Whole Body Diffusion Weighted MRI compared to 18F-FDG Position Emission Tomography for the detection and localization of malignant lesions

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PURPOSE

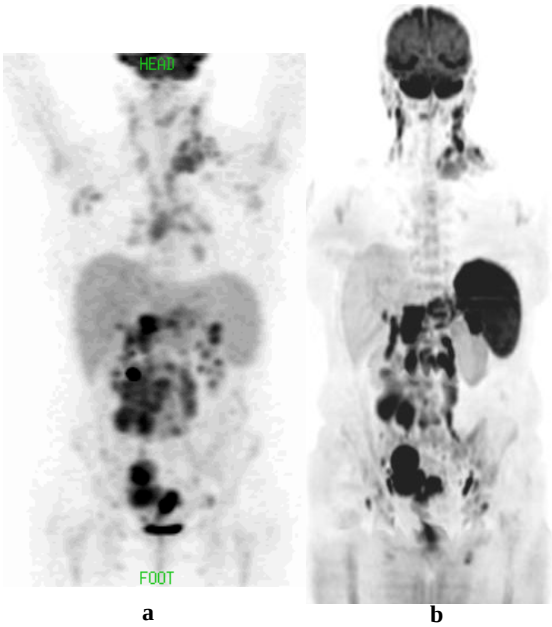
There are many reports on the usefulness of Diffusion weighted Imaging (DWI) with high b-values in the detection of malignant tumors in chest and abdomen [1-2]. The purpose of this study was to investigate the potential usefulness of whole body diffusion weighted imaging (DWI) in the detection and localization of malignant tumors. For clinical evaluation, we compare this new technique to the well established Fluorine-18 Fluoro-deoxyglucose (^{18}F-FDG) positron Emission tomography (PET)/Computed Tomography (CT).

MATERIAL AND METHODS

Twenty patients (11 man, mean age 60, range 41 to 81) were included in this study. The diagnoses were as follows: 10 with lung cancer (6 first diagnostic), 6 with lymphoma (one first diagnostic), 1 breast cancer (follow up), 1 uterus cancer (initial dignostic), 1 Sipple syndrome (suspected recurrence) and 1 anal cancer (suspected recurrence). All malignant lesions were histopathologically confirmed.

PET/CT imaging was performed on a PHILIPS GEMINI GXL 16 Channel. After at least 6 h of fasting, and one hour rest before imaging, each patient was injected with 5 MBq/Kg of ^{18}F-FDG before imaging using a 512x512 matrix, 5mm slice thickness, 0.9 pitch and 1.3 in-plane resolution. The parameters for CT were 120 Kv, 80 mAs.

DWI MR imaging was performed using a 1.5-T clinical imager (Vanatge Toshiba, Tokyo), equipped with a total of 128-element coil (Atlas SPEEDER coil) on a 16-receiver system. Four separate stations of 45 axial slices each were acquired to cover the head to upper legs with free breathing using a single shot EPI sequence with inversion pulse and the following parameters: TR= 6900 ms, TE=70ms, TI=170ms, matrix =128 x 128; FOV= 40x40, slice thickness= 10, slice overlap=3 mm, in plane resolution 1.6 x 1.6, NAQ= 2, b = 1000 sec /mm2; SPEEDER Factor = 2, time= 2 mn 12s.
The mean time-interval between PET and MR examinations was 17 days. The PET images were analyzed quantitatively by a nuclear medicine physician who measured the standardized uptake value (tumor activity concentration/injected dose per body weight). All DWI images were visually analyzed by 2 experienced radiologists. Positive/negative reversal display was used for identifying the lesions on the volumetric data, and MIP display was used to obtain an overall understanding of the lesion. The 18F-FDG *vs.* DWI comparison was later on carried out by the three medical doctors (the same 2 radiologists and the nuclear medicine physician).



a **b**

Fig 1: A 65 year old women with a non-Hodgkinian malignant lymphoma who was treated but referred back for suspicion of recurrence. (a) 18F-FDG uptake image (b) DWI images MIP with reversed gray scale display. The patient presented a diffuse recurrence.

RESULTS

It is very important to be aware of the typical distributions of ^{18}F-FDG accumulation and DWI hyperintensities in the normal subjects: ^{18}F-FDG accumulates typically in the brain, heart liver, kidney and urinary bladder, while typical DWI hyperintensities are found in the brain, spinal cord, superficial lymph node, bone marrow (especially in young subjects), spleen, ovaries, prostate, penis and testis [3]. Figure 1 shows an example of a 65 year old patient with non-Hodgkinian lymphoma.

Twenty three malignant lesions were detected on ^{18}F-FDG PET/CT images. On DWI, 22 out of the 23 lesions were clearly detected; a small pulmonary lesion located against the anterior wall of the left lung was not seen on the MIP image but could be seen on the original axial slices. A cerebral metastasis lesions was found in DWI image, confirmed by T1-weighted gadolinium enhanced image but not seen on the PET image. The number of mediastinal lymph nodes detected on PET/CT images was often larger than the number of nodes detected on DWI images.

CONCLUSION

This preliminary study demonstrated a very good agreement between PET/CT and whole body diffusion in the detection of malignant lesions (especially for pulmonary lesions). DWI was slightly less sensitive for mediastinal lymph node but for cerebral lesions, it proved to be superior to PET/CT. A better spatial resolution, namely a lower slice thickness (at the cost of a slight increase of scan time), might further improve the outcome.

The whole body DWI is a very interesting and promising technique. Being non-invasive and less costly it could be very well used for screening, the detection and localization of lesions and in follow-up of patients.

REFERENCES

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