IMAGING ASSESSMENT OF LOCAL EXTENT OF BREAST CANCER

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Mammographic determination of the extent of tumor depends on:

- **Calcification:** ductal cancer
  - Only develop if there is tumor necrosis
  - Reliably associated with comedo
  - Does not always develop with non-comedo

- **Mass:** invasive cancer
  - Rarely identified with DCIS

Mammography does not reliably demonstrate the extent of non-comedo DCIS especially when the identifiable lesion is $\geq 2$ cm
MAMMOGRAPHIC FINDINGS IN DCIS 
(N=54)

<table>
<thead>
<tr>
<th>Description</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcalcifications without mass</td>
<td>37</td>
<td>(68)</td>
</tr>
<tr>
<td>Mass with microcalcifications</td>
<td>16</td>
<td>(30)</td>
</tr>
<tr>
<td>Mass without microcalcifications</td>
<td>1</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Dershow. Radiology 170;411;1989
DCIS Pathology
Comedo

= Anaplastic cells with nuclear pleomorphism and prominent mitoses

= Extensive necrosis, producing calcification

= No skipped segments of the duct
NECROSIS WITH MAMMOGRAPHIC CALCIFICATION
CARCINOMA INTERMITTENTLY CONTAINING CALCIFICATIONS
RESIDUAL TUMOR AT SURGICAL EXCISION AFTER COMPLETE REMOVAL OF IMAGING FINDINGS AT NEEDLE BIOPSY

Liberman et al.  Radiology 1998; 206:711

| Needle Dx | Total BX | Residual Tumor |
|-----------|----------|----------------|----------------|
| DCIS      | 12       | 8              |
| IFDC      | 3        | 3              |
### MARGIN SIZE vs. TUMOR CLEARANCE FOR DCIS

<table>
<thead>
<tr>
<th>Clear margin at surgery</th>
<th>Residual tumor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 cm</td>
<td>32%</td>
</tr>
<tr>
<td>2 cm</td>
<td>17%</td>
</tr>
<tr>
<td>3 cm</td>
<td>11%</td>
</tr>
</tbody>
</table>
Spiculations caused by direct tumor extension and by fibrotic reaction have an identical mammographic pattern and cannot be differentiated on mammography.
INFILTRATING LOBULAR CARCINOMA

• 3-4% of infiltrating carcinomas
• Mass or ill-defined thickening on physical exam
• Calcifications are rare
INVASIVE LOBULAR CARCINOMA
## MR assessment of invasive lobular carcinoma

<table>
<thead>
<tr>
<th></th>
<th>Mammo</th>
<th>MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Assessment of Extent of tumor</td>
<td>32 %</td>
<td>85%</td>
</tr>
</tbody>
</table>

Rodenko et al.  
*AJR 1996;167:1415*
MRI staging

- Size of known lesion
- Presence of other malignant sites in the breast
- Nodal involvement: axilla and internal mammary chain
- Chest wall involvement
- Nipple
- Contralateral disease
- Treatment response
MRI staging

- **Size of known lesion**
  - Presence of other malignant sites in the breast
  - Nodal involvement: axilla and internal mammary chain
- Chest wall involvement
- Nipple
- Contralateral disease
- Treatment response
Infiltrating lobular carcinoma - extent
T3 Breast Cancer  Normal Contralateral
Diffuse infiltrating ductal carcinoma

2 minutes post

left

right

2 minutes post
Extensive carcinomas may be best appreciated on 3D reconstruction.
MRI staging

- Size of known lesion
- **Presence of other malignant sites in the breast**
  - Nodal involvement: axilla and internal mammary chain
  - Chest wall involvement
  - Nipple
  - Contralateral disease
  - Treatment response
Multifocal carcinoma
Multicentric carcinoma
Multicentric infiltrating ductal carcinoma
MRI IS IMPERFECT AND CAN MISS OBVIOUS CANCERS ON MAMMOGRAM
Axillary Nodal Metastases

- *Central fat obliterated*
- Same size as benign nodes
- Spiculation signifies perinodal tumor extension
- Microcalcifications very rare
- Number usually underestimated mammographically
- Hypertrophic nodes can have same pattern
Disrupted Axillary Nodes Due to Metastatic Breast Cancer: Sonographic Pattern
Spiculated Axillary Node: Extracodal Extension of Metastatic Breast Cancer
MRI staging

• Size of known lesion
• Presence of other malignant sites in the breast
• **Nodal involvement: axilla and internal mammary chain**
• Chest wall involvement
• Nipple
• Contralateral disease
• Treatment response
AXILLARY NODAL STAGING

LEVEL I

LEVEL II
AXILLARY NODAL STAGING

LEVEL I

LEVEL II

PECTORALIS

major

minor
Extensive tumor with axillary nodal involvement
Normal Internal Mammary Chain
Internal mammary adenopathy
Positron Emission Tomography

