Non-enhanced MRI DWIBS in assessment of liver metastasis in breast cancer patients

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Aims and objectives

To assess the diagnostic performance of whole body diffusion weighted imaging with background suppression (WBDWIBS) and no contrast agents in assessment of liver metastasis in breast cancer patients compared to enhanced 18 FDG-PET-CT.

Methods and materials

50 patients with pathologically proven

breast cancer having suspicious

liver lesions by ultrasound;

underwent both F-18-FDG PET-CT

and WB-MRI/DWIBS.

The study participants were categorized according to the phase of the disease at the time of presentation into two groups; pretherapy group including pathologically proved breast carcinoma lesions after biopsy or post-lumpectomy (A) , and post therapy group including patients who were receiving or had finished therapy (B).

Ethical approval was granted by Institutional Review Board of the NCI before the study started. Informed consent was obtained from all participants before being enrolled in the study. Patients who met the eligibility criteria underwent 18F FDG PET-CT and WB MRI DWIBS. They were performed for all the study participants with maximum 1 month time interval in-between. WB MRI DWIBS protocol design was conducted on a 1.5 T scanner (Achieva, Philips Medical Systems, Best, Netherlands, Release 2.6, and Level 3). Q-body coil used, with the patient positioned feet first on an extended anatomical coverage table, based on rolling-table technology (MobiTrak, Philips). The used sequences were: Coronal T1-weighted Turbo Spin Echo (TSE), Coronal Short Tau Inversion Recovery (STIR) from the head to the mid-thigh and axial DWIBS (single-shot echoplanar imaging (ss-EPI). The coronal T1WI was acquired with the Q body coil for signal reception and the following parameters: single shot turbo spin echo, TR/TE, shortest, slice thickness, 6mm, gap 1mm, number of slices for station, 39; field of view, 530x265; acquisition matrix, 208x287; reconstruction matrix 512; acquisition voxel size, 1.27x1.85x6.00; reconstructed voxel size, 1.04x1.04x6.00; number of acquisitions, 1; acquisition time\sequence, 63sec.The coronal STIR sequence was acquired with the Q body coil for signal reception and the following parameters: single-shot turbo spin echo, TR/TE, shortest/64; inversion time, 165 milliseconds; slice thickness, 6mm; gap, 1mm; number of slices for station, 39; field of view, 530x265; acquisition matrix, 336x121; reconstruction matrix, 512; acquisition voxel size, 1.58x2.18x6.00; reconstructed voxel size, 1.04x1.04x6.00; number of acquisitions, 2; acquisition time/ sequence, 62sec**.**

DWIBS sequences were acquired in the axial plane, with Q body coil for signal reception, in free-breathing and with the following parameters: single-shot EPI; TR/TE, shortest; inversion time, 180milliseconds; slice thickness, 6mm; gap, 0mm; number of slices for station, 44; field of view, 530x303; acquisition matrix,108x61; reconstruction matrix, 352; acquisition voxel size, 4.91x4.83x6.00; reconstructed voxel size, 1.51x1.50x6.00; half-

scan factor, 0.627; EPI factor, 61; b values 0-1000 s\mm²; number of acquisitions, 2; acquisition time\sequence, 3min and 29sec. Total examination time was average about 40 min for whole body DWIBS. All sequences were acquired during free breathing. No contrast agent applied. DWIBS axial images were reconstructed both on a radial plane (20 number of projections), for a volumetric view, and on a coronal plane (slice thickness, 4mm; gap, 1mm; number of images 44); then the reconstructed images in the coronal plane for each station were merged to obtain a coronal whole-body/DWIBS images.

Color coded fused T1-DWIBS images & ADC maps were through Phillips workstation software generated as well.

18 F FDG PET/CT scan was performed on an integrated PET/CT system with 16 slice CT (GE Medical Systems). This dedicated system permitted the acquisition of co-registered CT and PET images in one session. All patients were asked to fast for six hours prior to scan. An I.V. cannula was inserted in the patient's arm for administration of 18F-FDG. The patients were instructed to avoid any kind of strenuous activity prior to the examination and following injection of the radioisotope to avoid physiologic muscle uptake of FDG.18F-FDG administered in a standard dose of 5.5 MBq/Kg, 60 min before scan. The patients were positioned in a Comfortable head fixation with arms up.

