MRI in breast cancer: diagnosis and intervention

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Intervention will be discussed in High Risk Screening!
Indications UK and Europe:

Breast MRI is well established as a tool for certain recognised indications which include:

- Mammographically occult lesions in dense breasts
- Discrepancy in size (mammography/ultrasound/clinical)
- Suspected multifocal disease
- Lobular carcinomas
- Axillary lymphadenopathy, primary unknown
- Evaluation of response to primary chemotherapy
- Assessment of breast implant integrity
- High risk screening

EUSOBI 2008
Eusoma 2010: Evidence based
Indications US:

USA 12 indications

- Lesion characterization
- Neoadjuvant chemotherapy
- Infiltrating lobular and ductal carcinoma
- Axillary adenopathy, primary unknown
- Postoperative tissue reconstruction
- Silicone and non-silicone breast augmentation
- Invasion deep to the fascia
- Contralateral breast examination in patients with breast malignancy
- Postlumpectomy for residual disease
- Surveillance of high-risk patients
- Recurrence of breast cancer
Dynamic CE MRI

- Angiogenesis closely correlated with invasive cancer
- Neo capillaries ++
- Enlarged fenestrations
- Capillary leakage
- AV shunting
How we do it:

Dedicated breast coil mandatory
Multichannel
Access to prior conventional imaging
Double reporting
Cambridge MR protocols

- 1.5T GE
- 10/week (30 – 40 min) (High burden)
- Normal parenchymal enhancement least mid cycle
- Optimum imaging window day 6 to 16 of cycle
- No evidence stopping HRT reduces background parenchymal enhancement
- Iv Gd 1.5mmol/kg 3ml/sec (pink cannula)
Positioning

◆ Prone
◆ Feet first
◆ weight < 105kg
◆ No padding, allowing gravity to elongate breasts
◆ Discomfort: neck and arm ache
Side marking

- Transposing sides is a common reporting error
- Fish oil capsule marker
- We mark left breast
- Correlate with other imaging
- Viewing
Sequences

*Axial T1 & T2*

*DWI*

*Axial 3D dynamic “VIBRANT” –T1 FSPGR fat sat*
  - 2mm thick; FOV 34 X 34
  - 1 test: coverage, shimming for fat sat
  - 1 pre
  - 5 post contrast
  - Automatic Subtraction processing

*Research – diffusion, spectroscopy, other dynamic acquisition sequences, 3T*
Problems with fat sat

- Contralateral implants
- Recent biopsy (?metal)
- Portacaths (NB ruin DWI)

- Coils/clips – ok if Titanium – small local bloom
Post processing

◆ Subtraction
◆ MIP
◆ Multiplanar reconstruction
◆ Curve analysis (Functool)
◆ Spectroscopy
◆ Diffusion
◆ CAD (Cadstream)
Reporting: BI-RADS

- The ACR BI-Rads Lexicon widely used
- 5\textsuperscript{th} Edition published 2013
- Standardised:
  - Imaging findings terminology
  - Report organisation
  - Assessment structure
  - Classification of findings

Some differences in Europe
Eg no category 0, 4 abc in UK
no category 0,3,4ab in Germany

Cambridge Breast Unit
BIRADS

- BIRADS 0 (Needs additional imaging evaluation)
- BIRADS 1 (Normal)
- BIRADS 2 (Benign finding)
- BIRADS 3 (Probably benign finding - short interval follow-up) **AVOID IF POSSIBLE**
- BIRADS 4 Suspicious finding; further assessment and biopsy should be considered
- BIRADS 5 (Highly suggestive of malignancy; biopsy mandatory)
- BI-RADS 6 Known biopsy proven malignancy
Interpretation: BI-RADS descriptors

- **Density** (amount of FG tissue)
- **Background enhancement**
  - none/minimal: <25%
  - mild: 25-50%
  - moderate: 50-75%
  - marked: >75%
Reporting: First step
Mass or non-mass?
BI-RADS descriptors: Morphology

**Mass**
- 3 dimensional space occupying lesion <5mm
- Convex margin separate from surrounding FGT

**Shape:**
- round, oval,
- (Inc lobulated,
- irregular

**Margins:**
- smooth, irregular,
- spiculated

**Internal EH characteristics:**
- homogenous, heterogenous,
- rim, dark or enhancement,
- internal septations, central (target)

**Focus < 5 mm:** To small to characterize margins, etc
- Heywang-Köbrunner et al. Eur Rad 2001
BI-RADS descriptors: Enhancement

**Kinetics**
- washout, plateau, persistent
- (caveat: papillomas and lymph nodes washout)
- ~70% of invasive cancers wash out
- ~9% of DCIS washes out

