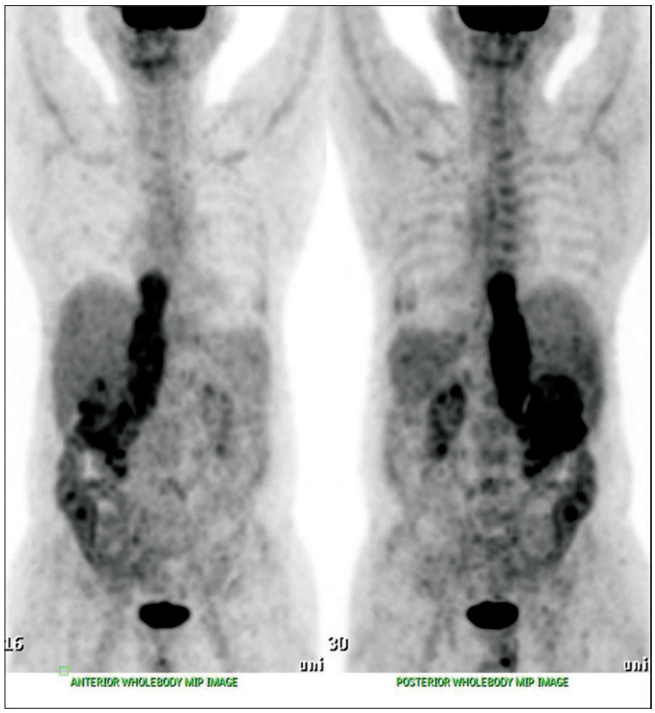

Figure 1: Whole body positron emission tomography maximum intensity projection anterior and posterior images showed increased fluorodeoxyglucose (FDG) uptake in the right renal mass and Grade IV tumor thrombus involving the right renal vein, entire suprarenal inferior vena cava (IVC) upto the right atrium, consistent with a tumor thrombus with no FDG uptake in the infrarenal IVC and iliac vein thrombi

whole-body tumor staging. Scan revealed FDG avid enlarged right renal mass, hypermetabolic thrombi involving the right renal vein, entire suprarenal IVC up to the right atrium, consistent with the malignant nature [Figures 1, 2c, 3a and b]. This finding was considered to favor the diagnosis of tumor thrombosis over venous blood thrombosis. There was no FDG uptake noted in the infrarenal IVC and bilateral iliofemoral venous thrombi [Figures 1, 2c and 3c]. This finding was considered to favor the diagnosis of venous blood thrombosis and not tumor thrombus. No other focus of abnormal focal FDG uptake noted in the rest of the whole body scan.

Tumor thrombus is a rare complication of many solid tumors including renal cell carcinoma (RCC), testicular tumor, adrenal cortical carcinoma, osteosarcoma,[1] Ewing's sarcoma etc., Adrenocortical carcinoma can cause venous tumor thrombosis in the IVC, portal vein, and renal vein,[2] and extensive tumor thrombosis reaching the right atrium has been reported.[3] In our patient, contrast-enhanced CT showed extensive filling defects in the IVC. The tumor thrombus was extending from the primary RCC, indicating direct venous invasion from the tumor via a renal vein and subsequent extension in the venous

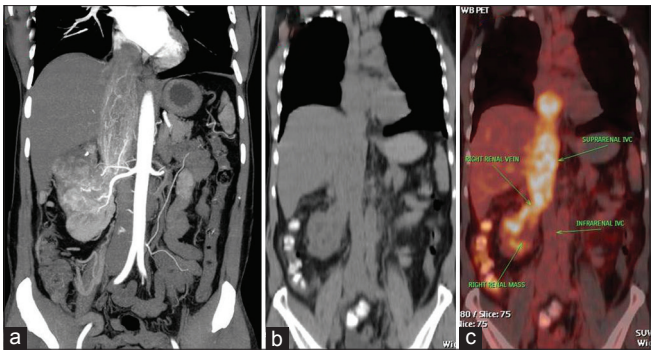

Figure 2: Coronal (a) contrast computerized tomography (CT) (b) noncontrast CT and (c) positron emission tomography-CT fusion images showed enhancing abnormal increased fluorodeoxyglucose (FDG) uptake in the right renal mass, in the right renal vein, entire suprarenal inferior vena cava (IVC) consistent with a tumor thrombus with no FDG uptake in nonenhancing the infrarenal IVC and iliac vein, that is bland thrombi

system suprarenal and infrarenal IVC. Although intense FDG uptake has been reported in a benign thrombus,[4] high FDG accumulation in a thrombus generally indicates a tumor thrombus.[4,5] Tumor thrombosis can cause blood thrombosis via insufficient circulation. The intense and extensive FDG uptake in this patient appeared to support the extensive growth of the tumor thrombus itself. Venous extension is optimally visualized during the corticomedullary phase of enhancement, when contrast enhancement of the renal vein is at its peak, as a low density-filling defect within the vein. Enhancement pattern of thrombi helps to distinguish tumor thrombi from bland ones.[6]

