STIR Turbo SE Imaging vs. Co-registered FDG-PET/CT: Quantitative and Qualitative Assessment of N-stage in Non-small Cell Lung Cancer Patients

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Introduction: In non-small cell lung cancer (NSCLC) patients, involvement of mediastinal lymph nodes is a very important prognostic factor. Therefore, FDG-PET or PET/CT has been widely utilized for this purpose (1, 2). However, some other investigators have suggested the limitation of FDG-PET or PET/CT due to the overlap of glucose metabolism between metastatic lymph nodes and inflammatory lymph nodes. Recently, STIR turbo spin-echo imaging (STIR MRI) has been reported as useful for quantitative and qualitative assessments of N-stage in lung cancer patients due to less overlap of signal intensity between metastatic lymph nodes and inflammatory lymph nodes (3, 4). However, we have not directly compared their diagnostic capabilities. Therefore, the purpose of the present study was to compare the diagnostic capability of mediastinal and hilar lymph node metastasis between STIR MRI and co-registered FDG-PET/CT.

Methods and Materials: 115 consecutive patients with NSCLC (59 male and 56 female; mean age, 68 years; age range, 35-81 years) underwent STIR MRI, contrast-enhanced MSCT, FDG-PET, surgical resections and pathological examinations. STIR MRI was acquired by using the centrically-reordered multi-shot black-blood STIR turbo SE with sensitivity encoding (SENSE) (TR=2-3 <R-R> ms, TE_{eff}=8 ms, TI=150 ms, reduction factor=4) sequence using 4-channel SENSE body coil at 1.5 T scanner (Gyroscan Intera, Philips Medical Systems). In each patients, STIR MRI was obtained with 0.9% normal saline phantom on the chest wall, and all STIR MRIs were acquired with breath-holding at end-inspiration. All contrast-enhanced CT and FDG-PET examinations were performed by using a 16-slice MSCT scanner and a PET scanner, and automatically co-registered by using the commercially available software.

For quantitative assessments of STIR MRI and PET/CT, ratios of signal intensity of lymph nodes to 0.9 % saline phantoms (lymph node-saline ratio: LSR) and SUVs of each lymph node were determined by using ROI measurement. For qualitative assessment of signal intensity and FDG uptake of each lymph node, 5-point visual scoring systems were adapted according to the past literatures. Then, feasible threshold values of quantitatively and qualitatively analyzed STIR MRI and FDG-PET/CT were determined by using ROC-based positive test on per node basis. Finally, diagnostic capability of N-stage by adaptation of each feasible threshold value was compared by McNemar test on per patient basis.

Results: All MSCT, MR examinations, FDG-PET and pathological examinations and co-registration between MSCT and FDG-PET were completed successfully. Representative examples are shown in Figure 1 and 2. The results of the ROC-based positive test on a per node basis are shown in Figure 3. Feasible threshold values of quantitatively and qualitatively assessed STIR MRI and PET/CT were determined as follows: LSR, 0.6; visual score of STIR MRI, 4; SUV, 2.0; and visual score of PET/CT, 4.

The results of comparison of diagnostic capability among quantitatively and qualitatively analyzed STIR MRI and FDG-PET/CT on per patient basis were shown in Table 1. When feasible threshold values were adapted, sensitivity and accuracy of quantitatively assessed STIR MRI were significantly higher than those of quantitatively and qualitatively assessed FDG-PET/CT on per patient basis ($p<0.05$). In addition, sensitivity of qualitatively assessed STIR MRI was also significantly higher than that of qualitatively assessed FDG-PET/CT on per patient basis ($p<0.05$).

Conclusion: STIR MRI is useful for diagnosis of N-stage in non-small cell lung cancer patients, when compared with FDG-PET/CT.

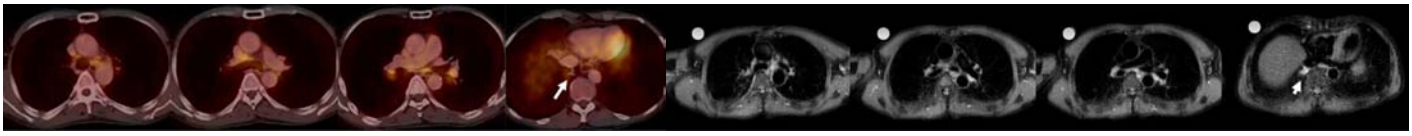

Fig. 1A **Fig. 1B**

Figure 1. 66-year-old male patient with mediastinal and hilar lymph node metastases (N3) from an adenocarcinoma in the right lower lobe.

A: On FDG-PET/CT, mediastinal and hilar lymph nodes demonstrated high SUVs (ranged 2.3-4.0) and high uptakes of FDG (scored as 4 or 5), and diagnosed as N3; tumor was seen (arrow). B: On STIR MRI**,** mediastinal and hilar lymph nodes demonstrated high LSRs (ranged 0.62-0.95) and high signal intensity (scored as 4 or 5), and also diagnosed as N3 stage; tumor was also seen (arrow).

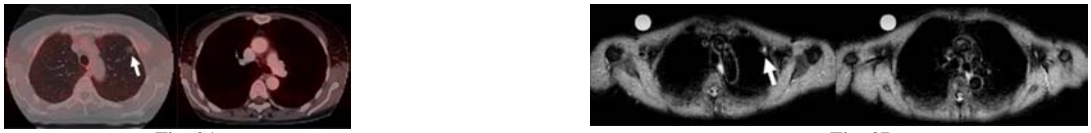

Fig. 2A **Fig. 2B**

Figure 2. 59-year-old female patient without mediastinal and hilar lymph node metastases (N0) from a bronchioalveolar carcinoma in the left upper lobe.

A: On FDG-PET/CT, mediastinal and hilar lymph nodes demonstrated low SUVs (ranged 0.5-1.2) and low uptakes of FDG (scored as 2 or 3), and diagnosed as N0; tumor was seen (arrow). B: On STIR MRI, mediastinal and hilar lymph nodes demonstrated low LSRs (ranged 0.13-0.54) and low signal intensity (scored as 2 or 3), and also diagnosed as N0; tumor was also seen (arrow).

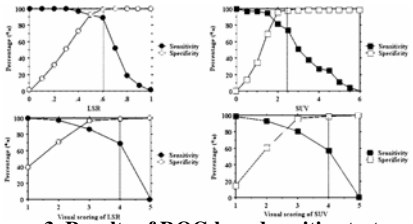

Figure 3. Results of ROC-based positive test.

Table 1. Comparison of diagnostic capability in each method on a per patient basis

Modality	Method	SE (%)	SP (%)	PPV (%)	NPV (%)	AC (%)
STIR MRI	*Quantitative*	90.1 (39/43)	90.3 (65/72)	83.0 (39/47)	95.6 (65/68)	90.4 (104/115)
	Qualitative	83.7 (36/43)	87.5 (63/72)	78.2 (36/46)	91.3 (63/69)	86.0 (99/115)
FDG-PET/CT	*Quantitative*	72.0* (31/43)	90.3 (65/72)	75.6 (31/41)	87.8 (65/74)	83.5* (96/115)
	Qualitative	69.8*, ** (30/43)	90.3 (65/72)	75.0 (30/40)	86.7 (65/75)	82.6* (95/115)

SE: Sensitivity
SP: Specificity
PPV: Positive predictive value
NPV: Negative predictive value
AC: Accuracy
*: Significant difference with quantitatively assessed STIR turbo SE imaging ($p<0.05$).
**: Significant difference with qualitatively assessed STIR turbo SE imaging ($p<0.05$).

References:

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