Comparative Analysis of Imaging and Pathology Features of Mucinous Carcinoma of the Breast

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Abstract

We aimed to explore the relationship among the mammographic, magnetic resonance (MR) features, and pathological manifestations of 9 mixed mucinous breast carcinomas (MMBCs) and 18 pure mucinous breast carcinomas (PMBCs). Results revealed that mucinous breast carcinomas commonly present as masses, most of them show well circumscribed, round, or lobular shapes on mammography. The MR features of PMBC seemed to combine benign and malignant traits. Compared with other benign and malignant lesions, mucinous carcinomas display markedly high apparent diffusion coefficient (ADC) values. The statistics showed bias because the samples were limited.

Background: The purpose of the study was to explore the relationship between the mammographic features, MR features, and pathological manifestations of PMBCs and MMBCs. **Patients and Methods:** Twenty-seven cases of mucinous breast carcinoma confirmed in surgical biopsy, including 18 cases of PMBC and 9 cases of MMBC, were included (mean age, 51.2 and 53.3 years, respectively). All patients underwent preoperative mammography, and 13 of 27 patients underwent preoperative MR imaging (MRI), 4 of whom underwent diffusion-weighted imaging. All mammographic and MRI information, such as the size, shape, borders of the mass, and evidence of calcification were classified according to the American Collage of Radiology (ACR) Breast Imaging–Reporting And Data System (BI-RADS) mammography/MR lexicon. The signal intensity of the mass was visually classified as low, iso, high, strongly high, or mixed in accordance with surrounding mammary gland tissues. The pattern of internal enhancement of the mass included homogeneity, rim enhancement, central enhancement, dark internal septation, and enhancing internal septation. The kinetic curve pattern was categorized into 3 types: persistent, plateau, or washout. **Results:** There was no significant difference PMBC and MMBC in the shape of tumor, calcifications, T2 signal intensity, internal mass enhancement, kinetic curve assessment, and positivity for estrogen receptor (ER), progesterone receptor (PR), and human epidermalgrowth factor receptor-2 (HER-2). The PMBC tumors were larger than MMBC tumors ($P < .001$), and MMBC tended to present as an ill-circumscribed mass ($P = .043$). The ADC values of the 5 lesions of 4 mucinous breast carcinoma (MBCs) ranged from 0.771 to 2.252 $\times$ 10^3 mm^2/s, markedly greater than that of conventional infiltrating ductal carcinoma (IDC). The ADC values of MMBC were visibly less than those of PMBC for the former mixed with massive tumor cells of IDC. **Conclusion:** MBC commonly presented as masses with well circumscribed, round, or lobular shapes. The remaining cases presented with focal symmetry. The rate of regional nodal involvement of MBC was less than that of IDC. The MR features of PMBC included benign (homogenous intensity on T1-weighted imaging [WI] and T2-WI, persistent enhancement pattern) and malignant characteristics (rim or heterogeneous enhancement). The ADC values of MBC were greater than those of benign lesions and other malignant tumors. We believe that the combination of mammography and Dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) may help to improve the diagnostic accuracy of MBC.

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Introduction

Mucinous breast carcinoma (MBC), also called colloid, mucous, or mucoid carcinoma, is a rare subtype of invasive breast cancer. The incidence of MBC ranges from 1% to 7 % of all invasive breast carcinomas.[1] The mean age of women with mucinous carcinoma is older than women with usual ductal carcinomas. There are 2 histological subtypes of MBC: pure mucinous carcinomas (PMBC) and mixed mucinous carcinomas (MMBC). Compared with MMBC, PMBC tends to progress more slowly than MMBC. It has infrequent lymphatic metastasis and a favorable prognosis. MMBC usually contains areas that are not surrounded by extracellular mucin. For this reason, the treatment and prognosis of MMBC is similar to that for infiltrating ductal carcinoma (IDC).

Some studies of mammography and sonography have demonstrated certain characteristics of MBC. However, only limited information is available regarding magnetic resonance (MR), particularly diffusion-weighted imaging (WI) features. The present efforts were aimed at exploring the relationship between the mammographic, MR features, and pathological manifestations of MMBC and PMBC. The apparent diffusion coefficient (ADC) value of 2 histological subtypes was preliminarily analyzed.

Patients and Methods

Patients

A computer search of the surgical records at our hospital revealed a total of 27 patients with MBC that were confirmed using surgical biopsy between April 2009 and March 2014, including 18 cases of PMBC and 9 cases of MMBC. Tumors containing areas of ductal carcinoma in situ (DCIS) were classified as PMBC. All of the patients underwent mammographic examination, and records of preoperative MR imaging (MRI) were available in 13 patients (8 were PMBC and 5 were MMBC); 4 cases of 13 MRI examinations contained diffusion-WI (2 were PMBC and 2 were MMBC).