Diagnostic CT with contrast was performed using the following parameters; (350 mA, 120 KV, 0.5 second tube rotation time, slice thickness 5 mm, 8 mm table feed & 3 mm incremental reconstruction). Non-contrast CT was done in patient with impaired renal function and/or had history of hypersensitivity for contrast media.

A PET emission scan was performed over several bed positions (5 to 7) for 2 minutes per bed position with an axial field of view of approximately 21.6 cm per bed position & in-plane spatial resolution of 2 mm covering the same field of view as with CT. Hundreds of trans-axial PET and CT images were first reconstructed. These are then reformatted into coronal and sagittal images to facilitate image interpretation. For each of these sets of PET and CT images, corresponding "fusion" images, combining the two types of data, also were generated. The whole acquisition time for an integrated PET/ CT scan was approximately **25 min**. PET image data sets were reconstructed using CT data for attenuation correction and co-registered images were displayed using special software

WB-MR/DWIBS image analysis: A) Visual (qualitative) analysis of WB-MR/DWIBS: The WB-MR/DWIBS data were evaluated by experienced radiologist (more than 10 years) who was unaware of the clinical history of each patient and prior 18F-FDG PET/ CT or CT results.

In general; for simplicity and to permit an easy and standardized comparison of the MRI DWIBS and PET CT results. The MIP image of the whole-body DWI sequence was assessed to determine possible lesions. The lesion was then confirmed by checking transversal whole-body DWIBS images using B-value of 1000 mm2/s **(B).** B-value 0 mm2/s together with B-value 1000 mm2/s was used to rule out T2-shine through effect

and to get anatomical information. The transverse DWIBS images were correlated to MIP images by reference lines. The signal intensity of the lesion should be equal or higher than the signal intensity from the organ with highest signal intensity. Breast masses considered to be suspicious if they were restricted in DWIBS images in **(B).** Loco-regional or distant lymph nodes larger than 10 mm in short-axis diameter were considered positive.

Several **normal structures** (including brain, salivary glands, tonsils, spleen, gallbladder, adrenal glands, endometrium, ovaries, spinal cord, peripheral nerves and bone marrow) can exhibit native restricted diffusion signals. Any **focal restricted signal intensity** in these organs at DWIBS was considered positive for tumor involvement (compared to their normal native signals).

Focal or patchy lesion of bone marrow lesion is considered suspicious restricted signal if it elicited signal intensity higher than the surrounding bone marrow signal intensity in DWIBS **(B)** (without calculation the apparent diffusion coefficients (ADC)), corresponding to a hypo-intense signal in T1W images and high signal intensity in STIR images. Areas of low signal intensity on both T1-weighted and STIR sequences were interpreted as sclerosis. On the other hand, a lesion was considered benign or negative if it was located adjacent to degenerative changes of vertebral end plates, near joint surfaces or when it did not display high signal intensity on DWIBS **(B)**.

B) Quantitative analysis of WB-MR/DWIBS: was done for breast lesions and the suspicious axillary lymph nodes**.** For each lesion recorded as positive on DWIBS **(B)**; the lesion with low signal intensity on ADC maps was identified, and traced by ROI measurement on the parametric ADC maps. ROI was manually drawn to encompass the entire cross section of the lesion.

Results

F-18 FDG PET-CT demonstrated slightly higher specificity indices than MR-DWIBS while the MRDWIBS displays higher sensitivity indices than FDG PET CT. A high degree of the agreement also existed between DWIBS and PET CT.

Images for this section:

