# The Path is Back: Now What? Volume 2 (MR)

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## Disclosure of Commercial Interest

- I receive funding from the NIH
- Neither I nor my immediate family members have a financial relationship with a commercial organization that may have a direct or indirect interest in the content.

## Overview

- How do we perform radiology-pathology correlation for MR detected lesions?
- How do we assess for imaging-histologic discordance after a MRI 9G-vacuum assisted biopsy (VAB)?
- False-negative biopsies
- Are upgrade rates the same for MR biopsies compared with stereotactic and US biopsies?
- Are there some lesions that don't need to be excised?

## Special MRI Biopsy Issues

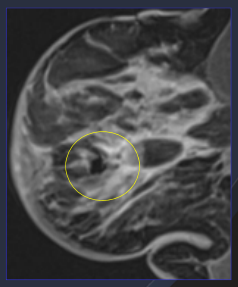
- MRI compatible devices
- "Evolving" image – lesion conspicuity
  - Vanishing target – contrast washes-out
- Patient must be removed from magnet to perform biopsy


## Special MRI Biopsy Issues

- Limited access to medial breast
- Breast is compressed
  - Lesion depiction isn't as clear as routine MR
  - Different positioning may raise doubt about index lesion
- Post biopsy changes obscures lesion
  - Hemorrhage, air, anesthesia
  - Uncertainty in adequacy of sampling on post-biopsy images
- Cannot visualize sample aperture

## Increase Lesion Conspicuity

- Flush the biopsy cavity with saline or aspirate biopsy cavity
- Any remaining contrast or enhancing lesion is easier to see
- Re-injecting before obtaining post-biopsy images may help the radiologist assess for residual enhancement



## Difficult to Confirm Lesion Retrieval

- Lack of specimen radiograph
  - Contrast is no longer in tissue
- Limitations of other modalities to confirm MRI lesion sampling
- MRI - pathology correlation is more difficult
- May need to perform follow-up MRI of benign findings to document lesion sampling

## Documentation of Clip Placement

- A clip should always be deployed
  - Localizes biopsy site if surgery is needed
  - Medico-legal concerns, identify site on subsequent mammograms
- Difficult to visualize
  - Same signal as an obturator and air
  - Document with post-procedure mammogram
- No data on frequency of clip migration
  - Clip can deploy away from target despite successful sampling*

*Li J, AJR 2009; 193:850-55

## MR Breast Biopsy

| Author | Cases | Needle size | Technical success | Malignancy |
|---|---|---|---|---|
| Heywang-K '99 | 100 | 11 g | 99% | 25% |
| Kuhl '01 | 78 | 14 g | 98% | 35% |
| Perlet '02 | 341 | 11 g | 98% | 25% |
| Liberman '03 | 20 | 9 g | 95% | 32% |
| Liberman '04 | 38 | 9 g | 87% | 27% |
| Chen '04 | 35 | 9 g | 97% | 29% |
| Lehman '05 | 38 | 9 g | 100% | 37% |
| Perlet '06 | 538 | 11 g | 96% | 27% |

## PPV of MR biopsy

- Average positive biopsy rate is 31%
  - PPV depends on clinical indication for initial MRI*
  - Highest among women with known primary cancer and unknown primaries
- Similar to mammography
- Audit your practice - 30% may serve as a point of reference

*Perlet C et al. Mar 1;106(5):982-90. Cancer 2006

## The Path Is Back….Now What?

- The diagnosis doesn't stop with the biopsy; it's even more important to correlate the biopsy results with the imaging finding!
- Assess if lesion was adequately sampled
- Assess whether pathology results account for the MRI findings
- May need to review with your pathologist
- Speak with the surgeon about your findings

## How Do We Perform Rad Path Correlation for MR lesions?

- Review the clinical indication for the MRI
- What was the index lesion?
- Review the original post-contrast and subtraction images that recommended the biopsy
- Identify the key sequence (usually post-contrast or subtraction) and images on the breast MRI
- Review the biopsy images: pre and post needle placement, biopsy cavity
  - Did we obtain representative sampling of the lesion?

