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Research Article

Comparison of ^{18}F-FDG PET/CT and ceCT Results in the Assessment of RCC Recurrence

Abstract

Aim: To compare the results of fluorine-18 (^{18}F) fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) and contrast enhanced computed tomography (ceCT) in the assessment of renal cell carcinoma (RCC) recurrences when ceCT had suspected lesions for local recurrence and/or distant metastases.

Methods: A total of 22 patients (14 Male, 8 Female; mean age: 59±9 years) who were referred to perform ^{18}F-FDG PET/CT for restaging of RCC were included in this study. All patients had suspected lesions in thoracal and/or abdominal ceCT for local recurrence and/or distant metastases before PET/CT. A retrospective analysis of the ^{18}F-FDG PET/CT results was compared with ceCT results. The compatibility ratios were calculated and accuracy of the ^{18}F-FDG PET/CT was determined. Aggrement between ^{18}F-FDG PET/CT and ceCT was calculated using kappa statistics.

Results: The overall concordance rate between the two imaging modalities was 32% (7/22 patients). The rate of concordance for local recurrence was 86% (Kappa:0.67), and for distant metastases was 68% (Kappa:0.40). Distant metastases were also separately investigated and the two imaging methods showed a concordance of 86% (Kappa:0.70) for distant lymph node, 86% (Kappa:0.67) for lung, 91% (Kappa:0.64) for liver and 86% (Kappa:0.33) for bone and 95% for spleen.

Conclusion: ^{18}F-FDG PET/CT is not enough alone in the detection of local recurrence and distant metastases of RCC. On the other hand, evaluation of ^{18}F-FDG PET/CT and ceCT together significantly improves the detection of RCC recurrence. A negative ^{18}F-FDG PET/CT may contribute to exclusion of suspected metastatic lesions, unless they are milimetric.

Introduction

Renal cell carcinoma (RCC) is the most common type of kidney cancer in adults, and it is also known to be the most lethal of all the genitourinary tumors [1]. RCC is generally silent and is generally detected incidentally by abdominal ultrasonography or contrast enhanced computed tomography (ceCT) which is performed for some other indications. Primary treatment for RCC is radical or partial nephrectomy. However, metastasis is seen in 20-30% of the patients who have undergone surgery. The rate of metastasis at diagnosis 20-30% and solitary metastasis is found in 5% of the patients [2,3]. Metastasis is a strong predictor of bad prognosis [4], 5 years survival rates are reported as less than 10% [5,6]. Early detection and management of metastatic disease is crucial to improve prognosis and quality of life.

ceCT is currently used imaging modality for staging and restaging of RCC. Although ceCT has been used for the detection of the localization of recurrent or metastatic disease, it has some limitations in the differentiation of the recurrence from postoperative changes and in the detection of intraabdominal lymph node metastases. ceCT is also risky for it may cause renal functional damage and allergy to contrast agent may develop.

Nowadays, Fluorine-18 (^{18}F) fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) is a hybrid imaging modality which can provide anatomic and functional information together and it has been used for staging and restaging of several cancers. ^{18}F-FDG PET (non-hybrid) and ^{18}F-FDG PET/CT also has been performed for staging and restaging of RCC. It has been shown in several studies; ^{18}F-FDG PET and ^{18}F-FDG PET/CT did not have a role for the primary diagnosis of RCC, because of urinary excretion of the radioisotope [7-12]. However, it seems to be more effective in the detection of distant metastases [8,10].

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The purpose of this study was to compare the results of fluorine-18 (^{18}F) fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) and contrast enhanced computed tomography (ceCT) in the assessment of renal cell carcinoma (RCC) recurrences when CT had suspected lesions for local recurrence and/or distant metastases.

Material and Method

Patient group

A total of 22 patients (14 M, 8 F; mean age: 59.09±11.71, range: 34-74 years) who were referred to perform ^{18}F-FDG PET/CT for restaging of RCC were included in this study. 2 patients have undergone two PET/CT scans. Before ^{18}F-FDG PET/CT, all patients had suspected lesions in thoracal and/or abdominal ceCT for local recurrence and/or distant metastases. The retrospective analysis of ceCT results was compared with the ^{18}F-FDG PET/CT results.

