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Case Report

68Ga-PSMA-11 PET-CT is superior to bone scintigraphy for detection bone metastasis in low and high grade of prostate cancer

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Abstract

Bone with distant metastasis and morbidity due to skeletal complications is a lesion that encouraged many authors to focus on the new radiotracers for better diagnosis regarding high sensitivity and specificity. However, 99mTc-Methylene diphosphonate (MDP) bone scintigraphy (BS) is the current standard imaging due to increase adsorption of the tracer at osteoblastic sites; it shows false-positives in degenerative changes and false-negatives in bone marrow metastasis. Recently, Prostate Specific Membrane Antigen (PSMA) is the promising target in prostate cancer imaging due to the over-expression in cancer cells. 68Ga-PSMA-11, a small molecule with PSMA enzyme inhibition activity has benefit in bone and lymph-node recurrences and staging. Moreover, as degenerative changes do not have PSMA uptake will have not positive in response to therapy, bone scan has enough quality for degenerative changes. With this consideration, BS is unable to differentiate bone metastasis from degenerative changes. 68Ga-PSMA-11 could overcome to this limitation from conventional imaging as well. Finally, we concluded that PSMA PET-CT would have better sensitivity and specificity due to unique distinction for detecting metastases.

Key words: 68Ga-PSMA-11 , PET-CT Prostate Cancer, bone metastasis

Introduction

99mTc-MDP BS is the most common scan for detecting bone metastasis with high sensitivity (range 62-89%) for bone metastasis in PCa [1]. Therefore, guidelines suggest BS to be performed in patients with high risk PCa or those presenting with bone symptoms [2-4]. As bone metastasis firstly commence in bone marrow, hence BS not able to detect bone marrow lesions or early osteoblastic activity. With modern hybrid imaging SPECT-CT (Single Photon Emission Computed Tomography Computed Tomography), MDP BS able to correctly characterized planner imaging equivocal lesions [5]. Despite these limitations, bone scan preferred as standard scan for bone metastasis in clinical diagnosis of prostate cancer. 18F-Fluoride PET [6] is superior to BS for detection of bone metastasis due to the prostate cancer but it did not routinely perform in clinical practice. These days prostate-specific membrane antigen (PSMA) has been a promising tracer in low and high grade of PCa. Regarding to its high expression in PCa cells [7], it used as a biomarker like gleason score for evaluation of metastasis and progression [8]. Meanwhile, small molecule inhibitors have been developed to target PSMA; Glu-NH-CO-NH-Lys-(Axe)-[68Ga (HBED-CC)] (68Ga-PSMA -11) is the most investigated ligand which has high clinical value for lymph node staging [9] and detection of local recurrence [10, 11].

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PSMA PET is very sensitive for high grade prostate cancer cells as well as low levels but BS seems to be sensitive for high grades and is controversial for low level of PSA [12, 13]. In short, PSMA-PET has shown higher sensitivity and specificity than BS (90.5% vs. 73.68%, and 97.0% vs. 86%) for bone metastasis of prostate cancer [14].

Case report

69 Years male with adenocarcinoma prostate, PSA 115 ng/ml enrolled in our center for more evaluation of prostate cancer metastasis. After IV injection of 20mci of 99mTC-MDP scanning was performed three hours later in multiple spot views.

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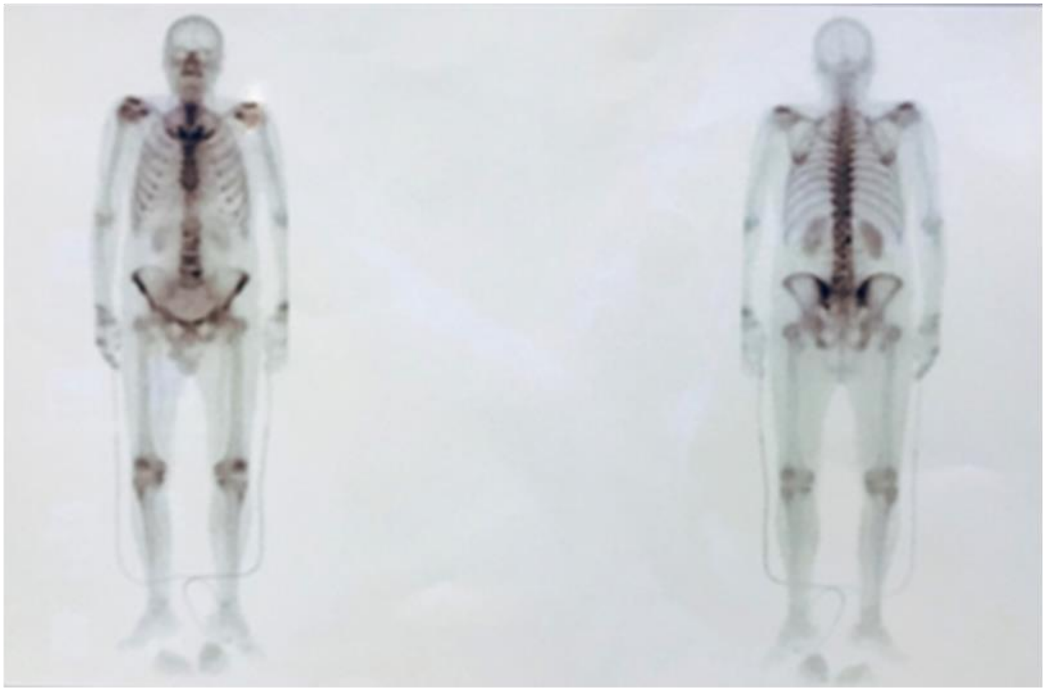
The scan showed abnormally increased inhomogeneous uptake in lumbar spine. No other abnormal uptake was noted in the rest of the skeleton. In short, bony lesion with osteoblastic reaction of lumbar vertebrae is involved. Moreover, SPECT imaging was performed from thoracolumbar spine and reconstruction was performed in the transverse, coronal and sagital axes. The SPECT slices showed abnormal uptake in body of lumbar vertebrae. For more assessment MRI correlation for ruling out of metastasis and degenerative change was recommended.