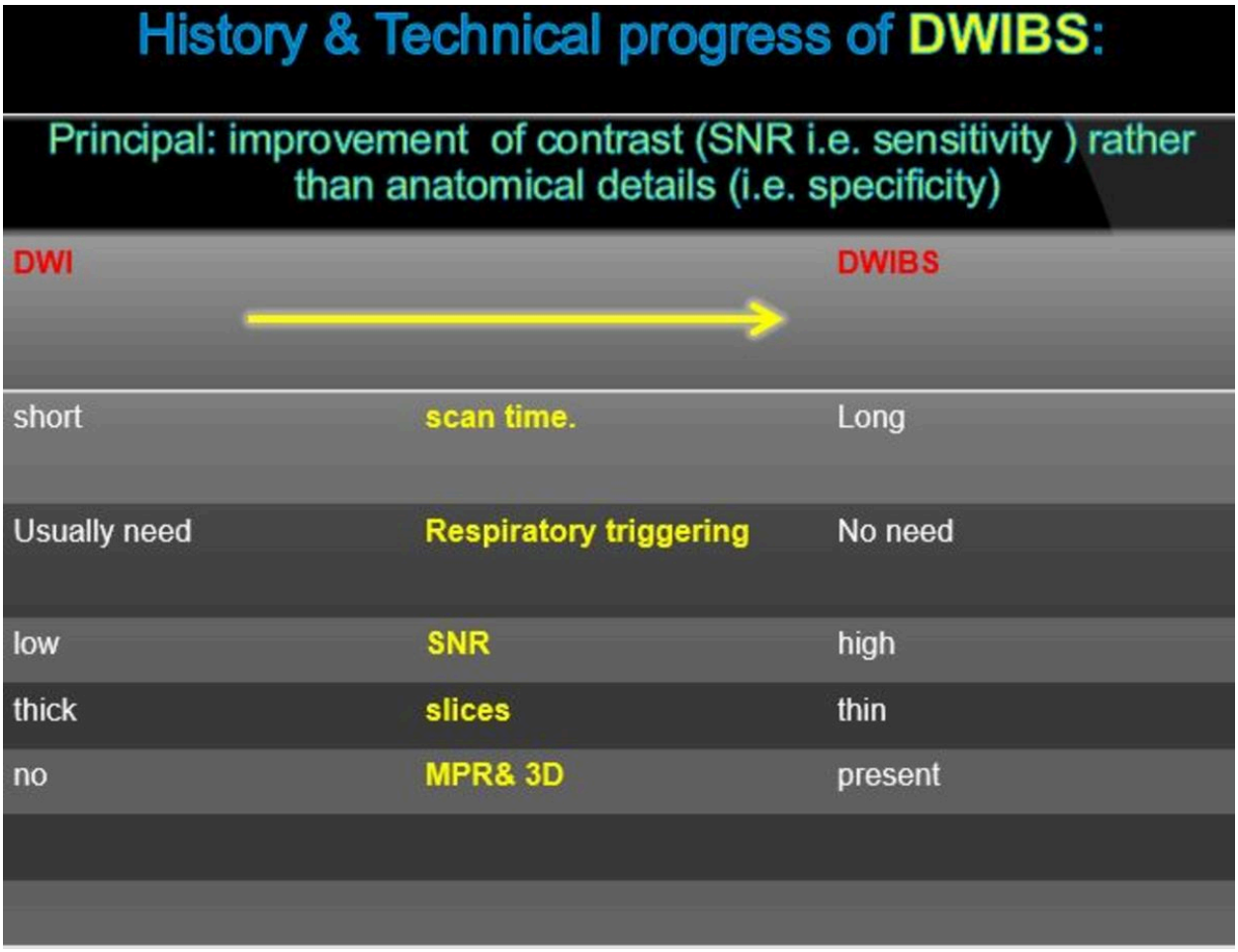

Fig. 4: summary between DWI and DWIBS

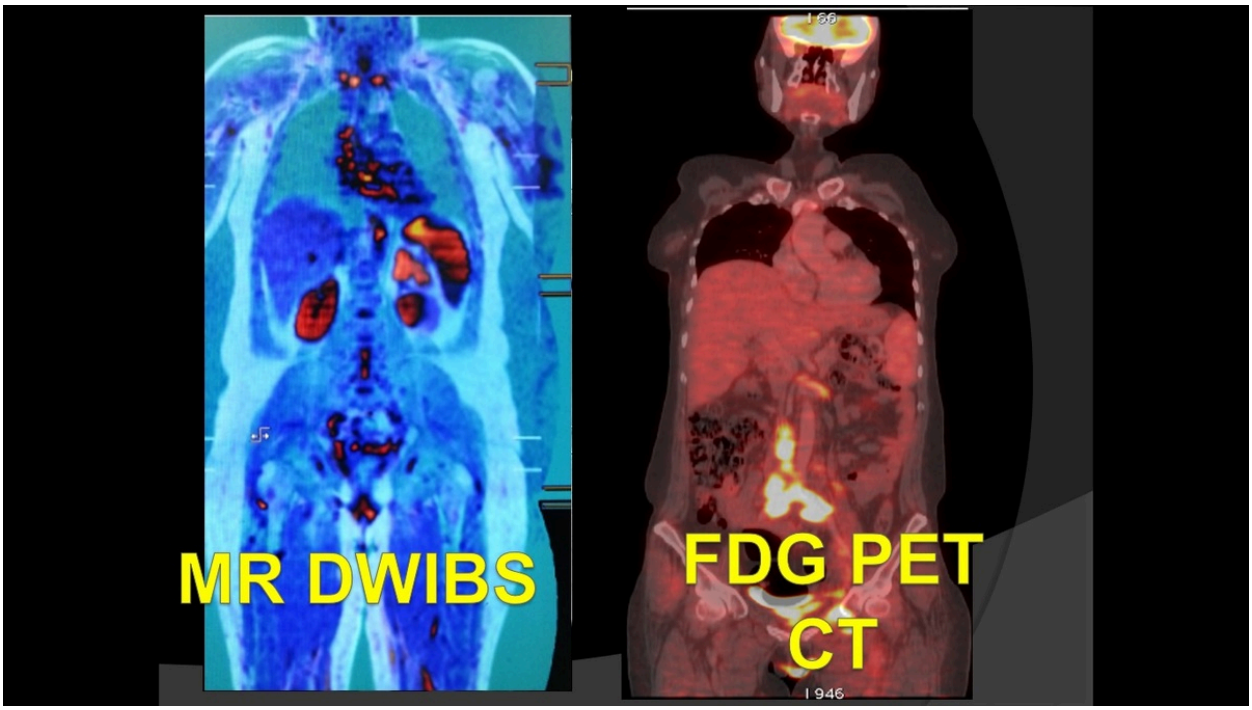

Fig. 5: differences and similarity between MR-DWIBS, 18FDG PET CT

