

# Whole-Body MRI vs. Co-registered Whole-Body FDG-PET with MRI (PET/MRI) vs. Integrated FDG-PET/CT: Capability of Clinical Stage and Operability Assessments in Non-Small Cell Carcinoma

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**Introduction:** Accurate tumor staging is essential for choosing the appropriate treatment strategy for non-small cell lung cancer (NSCLC) patients. In the last decade, FDG-PET/CT and whole-body MR imaging (MRI) without and with diffusion-weighted imaging on 1.5T or 3T MR systems have been suggested as useful in this setting, although previous whole-body MRIs were examined by body coil without parallel imaging capability (1-3). Recently, 3T MR systems from a few vendors are available to apply multiple array coil with parallel imaging capability, and improve spatial and temporal resolutions in various examination purposes. In addition, quick and segmented 3D T1-weighted gradient echo sequence (Quick 3D) and double fat suppression pulse technique (DFS) has been suggested as useful for improving diagnostic capability of whole-body MRI in routine clinical practice (4). In this situation, integrated and co-registered whole-body FDG-PET/MRI are also available in routine clinical practice, and suggested as useful for oncologic patients as well as FDG-PET/CT (5). However, no direct comparison for clinical stage and operability assessment capability has been made among whole-body MRI, co-registered FDG-PET/MRI and integrated FDG-PET/CT examinations in NSCLC patients.

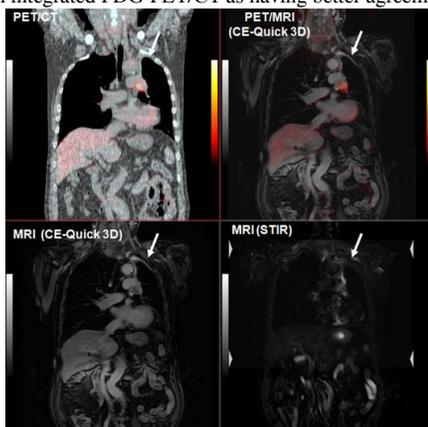
We hypothesized that whole-body MRI at 3T MR system, which is utilized multiple array coil with parallel imaging capability and Quick 3D sequence with DFS technique, has equal to or better potential for T, N and M factors and operability assessments in NSCLC patients than co-registered FDG-PET/MRI and integrated FDG-PET/CT. The purpose of this study was to directly compare the capability for clinical stage and operability assessments among whole-body MRI, co-registered FDG-PET/MRI and integrated FDG-PET/CT in NSCLC patients.

**Materials and Methods:** 70 consecutive pathologically diagnosed NSCLC patients (43 males, 37 females; mean age 74 years) prospectively underwent standard whole-body MRI, which was consisted with STIR and non-CE- and CE-Quick 3D and DFS, FDG-PET/CT, conventional radiological examination, pathological examination, surgical or conservative treatments, and more than 2-year follow-up examinations. All whole-body 3T MRIs were obtained by using a 3T MR system (Vantage Titan 3T, Toshiba Medical Systems) with multi-channel whole-body coil as having parallel imaging capability (Atlas SPEEDER coil, Toshiba). Based on the results of preoperative radiologic and postoperative pathological examination, 24 of the patients were diagnosed with stage IA, 5 with stage IB, 13 with stage IIA, nine with stage IIB, 5 with stage IIIA, 6 with stage IIIB, and 8 with stage IIV diseases. Final diagnosis in each patient was determined according to the results of all preoperative and postoperative examinations by tumor board meeting. All whole-body MRI, co-registered PET/MRI and integrated PET/CT were independently evaluated by two chest radiologists with more than 8 years whole-body MRI experiences, two MR physicians with more than 3 years PET experiences and two PET physicians with more than 10 years CT examinations. In each patient, all readers evaluated T, N and M factors and clinical stage according to "The 7th lung cancer TNM classification and staging system (UICC)". Final clinical stage and operability assessments in each patient were made by consensus of two readers.

To evaluate interobserver agreement on each modality, weighted kappa statistics for T, N and M factors were used on a per patient basis. For determination of agreement between clinical stage and final diagnosis, weighted kappa statistics were also performed. On comparison of diagnostic capability for operability assessment (stage I or II vs. stage III or IV) among all methods, sensitivities, specificities and accuracies were statistically compared each other by using McNemar's test. A p value less than 0.05 was considered statistically significant for all statistical analyses.

**Results:** Representative case is shown in Figure 1. Interobserver agreement on each method was assessed as almost perfect (0.80<kappa<0.94). The agreement between clinical stage and final diagnosis on all modalities were also assessed as follows: whole-body MRI, kappa=0.87; co-registered PET/MRI, kappa=0.87; and integrated PET/CT, kappa=0.55. Results of comparison for operability assessment among all modalities are shown in Table 1. Sensitivities and accuracies of whole-body MRI and co-registered PET/MRI were significantly higher than those of integrated PET/CT (p<0.05).

**Conclusion:** Whole-body MRI as well as co-registered FDG-PET/MRI can more sensitively and accurately evaluate clinical stage and operability in NSCLC patients than integrated FDG-PET/CT as having better agreement with final diagnosis.



**Figure 1. 73-year-old male with invasive adenocarcinoma (pT1bN2M1a; pStage IV)**

Integrated PET/CT and co-registered PET/MRI show mediastinal lymph node metastasis as high FDG uptake and pleural thickening as no FDG uptake (arrow). On the other hand, whole-body MRI also demonstrate mediastinal lymph node metastases on Quick 3D with DFS and STIR as abnormal intensities. In addition, whole-body MRI and co-registered PET/MRI demonstrate pleural thickening (arrow) with contrast-enhancement on Quick 3D with DFS and abnormal intensity on STIR. Contrast-enhancement and abnormal intensity of pleura on both modalities can easily diagnose as dissemination. This case is accurately assessed T, N and M factors and clinical stage on whole-body MRI and co-registered PET/MRI, and can not be accurately evaluated by integrated PET/CT.

**Table 1. Comparison of diagnostic performance by four methods for operability assessment in NSCLC patients.**

	SE (%)	SP (%)	PPV (%)	NPV (%)	AC (%)
<b>Whole-Body MRI</b>	100 (51/51)	84.2 (16/19)	94.4 (51/54)	100 (16/16)	95.7 (67/70)
<b>Co-registered FDG-PET/MRI</b>	100 (51/51)	84.2 (16/19)	94.4 (51/54)	100 (16/16)	95.7 (67/70)
<b>Integrated FDG-PET/CT</b>	86.3*, ** (44/51)	84.2 (16/19)	93.6 (44/47)	69.6 (16/23)	85.7*, ** (60/70)

SE: sensitivity, SP: specificity, PPV: positive predictive value, NPV: negative predictive value, AC: accuracy

\*: Significant difference with whole-body MRI (p<0.05). \*\*: Significant difference with co-registered PET/MRI (p<0.05).

## References:

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