Imaging Features of Phyllodes Tumor in the Breast

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Learning objectives

The purpose of this study is to characterize imaging findings that suggest the benign or borderline and malignant histological nature of PTs.
Background

Formerly called "cystosarcoma phylloides", is a breast fibroepithelial neoplasm. [1] Accounts for 0.3%-1.0% of all breast tumors and 2-3% of fibroepithelial breast lesion. Composition is epithelial elements and a connective tissue. Similar histologically to a fibroadenoma [1,2] The etiology is still unknown [3] Histologically, PTs are classified into categories of benign, borderline or malignant. [3] Local recurrences and distant metastases can occur regardless of the histological type. [4,5] Haydu et al. reported a high incidence of local relapse of PTs, with an incidence of 20%. [6] Treatment of both benign and malignant PTs requires complete surgical resection with wide margins. [2] According to the literature [7-10], mammography and sonography cannot be used to differentiate benign from malignant PTs. Yabuuchi et al. reported that some MR findings can be used to help determine the histologic grade of PTs. [2] However, the histologic grade of PTs cannot be precisely determined on breast MRI.
Findings and procedure details

Subjects:

Patients with a histopathologic diagnosis of PT of the breast who had undergone mammography, sonography, or MRI between 2003 and 2013.

Equipments:

- **Mammography** - DMR+ or Senographe 2000DS, GE Healthcare, Milwaukee, WI. Standard two-view mammography (craniocaudal and mediolateral oblique) had been performed, with additional views as necessary.
- **Ultrasonography** - 7-12 MHz linear-array transducer (iU22 Ultrasound System, Philips Ultrasound; Bothell, WA, USA) 5-12 MHz linear-array transducer (HDI- 5000 Ultrasound System, ATL, USA)
- **Magnetic resonance image** - prone in a 3-T scanner (Philips Healthcare, Achieva) using a SENSE-Breast7TX eight-channel breast coil (MRI Devices, Achieva) Bilateral axial eTHRIVE (TR/TE, 6.5/3.3) Axial fat-suppressed T2-weighted fast spin echo (6608/70) or T2 STIR Diffusion WI (15000/89) T1 pre-, post-dynamic, fat-suppressed fast-spoiled gradient echo (4.4/2.2, flip angle : 10o; bandwidth : 220 Hz) Post-dynamic : Five times after patients were given an intravenous bolus injection of gadobutrol (0.2 mmol/kg body weight, Gadovist, Bayer Schering Pharma, Berlin, Germany) at 1 mL/s with a Spectris injector (Medrad, Pittsburgh, Pa). Delayed contrast-enhanced axial eTHRIVE. The field of view was 200 mm, and the matrix size was 256x256 pixels. Subtraction images and time-intensity analysis were also reviewed.

Histologic confirm

8-gauge vacuum assisted biopsy is 3 cases and surgery is 32 cases.

Analysis

- Retrospectively, two radiologists reviewed the imaging studies using the ACR BI-RADS® lexicon with consensus.
- Statistical analyses were performed with SPSS 15.0 software, using Fisher’s exact test, K independent samples test and Spearman correlation. P < 0.05 was considered statistically significant.

Result

Thirty five patients
• All women
• Benign PT (24 patients)
  Range: 24 - 71 years
  Mean: 44 years
  Median: 43.5 years
  Clinical symptom: palpable mass (18.75%), no symptom (3.12.5%), uncheckable (3.12.5%)

• Borderline and malignant PT (11 patients)
  Range: 27 - 63 years
  Mean: 48 years
  Median: 46 years
  Clinical symptom: palpable mass (11.100%)

Mammography

• Benign PTs (available in 11 patients)
  All of 11 patients were demonstrated as a mass.
  The most common mammographic findings of benign PTs were oval shape (6.54%), circumscribed or obscured (11.100%) and high density (8.72%).

• Borderline or malignant PTs (available in 5 patients)
  All of 5 patients were demonstrated as a mass.
  The most common mammographic findings of borderline or malignant PTs were lobular shape (4.80%), indistinct margin (3.60%) and high density (4.80%).

Ultrasonography

• Benign PTs (available in 24 patients)
  All of 24 patients were demonstrated as a mass (mean size, 3.3 cm; range, 0.7-6.9 cm).
  The most common sonographic findings of benign PTs were oval or round shape (23.96%), circumscribed margin (18.75%), hypoechogenicity (17.70%), posterior enhancement (20.83%), parallel orientation (22.91%) and increased vascularity in the lesion (12.50%).