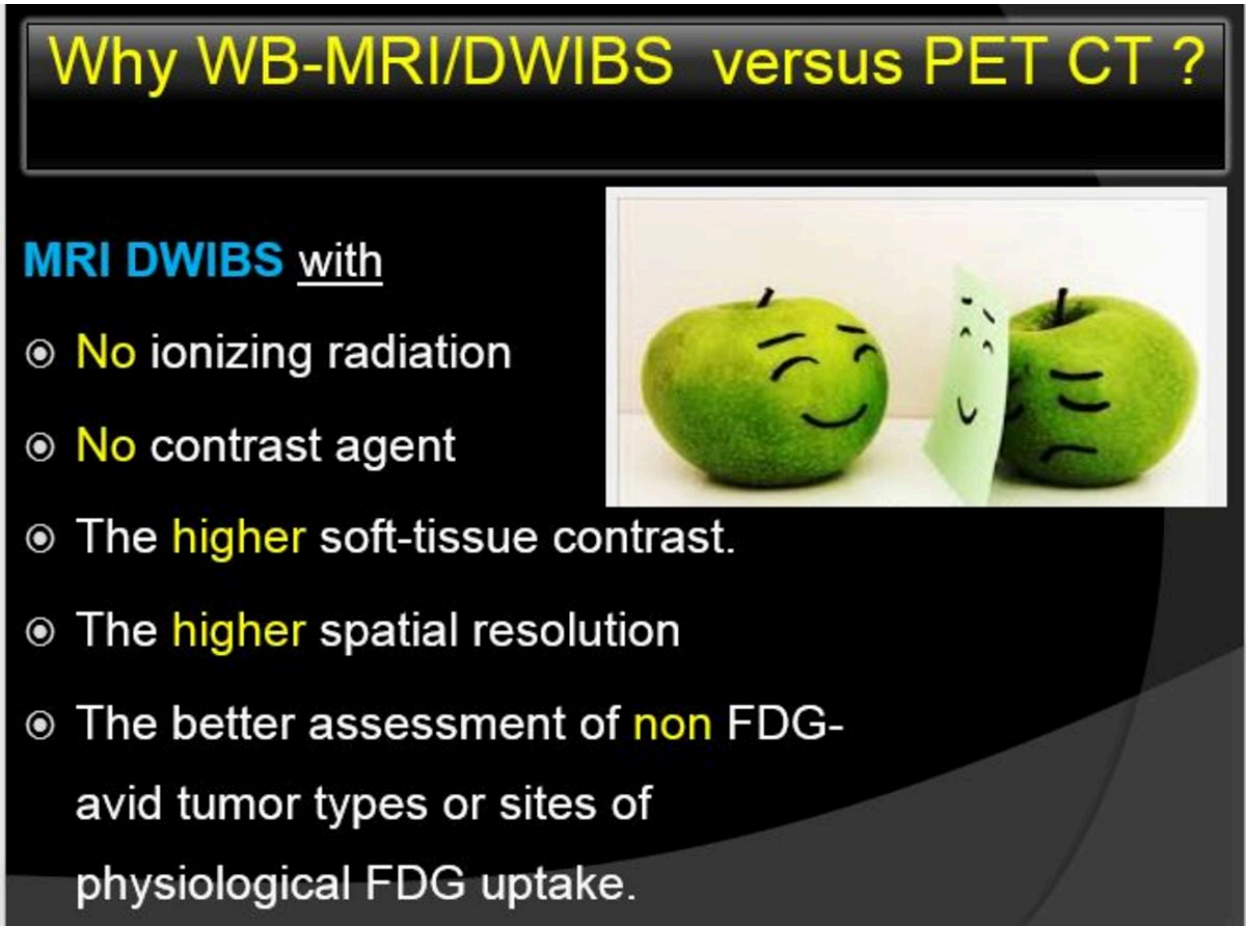

Fig. 6: CONS VS PROS

Conclusion

WB-MRI/DWIBS is a promising tool in evaluation of liver metastasis in breast cancer patient.

CLINICAL RELEVANCE/APPLICATION

