Breast MRI: Role in 2016

Belinda Curpen, MD, FRCPC
Sunnybrook Health Sciences Centre
University of Toronto
Head of Breast Imaging
Objectives

- Breast MRI screening in high risk patients
- Current indications of diagnostic breast MRI
- Controversies of pre-op MRI
- Which patients with newly diagnosed malignancy would benefit most from pre-operative MRI
Introduction

• Breast MRI available for more than 20 years
• Marked increase last 10 years
• Most sensitive test for breast cancer (BC) detection
• Use has become somewhat controversial
• Review controversies around pre-op breast MRI
• New clinical indications
Indications

• High Risk Screening (most common)
• Pre-operative staging of BC
  • Multifocal/multicentric (controversial)
  • pec/ chest wall invasion
• Pre/post-neoadjuvant chemotherapy
• Residual disease post lumpectomy
• Axillary lymphadenopathy, unknown 1airy
• Breast implants
• Problem solving
Ontario Breast Screening Program
High Risk (OBSPHR)

- BRCA1 or 2 mutation carrier
- 1st degree relative of a mutation carrier
- ≥ 25% lifetime risk assess by risk assessment tool by genetic clinics (IBIS or BOADICEA)
- Chest radiation treatment before age 30 or at least 8 years previously
- Cowden’s, Li-Fraumeni, Riley-Ruvalcaba
OBSPHR MRI Screening

- Starts at age 30
- Yearly MMG and MRI
- Premenopausal women imaged day 7-10 of menstrual cycle
Raikhlin, Curpen et al

- Retrospective study
- July 2011 to Dec 2012
- 650 women
- 878 screening studies
- 70% cancer detected by MRI only

## Performance MMG and MRI

<table>
<thead>
<tr>
<th>Parameters</th>
<th>MMG</th>
<th>MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca detection rate/1000</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>31</td>
<td>92</td>
</tr>
<tr>
<td>Specificity</td>
<td>97</td>
<td>86</td>
</tr>
<tr>
<td>PPV</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>NPV</td>
<td>38</td>
<td>99</td>
</tr>
</tbody>
</table>

60 yo high-risk screening BRCA1

IDC
49 yo high-risk screening (+ve Family hx)

IDC
55 yo BRCA1

High grade DCIS
Pre-op MRI
Pre-op MRI
Pre-op MRI - Controversies

- Meta-analysis of 9 eligible studies
- Comparing pts BC with/without pre-op MRI
- MRI detects 16% additional CA
- No change in reexcision rate in women with/without MRI
- More extensive surgery than planned due to FP in MRI group
- Mastectomy rates increased in MRI group – overtreatment
- No difference in recurrence rate
- Randomized clinical trials did not show benefit for pre-op MRI

• 53,015 patients 2003-2012

• Database in Ontario

• 14.8 % had preop MRI

• Use of MRI associated with young age, high socioeconomic status, teaching hospital, fewer years of surgeon’s experience

• MRI higher likelihood of additional ultrasounds, biopsies post diagnosis, prophylactic mastectomy, delay of surgery >30 days

Use of preop MRI for breast cancer: a canadian population-based study. Jama Oncol. 2015 Dec 1;1(9):1238-50

- Retrospective study
- Premenopausal women with dense breasts
- Confirmed invasive lobular histology
- MRI showed additional malignancy in 21%
- 2.5 % controlateral disease
Pre-op MRI

Pre-op breast MRI beneficial

- Mammographically dense breasts
- Invasive lobular carcinoma
- High risk for hereditary breast cancer
- Partial breast irradiation candidate
Axillary LN – 1\textsuperscript{airy} unknown

75 year old woman, contralateral mastectomy for IDC 15 years ago
Tumor Recurrence - Scar vs Ca
Response to Neoadjuvant Chemo
Response to Neoadjuvant Chemo
Technique

• Not significantly changed
• Axial versus sagittal
• 1.5T vs 3T
• High spatial and temporal resolution still very important
Prospective study
All patients underwent both 1.5 and 3T
Pre-op assessment of extent of DCIS
Higher correlation of final pathology size with 3T
Only 20 pts

1.5T vs 3T

- Retrospective review
- 147 MR on 3T
- 98 MR on 1.5T
- PPV 3T 44%
- PPV 1.5T 27%

3T vs 1.5T

• Advantages
  - Higher SNR (x2)
  - Higher spatial and temporal resolution
  - Metabolic imaging (choline and sodium)
  - Increased homogeneity fat saturation

• Disadvantages
  - Non uniformity of RF pulses
  - Non uniform signal intensity across image
  - Greater chemical shift
Computer Aided Diagnosis (CAD)

- Sensitivity of MRI high but specificity low
- Kinetics improve specificity
- Visual estimations inaccurate
- Quantitative methods necessary but not readily available on PACS
- CAD developed to improve detection and analysis of kinetic information
CAD

- Most CAD has motion correction to reduce subtraction artifact, important for MIPs
- Necessary when no fat suppression
- CAD-stream, Dyna-Cad and Aegis
- Not based on morphology, only kinetics
- Yellow for plateau and red for wash-out
- Lesions suspicious on morphology should be biopsied regardless of enhancement kinetics
Diffusion Imaging (DWI)

- Relatively new MRI technique
- Quantifies diffusion of water molecules in tissues
- Dependant on tissue cellularity and intact cell membrane
- Water moves freely in less cellular tissue and in disrupted cell membranes
- Malignant tumors allows less diffusion
- No contrast necessary
Diffusion Imaging (DWI)

- From DWI an apparent diffusion (ADC) map coefficient is calculated.
- ADC measures an average area covered by a molecule per unit over time.
- Low ADC - less diffusion – malignant.
- High ADC – more diffusion – benign.
- Potential to increase specificity of MRI.
- Do not perform as well in DCIS – less cellularity.
Indications of breast MRI have changed

Used more often for screening high risk women

MRI for extent of disease reserved to a small group of patients

Other indications unchanged

Technical aspect still evolving
MRI Guided Breast Biopsy

ACR Guidelines:

• If performing breast MRI, it is considered important to have MRI guided biopsy capability

• Otherwise, mutually agreed upon relationship with a facility that provides MR biopsy
Biopsy Equipment

- Localizing Obturator
- Trocar
- Introducer Sheath
- Needle Guide
Review Imaging
Lesion Targeting
Check Position

T1 Obturator Sagittal

T1 Obturator Axial
Post-Biopsy, Pre-clip Images
Clip placement
Post Clip Images
MRI Guided Breast Intervention: Pitfalls

- Lesion not seen
- Cannot position lesion in grid
- Motion
- Clip migration
- Hematoma
- Wrong Target
- Missed Target
Conclusions

• MRI is a highly sensitive investigation for detection of breast cancer
  – High risk screening
  – Preop evaluation in select patients
  – Metastatic disease of unknown primary
  – Assessing response to therapy
• Should not replace MMG or US
• MRI biopsy capability is an important part of breast MRI program
Response to Neoadjuvant Chemo