After bone SPECT, the patient refers to the 68Ga-PSMA PET-CT for better diagnosis. In this reason, therefore, 4.4 mCi of 68Ga-PSMA-11 was administered intravenously via the vein in the dorsum of the left hand. To allow for distribution and uptake of radiotracer, the patient was allowed to rest quietly for 60 minutes in a shielded room. Imaging was performed on an integrated 6-slice PET/CT scanner, with scanning from the skull top to the mid thigh. CT scanning was performed without oral or intravenous contrast material. There are PSMA uptakes in the peri-vascular, sub carina and right hilar lymph node with SUVmax up to 17.71. There are numerous nodal abnormal uptakes in the para-aortic and pelvic chains with SUVmax up to 40.16. In addition the scan showed PSMA uptake in the peripheral of the liver. Moreover, Physiologic tracer uptake was seen throughout spleen, small intestine and urinary bladder. Intense PSMA uptake at prostate gland with SUVmax 27.20 was seen. Numerous Osteoblastic bone metastasis throughout the axial and appendicualr skeleton including spine, ribs bilaterally sternum, scapulae, clavicle, humera, pelvic and proximal both femura.
Regarding patient's history, PSMA activity at prostate gland as a primary tumor, multiple para-aortic and pelvic chain lymph nodes metastasis, liver metastasis and wide spread bone metastasis as mentioned above.

Result and Conclusion

For the current patient, as discussed above, bone scan and 68Ga-PSMA PET were performed between one week distances. Bone scan showed one lesion in lumbar spine while PET scan revealed multiple bone metastases Therefore, in this case disseminated and/or refractory to treatment, RIT with 177Lu-PSMA is recommended. While 99mTc-MDP BS is the current standard imaging for bone metastasis of prostate cancer but it seems that PSMA PET is superior to BS for metastatic work up in high risk prostate cancer [Figures 1-3 section A, B].

FIG1. a) After IV injection of 20mci of ^{99m}TC-MDP scanning was performed 3 hours later in multiple spot views. The scan showed abnormally increased inhomogeneous uptake in lumbar spine. No other abnormal uptake was noted in the rest of the skeleton. b) SPECT imaging was performed from thoracolumbar spine and reconstruction was performed in the transverse, coronal and sagital axes. The SPECT slices showed abnormal uptake in body of lumbar vertebrae.



