

学位論文の要旨

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学位論文名 Breast 3 T-MR Imaging: Indication for Stereotactic Vacuum-Assisted Breast Biopsy
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論文内容の要旨

INTRODUCTION

Percutaneous imaging-guided breast biopsy is widely used to evaluate predominantly impalpable breast lesions. There has been steady development of percutaneous biopsy techniques and stereotactic vacuum-assisted breast biopsy (SVAB) has been established as a reliable method for the diagnosis of impalpable lesions with microcalcification detected by mammography. Because of the wider adoption of mammography, an increasing number of women with microcalcification on mammography are undergoing SVAB for more detailed examination. SVAB is much less invasive than conventional open biopsy. However, it still involves physical and mental burdens for the patient, so it is important to avoid unnecessary procedures.

Breast magnetic resonance (MR) imaging has increasingly been performed over the past 10 years because of its well-documented high sensitivity for detecting breast cancer, especially occult tumors missed by conventional imaging modalities. Since malignant tumors typically exhibit increased vascularity, an early remarkable enhancement and some specific pattern of contrast enhancement, an essential part of many breast MR studies is T1-weighted dynamic contrast-enhanced imaging. In recent years, MR scanners with stronger magnetic fields (such as 3 T scanners) and thus a higher signal-to-noise ratio have become more widely available and have opened up new horizons for contrast-enhanced breast MR imaging.

The purpose of this study was to assess indications for SVAB evaluated by breast 3 T- MR imaging in patients showing suspicious microcalcifications on mammography and negative ultrasound (US) findings.

MATERIALS AND METHODS

Fifty-five patients with 55 breast lesions showing suspicious microcalcifications on mammography and negative US findings underwent preoperative breast MR examinations. All

patients underwent SVAB within 1 month of MR imaging. The pathological diagnosis of each breast lesion was made by examining tissues obtained by SVAB or radical/partial mastectomy.

MR imaging was performed using a 3T-MR system. The protocol included T1-weighted dynamic contrast-enhanced sequence.

3 T-MR imaging findings were evaluated by using the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) MRI and lesions were categorized using the flowcharts and interpretation method of previous reports. Thus we classified MR findings into five categories: category 1-2 negative/benign, category 3 probably benign and category 4-5 probably malignant/malignant. And then we were correlated with the histopathological findings. Two radiologists of experience in breast MR imaging, who made consensus decisions about the diagnosis, evaluated the contrast-enhanced MR images retrospectively.

When BI-RADS 4 and 5 MR imaging lesions were assumed to be malignant, the usefulness of 3 T-MR imaging was evaluated for diagnosis of impalpable breast lesions by SVAB among lesions with microcalcification detected by mammography and negative US findings.

The Ethics Committee of Shimane University approved this retrospective study, as the retrospective study used the past acquired image data, and the need to obtain informed consent was waived.

RESULTS AND DISCUSSION

SVAB was performed successfully in all 55 patients without any complications. Examination of the biopsy specimens revealed that 21 patients (38.2%) had carcinoma and 34 patients (61.8%) had benign disease. In the patients with malignant lesions, surgical excision was performed. The final histopathological diagnosis was invasive ductal carcinoma in five patients, ductal carcinoma in situ (DCIS) in 16 patients.

Based on MR imaging findings, 21 lesions were in categories 1 or 2, 14 lesions were in category 3, 18 lesions were in category 4, and two lesions were in category 5. The detection rate of malignancy in category 3, category 4, and category 5 was 7.1% (1/14), 94.4% (17/18), and 100% (2/2), respectively. Malignant lesions were more frequent when the MR imaging diagnosis was positive (categories 4 or 5) than when MR imaging was negative (categories 1, 2, or 3) (Fisher's exact test, $P < 0.001$). The number of benign and malignant lesions in each category was significantly different (Mann-Whitney U-test, $P < 0.001$).

If BI-RADS categories 4 and 5 were assumed to be malignant, for selecting lesions that required SVAB, 3 T-MR imaging for lesions with microcalcification had a sensitivity of 90.5%, specificity of 97.1%, positive predictive value of 95.0%, negative predictive value of 94.3%, and accuracy of 94.5%.

