Diagnosis of Breast Lesions with MRI
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Overview
- Breast MRI Indications
- Is breast MRI the best test?
- Key concepts to high quality breast MRI
  - What are some things a technologist can do to improve the chances of answering the clinical question?
- Breast MRI findings
  - What is the radiologist looking for?

Is Breast MRI the Best Test?
- Indications
- Guiding principles
- Alternatives
- Controversies

Indications
- The best test depends on what clinical problem one is trying to solve.

Clinical Problem #1
- Does my asymptomatic patient have breast cancer?
- Screening.

Screening bMRI
- Principle #1: Earlier detection reduces the risk of dying of breast cancer.
- Principle #2: Any test is more accurate when the disease is more common. Therefore, higher risk groups are favored populations for screening.
High Risk Indications

- BRCA1 & BRCA2 & other genetic Mutations
- Strong family history of breast and/or ovarian cancer without known mutations—risk models
- Prior mantle XRT between 10 & 30 yrs old
- Personal history of breast cancer
- Personal history of LCIS, ALH or ADH
- Mammographic density

ACS Recommendations

<table>
<thead>
<tr>
<th>Screening bMRI</th>
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<tr>
<td>Alternatives &amp; Controversies:</td>
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<tr>
<td>Do nothing</td>
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<tr>
<td>Self breast exam</td>
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<tr>
<td>Clinical breast exam</td>
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<tr>
<td>Mammography</td>
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<td>Ultrasound</td>
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Clinical Problem #2

- Does my symptomatic patient have breast cancer?
  - Lump
  - Skin changes like dimpling, redness, thickening
  - Nipple discharge
    - Bloody
    - Clear
    - Serous
  - Pain

Symptomatic bMRI

- Alternatives & Controversies:
  - Do nothing
  - Self breast exam
  - Clinical breast exam
  - Mammography
  - Ultrasound
  - Surgical consultation

Breast MR should not be used as a first line problem solving tool.
Clinical Problem #3

- How much breast cancer is present in my patient with a NEW breast cancer diagnosis?
- Local Staging

This use of breast MR for staging varies from surgeon to surgeon and hospital to hospital.

Staging bMRI

- Principle #1: Studies show detection of previously undetected contralateral breast cancer in 4% of cases.
- Principle #2: MRI detects more breast cancer than mammography and ultrasound.
- Principle #3: No studies have proved change in mortality.

Staging bMRI

- Alternatives & Controversies:
  - Do nothing
  - Self breast exam
  - Clinical breast exam
  - Mammography
  - Ultrasound
  - Surgical consultation

Clinical Problem #4

- My patient has breast cancer in an axillary lymph node or distant metastatic disease without any physical, mammographic or other evidence of cancer in the breast—occult primary breast cancer.
- Where is the primary breast cancer?

Occult Primary bMRI

- Principle #1: MRI can find the tumor about 2/3 of the time.

- Principle #2: Gross pathology/Histology can find the tumor about 2/3 of the time.

Occult Primary bMRI

- Alternatives & Controversies:
  - Do nothing
  - Self breast exam
  - Clinical breast exam
  - Mammography
  - Ultrasound
  - Surgical consultation
Clinical Problem #5

- My patient is getting neoadjuvant chemotherapy. Is the tumor responding?
- Response to therapy.

Response to Therapy bMRI

- Principle #1: In theory, if the chemo isn’t working, you could stop it or change to something different.

Pre / Post Example

Demonstrates importance of clip

Response to Therapy bMRI

- Alternatives & Controversies:
  - Do nothing
  - Self breast exam
  - Clinical breast exam
  - Mammography
  - Ultrasound
  - Surgical consultation

MRI can give us functional information by showing a decrease in the degree of enhancement before a decrease in size.

Clinical Problem #6

- Does my patient have recurrent breast cancer?
- Similar to SCREENING and SYMPTOMATIC bMRI.

Recurrence

- Alternatives & Controversies:
  - Do nothing
  - Self breast exam
  - Clinical breast exam
  - Mammography
  - Ultrasound
  - Surgical consultation
Clinical Problem #7

- Are my patient’s silicone breast implants intact or ruptured?

Silicone implant rupture

- Sagittal T2-weighted short-T1 inversion-recovery MR image (3,000/60 [repetition time msec/echo time msec]) obtained with fat suppression
  - shows intracapsular rupture of a silicone breast implant, as demonstrated by the linguine sign (arrow).

