EVALUATION OF SOLITARY PULMONARY NODULES

PJR Jan - Mar 2008; 18(1): 30-32

Commentary

Evaluation of solitary pulmonary nodules poses a great challenge to both radiologists and oncologists. Chest computed tomography along with PET is considered the standard technique for nodule assessment. Although the clinical role of magnetic resonance imaging for pulmonary nodule remains limited, considerable advancement has occurred in MRI of thoracic diseases especially after the advent of newer techniques. MRI can be used to differentiate benign versus malignant, based on tumor vascularity, interstitium and vascular endothelial growth factor expression that can be used for predicting survival outcome and treatment response. Abstracts from three articles from recent issues of American journal of Roengenology, all highlighting the various techniques of Magnetic resonance imaging (MRI) used for detection and characterizing pulmonary nodules are included here.

The paper by Satoh et al demonstrate that diffusion weighted MRI can differentiate malignant pulmonary nodule from benign pathologies. Although this is a small study comprising only 44 patients and majority nodules are greater than 30mm that can be easily evaluated with other easily available imaging modalities and diffusion imaging was unable to differentiate malignancy from benign pathology in 20 mm or less in size pulmonary nodules. The reported specificity for greater than 20 mm nodule is only 33.3% which is quite embarrassing for a diagnostic test. Dynamic contrast MRI is another technique for pulmonary nodule assessment. Zou et al concluded that dynamic MRI is useful tool for differentiating benign pulmonary nodules from malignancy. Although there are statistical problems with the way results are presented and interpreted it nevertheless highlights another tool in the radiologists may use to answer the question. Although dynamic MRI values of benign lesion were different from rest of the population but it was unable to differentiate malignancy from active inflammatory lesions.

Fujimoto et al reporting the usefulness of dynamic MRI in differentiating benign from malignant pulmonary nodules. Enhancement characteristic of malignant lesion was different from benign inactive pulmonary lesion however they did report their findings in the active inflammatory lesion, which is of special interest to as tuberculosis is endemic in our population . This study demonstrated good sensitivity, specificity and accuracy of dynamic MRI for the assessment of pulmonary nodule.

Waseem Akhtar
Senior instructor Radiology
Aga khan university hospital, Karachi

American Journal of Roengenology August 2008

Shiro Satoh[1], Yoshio Kitazume[1], Shinichi Ohdama[2,3], Yuji Kimula[4,5], Shinichi Taura[1] and Yasuyuki Endo[2,6]

[1] Department of Radiology, Ohme Municipal General Hospital, 4-16-5, Higashi-Ohme, Ohme City, Tokyo 198-0042, Japan.
[2] Department of Pulmonary Medicine, Ohme Municipal General Hospital, Ohme City, Tokyo, Japan.
[3] Present address: Department of Pulmonary Medicine, National Printing Bureau Tokyo Hospital, Tokyo, Japan.
[4] Department of Pathology, Ohme Municipal General Hospital, Ohme City, Tokyo, Japan.
[5] Present address: Department of Pathology, Kurashiki Medical Center, Kurashiki, Japan.
[6] Present address: Department of Pulmonary Medicine, Graduate School of Tokyo Medical and Dental University, Tokyo, Japan.

Can Malignant and Benign Pulmonary Nodules Be Differentiated with Diffusion-Weighted MRI?

OBJECTIVE. The objective of our study was to evaluate whether diffusion-weighted imaging (DWI) with a high b factor can be used to differentiate malignancies from benign pulmonary nodules.

MATERIALS AND METHODS. This study included 54 pulmonary nodules (5 mm in diameter) in 51 consecutive patients (37 men, 14 women; mean age, 65.7 years; age range, 31–88 years). Thirty-six (67%) of the 54 pulmonary nodules were malignant, and 18 (33%) were benign. Two radiologists independently reviewed the signal intensity of the nodules on DWI with a b factor of 1,000 s/mm2 using a 5-point rank scale without knowledge of clinical data. This scale was based on the following scores: 1, nearly no signal intensity; 2, signal intensity between 1 and 3; 3, signal intensity almost equal to that of the thoracic spinal cord; 4, higher signal intensity than that of the spinal cord; and 5, much higher signal intensity than that of the spinal cord. The Mann-Whitney U test and the receiver operating characteristic (ROC) curve were used to calculate the difference between the scores of malignant and benign nodules.

RESULTS. On DWI, the mean score of malignant pulmonary nodules (4.03 ± 1.16 [SD]) was significantly higher ($p < 0.01$) than that of benign nodules (2.50 ± 1.47), with an area under the ROC curve of 0.796 (95% CI, 0.665–0.927). When a score of 3 was considered as a threshold, the sensitivity, specificity, and accuracy were 88.9% (95% CI, 78.6–99.2%), 61.1% (38.6–83.6%), and 79.6% (68.9–90.3%), respectively. Three small metastatic nodules (13, 16, and 20 mm) and one bronchioloalveolar carcinoma scored 1 or 2 on the 5-point rank scale. Three granulomas, two active inflammatory lung nodules, and one fibrous nodule scored 4 or 5.

