

Differentiation of Metastatic vs. Non-metastatic Mediastinal Lymph Nodes in Patients with Non-small Cell Lung Cancer using Respiratory-Triggered STIR Turbo Spin-Echo MR Imaging

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We hypothesized that STIR turbo SE imaging can differentiate metastatic lymph nodes from non-metastatic lymph nodes. One hundred and forty pathologically diagnosed mediastinal lymph nodes in 25 lung cancer patients were examined by respiratory-triggered STIR turbo SE imaging. Signal intensity of lymph nodes were normalized by signal intensity of saline phantom (LSR). LSR of the metastatic lymph node group was significantly higher than that of the non-metastatic lymph node group ($p < 0.0001$). With 0.6 as the threshold value of LSR, diagnostic accuracy of metastatic lymph nodes was 96%. In conclusion, respiratory-triggered STIR turbo SE imaging can differentiate between metastatic lymph nodes and non-metastatic lymph nodes.

Introduction

Accurate tumor staging is essential for choosing the appropriate treatment strategy for lung cancer patients. Due to the substantial limitation of CT and MR imaging in depicting mediastinal lymph node metastases, mediastinoscopic biopsy is necessary for an adequate assessment of hilar and mediastinal nodes [1]. On the other hand, promising results using positron emission tomography (PET) with 2-[fluorine-18] fluoro-2-deoxy-D-glucose (FDG) or [carbon-11]-chorine have been reported. Elevated levels of glucose metabolism indicates a tumor, but could also be a result of infectious and inflammatory processes [2]. Moreover, spatial resolution in PET images is inferior to that of CT and MR. Therefore, the diagnostic capability of the FDG-PET imaging is also limited.

Recently, some investigators have discussed the utility of short inversion time (TI) inversion recovery (STIR) imaging for the detection of metastatic tumors and metastatic lymph nodes [3]. The STIR turbo spin-echo (SE) is a simple sequence which can be easily incorporated into clinical protocol.

In the present study, we hypothesized that metastatic vs. non-metastatic lymph nodes in patients with non-small cell lung cancer were well differentiated using respiratory-triggered STIR turbo SE imaging.

Materials and Methods

One hundred and forty pathologically diagnosed mediastinal lymph nodes in 25 non-small cell lung cancer patients (19 males, 6 females; mean age, 64.5 years) were included in this study. MR images were performed on a 1.5 T superconducting magnet (Gyroscan ACS-NT; Philips Medical systems, Best, The Netherlands) using a body coil. Axial respiratory-triggered STIR turbo SE images (TR=2569-2721 ms, TE_{eff}=15 ms, TI=150 ms, echo train length=5, number of excitation=2, slice thickness=8 mm, slice gap=1.6 mm, matrix=256x208, field of view = 320 mm) were obtained with a 0.9% saline phantom of the chest wall. On STIR images, signal intensities (SIs) were measured from circular or oval (occasionally, cross-sections of nodes which were nonspherical) regions of interest (ROIs) drawn over the mediastinal lymph nodes and 0.9% saline phantom.

To compare the difference in signal intensity of metastatic and non-metastatic lymph nodes, all signal intensities of lymph nodes were normalized by 0.9% saline phantoms (lymph node-saline ratio: LSR). The significance of the difference in LSRs between the two groups was analyzed by means of the Student's t-test.

Receiver operating characteristic (ROC) analysis was used to evaluate the effectiveness of the LSR as a marker for metastatic lymph nodes versus non-metastatic lymph nodes. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated for each level of LSR by varying the lymph node-saline ratio that signified a positive test (threshold value). On all statistical analyses, a p value less than 0.05 was considered significant.

Results

Twenty-one of 140 lymph nodes were pathologically diagnosed as metastatic lymph nodes, and 119 lymph nodes were diagnosed as non-metastatic lymph nodes including 5 inflammatory nodes (lymphatic edema: n=4, and sarcoid reaction: n=1), 29 silicotic nodes, 24 calcified nodes, 17 anthracosilicotic nodes, 14 fibrotic nodes, 8 coagulation necroses, and 22 normal lymph nodes.

The mean LSR of the metastatic lymph node group was significantly higher than that of the non-metastatic lymph node group ($p < 0.0001$) (Fig. 1). Representative cases of lymph node with metastasis are shown in Figure 2. Representative cases of lymph node without metastasis are shown in Figure 3. When 0.6 was adopted as the threshold value of LSR, sensitivity, specificity, and accuracy of differentiation of metastatic lymph nodes from non-metastatic lymph nodes were 100%, 96% and 96%, respectively (Fig. 4).

Conclusion

Metastatic vs. non-metastatic lymph nodes in patients with non-small cell lung cancer were well differentiated using respiratory-triggered STIR turbo SE imaging. Respiratory-triggered STIR turbo SE imaging is able to improve diagnostic capability in lymph node metastasis.

References

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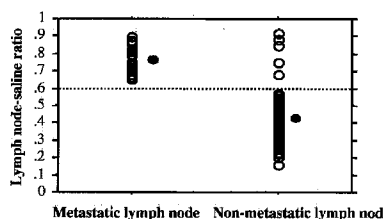


Figure 1. The results of lymph node-saline ratios of all cases. Mean and SE are also expressed.

The mean LSR of metastatic lymph nodes was significantly higher than that of non-metastatic lymph nodes ($p < 0.0001$).



Figure 2. A 73-year-old male with metastatic lymph nodes from squamous cell carcinoma.

Respiratory triggered STIR turbo SE image demonstrates the right pretracheal node as high signal intensity. The lymph node-saline ratio is 0.68.

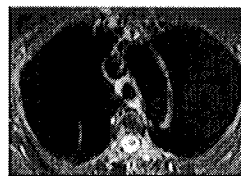


Figure 3. A 68-year-old female with lymph node without metastasis from adenocarcinoma.

Respiratory triggered STIR turbo SE image demonstrates the right pretracheal node as low signal intensity. The lymph node-saline ratio is 0.32.

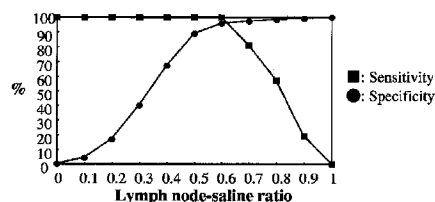


Figure 4. Analysis of sensitivity and specificity of lymph node-saline ratio as a marker for lymph nodes with metastasis versus lymph nodes without metastasis.