Easy technique for detection and assessment of metastasis with no radiation exposure or contrast agents.

References

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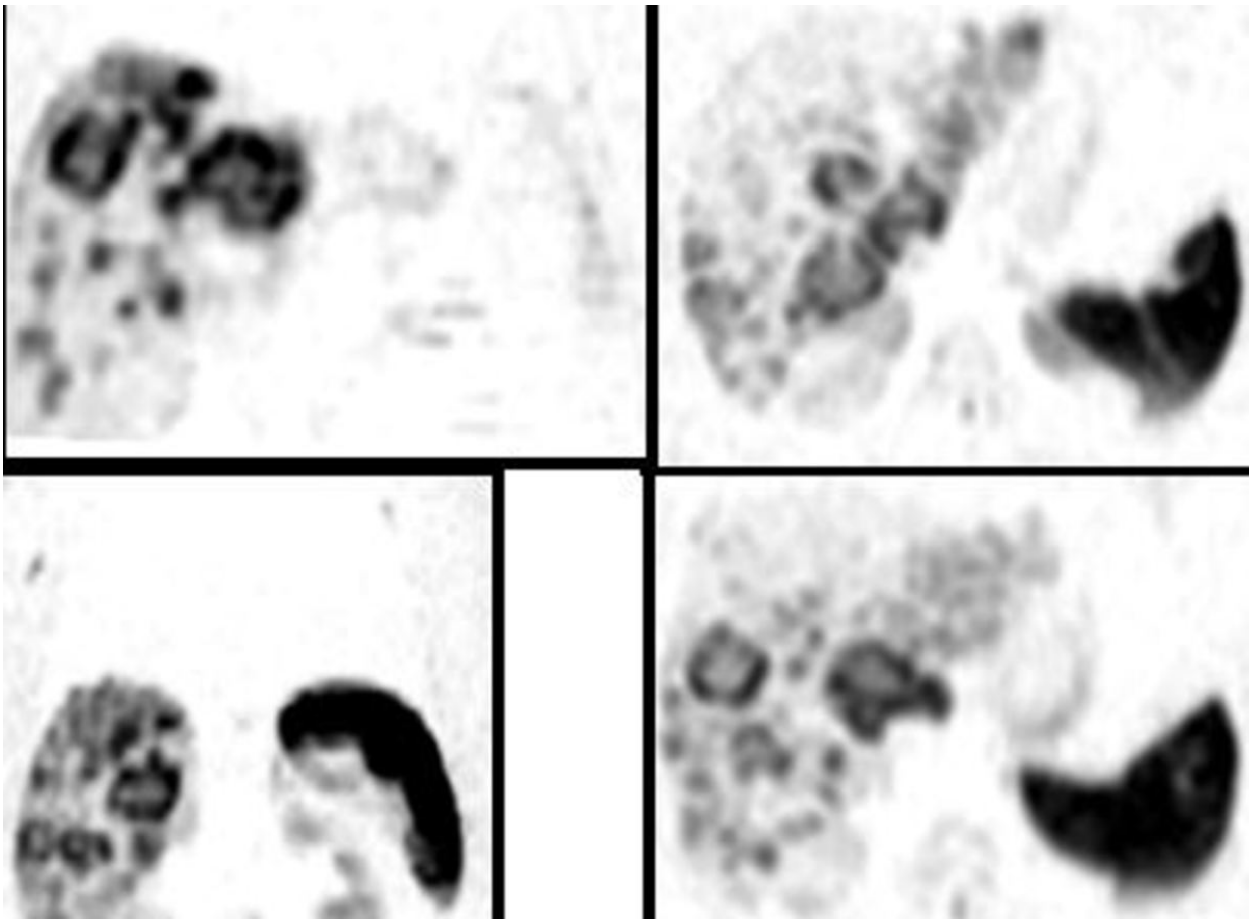