^{18}F-FDG PET/CT

^{18}F-FDG PET/CT images were acquired with a GE Discovery ST PET/CT scanner. During imaging, patients were under at least 6 hour fasting and checked whether or not their blood glucose levels were under 150 mg/dl. Oral or intravenous contrast agents were not given to the patients. Whole body ^{18}F-FDG PET/CT imaging was performed approximately 1 hour after an intravenous injection of 8-10 mCi ^{18}F-FDG while the patients were in supine position from the vertex to the proximal femur. During the waiting period the patients rested in a quiet room without administrating muscle relaxant. PET images were acquired for 4 minutes per bed position and emission PET images were reconstructed with non-contrast CT images obtained from the patients with the use of a standardized protocol involving 140 kV, 70 mA, a tube rotation time of 0.5 s per rotation, a pitch of 6 and a section thickness of 5 mm. The patients were allowed to breathe normally during the procedure. Attenuation-correction was done by PET/CT fusion images on three planes (transaxial, coronal and sagittal) and was reviewed by a Xeleris Workstation (GE Medical System).

Image analysis

Whole body ^{18}F-FDG PET/CT images were interpreted visually and semi-quantitatively by two experienced nuclear medicine physicians by consensus. The comparison was made between foci showing increased uptake and background/blood pool activity. Their anatomic confirmation was made with CT images. The criterion for malignancy was accepted as a FDG hypermetabolism at the site of the pathological changes on CT or a marked focal hypermetabolism at the physiological uptake sites.

Statistical analysis

The results of ^{18}F-FDG PET/CT and ceCT studies were compared in terms of the local recurrence and distant metastases. Then the aggrement between two imaging techniques were evaluated by Kappa statistics. SPSS version 16.0 (SPSS Inc; Chicago, Illinois, USA) was used for the statistical analysis. The concordance and discordance between two imaging methods were investigated by checking the reability. In the most of the patients, histopathological confirmation could not be possible. So sensitivity, spesificity, positive and negative predictive value and accuracy could not be calculated.

Results

Before ^{18}F-FDG PET/CT, all the patients had undergone nephrectomy (4 partial and 18 radical). Three patients also had undergone lymph node dissections. Primary tumor localizations were the right side in 10 patients and the left side in the rest of the patients. Before ^{18}F-FDG PET/CT, all the patients had suspected lesions in thoracal and/or abdominal ceCT for local recurrence and/or distant metastases. The mean period between nephrectomy and ^{18}F-FDG PET/CT scans was 9.5 (range: 0,5-180) months.

The details of ^{18}F-FDG PET/CT and ceCT results for all patients are shown in Table 1. The number of patients who had compatible results of ^{18}F-FDG PET/CT and ceCT (overall concordance) was 7/22 (32%). The two imaging modalities showed concordant findings in 19/22 patients (86%) (Kappa:0.67) for local recurrence (at the renal fossa, ipsilateral adrenal gland or ipsilateral regional lymph nodes) and in 15/22 patients (68%) (Kappa:0.40) for distant metastases. The subgroup analysis of distant metastases was also done. The regions of distant metastases were distant lymph nodes (mediastinium/abdomen), lungs, liver, bone, and spleen. The number of patients who had concordant findings for defining distant lymph nodes metastases was 19 (86%) (Kappa:0.70), lung metastases was 19 (86%) (Kappa:0.67), liver metastases was 20 (91%) (Kappa:0.64), bone metastases was 19 (86%) (Kappa:0.33), and spleen was 21 (95%). Kappa could not be calculated in one patient who had spleen metastases (Table 2).

Discussion

Presence of metastatic disease is a strong predictor of poor survival in patients with RCC. About 20-30% of patients had metastatic disease at diagnosis and 20-40% of patients develop metastases during the course of disease. In the presence of metastases, the 5 year survival drops to below 10% [2-6]. Therefore, accurate staging is important to decide correct therapy management and to determine prognosis of disease. Nowadays, ceCT is one of the commonly used imaging methods to stage and restage RCC. However, ceCT has some limitations such as postoperative changes, make interpretation of ceCT of the renal bed difficult. ceCT is also risky for renal functional damage and allergy to contrast agent. ^{18}F-FDG PET which is a functional imaging modality, also has limited sensitivity for evaluating metastatic RCC, especially for milimetric metastatic lesions [11,13,14]. Nowadays, ^{18}F-FDG PET/CT that is a hybrid imaging modality, is a promising method for restaging of RCC [15-21]. In this study, we compared the results of ^{18}F-FDG PET/CT and ceCT in patients who had suspected lesions in ceCT for local recurrence and/or distant metastases.

