Prospective evaluation of planar bone scintigraphy, SPECT/CT, ^{18}F NaF PET/CT and whole body 1.5T MRI for detection of bone metastases in high risk breast and prostate cancer patients

Ivan Jambor, MD; Anna Kuisma, MD; Riikka Huovinen, MD, PhD; Minna Sandell, MD; Joakim Auren, MD; Sami Kajander, MD, PhD; Jukka Kemppainen, MD, PhD; Jani Saunavaara, PhD; Tommi Noponen, PhD; Heikki Minn, MD, PhD; Hannu J. Aronen, MD, PhD; Marko Seppänen, MD, PhD

Purpose

The aim of the study was to compare the diagnostic accuracy of ^{99m}Tc methylene-diphosphonate planar bone scintigraphy (^{99m}Tc-MDP BS), ^{99m}Tc methylene-diphosphonate single photon emission tomography/computed tomography (^{99m}Tc-MDP SPECT/CT), ^{18}F NaF PET/CT and whole body 1.5 Tesla MRI (wbMRI) for the detection of bone metastases in high risk breast cancer and prostate cancer patients.

Materials and Methods

Twenty-five breast cancer and twenty-six prostate cancer patients at high risk of bone metastases prospectively underwent ^{99m}Tc-MDP BS, ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI. Coronal T1-weighted, T2-weighted STIR, axial diffusion weighted images (b-values: 0, 150, 1000 s/mm^2) covering whole body were acquired. Four independent reviewers interpreted each individual modality, grading lesions as suspicious, equivocal and benign, without the knowledge of other imaging findings. The final metastatic status was based on the consensus reading of all imaging modalities. The bone findings were compared on patient and region basis. In the region based analysis, the skeleton was divided into five regions.

Results

Based on the consensus reading, 18 (35%) patients and 54 (21%) regions had presence of bone metastases while 33 patients and 201 regions were free of bone metastases. ^{99m}Tc-MDP BS was false negative in 4 patients. In the region based analysis, the sensitivity for

^{99m}Tc-MDP BS, ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI was 70%, 87%, 98% and 90%, respectively. The number of equivocal findings for ^{99m}Tc-MDP BS, ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and wbMRI was 30, 6, 8, 2, respectively. wbMRI provided clinically useful information concerning soft tissues in 6 patients while CT in 4 patients.

Conclusions

Whole body 1.5T MRI, including diffusion weighted imaging, had similar diagnostic accuracy for detecting bone metastases in high risk breast and prostate cancer patients as ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT. These modalities were significantly more sensitive in region based analysis than ^{99m}Tc-MDP BS and provided increased diagnostic confidence. Additional soft tissues information provided by whole body 1.5T MRI has potential to affect the patient management.

Clinical relevance statement:

Whole body MRI showed similar sensitivity for detecting bone metastases in high risk breast and prostate cancer patients as ^{99m}Tc-MDP SPECT/CT, ^{18}F NaF PET/CT and was superior to bone scintigraphy.