**Non Mass Enhancement**
- Symmetric or assymmetric?
  - focal, linear ductal, linear clumped, segmental patchy/clumped, regional, diffuse stippled, punctate,

**Linear Enhancement**
- Rare, beware movement artifact
Interpretation: you do these!

DCIS: Non-masslike
Linear clumped enhancement
Segmental, or ductal asymmetric pattern

Invasive Ductal Cancer
Irregular or spiculate mass
Heterogenous enhancement
Fast uptake and washout

36% Persistent  35% Plateau  29% Washout
9% Medium  91% Rapid
MRI features and PPV

◆ Mass
  ▪ spiculated mass : 80 %
  ▪ irregular shape : 32 %
  ▪ < 5 mm mass : 3 %

◆ Non mass
  ▪ Linear (rare)
  ▪ segmental : 67 %
  ▪ clumped ductal : 31 %
MRI features and PPV

Enhancement
- Lack of enhancement has high negative predictive value (NPV) for malignancy (88%–96%)
- **Type I curve:** progressive enhancement pattern
  - considered benign ~9% malignant
- **Type II curve:** plateau pattern
  - concerning for malignancy 34% malignant
- **Type III curve:** washout pattern
  - rapid uptake and washout
  - strongly suggestive of malignancy 57%
Scar tissue:

**No indication** for MRI routinely for scar tissue. It should NOT replace conventional assessment and core biopsy.

- Mass or non-masslike
- Irregular lesion
- No enhancement
- Low T2 signal
Indications UK and Europe:

- Mammographically occult lesions in dense breasts
- Problem solving: Discrepancy in size or position (mammography/ultrasound/clinical)
- Suspected multifocal disease
- Lobular carcinomas
- Axillary lymphadenopathy, primary unknown
- Evaluation of response to primary chemotherapy
- Assessment of breast implant integrity
Occult lesion, Dense breast
Occult lesion, Dense breast
Problem Solving

- MRI to assess screen detected abnormality right breast
- Original mammographic lesion appeared to be upper inner quadrant. Ultrasound lesion (B2) seemed to be a bit too lateral for true correlation.
Problem solving

- MRI RIGHT shows a unifocal irregular area with rapid enhancement measuring 12 mm x 12 mm x 8 mm situated in the lower inner quadrant. On review of mammograms there is faint change in this area on the MLO film.
- LEFT: normal
- needs second look u/sound
Lobular carcinoma

- Mass or non-masslike enhancement
- Heterogenous enhancement
- Variable curve type
- T2 isointense to fibroglandular tissue
Lobular carcinoma

- 22mm grade 2 invasive lobular ca
- MR detected multifocality

2\textsuperscript{nd} lesion inferiorly lobular ca on US biopsy
Unknown primary
47 year old presented with axillary lymphadenopathy
Unknown primary
Neoadjuvant baseline
Neoadjuvant Mid Rx
Comparison – response
Implants

MRI is indicated for problem solving focal abnormalities where triple assessment has failed to resolve the diagnosis. It is considered by many as the “gold standard” for assessment of implant rupture.
Implants: EUSOMA Guidance

- MRI **not** recommended for screening for implant rupture in asymptomatic women.
- Symptoms suggestive of implant rupture, etc. after conventional imaging, non-contrast MRI is recommended to confirm or exclude rupture.
- Signs/symptoms of parenchymal disease (e.g. breast lump), when conventional imaging is not diagnostic, non-contrast MRI and DCE MRI is indicated.
- In symptomatic patients that have undergone breast augmentation with direct polyacrylamide gel injection, non-contrast MRI and dynamic contrast-enhanced MRI are indicated.

(Sardanelli 2010):
Sequences Implants

- Single breast (less chemical shift)
- Axial STIR
- Axial stir water sat (silicone only)
- Sagittal STIR
- Axial VIBRANT single phase
Implant failure

- Linguini
- Noose
- Keyhole
- Silicone leak
- Salad oil
Pre-operative MRI

- MRI improves diagnosis of breast cancer, but does it reduce rates of reoperation and recurrence?
- COMICE and MONET trials suggested not
- Preoperative Breast MRI in Clinical Practice: Multicenter International Prospective Meta-Analysis (MIPA) of Individual Woman Data An EIBIR-EuroAIM/EUSOBI Study (due 2018) (Sardinelli)
Take home messages

◆ Mass: Shape, margins etc **do not** override enhancement kinetics
◆ Lobular cancers may not show typical malignant type enhancement
◆ NME: distribution, symmetry key
◆ MRI is not needed to assess a tumour before surgery for biopsy-proven invasive breast cancer or DCIS except in specific clinical situations.
◆ Carrying out an unnecessary preoperative MRI scan may cause additional stress without any benefit and waste healthcare resources
◆ Do not substitute for conventional imaging and biopsy unless specific indications
Thank you