In our analysis, the overall concordance rate between the two imaging modalities was found as low as 32% (7/22

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Table 1: The details of **^{18}F-FDG PET/CT and CT** results for all patients.

			Local recurrence		Distant metastases	
			CT	PET	CT	PET
1	71	male	-	-	Lung	-
2	42	male	-	-	lung, mediastinum	lung,mediastinum
3	57	male	-	-	mediastinum	mediastinum
4	55	male	-	-	lung, lymph nodes	lung, lymph nodes, bone
5	61	male	renal fossa	renal fossa	mediastinum	mediastinum
6	69	male	-	-	lung, mediastinum, bone	lung, mediastinum, bone
7	74	female	ipsilateral adrenal	ipsilateral adrenal	-	-
8	53	female	renal fossa	renal fossa + ipsilateral surrenal	-	-
9	73	female	-	-	Lung, mediastinum	lung
10	43	man	Ipsilateral lymph node	-	lung	-
11	61	man	-	-	liver	-
12	73	female	-	-	lung	lung, mediastinum, bone
13	64	man	ipsilateral lymph nvode	ipsilateral lymph node	-	-
14	66	man	-	-	liver	-
15	68	female	-	-	liver	liver, spleen,lymph nodes
16	34	female	-	-	contralateal adrenal	-
17	40	female	ipsilateral adrenal	ipsilateral adrenal	liver, lymph nodes	liver, lymph nodes
18	70	female	-	-	thyroid	-
19	48	man	ipsilateral lymph node	-	-	-
20	55	man	-	-	Pleural effusion	-
21	61	man	-	-	Lung, bone, lymph nodes	Lymph nodes
22	62	man	renal fossa	-	-	-

Table 2: The rates of concordance and discordance and calculated Kappa values for ^{18}F-FDG PET/CT and CT.

	Concordance	Discordance	Kappa
Local recurrence	19 (86%)	3 (14%)	0.67
Distant metastases	15 (68%)	7 (32%)	0.40
Lung	19 (86%)	3 (14%)	0.67
Liver	20 (91%)	2 (9%)	0.64
Bone	19 (86%)	3 (14%)	0.33
Lymph node	19 (86%)	3 (14%)	0.70
Spleen	21 (95%)	1 (5%)	
Overall	7 (32%)	15 (68%)	

patients). There was concordance for local recurrence in 2/7 patients, distant metastasis in 3/7 patients, for both local and distant metastasis in 2/7 patients. In the separate evaluation of local recurrence, the rates of concordance was 86% (19/22 patients) (Kappa:0.67). In 5/19 patients, the results of both imaging methods were concordantly positive and in 14/19 patients were concordantly negative. In one of the patients (patient 8) with concordantly positive ceCT and ^{18}F-FDG PET/CT results for local recurrence, one extra focus was shown by ^{18}F-FDG PET/CT. In three patients (patients 10, 19 and 22) there were foci reported on ceCT but not FDG avid on ^{18}F-FDG PET/CT. These foci were lymph nodes in 2 patients and suspected lesion in the renal fossa in 1 patient. Due to the limitations in resolution of PET systems, lesions <1cm may not be detectable by ^{18}F-FDG PET/CT [19,21]. However, all of these 3 lesions were >1cm and none of them were FDG avid. Park, et al., compared FDG PET/CT to conventional imaging modalities for restaging of RCC because of high risk of local recurrence or distant metastasis [15]. FDG PET/CT had 92.6% negative predictive value in detecting recurrence or metastasis. In the same study, conventional methods had lower positive predictive value (75%) in detecting recurrence or metastasis. Heidenreich et al., reported that 3-43% false positive rate for CT in preoperative evaluation of lymph node in patients with RCC [22]. Türkvatan et al., published that the moderate agreement between pathology and CT for N staging of RCC (Kappa: 0.40) [23]. The limited role of CT in the differentiation of postoperative changes from residue or local recurrence is well known. In one of our patients, the differentiation between postoperative changes and recurrence was not possible for the lesion detected by ceCT in the renal fossa. No FDG uptake was seen in this focus and the other two lymph nodes in the follow up no recurrence were detected in the suspected areas. Although our results show relatively high concordance between CT and ^{18}F-FDG PET/CT in 19/22 patients for local recurrence, it is still likely that ^{18}F-FDG PET/CT is useful to exclusion of recurrence in suspected cases.