Fig. 1: DWIBS images show multiple metastatic lesions with restricted DWI signals

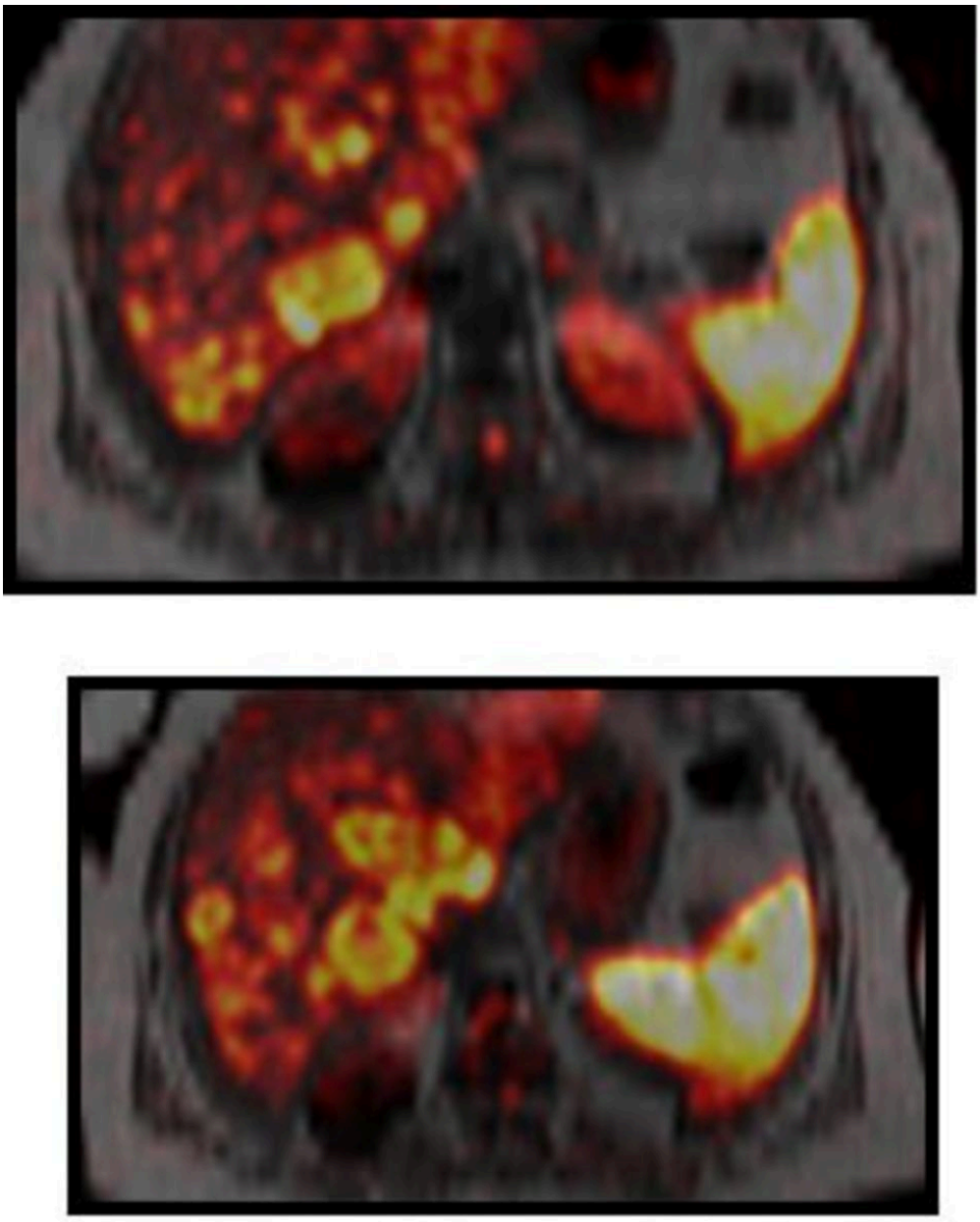

Fig. 2: T1/DWIBS fused images show multiple