• Borderline or malignant PTs (available in 11 patients)
  All of 11 patients were demonstrated as a mass (mean size, 5.0 cm; range, 2.4-13 cm).
  The most common sonographic findings of borderline or malignant PTs were irregular shape (7.64%), indistinct or microlobulated margin (7.64%), complex echogenicity (8.72%), posterior enhancement (8.80%), parallel orientation (11.100%) and increased peripheral vascularity (6.54%).

MRI
• **Benign PT (available in 1 patient)**
  - Mass: irregular shape, smooth margin, heterogeneous enhancement and persistent kinetic curve

• **Borderline PT (available in 1 patient)**
  - Mass: oval shape, smooth margin, heterogeneous enhancement and plateau kinetic curve

**Statistical significant findings**

• **MMG**: Indistinct margin was more common in borderline and malignant PTs \(p=0.004\).
  - **US**: Irregular shape \(p=0.000\), indistinct or microlobulated margin \(p=0.014\) and complex echogenicity \(p=0.003\) were more common in borderline or malignant PTs.
  - **Size**: Borderline and malignant PTs were more larger than benign PTs \(p=0.025\).
**Table 1:** The mammographic findings of benign phyllodes tumor

<table>
<thead>
<tr>
<th>MMG findings</th>
<th>No. (%) of Findings</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benign (11)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Borderline &amp; Malignant (5)</td>
<td></td>
</tr>
<tr>
<td><strong>Breast density</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adipose</td>
<td>1 (9)</td>
<td>0</td>
</tr>
<tr>
<td>Scattered</td>
<td>0</td>
<td>1 (20)</td>
</tr>
<tr>
<td>Heterogeneous</td>
<td>6 (54)</td>
<td>4 (80)</td>
</tr>
<tr>
<td>Dense</td>
<td>4 (36)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Breast lesion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass only</td>
<td>11 (100)</td>
<td>4 (80)</td>
</tr>
<tr>
<td>Mass with calcification</td>
<td>0</td>
<td>1 (20) – coarse, clustered</td>
</tr>
<tr>
<td><strong>Mass shape</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oval</td>
<td>6 (54)</td>
<td>1 (20)</td>
</tr>
<tr>
<td>Lobular</td>
<td>5 (45)</td>
<td>4 (80)</td>
</tr>
<tr>
<td><strong>Mass margin</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circumscribed or obscured</td>
<td>11 (100)</td>
<td>2 (40)</td>
</tr>
<tr>
<td>Indistinct</td>
<td>0</td>
<td>3 (60)</td>
</tr>
<tr>
<td><strong>Mass density</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal to iso density</td>
<td>3 (27)</td>
<td>1 (20)</td>
</tr>
<tr>
<td>High density</td>
<td>8 (72)</td>
<td>4 (80)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>US findings</th>
<th>No.(%) of Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breast lesion</strong></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>24(100)</td>
</tr>
<tr>
<td><strong>Mass shape</strong></td>
<td></td>
</tr>
<tr>
<td>Oval or round</td>
<td>23(96)</td>
</tr>
<tr>
<td>Irregular</td>
<td>4(36)</td>
</tr>
<tr>
<td><strong>Mass margin</strong></td>
<td></td>
</tr>
<tr>
<td>Circumscribed</td>
<td>18(75)</td>
</tr>
<tr>
<td>Indistinct or Microlobulated</td>
<td>4(36)</td>
</tr>
<tr>
<td><strong>Mass echogenicity</strong></td>
<td></td>
</tr>
<tr>
<td>Isoechoic</td>
<td>3(12)</td>
</tr>
<tr>
<td>Hypoechoic</td>
<td>2(18)</td>
</tr>
<tr>
<td>Complex</td>
<td>27(70)</td>
</tr>
<tr>
<td><strong>Posterior acoustic features</strong></td>
<td></td>
</tr>
<tr>
<td>Posterior enhancement</td>
<td>20(83)</td>
</tr>
<tr>
<td>None</td>
<td>8(30)</td>
</tr>
<tr>
<td><strong>Orientation</strong></td>
<td></td>
</tr>
<tr>
<td>Parallel</td>
<td>22(91)</td>
</tr>
<tr>
<td>Non-parallel</td>
<td>11(100)</td>
</tr>
<tr>
<td><strong>Vascularity</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2(8)</td>
</tr>
<tr>
<td>Peripheral</td>
<td>6(25)</td>
</tr>
<tr>
<td>In the lesion</td>
<td>6(54)</td>
</tr>
<tr>
<td>Penetrating</td>
<td>12(50)</td>
</tr>
<tr>
<td></td>
<td>3(27)</td>
</tr>
<tr>
<td>Penetrating</td>
<td>5(20)</td>
</tr>
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<td>2(18)</td>
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<table>
<thead>
<tr>
<th>p-value</th>
<th></th>
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<tbody>
<tr>
<td>Mass</td>
<td>0.000</td>
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<tr>
<td>Mass margin</td>
<td>0.014</td>
</tr>
<tr>
<td>Mass echogenicity</td>
<td>0.003</td>
</tr>
<tr>
<td>Posterior acoustic features</td>
<td>0.816</td>
</tr>
<tr>
<td>Orientation</td>
<td>0.347</td>
</tr>
<tr>
<td>Vascularity</td>
<td>0.264</td>
</tr>
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</table>