The one false-negative lesion (high-grade DCIS) was less than 1.0 mm in diameter on

pathology and very small clustered pleomorphic microcalcification and bilaterally symmetrical enhancement (category 2). DCIS sometimes showed poor and indistinct enhancement on MRI because of relatively poor or absent angiogenesis. Moreover, bilaterally symmetrical enhancement lowers the sensitivity of breast MR imaging in previous reports. Therefore, it should be remembered that very small calcified lesions may be false negative on MR imaging.

The one false-positive case was ductal adenoma with a linear ductal pattern of enhancement (category 4). Ductal adenomas tend to show like malignant lesions on MR imaging, it would be difficult to distinguish from malignant lesions in previous reports.

3 T-MR imaging for lesions with microcalcification had a high sensitivity, specificity, PPV, NPV, and accuracy for deciding the indication for SVAB. Therefore, 3 T-MR imaging may be useful to determine candidate lesions for SVAB after mammography detects microcalcification. When the candidate lesion shows abnormal enhancement along with calcification, it should be subjected to SVAB. If the lesion has no abnormal enhancement on MR imaging, follow up could be a good choice.

CONCLUSION

3 T-MR imaging may be useful for deciding the indications for SVAB in patients who have breast lesions with microcalcification that are impalpable and are detected by mammography and negative US findings.

論文審査及び最終試験又は学力の確認の結果の要旨

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論文審査の結果の要旨

近年、マンモグラフィ（MMG）検診の普及に伴い非触知石灰化病変が多く検出されるようになってきている。その診断にステレオガイド下吸引式乳房組織生検（SVAB）は有用であるが、侵襲を伴うため適切な症例選択が重要である。乳癌診断に従来の1.5Tと比較して3T-MRIの有用性が報告されており、本研究ではMMGで検出された乳腺石灰化病変のSVAB適応決定における3T-MRIの有用性を検討した。

MMGで検出されたカテゴリー（C）3以上の石灰化病変のうち、超音波検査で異常所見のない55症例を対象として3T-MRIの精度を検討した。MRI診断はACRのBI-RADS-MRIに基づいて評価し、C4以上を悪性、C3以下を良性と診断した。MRIで悪性と診断した症例は20例で、病理では悪性19例、良性1例（ductal adenoma）であった。MRIで良性と診断した症例は35例で、この内2例が病理では悪性であり、偽陰性2例はいずれも非浸潤性乳管癌（DCIS）であった。DCISは新生血管の増生に乏しくMRI濃染が目立たない場合がある。また背景乳腺の造影効果が目立つ場合は乳癌の検出感度が低下することが知られている。よってこのような場合は他検査との総合的な判断が必要である。3T-MRIの乳癌検出率は、感度90.5%、特異度97.1%、陽性的中率（PPV）95.0%、陰性的中率（NPV）94.3%、正診率94.5%と良好な結果が得られ、石灰化に一致したMRI濃染がある場合はSVABを積極的に施行し、ない場合は不必要な生検を回避できることを明らかにした。

本研究は乳癌の早期発見における非触知石灰化病変のSVAB適応決定に有用で臨床的に価値の高い研究であると判断した。

最終試験又は学力の確認の結果の要旨

申請者は、マンモグラフィ陽性で超音波検査陰性である非触知石灰化乳腺病変を3T-MRIを用いて評価してすぐれた乳癌検出率を示すことにより、本研究が侵襲的なSVABの的確な適応決定に有用であることを明らかにした。公開審査における質疑応答も的確で背景、関連する分野の知識も充分であり、学位授与に値すると判断した。

（主査：猪俣 泰典）

申請者は、超音波検査で描出できないマンモグラフィ陽性の非触知石灰化乳腺病変55例を3T-MRIで評価し、本法が乳癌の早期発見と不必要な生検を回避する診断ツールとして有用であることを示した。乳癌の臨床に裨益する研究であり、学位に値すると判断した。

（副査：田島 義証）

申請者は、非腫瘍形成乳癌の早期診断における3T-MRIの有効性を明らかにした。本研究は従来マンモグラフィの偽陽性患者に対し行っていた侵襲的生検術の真の適応患者を絞り込むための検査法を見出す画期的な成果を示しており、学位授与に値すると判断した。

（副査：秋山 恭彦）

（備考）要旨は、それぞれ400字程度とする。