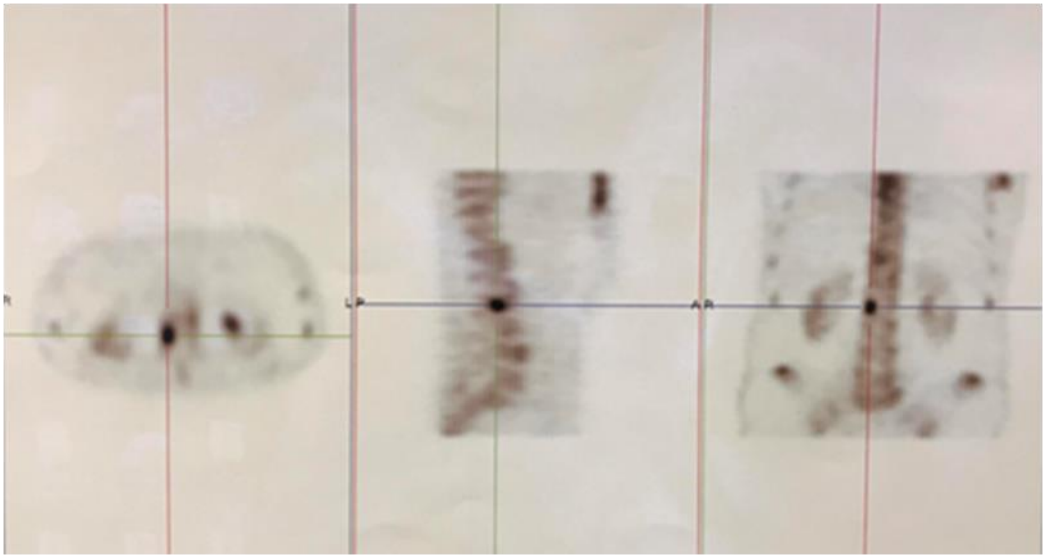


FIG2. B) ^{68}Ga-PSMA-11 PET-CT scan

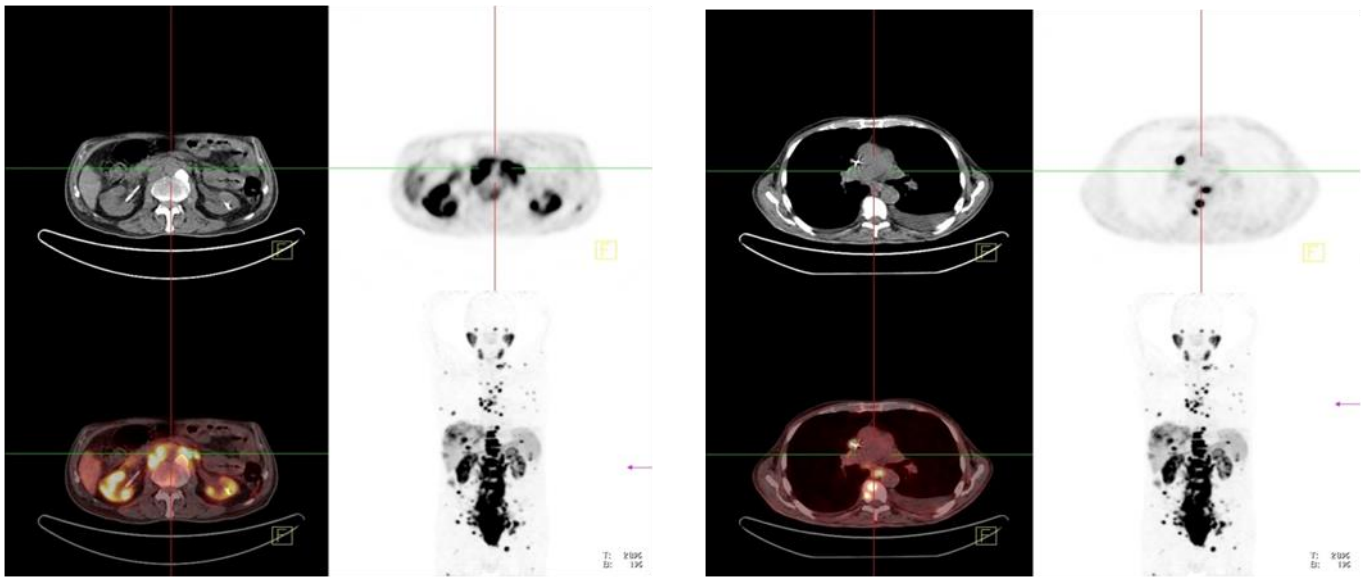
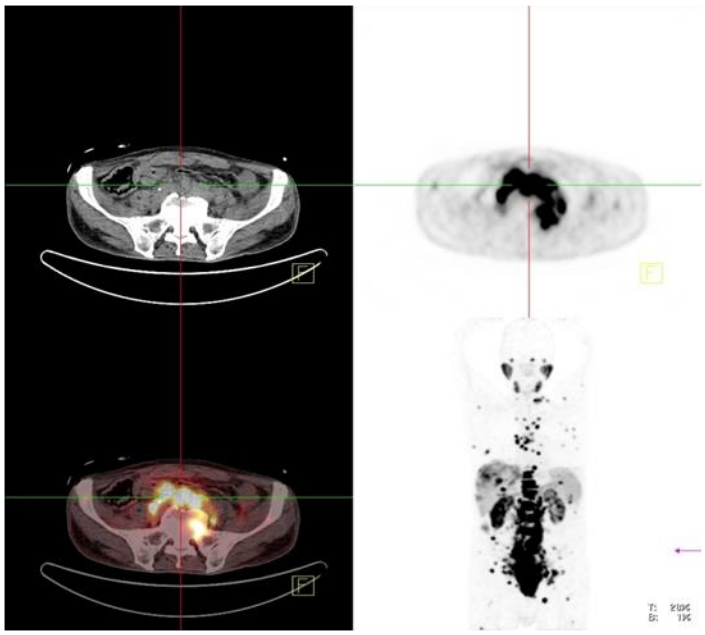


FIG3. ^{68}Ga-PSMA PET/CT scan, Skull top to Mid-Thigh



Moreover, as degenerative changes do not have PSMA uptake will have not positive in response to therapy, bone scan has enough quality for degenerative changes. With this consideration, BS is unable to differentiate bone metastasis from degenerative changes. In addition, we believe that PSMA PET will have upper hand in degenerative changes versus bone scan.