## Rad Path Correlation

- Compare what is seen under the microscope with the MRI findings
- Do the histologic findings provide a sufficient explanation for the imaging findings?
  - If yes, there is concordance
  - If no, there is discordance
  - If there is doubt, discuss with the pathologist
- BI-RADS 4 lesion yields histology that does NOT match the imaging pattern (i.e., a discreet mass yields benign breast tissue)
- BI-RADS 5 lesion yields benign results

## Rad-Path Correlation for MR Lesions

- Multi-disciplinary management conferences
  - Radiologic-pathologic correlation is essential to ensure concordance, eg florid vs. isolated adenosis
  - Discuss management and follow up of patient
- Rad–path correlation should be referenced by an addendum or documentation
  - Concordant results, indicate the next step
  - Discordant results, discuss the case with the pathologist and referring physician
  - Document the final consensus

## Discordant Biopsy Results

- The **benign** pathology results do NOT account for the imaging findings
- Concern for a false-negative biopsy results
  - Although needle biopsy results are benign, repeat biopsy or surgical excision may yield a cancer
- Lee et al found 7% of lesions were discordant and 30% of discordant lesions that were excised were malignant*
  - Discordant rate is higher in lesions that were missed rather than sampled

*Lee JM AJR 2007: 189(4):852-9

## Imaging-Histologic Discordance at Percutaneous Biopsy

| Study | Method | No. Discordant/ No. of Lesions (%) | No. Cancer/ No. Surgery (%) |
|---|---|---|---|
| Total stereo and US | Core biopsies and VAB | 123/4002 (3) | 14/101 (14) |
| Orel 2006 | MRI 9G-VAB | 2/85 (2) | 2/2 (100) |
| Lee 2007* | MRI 9G-VAB | 24/342 (7) | 6/20 (30) |
| Lewin 2015** | MRI 9G-VAB | 25/1314 (2) | 9/25 (36) |
| Total MRI | MRI 9G-VAB | 51/1741 (2.9%) | 17/47 (36) |

Higher discordance rate with MRI-VAB*
HR women undergo MRI VAB
Relative novelty of MRI interpretation and biopsy
Limitations of other methods to confirm MRI lesion sampling
Variability of enhancement in pre-menopausal women

Orel S. Radiology 2006. *Lee JM AJR 2007. **Lewin RSNA 2015 - submitted

## False Negative (FN) Biopsy

- Benign biopsy ➔ Pathology-proven cancer
- Review biopsy images – Proof of sampling is indirect and more difficult
- Did not get a representative sample ➔ Don't want delay in diagnosis
- No specimen radiograph

Bagnall et al Rad Clin 2000

## False Negative MRI-VAB

- MR biopsy: FN rate 1.9 – 12.5%
- Rad-path correlation to find discordant results
  - Compression alters the appearance and location of the lesion
  - Compression may lead to delay or decreased enhancement
  - NME lesions are especially challenging; part of BPE
- If you believe the benign results are concordant, stability should be documented on follow up exams
- Cohort of women who undergo a MRI are high risk

## Short-term Follow Up After a Benign Biopsy

- Studies on stereotactic biopsy and US biopsy are mixed after a benign concordant biopsy
  - False-negative rate is very low*
  - Recent reports suggest follow-up at 12 months
- Should there be different follow-up protocols after a benign concordant specific (eg. fibroadenoma) vs. benign concordant non-specific (eg. fibrocystic change)? **

*Salkowski LR (2011) Radiology 258:380–387, **Lee CH, et al (1999) Radiology 212:189–194

## Short-term Follow Up After A MR Biopsy

- 55 -70% of MR VAB yield benign results
- Overlap in the MRI appearance of benign and malignant lesions
- Want to avoid a delayed of diagnosis of FN biopsy
- Li et al: 177 lesions were followed: 155 lesions were decreased, 14 were stable and 8 got bigger
- 17 (9.6%) lesions underwent a second biopsy
  - 4 (24%) were cancer
- Missed cancers did not enlarge before 6 months

*Li, J AJR 2009:193:850-855

## Short-term Follow Up After MR Biopsy

- 2008 European consensus on MR VAB: MRI follow-up after 6–12 months for non-neoplastic benign lesions.
- Sung et al., short-term follow-up is a “specimen radiograph” as there is no immediate confirmation of successful sampling with MRI guided biopsy.
  - Proof of sampling is more difficult on MR biopsy
  - No specimen radiograph is obtained

*Heywang-Köbrunner SH (2009) Eur J Radiol 72:289–294, **Sung JS (2012) AJR 198: 1464–1469.