metastatic lesions with restricted DWI signals

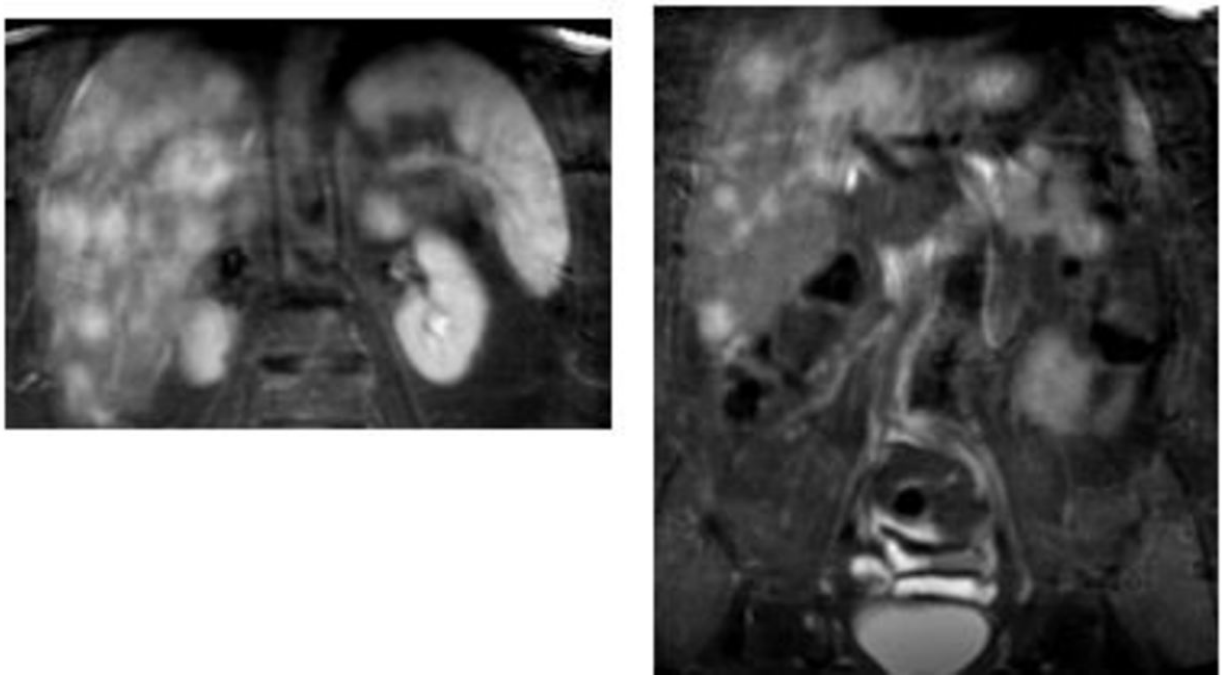

Fig. 3: DWIBS images show multiple metastatic lesions with restricted DWI signals