Fibrocystic changes of the breast: lesion characterization using dynamic contrast-enhanced and diffusion-weighted MR images

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Authors: M. Nadrljanski, N. Gusic, Z. Milovanovic, V. Plesinac - Karapandzic, O. Radulovic, Z. C. Milosevic; Belgrade/RS  
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Purpose

Fibrocystic changes (FCCs) are the most frequent benign lesions that occur in the breast of premenopausal women between 20 and 50 years of age.

Pathogenesis of FCCs is related to the response of the breast tissue to fluctuations of estrogen and progesterone levels during menstrual cycle. Clinically, FCCs are present in more than 50% of women without breast disease, usually in the form of cyclic, multifocal and bilateral breast pain or tender nodularities [1]. Histologically, FCCs are observed in up to 90% of women, as a heterogeneous group of disorders that includes cysts (macro- and microcysts) and solid lesions (adenosis, epithelial hyperplasia with or without atypia, apocrine metaplasia, radial scar, and papilloma) [2].

Significance of this benign condition is defined by at least three facts:

1. FCCs may simulate a malignant lesion by physical examination or imaging studies that lead to the unnecessary surgical procedures.
2. The coexistence of FCCs can be a reason for the false negative findings on mammography, especially in women with dense breasts.
3. Some histologic subtypes of FCCs are associated with an increased risk for subsequent development of breast cancer [3, 4].

In 1985, Dupont and Page first proposed a practical classification system for FCCs with three categories: nonproliferative lesions, proliferative lesions without atypia, and proliferative lesions with atypia (atypical ductal or lobular hyperplasia) [5]. In each of these lesions, the subsequent risk for breast cancer is associated with the histologic appearance of the lesion. Compared with the general population, women with nonproliferative lesions on breast biopsy have no risk for breast cancer, whereas women having proliferative disease without atypia and women with atypical ductal or lobular hyperplasia have a greater breast cancer risk, with relative risks 1.3-1.9 and 3.9-13.0, respectively [6].

The purposes of our paper are:

- To analyze morphologic characteristics, kinetic enhancement patterns and apparent diffusion coefficient (ADC) of histologically confirmed FCCs at dynamic contrast-enhanced (DCE-MRI) and diffusion-weighted MR images (DWI);

- To assess the possibilities of breast MRI in differentiation of nonproliferative lesions from other two categories of FCCs at risk of developing breast cancer.
Methods and Materials

Between March 2009 and December 2011 at the Dept. of Diagnostic Imaging, Institute of Oncology and Radiology of Serbia (IORS), Belgrade, Serbia the breast MRI examination was performed prior to biopsy in 53 patients with FCC, with the 1.5-T system (Avanto, Siemens, Erlangen, Germany), the standard bilateral breast coil, and with the standardized breast MRI protocol.

In women with a palpable breast lesion, core-needle biopsies were performed.

In women with a nonpalpable lesion, second-look breast ultrasound and radioguided occult lesion localization (ROLL) were done prior to the surgical biopsy.

The histologic diagnoses were:

- nonproliferative lesions in 12 women (22.6%),
- proliferative lesions without atypia in 33 women (62.3%), and
- proliferative lesions with atypia in eight (15.1%).

The MRI features were interpreted based on the terms proposed by the ACR BI-RADS lexicon [7].

ADC values were calculated for b=900 s/mm² with the cut-off value of 1.2 x 10⁻³ mm²/s to distinguish malignant from benign lesions [8].
Results

DCE-MRI demonstrated 53 unilateral lesions of the following type:

- Nonmasslike enhancement (NMLE) in 38 patients (71.7%), (Fig. 1 - 8);
- Nonenhancing asymmetric tissue in eight patients (15.1%);
- Masses in six patients (11.3%);
- Focus in one (1.9%) patient;

without the difference between the three categories of FCCs ($p=0.47$) 
(Table 1).

The features of NMLE lesions in 38 patients are shown in Table 2.

The majority of NMLE lesions were larger than 1 cm (94.7%), and were most often described as a focal area, multiple regions, diffuse, or regional distribution (79%) of heterogeneous, clumped, or reticular (76.3%) enhancement, with plateau kinetics (55.3%), and without influence of FCCs category on above-mentioned descriptors ($p=0.62$, $p=0.44$, $p=0.74$, $p=0.20$, respectively).

The DWI detected 49 of 53 lesions. Mean ADC was in the range of benign lesions ($1.53 \pm 0.39 \times 10^{-3}$ mm$^2$/s).
Fig. 1: A 48 year-old asymptomatic woman with inconclusive findings of mammography and breast ultrasound (Fig.8-movie). Axial T2-weighted MR image (Fig.1) and turbo inversion recovery magnitude (TIRM) sequence (Fig.2) show clustered microcysts in the upper outer quadrant of the left breast. In comparison to precontrast study (Fig.3), contrast-enhanced T1-weighted MR image 90 s after administration of gadolinium (Fig.4) and corresponding subtraction image (Fig.5) show the regional, heterogeneous, nonmasslike enhancement (2.7x1 cm) with fast wash in (180%/90 s) and type 2 of Time-intensity curve (TIC) (Fig.6). ADC map shows the lesion (Fig.7) with the calculated apparent diffusion coefficient borderline value (ADC=1.15x10^-3mm²/s). Histological diagnosis: proliferative fibrocystic changes, focal fibroadenomatoid hyperplasia and sclerosing adenosis.