**Table 3:** The sonographic findings of benign phyllodes tumor
Fig. 1: Case-1 (Benign PT of right breast in 50-year-old woman) A. Right mammogram shows a **lobular hyperdense mass with obscured margin**. B,C. Sonograms show an **irregular hypoechoic mass with indistinct margin and posterior enhancement and increased vascularity in the lesion**.
**Fig. 2:** Case-1 (Benign PT of right breast in 50-year-old woman) C,D. Axial T1 and T2 weighted MRI show internal hypointense septations within the multinodular-like fusion mass. E. Early-phase, sagittal, dynamic contrast-enhanced subtraction MRI of the right breast shows an irregular mass lesion with heterogeneous enhancement. F. Corresponding kinetic analysis of figure (E) shows persistent enhancement pattern.
**Fig. 3:** Case-1 (Benign PT of right breast in 50-year-old woman) Photomicrographs show the feature resembling intracanalicular fibroadenoma as a double layered epithelial component arranged in cleft surrounded by a hypercellular stroma. The mitotic count is rare (<2/10HPF).

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Fig. 4: Case-2 (Borderline PT of left breast in 63-year-old woman) A. Left mammogram shows a lobular, circumscribed, hyperdense mass. B,C. Sonograms show an oval, circumscribed and complex echoic mass with increased penetrating vascularity.

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**Case-2** (Borderline PT of left breast in 63-year-old woman)

C,D. Axial T1 and T2 weighted MRI show an **oval smooth mass of heterogeneous SI with hemorrhagic portion**. E. Early-phase, sagittal, dynamic contrast-enhanced subtraction MRI of the left breast shows an **oval mass lesion with heterogeneous enhancement**. F. Corresponding kinetic analysis of figure (E) shows **plateau enhancement pattern**.

**Fig. 5**: Case-2 (Borderline PT of left breast in 63-year-old woman) C,D. Axial T1 and T2 weighted MRI show an oval smooth mass of heterogeneous SI with hemorrhagic portion. E. Early-phase, sagittal, dynamic contrast-enhanced subtraction MRI of the left breast shows an oval mass lesion with heterogeneous enhancement. F. Corresponding kinetic analysis of figure (E) shows plateau enhancement pattern.

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Case-2 (Borderline PT of left breast in 63-year-old woman) Photomicrographs show mild to moderate cytologic atypia and the mitotic count is variable but not exceeding 10/10 HPF.

**Fig. 6:** Case-2 (Borderline PT of left breast in 63-year-old woman) Photomicrographs show mild to moderate cytologic atypia and the mitotic count is variable but not exceeding 10/10 HPF.

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**Case-3** (Malignant PT of right breast in 39-year-old woman)

A. Right mammogram shows a **lobular hyperdense mass with indistinct margin and marginal clustered coarse heterogeneous calcifications (arrow)**. B,C. Sonograms show an **irregular complex echoic mass with indistinct margin, posterior acoustic enhancement and increased peripheral vascularity**. Initial core needle biopsy proved to be a fibroadenoma.

**Fig. 7:** Case-3 (Malignant PT of right breast in 39-year-old woman) A. Right mammogram shows a lobular hyperdense mass with indistinct margin and marginal clustered coarse heterogeneous calcifications (arrow). B,C. Sonograms show an irregular complex echoic mass with indistinct margin, posterior acoustic enhancement and increased peripheral vascularity. Initial core needle biopsy proved to be a fibroadenoma.