The two imaging modalities showed concordant findings in 15/22 patients (68%) (Kappa:0.40) for distant metastases. When compared with local recurrence (Kappa:0.67), the concordance between the two methods was relatively low in detection of distant metastasis. This was probably because the whole body

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imaging tool ^{18}F-FDG PET/CT has an additive value in the detection of distant metastasis, especially skeletal metastasis. The data reported by Aide et al., revealed that ^{18}F-FDG PET/CT is an effective method for evaluation of distant metastasis in the early postoperative staging of RCC [10]. The accuracy of ^{18}F-FDG PET/CT in detecting distant metastasis was 94%, while the accuracy of ceCT was 89%. They emphasized that ^{18}F-FDG PET is especially needed for metabolic characterization if there is a solitary suspected lesion in a local advanced case [10]. In our study, although a detailed analysis of disease stage was not possible in all patients, 3 patients with distant metastasis had extensive lymphovascular invasion reported in the nephrectomy material. This reminds us the fact that ^{18}F-FDG PET/CT is more important in the follow up of patients with high risk for distant metastasis. When the subgroup analysis of the patients with distant metastasis was made, the highest compatibility ratios between ceCT and ^{18}F-FDG PET/CT was detected in distant lymph nodes (Kappa:0.70), lung (Kappa:0.67) and liver (Kappa:0.64). The correspondence for skeletal metastasis was quite low (Kappa:0.33).

In our study, mediastinum is the most common localization of distant lymph node metastasis. The two imaging modalities showed concordant findings in 20/22 patients (Kappa:0.75) for distant lymph node metastasis. In a patient with incompatible result, paratracheal-bronchopulmoner two lymph nodes and lung nodules with pathologic appearance were defined on ceCT. While multiple pathologic FDG uptake (SUVmax:12.4) were seen on lung nodules, there was no uptake of FDG in defined lymph nodes on ceCT. This situation can be explained with the limitation of ^{18}F-FDG PET/CT in evaluation of lymph nodes adjacent to lesions with high FDG uptake. In another case, there was a lymph node that was not considered pathologic on ceCT, however it was FDG avid on ^{18}F-FDG PET/CT. Although histopathological evaluation of lymph node is not possible, ceCT found inadequate for the evaluation of lymph node in this patient because of lung metastases as shown in both modalities and additional bone metastases detected by ^{18}F-FDG PET/CT.

Lung metastasis of RCC is frequently present in 0.5 to 2 cm diameter, well-defined, solitary or multiple asymptomatic nodules [21]. Nodule size is an important in evaluation of lung metastasis. Kang, et al., have reported that the sensitivity of ^{18}F-FDG PET and ceCT was 75% and 91% respectively for the detection of metastasis in RCC [11]. Although calculating sensitivity and specificity in our study, the concordance for lung metastasis was positive in 19/22 patients (kappa:0.67). In the two patients with discordant results, while nodules <1cm were seen on ceCT, there was no FDG uptake in the nodules. There was no change in the size and SUVmax of the nodule on the ^{18}F-FDG PET/CT performed 6 months later for restaging. The follow up results of the other patient was uncertain but because the patient had pathological uptake in the mediastinal and abdominal lymph nodes shown by ^{18}F-FDG PET/CT, assuming the disease is extensive, lung nodules could much probably be metastatic but ^{18}F-FDG PET was not able detect them. On the ceCT scan of the last patient with discordant findings, there was a focal ground-glass appearance. The ^{18}F-FDG PET/CT of the same patient performed 3 months later was negative. As a result, ^{18}F-FDG PET/CT truely ruled out metastasis in 2/3 suspected patients. However it missed one patient with probably metastatic millimetric nodules. This reveals the complementary role of conventional ceCT and ^{18}F-FDG PET/CT.

The results were concordant in the 20/22 patients for liver lesions (2 positive and 18 negative), and were discordant in 2/22 patients (Kappa:0.64). Both two patients with discordant results had hypodense lesions on ceCT (15mm and 20mm) but they were not FDG avid. Majhail et al have reported the sensitivity of ^{18}F-FDG PET/CT in detecting lesions 1.5cm and 2cm size as 83.3% and 92.9% respectively. They also revealed that ^{18}F-FDG PET/CT can be a helpful complementary tool, especially if there are suspected lesions over 1.5cm to evaluate [13]. In the same study, it is also proposed that if a suspected lesion >1.5 cm is FDG avid, then biopsy should be performed. Conversely, if the lesion >1.5 cm does not show any FDG uptake, malignity cannot be ruled out and histopathological examination decision should be made by clinical correlation. In this study, in addition to the non-FDG avid two liver lesions, 1 adrenal lesion, 1 thyroid nodule (20mm ecopenic solid, aspiration biopsy: hypocellular) and pleural effusion was also detected in three patients respectively. These lesions were all FDG negative and no metastasis was detected at these sites in any of the patients in the follow up. Our data suggest that an FDG negative study helps in ruling out metastasis in suspected cases except for millimetric lesions. In one of the cases, abdominal lymph node and spleen involvement could be demonstrated by ^{18}F-FDG PET/CT but not ceCT alone. Because the patient had liver metastasis, clinical approach did not change but the extension of the disease could be perfectly shown.