## Short-term Follow up After A Benign MR Biopsy

- Shaylor et al, no additional cancers were detected on short-term follow-up in 188 lesions
  - 1 cancer at 18 months of follow up
- Perform good rad-path correlation
- Short-term follow up may not be necessary after benign concordant MR biopsy
- Be careful! MRI population is HR women who have a higher prevalence of disease

* Shaylor S et al (2014) Eur J Radiol 24:1176–1185

## Canceled MRI-Guided Biopsies

- Get delayed images and ease compression
- If lesion is still not visualized; it does not imply that the lesion is benign
- Brennan et al, MRI biopsies cancelled in 8% (70/907) of lesions
  - 2% cancer detection rate: a DCIS detected in mastectomy specimen
- Niell et al, MR biopsies aborted in 13% (56/445) lesions
  - 5/50 (10%) subsequent malignancy: 3 IDC and 2 DCIS
- Short-term follow up is warranted

*Brennan, Radiology 2011, Niell AJR 2014

## High-Risk Lesion After a MR biopsy

- High-risk (HR) lesions may be upgraded to malignancy because of underestimation at biopsy due to:
- Undersampling at biopsy
- Difference of opinion among pathologists over the criteria for defining a high-risk lesion versus a cancer
- Targeting was inaccurate and the lesion may have been missed

* Heller S et al (2013) Magn Reson Imaging Clin N Am. 2013;21(3):583-599.

## High-Risk Lesions

- High-risk lesions that may be upgraded include:*
  - Atypical ductal hyperplasia
  - Flat epithelial atypia
  - Lobular neoplasia (atypical lobular hyperplasia and lobular carcinoma in situ)
  - Radial scar and other complex sclerosing lesion
  - Phyllodes tumor
  - Papillary lesion

* ACR Appropriateness Criteria for Stereotactic, Ultrasound and MRI guided biopsies

## Upgrade rates for MR VAB are higher than stereotactic biopsies

- Underestimation rate on stereo biopsies 3 - 21% compared with MR-VAB 13 – 57%
- Perhaps related to the overall higher risk of breast cancer in women who undergo MRI
- Heterogeneous and non-contiguous nature of HR lesion*
- MR detected HR lesions enhance and may be distinct from HR lesions detected on mammography and US**

*Liberman L, AJR 2007, Heller SL, AJR 2014

## High-Risk Lesion After a MR Biopsy

- No MRI features are predictive of a HR lesion
- No MRI features predict the likelihood of upgrade
- ADH is the most common HR lesion
- ADH accounts for 15 -65% of all HR lesions for which repeat biopsy is recommended
- ADH has the highest likelihood of being upgraded to malignancy of the high-risk lesions

* Heller S et al (2013) Magn Reson Imaging Clin N Am. 2013;21(3):583-599

## Frequency and Upgrade of ADH at MRI-VAB

Table 2
Review of studies reporting both frequency and upgrade rate of atypical ductal hyperplasia detected on MRI imaging

| Author | Total No. of Lesions | Total High-risk Lesions | Frequency of ADH/Total (%) | No. ADH Excised | ADH Upgrade (%) | Final Surgical Histology |
|---|---|---|---|---|---|---|
| Liberman et al.[30] 2003 | 27 | 1 | 1/27 (3.7) | 1 | 1/1 (100) | DCIS |
| Chen et al.[27] 2004 | 35 | 5 | 5/35 (14) | 4 | 2/4 (50) | 2 IDC |
| Liberman et al.[31] 2005 | 95 | 10 | 4/95 (4) | 4 | 2/4 (50) | 2 DCIS |
| Lehman et al.[32] 2005 | 38 | 2 | 2/38 (5.3) | 2 | 1/2 (50) | DCIS |
| Ghate et al.[28] 2006 | 19 | 4 | 2/19 (11) | 2 | 1/2 (50) | 1 IDC |
| Perlet et al.[29] 2006 | 517 | 17 | 17/517 (3.3) | 17 | 5/17 (29.4) | 5 DCIS |
| Orel et al.[33] 2006 | 85 | 18* | 8/85 (9.4) | 8 | 2/8 (25) | 2 DCIS |
| Liberman et al.[26] 2007 | 237 | 15 | 15/237 (6.3) | 13 | 5/13 (38.5) | 5 DCIS |
| Mahoney et al.[34] 2008 | 55 | 7 | 3/55 (5.5) | 3 | 2/3 (66.7) | 2 IDC |
| Malhaire et al.[35] 2010 | 72 | 10 | 1/72 (1) | 1 | 1/1 (100) | 1 DCIS |
| Perretta et al.[37] 2008 | 47 | 4* | 4/47 (8.5) | 4 | 1/4 (25) | 1 DCIS |
| Noroozian et al.[38] 2010 | 75 | 7 | 2/75 (2.7) | 2 | 0/2 (0) | NA |
| Strigel et al.[39] 2010 | 482 | 51 | 51/482 (10.6) | 34 | 11/34 (32.4) | 1 ILC<br>4 DC<br>6 DCIS<br>(1 ADH and LCIS) |
| Tozaki et al.[25] 2010 | 102 | 9* | 4/102 (4) | 2 | 2/2 (100) | 2 DCIS |
| Crystal et al.[24] 2011 | 161 | 31 | 6/161 (3.7) | 6 | 3/6 (50) | 2 DCIS<br>1 IC, NOS |
| Rauch et al.[41] 2012 | 218 | 37* | 13/218 (6) | NS | 4/NS | 3 DCIS<br>1 IDC |
| Ozner et al.[54] 2012 | 187 | 16* | 15/187 (8) | NS (data on 3 cases) | 2/NS | 2 DCIS |
| Dogan et al.[43] 2012 | 199 | 31 | NS | NS (data on 2 cases) | 2/NS | 1 DCIS<br>1 IDC |
| Range (%) | 19–572 | 1–51 | 1–19 | | 0–100 | |