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Fig. 2: A 48 year-old asymptomatic woman with inconclusive findings of mammography and breast ultrasound (Fig.8-movie). Axial T2-weighted MR image (Fig.1) and turbo inversion recovery magnitude (TIRM) sequence (Fig.2) show clustered microcysts in the upper outer quadrant of the left breast. In comparison to precontrast study (Fig.3), contrast-enhanced T1-weighted MR image 90 s after administration of gadolinium (Fig.4) and corresponding subtraction image (Fig.5) show the regional, heterogeneous, nonmasslike enhancement (2.7x1 cm) with fast wash in (180%/90 s) and type 2 of Time-intensity curve (TIC) (Fig.6). ADC map shows the lesion (Fig.7) with the calculated apparent diffusion coefficient borderline value (ADC=1.15x10^-3mm2/s). Histological diagnosis: proliferative fibrocystic changes, focal fibroadenomatoid hyperplasia and sclerosing adenosis.

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**Fig. 3:** A 48 year-old asymptomatic woman with inconclusive findings of mammography and breast ultrasound (Fig.8-movie). Axial T2-weighted MR image (Fig.1) and turbo inversion recovery magnitude (TIRM) sequence (Fig.2) show clustered microcysts in the upper outer quadrant of the left breast. In comparison to precontrast study (Fig.3), contrast-enhanced T1-weighted MR image 90 s after administration of gadolinium (Fig.4) and corresponding subtraction image (Fig.5) show the regional, heterogeneous, nonmasslike enhancement (2.7x1 cm) with fast wash in (180%/90 s) and type 2 of Time-intensity curve (TIC) (Fig.6). ADC map shows the lesion (Fig.7) with the calculated apparent diffusion coefficient borderline value (ADC=1.15x10-3mm2/s). Histological diagnosis: proliferative fibrocystic changes, focal fibroadenomatoid hyperplasia and sclerosing adenosis.

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Fig. 7: A 48 year-old asymptomatic woman with inconclusive findings of mammography and breast ultrasound (Fig.8-movie). Axial T2-weighted MR image (Fig.1) and turbo inversion recovery magnitude (TIRM) sequence (Fig.2) show clustered microcysts in the upper outer quadrant of the left breast. In comparison to precontrast study (Fig.3), contrast-enhanced T1-weighted MR image 90 s after administration of gadolinium (Fig.4) and corresponding subtraction image (Fig.5) show the regional, heterogeneous, nonmasslike enhancement (2.7x1 cm) with fast wash in (180%/90 s) and type 2 of Time-intensity curve (TIC) (Fig.6). ADC map shows the lesion (Fig.7) with the calculated apparent diffusion coefficient borderline value (ADC=1.15x10-3mm2/s). Histological diagnosis: proliferative fibrocystic changes, focal fibroadenomatoid hyperplasia and sclerosing adenosis.

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### Table 1: Morphologic MRI features of FCCs

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<table>
<thead>
<tr>
<th>Lesion</th>
<th>Nonproliferative lesions</th>
<th>Proliferative lesions without atypia</th>
<th>Proliferative lesions with atypia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonmasslike enhancement</td>
<td>9</td>
<td>24</td>
<td>5</td>
<td>38 (71.7%)</td>
</tr>
<tr>
<td>Focus or foci</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td>Mass</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>6 (11.3%)</td>
</tr>
<tr>
<td>Nonenhancing asymmetric tissue</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8 (15.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>12 (22.6%)</td>
<td>33 (62.3%)</td>
<td>8 (15.1%)</td>
<td>53 (100%)</td>
</tr>
</tbody>
</table>

### Table 2: BI-RADS descriptors of nonmasslike enhancement lesions and subtypes of FCCs

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<table>
<thead>
<tr>
<th>BI-RADS Descriptors, Nonmasslike Enhancement Lesions</th>
<th>SUBTYPES OF FIBROCYSTIC CHANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Nonproliferative lesions</td>
</tr>
<tr>
<td>= 1 cm</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 1 cm</td>
<td>8</td>
</tr>
<tr>
<td>Enhancement type</td>
<td></td>
</tr>
<tr>
<td>Homogeneous, stippled, or punctate</td>
<td>3</td>
</tr>
<tr>
<td>Heterogeneous, clumped, reticular, or dendritic</td>
<td>6</td>
</tr>
<tr>
<td>Distribution</td>
<td></td>
</tr>
<tr>
<td>Linear, segmental, or ductal</td>
<td>1</td>
</tr>
<tr>
<td>Focal area, multiple regions, diffuse, and regional distribution</td>
<td>8</td>
</tr>
<tr>
<td>Wash-in</td>
<td></td>
</tr>
<tr>
<td>Slow</td>
<td>4</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Fast</td>
<td>3</td>
</tr>
<tr>
<td>Type of TIC</td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>4</td>
</tr>
<tr>
<td>Type 2</td>
<td>3</td>
</tr>
<tr>
<td>Type 3</td>
<td>2</td>
</tr>
</tbody>
</table>
Conclusion

The main goals of breast MRI are: to distinguish FCCs from breast cancer and to differentiate nonproliferative lesions from other two categories of FCCs, at risk of developing breast cancer.

In our study, DCE-MRI findings were unrelated to subtle histological differences of FCCs categories, while DWI added valuable data for differentiation of FCCs from breast cancer, especially in the cases of nonenhancing FCCs lesions.
References


Personal Information

**Corresponding author:**

**Mirjan M. Nadrljanski, MD, M.Sc.**

Dept. of Diagnostic Imaging

Institute of Oncology and Radiology of Serbia (IORS)

Belgrade / RS

dr.m.nadrljanski@gmail.com

**Zorica C. Milosevic, MD, PhD, Professor of Radiology**

Dept. of Radiology

Faculty of Medicine

University of Belgrade

Belgrade / RS

Dept. of Diagnostic Imaging

Institute of Oncology and Radiology of Serbia (IORS)

Belgrade / RS

pipa011@ptt.rs