Bone metastasis in RCC is often characterized by large, lytic, expansile lesions. Bone scintigraphy has modarete sensitivity as 10-60% for detection of these lesions [24]. However, it has been reported that sensitivity and accuracy of ^{18}F-FDG PET for detection of bone metastases may be as high as 100% [25]. In our study, the rate of discordance was 14% (3/22 patients) although ceCT showed no bone lesions in 2/24 patients, ^{18}F-FDG PET/CT showed widespread bone metastases. However, in 1/22 patient, ^{18}F-FDG PET/CT failed to show the sclerotic-lytic mixed lesions on reported ceCT.

There were some limitations of the study. The number of patients was small and histopathologic confirmation of metastases could not be possible for every patient. In most patients, histopathologic details of the primary tumor could not be obtained because patients were referred from different centers. For this reason, ^{18}F-FDG PET/CT results and histologic subtype/nuclear grade could not be compared.

As a conclusion; ^{18}F-FDG PET/CT is not enough alone in the detection of local recurrence and distant metastases of RCC. On the other hand, evaluation of ^{18}F-FDG PET/CT and ceCT together significantly improves the detection of RCC recurrence. A negative ^{18}F-FDG PET/CT may contribute to exclusion of suspected metastatic lesions, unless they are milimetric.

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References

1. Jemal A, Siegel R, Ward E, Murray T, Xu J, et al., (2007) Cancer statistics, 2007. CA Cancer J Clin 57: 43-66. Link: https://goo.gl/Ul7MyQ

2. Lam JS, Shvarts O, Leppert JT, Figlin RA, Belldegrun AS (2005) Renal cell carcinoma 2005: new frontiers in staging, prognostication and targeted molecular therapy. J Urol 173: 1853-1862. Link: https://goo.gl/HkrcBj

3. Gupta K, Miller JD, Li JZ, Russell MW, Charbonneau C (2008) Epidemiologic and socioeconomic burden of metastatic renal cell carcinoma (mRCC): a literature review. Cancer Treat Rev 34: 193-205. Link: https://goo.gl/LdBMWE

4. Leibovich BC, Blute ML, Cheville JC, Lohse CM, Frank I, et al., (2003) Prediction of progression after radical nephrectomy for patients with clear cell renal cell carcinoma: a stratification tool for prospective clinical trials. Cancer 97: 1663-1671. Link: https://goo.gl/h5pJZh

5. Ficarra V, Righetti R, Pilloni S, D'amico A, Maffei N, et al., (2002) Prognostic factors in patients with renal cell carcinoma: retrospective analysis of 675 cases. Eur Urol 41: 190-198. Link: https://goo.gl/1mcx1w

6. Van Brussel JP, Mickisch GH (1999) Prognostics factors in renal cell and bladder cancer. BJU Int 83: 902-908. Link: https://goo.gl/LoQJGk

7. Bouchelouche K, Oehr P (2008) Recent developments in urologic oncology: positron emission tomography molecular imaging. Curr Opin Oncol 20: 321-326. Link: https://goo.gl/t4OTMK

8. Powles T, Murray I, Brock C, Oliver T, Avril N (2007) Molecular positron emission tomography and PET/CT imaging in urological malignancies. Eur Urol 51: 1511-1520. Link: https://goo.gl/NcV8Kf

9. Ramdave S, Thomas GW, Berlangieri SU, Bolton DM, Davis I, et al., (2001) Clinical role of F-18 fluorodeoxyglucose positron emission tomography for detection and management of renal cell carcinoma. J Urol 166: 825-830. Link: https://goo.gl/kLLdjO