Mammography Technique

Twenty-seven patients had their standard mediolateral oblique view and craniocaudal view examinations on a Siemens Mammomat Novation system. All mammographic information, such as the size, shape, borders of the mass, and evidence of calcification were classified using the American Collage of Radiology (ACR) Breast Imaging—Reporting And Data System (BI-RADS) Mammography Lexicon (Fourth Edition, 2003) based on a mammographic workstation that included two 5-megapixel liquid crystal displays. The sizes of the nonmass lesions such as focal asymmetry and architectural distortion depended on the pathological report. Images were reviewed by 3 breast radiologists, each with $>$ 10 years of experience. When the reviewers disagreed, a consensus among all 3 was reached after discussion.

Magnetic Resonance Imaging Technique

Magnetic resonance imaging of the breast was performed with a 3.0 T MR system (Signa Echospeed, GE Medical Systems). All postprocessing was performed with an ADW 4.2 workstation. Commercially dedicated bilateral breast surface coils were used in all cases.

Image Parameters. A sagittal T2-weighted image was acquired using a fat-suppressed fast spin echo sequence, repetition time (TR)/echo time (TE): 4660/85.5 ms; matrix: 320 $\times$ 224; field of view: 26 $\times$ 26 cm; slice thickness: 6 mm; and slice gap: 2 mm. A transverse T1-weighted image was acquired using fast spoiled gradient echo sequence imaging: TR/TE 440/9.7 ms; image matrix: 320 $\times$ 192; field of view: 32 $\times$ 32 cm; slice thickness: 6 mm; and slice gap: 1.5 mm.

For contrast-enhanced MR, gadopentetate dimeglumine (Magnevist, Schering, Berlin, Germany) was intravenously injected using 0.1 mmol/kg at a rate of 2.0 mL/s. Fat-suppressed T1-weighted transverse images were acquired using the following parameters: TR/TE: 3.6/1.7 ms, slice thickness/slice gap: 4.4 mm/2.2 mm, image matrix: 128 $\times$ 128, and field of view: 32 cm $\times$ 32 cm.

For the time intensity curve (TIC), the region of interest (ROI) was designated manually at the edge of the lesions that demonstrated rim enhancement, or at an area that demonstrated localized heterogeneous enhancement. The size of ROI ranged from 9 to 18 mm^2.

For diffusion-weighted MR images, a spin echo single-shot echo planar transverse imaging sequence was used; TR/TE, 2000/60.0 ms; b values, 600 and 800 s/mm^2; image matrix, 128 $\times$ 128; field of view, 32 $\times$ 32 cm; slice thickness: 6 mm; and slice gap, 1 mm. ROIs were drawn manually to include the highest level of visual enhancement and the nonenhanced area of the tumor using dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) information for reference purposes.

Imaging Analysis. All MRI information, such as the size, shape, and borders of the mass were classified according to the ACR BI-RADS-MR Lexicon, First Edition (2003). The signal intensity of the mass was visually classified as low, iso, high, strongly high, or mixed, relative to surrounding mammary gland tissues. The pattern of internal enhancement of the mass included homogeneity, rim enhancement, central enhancement, dark internal septation, and enhancement of internal septation. The kinetic curve pattern was categorized into 3 types: persistent (I), plateau (II), and washout (III).

Pathology

The World Health Organization Histological Classification of Tumors defines classic pure MBC as any carcinoma that consists of aggregates of tumor cells surrounded by abundant pools of extracellular mucin.[2] The internal components of the tumor can be classified as PMBC.[3] DCIS generally can be found at the edge of the lesions. The mixed MBC contains areas of IDC not surrounded by mucin. The ratio of MBC to IDC should be larger than 1. One experienced pathologist reviewed the pathological sections of all patients and labeled these sections according to the region of tumors so that they could be matched to features of MRI.

All of the tissues were fixed in 4% neutral formalin and desiccated and embedded in paraffin, and the 4-μm sections were routinely stained with hematoxylin and eosin. Immunohistochemical stains were performed on sections using 3,3-diaminobenzidine (DAB) staining and desiccated and restained with hematorylin. Factor-VIII-related antigen was used to indicate the microvessel density within the lesions. Human epidermalgrowth factor receptor-2 (HER—2) immunohistochemistry 3+ and/or HER—2 gene amplification were defined as positive results, Ki-67 proliferation indices $<$ 10% were defined as low, 10% to 30% as intermediate, and $>$ 30% as high.[4]