CONCLUSION. The signal intensity of pulmonary nodules may be useful for malignant and benign differentiation on DWI. However, the interpretation of small metastatic nodules, nonsolid adenocarcinoma, some granulomas, and active inflammatory nodules should be approached with caution.

American Journal of Roengenology July 2008; 191:252-259

Yu Zou[1], Minming Zhang[1], Qidong Wang[1], Desheng Shang[1], Lijun Wang[2] and Guowei Yu[3]

[1] Department of Radiology, First Affiliated Hospital, College of Medicine, Zhejiang University, 79 Qinchun Rd., Hangzhou, Zhejiang Province China.
[2] Department of Pathology, First Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou, China.
[3] Department of Thoracic and Cardiovascular Surgery, First Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou, China.

Quantitative Investigation of Solitary Pulmonary Nodules: Dynamic Contrast-Enhanced MRI and Histopathologic Analysis

OBJECTIVE. The purposes of this study were to analyze the relation between enhancement patterns on dynamic enhanced MRI and histologic microvessel patterns of solitary pulmonary nodules (SPNs) and to address the topic of false-positive findings in differentiating SPNs with dynamic MRI.

SUBJECTS AND METHODS. Sixty-eight patients with 68 pathologically proven SPNs (diameter 30 mm) underwent dynamic 1.5-T MRI. On time–signal intensity curves generated after bolus injection of contrast material, steepest slope, peak height, and enhancement ratios of signal intensity at the first, second, and fourth minutes were calculated. The relation between dynamic MRI values and microvessel density was analyzed. The morphologic differences between malignant SPNs and active inflammatory SPNs also were analyzed. Threshold dynamic MRI values for differential diagnosis were determined.

RESULTS. The dynamic MRI values of benign SPNs were significantly lower than those of the other SPNs ($p < 0.01$). The enhancement ratio at the fourth minute for active inflammatory SPNs was significantly higher than that of malignant SPNs ($p < 0.01$). A high correlation coefficient ($r = 0.87$, $p < 0.001$) was found between steepest slope and microvessel density. With steepest slope 1.5%/s or less, benign SPNs were clearly differentiated from other SPNs. With enhancement ratio at the fourth minute 65% or less, malignant SPNs were differentiated from active inflammatory SPNs with high sensitivity (93%) and high specificity (100%).

CONCLUSION. Dynamic MRI values reflect the quantitative and morphologic characteristics of microvessels in SPNs and are a useful tool for differentiating SPNs with little overlap.

American Journal of Roengenology Jan 2007; 188:26-36

Rei Kono[1], Kiminori Fujimoto[1], Hiroshi Terasaki[1], Nestor L. Müller[2], Seiya Kato[3], Junko Sadohara[1], Naofumi Hayabuchi[1] and Shinzo Takamori[4]

[1] Department of Radiology, Kurume University School of Medicine, 67 Asahi-machi, Kurume, Fukuoka 830-0011, Japan.
[2] Department of Radiology, Vancouver General Hospital and University of British Columbia, Vancouver, BC, V5Z 1M9, Canada.
[3] Department of Pathology, Kurume University School of Medicine, Kurume, Japan.
[4] Department of Surgery, Kurume University School of Medicine, Kurume, Japan.

Dynamic MRI of Solitary Pulmonary Nodules: Comparison of Enhancement Patterns of Malignant and Benign Small Peripheral Lung Lesions

OBJECTIVE. The purpose of this study was to compare the dynamic contrast-enhanced MRI enhancement characteristics of malignant and benign solitary pulmonary nodules.

MATERIALS AND METHODS. The characteristics of 202 solitary pulmonary nodules (diameter, 1-3 cm; 144 cases of primary lung cancer, 31 cases of focal organizing pneumonia, 15 tuberculomas, 12 hamartomas) were reviewed retrospectively. In all cases dynamic MR images were obtained before and 1, 2, 3, 4, 5, 6, and 8 minutes after bolus injection of gadopentetate dimeglumine. Maximum enhancement ratio, time at maximum enhancement ratio, slope of time-enhancement ratio curves, and washout ratio were assessed. Statistical analyses were performed with the Kruskal-Wallis test with Bonferroni correction, chi-square test, and receiver operating characteristic curves.

RESULTS. For 122 (85%) of 144 primary lung cancers, time at maximum enhancement ratio was 4 minutes or less. For all tuberculomas and hamartomas, time at maximum enhancement ratio was greater than 4 minutes or gradual enhancement occurred without a peak time ($p < 0.0001$). Lung cancers had different maximum enhancement ratios and slopes than benign lesions (all $p < 0.005$). With 110% or lower maximum enhancement ratio as a cutoff value, the positive predictive value for malignancy was 92%; sensitivity, 63%; and specificity, 74%. With 13.5%/min or greater slope as a cutoff value, sensitivity, specificity, positive predictive value, and negative predictive value for malignancy were 94%, 96%, 99%, and 74%, respectively.

CONCLUSION. Dynamic contrast-enhanced MRI is helpful in differentiating benign from malignant solitary pulmonary nodules. Absence of significant enhancement is a strong predictor that a lesion is benign.