The diagnostic effect of PET is dependent on the abnormal uptake of 18-fluoro-2-deoxyglucose by the tumor tissues and its hypermetabolic thrombi with a sensitivity of 77–94% in RCC.[7] The drawbacks of PET in RCC include: (i) FDG is renally excreted without significant tubular reabsorption, (ii) Its ability to demonstrate modest FDG uptake in granulation tissues and inflammatory venous processes including catheter-induced thrombi and septic thrombophlebitis that may be misinterpreted as malignancy.[6,7] Recent studies reported the significance of using a combined PET/CT imaging system to gain the diagnostic benefits of both investigative techniques in anatomic localization and definition of RCC and the level and pathologic nature of any associated IVC thrombi, which may be equivalent to or more sensitive than magnetic resonance imaging.[7]

In summary, we report the imaging findings of a patient with RCC where PET/CT not only ruled out locoregional adenopathy and distant metastases, but also distinguished tumor thrombi from bland thrombi in the same patient.

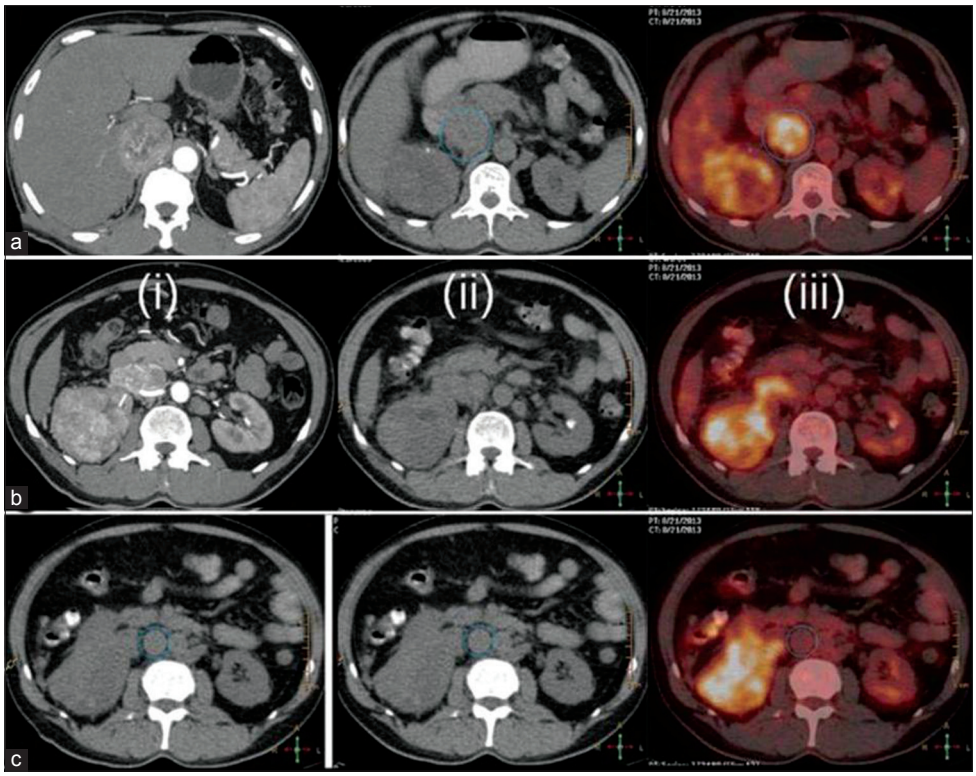

Figure 3: Transaxial (i) contrast computerized tomography (CT) (ii) noncontrast CT and (iii) positron emission tomography-CT fusion images: (a) Increased FDG uptake in the enhancing suprarenal inferior vena cava (IVC) thrombus, suggestive of tumor thrombus, (b) Abnormal increased fl uorodeoxyglucose (FDG) uptake in the enhancing right renal mass and in the right renal vein, (c) No FDG uptake in the nonenhancing infrarenal IVC thrombus, suggesting bland thrombus

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