10. Aide N, Cappele O, Bottet P, Bensadoun H, Regeasse A, et al., (2003) Efficiency of [(18)F] FDG PET in characterising renal cancer and detecting distant metastases: a comparison with CT. Eur J Nucl Med Mol Imaging 30: 1236-1245. Link: https://goo.gl/I9plfD

11. Kang DE, White RL Jr, Zuger JH, Sasser HC, Teigland CM (2004) Clinical use of fluorodeoxyglucose F18 positron emission tomography for detection of renal cell carcinoma. J Urol 171: 1806-1809. Link: https://goo.gl/PjpJUB

12. Miyakita H, Tokunaga M, Onda H, Usui Y, Kinoshita H, et al., (2002) Significance of 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) for detection of renal cell carcinoma and immunohistochemical glucose transporter 1 (GLUT-1) expression in the cancer. Int J Urol 9: 15-18. Link: https://goo.gl/saeRDR

13. Majhail NS, Urbain JL, Albani JM, Kanvinde MH, Rice TW, et al., (2003) F-18 fluorodeoxyglucose positron emission tomography in the evaluation of distant metastases from renal cell carcinoma. J Clin Oncol 21: 3995-4000. Link: https://goo.gl/IVkI9j

14. Schöder H, Larson SM (2004) Positron emission tomography and prostate, bladder and renal cancer. Semin Nucl Med 34: 274-292. Link: https://goo.gl/9BfBrp

15. Park JW, Jo MK, Lee HM (2009) Significance of 18F-fluorodeoxyglucose positron-emission tomography / computed tomography for the postoperative surveillance of advanced renal cell carcinoma. BJU International 103: 615-619. Link: https://goo.gl/YXU9Fh

16. Kumar R, Shamim SA, Shandal V, Sharma P, Gadodia A, et al., (20011) FDG PET/CT in detection of adrenal metastasis in patients with renal cell carcinoma. Clin Nucl Med 367: 513-517. Link: https://goo.gl/YkmPjZ

17. Namura K, Minamimoto R, Yao M, Makiyama K, Murakami T, et al., (2010) Impact of maximum standardized uptake value (SUVmax) evaluated by 18-F-Fluoro-2-deoxy-D-glucose positron emission tomography/computed tomography (18F-FDG-PET/CT) on survival for patients with advanced renal cell carcinoma: a preliminary report. BMC Cancer 10: 667. Link: https://goo.gl/MLJoOj

18. Kumar R, Shandal V, Shamim SA, Jeph S, Singh H, et al., (2010) Role of FDG PET/CT in recurrent renal cell carcinoma. Nucl Med Commun 31: 844-850. Link: https://goo.gl/zR1lL1

19. Fuccio C, Ceci F, Castellucci P, Spinapolice EG, Palumbo R, et al., (2014) Restaging clear cell renal carcinoma with 18F-FDG PET/CT. Clin Nucl Med 39: 320-24. Link: https://goo.gl/okFCfW

20. Win AZ, Aparici CM (2005) Clinical efectiveness of (18)f-fluorodeoxyglucose positron emission tomography/computed tomography in management of renal cell carcinoma: a single institution experience. Worl J Nucl Med 14: 36-40. Link: https://goo.gl/u1HCHF

21. Alonghi P, Picchio M, Zattoni F, Spallino M, Gianolli L, et al., (2016) Recurrent renal cell carcinoma: clinical and prognostic value of FDG PET/CT. Eur J Nucl Med Mol Imaging 43: 464-473. Link: https://goo.gl/n428T2

22. Heidenreich A, Ravery V (2004) Preoperative imaging in renal cell cancer. World J Urol 22: 307-315. Link: https://goo.gl/1mHSOv

23. Türkvatan A, Akdur PO, Altınel M, Olçer T, Turhan N, et al., (2009) Preoperative staging of renal cell carcinoma with multidetector CT. Diagn Interv Radiol 15: 22-30. Link: https://goo.gl/PClrdM

24. Mueller-Lisse UG, Mueller-Lisse UL (2010) Imaging of advanced renal cell carcinoma. World J Urol 28: 253-261. Link: https://goo.gl/dg1dJh

25. Wu HC, Yen RF, Shen YY, Kao CH, Lin CC, et al., (2002) Comparing whole body 18F-2-deoxyglucose positron emission tomography and technetium-99m methylene diphosphate bone scan to detect bone metastases in patients with renal cell carcinomas - a preliminary report. J Cancer Res Clin Oncol 128: 503-506. Link: https://goo.gl/u31uxJ

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