- 45-year-old woman with extracapsular rupture of 15-year-old subpectoral single-lumen silicone gel implant

Summary of Indications

- Most Accepted
  - High Risk Screening
  - Occult Primary
  - Silicone Implant Evaluation

- Less Widespread Agreement
  - Staging
  - Response to Therapy
  - Recurrence Evaluation
  - Symptomatic Workup

Questions?
Keys to High Quality (HQ) bMRI

- Technologist
- Sequences and Resolution
- Appropriate clinical history and timing
- Patient positioning, comfort and cooperation

HQ: Sequences & Resolution

- Breast Cancer Sequences
  - Axial, simultaneous acquisition with FOV & matrix to allow for sub-millimeter in-plane resolution
  - Slice width close to 1 mm. No greater than 3 mm.
  - T1 Non-Fat-Sat
  - T1 Fat-Sat—Dynamic (Pre & Post)
  - Subtraction & Reconstruction
  - T2 Fat-Sat
  - +/- Diffusion (research)
  - +/- Spectroscopy (research)

- Breast Implant Sequences
  - Two plane acquisition (axial and sagittal)
  - T1 for basic anatomy
  - Axial & Sagittal SILICONE SENSITIVE
    - Water Sat – ACTIVE
    - Fat-Sat – INVERSION RECOVERY
  - T2 for incidentals
HQ: Clinical History & Timing

- Why is the study being done?
  - Screening vs Symptom
  - New Cancer vs Response vs Recurrence
  - Implant Evaluation
- What prior imaging has been done?
  - Mammography
  - Ultrasound
  - Comparison MRIs
- When & Where was prior imaging done?
  - Outside films
  - Local films

HQ: Technologist

- How can I help answer the clinical question?
- How can I help speed and accuracy of interpretation?
  - Document/Clarify Clinical History
  - Ask about previous imaging and get signed release form

HQ: Patient Factors

- Positioning
- Comfort
- Cooperation

HQ: Positioning

- Make sure the coil is adequately open
HQ: Positioning

- Make sure the breast is pulled down into the coil and centered.

HQ: Patient Comfort & Cooperation

- Explain how motion can decrease the effectiveness of the exam.
- Explain how we want the best exam possible.
- Help the patient understand that it’s best to hold still passively rather than actively.
- Help the patient get comfortable so they can “relax still.”
- Assess patient’s anxiety/buy in/cooperation.

BI-RADS MR Lexicon

- Focus/Foci
- Mass
- Non-Mass-Like Enhancement
- Internal Enhancement Patterns
- Associated Findings
- Lesion Location
- Kinetic Curve Assessment

Morphology

- Mass = 3D, space occupying lesion
- Shape
  - Round
  - Oval
  - Lobulated
  - Irregular
### Morphology

- **Mass:** 3D, space occupying lesion
- **Shape:**
  - Round
  - Oval
  - Lobulated
  - Irregular
- **Margin:**
  - Smooth
  - Irregular
  - Spiculated
- **Internal Enhancement Characteristics:**
  - Non
  - Homogeneous
  - Heterogeneous
  - Rim
  - Dark internal septations
  - Enhancing internal septations
  - Central enhancement

### Non-Mass Findings

- **Enhancement:**
  - Distribution
    - Focal area
    - Linear
    - Ductal
    - Segmental
    - Regional
    - Multiple regions
    - Diffuse
Non-mass Morphology?

- Enhancement
- Distribution
- Focal area
- Linear
- Ductal
- Segmental
- Regional
- Multiple regions
- Irregular
- Pattern
- Homogeneous
- Heterogeneous
- Striated / Function
- Clumped / Coalescent
- Nodular / Dendritic
- Symmetry / Asymmetry
- Laterality
- Dr. Orel's change


Associated Findings

- Nipple retraction or inversion
- Pre-contrast high duct signal
- Skin retraction
- Skin thickening
- Skin invasion
- Edema
- Lymphadenopathy
- Pectoralis invasion
- Chest wall invasion
- Hematoma
- Abnormal signal void
- Cyst
- "Corners"
- Liver mets, etc.


MR Guided Biopsies

- Plan ahead
- Touch base with mammography technologists and radiologist performing the biopsy, preferably in the day or two prior to the biopsy, often scheduled early
- Double check equipment and expiration dates

Questions?