- Determination of axillary nodal status
  - Sensitivity: 33-100%
  - Specificity: 66-100%
  - Best with larger tumor burden in axillary nodes
  - Poor performance in women with T1 tumors
    - Sensitivity reported as low as 25%

- Useful for determination of status of internal mammary and mediastinal nodes
Breast cancer met to axillary node
MRI staging

- Size of known lesion
- Presence of other malignant sites in the breast
- Nodal involvement: axilla and internal mammary chain
- **Chest wall involvement**
  - Nipple
  - Contralateral disease
  - Treatment response
Invasion deep to fascia

chest wall involvement (stage IIIb)
- ribs
- intercostal muscles
- serratus anterior muscle
Determination of Chest Wall Involvement

Tumor free of chest wall
Tumor abuts but does not invade chest wall
Chest Wall Invasion
Pectoralis muscle and chest wall involvement
Tumor extends through chest wall
MRI staging

- Size of known lesion
- Presence of other malignant sites in the breast
- Nodal involvement: axilla and internal mammary chain
- Chest wall involvement
- **Nipple**
- Contralateral disease
- Treatment response
Tumor extends toward without involving nipple
PAGETS DISEASE

Growth of ductal carcinoma in major ducts over the nipple and areola. Clinically evident as ectemoid change in nipple-areola complex.

Always accompanied by an intraductal carcinoma. May or may not be invasive.

Mammogram normal in 50%, but can show extensive tumor in underlying breast.
PAGET'S DISEASE: MAMMOGRAPHY

CALCIFICATIONS AT THE NIPPLE

NORMAL
PAGET'S DISEASE: MRI
PAGET'S DISEASE: MRI
MRI staging

- Size of known lesion
- Presence of other malignant sites in the breast
- Nodal involvement: axilla and internal mammary chain
- Chest wall involvement
- Nipple
- Contralateral disease
- Treatment response
## Synchronous, Contralateral Breast Cancer Found by MRI

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>#Pts</th>
<th>Bx PPV</th>
<th>#cancer</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Rieber 1998</td>
<td>34</td>
<td>---</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Fischer 1999</td>
<td>336</td>
<td>---</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Woo 2000</td>
<td>90</td>
<td>50%</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Kuhl 2000</td>
<td>710</td>
<td>49%</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Slanetz 2002</td>
<td>17</td>
<td>80%</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Liberman 2003</td>
<td>223</td>
<td>20%</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Lehman 2007</td>
<td>969</td>
<td>25%</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>Pediconi 2007</td>
<td>87</td>
<td>64%</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2466</td>
<td></td>
<td>132</td>
<td>5</td>
</tr>
</tbody>
</table>
Bilateral invasive lobular carcinoma with left found at time of right staging MRI
Contralateral Findings

Right breast DCIS

Left breast proliferative changes
52 patients imaged pre- and post-chemo; results compared to clinical exam

MR correlation with pathology was 0.89
CE correlation with pathology was 0.60

All cases with residual disease had positive MRI
5 cases with residual disease had negative CE
scanned before, during and after neoadj chemo

<table>
<thead>
<tr>
<th></th>
<th>true+</th>
<th>true-</th>
<th>false+</th>
<th>false-</th>
</tr>
</thead>
<tbody>
<tr>
<td>HER-2 + (N=25)</td>
<td>20%</td>
<td>72%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>HER-2 – (N=26)</td>
<td>34%</td>
<td>31%</td>
<td>4%</td>
<td>31%</td>
</tr>
<tr>
<td>Total (N=51)</td>
<td>27%</td>
<td>51%</td>
<td>4%</td>
<td>18%</td>
</tr>
</tbody>
</table>
CONCLUSION

MRI may be highly accurate for predicting pathologic complete response in HER-2 + women but has a high false-negative rate in HER-2, particularly if they have been treated with anti-angiogenic agents. Interpretation of response, particularly if used to plan surgery, should consider these factors.
Induction chemotherapy – evaluation of response

pre chemo 3 cycles: no response
NECROTIC TUMOR SHOWING RESPONSE TO TREATMENT WITH DEVELOPING FAT NECROSIS
MRI imaging patterns & likelihood of complete or partial response

- circumscribed mass 77%
- nodular tissue infiltration 37.5%
- diffuse tissue infiltration 37.5%
- patchy enhancement 20%
- septal spread 25%

AJR 2002;179:1193-9
Dynamic curves change

- Contrast uptake (time of maximum enhancement) significantly reduced after chemotherapy
- Curves flatten & shift to the right
  - May be seen after first cycle

Rieber et al BJR 1997;70:452-458
MRI pattern of response may be predictive

may help set patients’ expectations about prognosis or potential for breast conservation