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**Case-3** (Malignant PT of right breast in 39-year-old woman) D,E. After 17 months the mass shows *interval enlargement on follow up sonogram, from 4.1cm to 5.8cm, and increased internal vascularity*. This lesion was finally confirmed as a malignant phyllodes tumor by excision biopsy. E. Breast specific gamma imaging (E) shows mild and heterogeneous hypermetabolic mass lesion in the subareolar area of right breast.

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Case 3 (Malignant PT of right breast in 39-year-old woman) Photomicrographs show stromal overgrowth and moderate cytologic atypia. Also mitotic count is variable and focally exceeding 10/10HPF.

Fig. 9: Case-3 (Malignant PT of right breast in 39-year-old woman) Photomicrographs show stromal overgrowth and moderate cytologic atypia. Also mitotic count is variable and focally exceeding 10/10HPF.

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Conclusion

Definition of phyllodes tumor

- Develop from the periductal stroma and contain sparse lobular elements. [11]
- In comparison with fibroadenoma, PTs are characterized by expansion and increased cellularity of the stroma. In addition, elongated epithelium-clefts are present. [11,12]

Histologically, PTs are classified into categories of benign, borderline or malignant. [3] (Table)

Benign

- Histopathologic
  moderate~marked cellular overgrowth
  slight~moderate cellular pleomorphism
- Not metastasize
- Local recurrence after excision (20%)

Borderline

- Histopathologic
  zone of microscopic invasion around borders
  2~5 mitoses / 10 HPF
  moderate stromal cellularity
  heterogeneously distributed in hypocellular areas
- Low metastasis (< 5%)
- Local recurrence (> 25%)

Malignant

- Histopathologic
  marked hypercellular stromal overgrowth
  >5 mitoses /10 HPF
  invasive border
- 5-25% of phyllodes tumors
- < 20% : hematogenous metastasis to the lungs, pleura, or bone

Imaging findings of PTs

- Buchberger et al. [8]
  Neither mammography nor sonography can be used to differentiate reliably between malignant and benign PTs.
• Liberman et al. [7]
  Substantial overlap in the imaging characteristics of benign and malignant PTs
  A tumor diameter of 3cm or greater appears to be associated with a higher likelihood of malignancy.
• A. Jorge Blanco et al. [9]
  None of the clinical or radiologic characteristics of the tumors were useful in predicting their histologic nature or their behavior after surgery.
• H. Tan et al. [3]
  The malignant PTs were significantly larger than benign PTs
  Mean size of PTs, benign : 4.8cm / borderline : 5.9cm / malignant : 6.4cm)

  An irregular shape of PTs on sonography was significantly correlated with malignant and borderline PTs.

  MRI is a useful tool for the diagnosis of breast PTs, and internal non-enhanced septations, slit-like patterns in enhanced images and signal changes from T2-weighted to enhanced images correlated significantly with the histologic grade (next slide).

**Management**

• Treatment for PTs is complete local excision with a broad surgical margin to lessen the likelihood of tumor recurrence. [11]
• Mastectomy may be needed for very large lesions. [11]

**Prognosis**

• Overall 5-year survival with PTs is about 90%. [15]
• However, in patients with high grad phyllodes tumors, the 5-year survival is only 65%. [16]

**Conclusion**

Indistinct margin of tumor on mammography, irregular shape, indistinct or microlobulated margin and complex echogenicity on sonography are more common in borderline and malignant PTs than benign PTs.
<table>
<thead>
<tr>
<th>Benign</th>
<th>Borderline</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate–marked cellular overgrowth</td>
<td>Zone of microscopic invasion around borders</td>
<td>Marked hypercellular stromal overgrowth</td>
</tr>
<tr>
<td>Slight–moderate cellular pleomorphism</td>
<td>2–5 mitoses / 10 HPF</td>
<td>&gt;5 mitoses /10 HPF</td>
</tr>
<tr>
<td>Not metastasize</td>
<td>Moderate stromal cellularity</td>
<td>Invasive border</td>
</tr>
<tr>
<td>Local recurrence after excision (20%)</td>
<td>Heterogeneously distributed in hypocellular areas</td>
<td>5-25% of phyllodes tumors</td>
</tr>
<tr>
<td></td>
<td>Low metastasis (&lt; 5%)</td>
<td>&lt; 20% : hematogenous</td>
</tr>
<tr>
<td></td>
<td>Local recurrence (&gt; 25%)</td>
<td>metastasis to the lungs, pleura, or bone</td>
</tr>
</tbody>
</table>

**Table 2:** Histologic classification of PTs

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References