Abbreviations: IC NOS, invasive cancer not otherwise specified; NS, not stated.
* Papillomas not counted as high-risk lesions in study.

* Heller S et al (2013) Magn Reson Imaging Clin N Am. 2013;21(3):583-599

## Outcomes of HR Lesions After MR Biopsy

- Retrospective review of 1145 lesions in 1003 women
- 709 (61.9%) benign, 252 (22%), 184 (16.1%) HR lesions
- 30 (20.4%) were upgraded ➔19 DCIS, 12 invasive
- Upgrade rate was highest for ADH, LCIS and radial scar
- Upgrade rate was significantly higher for women with a personal history of breast cancer
- No imaging features predictive of upgrade

* Heller S et al AJR 2014;202:237-245

## Frequency and Upgrade of Papillary Lesions, Radial Scars, ALH and LCIS at MRI-VAB

Table 3
Studies detailing incidence and upgrade rate of papillary lesion, radial scar, ALH, and LCIS on MR*

| Author | Total Lesions No. | Papillary Lesion No./Upgrade No. | Radial Scar No./Upgrade No. | ALH No./ Upgrade No. | LCIS No./ Upgrade No. |
|---|---|---|---|---|---|
| Liberman et al.[30] 2003 | 95 | 1/1 (DCIS)† | 1/0 | 1/0 | 3 (2 excised)/0 |
| Orel et al.[33] 2006 | 85 | 0/0 | 3/0 | 2/0 | 5/0 |
| Mahoney[34] 2008 | 55 | 3/1 (DCIS) | 0/0 | 0/0 | 1/1 → IDC |
| Noroozian et al.[38] 2010 | 75 | 0/0 | 0/0 | 2 (1 excised)/0 | 3/1 → DCIS |
| Strigel et al.[39] 2010 | 482 | 0/0 | 1/0 | 6/1 → DCIS | 3/1 → DCIS |
| Malhaire et al.[35] 2010 | 72 | 2/0 | 1/0 | 2(none excised) 1/0 | |
| Crystal et al.[24] 2011 | 161 | 3/0 | 2/0 | LN NOS-8/1 → IC, 3/3 → DCIS | |
| Brennan et al.[42] 2012 | 1487 | 75 (67 excised)/2 DCIS of 23 with atypia<br>2 DCIS of 44 without atypia | | | |
| Niell et al.[13] 2012 | | | LN-12/2<br>19/2 (excluding either pLCIS or FEA with LCIS) | | |

Abbreviations: IC, invasive cancer; LN NOS, lobular neoplasia not otherwise specified.
* Biopsy specimens reported as containing mixed-high-risk pathologic abnormality were excluded.
† DCIS found 0.7 cm anterior to the papillary lesion on excision in a patient with known Paget disease.

Most series have small number of these HR lesions

* Heller S et al (2013) Magn Reson Imaging Clin N Am. 2013;21(3):583-599

## LCIS Diagnosed on MR Biopsy

- LCIS and ALH ➔ lobular neoplasia
  - Overlap with ADH and DCIS
- Found incidentally in 3% of the breasts
- Upgrade rates on stereotactic and US biopsies*
  - LCIS: 10 – 25%
  - ALH: 6 – 22%
- Upgrade rates on MR VAB are variable

* Brem AJR 2008, Cangiarella Arch Path 2008

## Papilloma on MR VAB

- Retrospective review
- 75/1487 (5%) MRI VAB
  - 33% (25) atypical at biopsy
  - 67% (50) no atypia at biopsy
- Overall rate of malignancy 6%
  - 4/67 cases were upgraded (all DCIS)
  - 9% of cases with atypia
  - 5% of cases without atypia

Brennan S B et al. AJR 2012.

## May Some HR Lesions be Followed?

- Microscopic radial scars or papilloma
  - Lack of enhancement may suggest no invasive disease
  - Radial scars and DBT
- Pure ALH*
  - 33/45 (73%) were pure ALH and 12/45 (27%) were ALH/ADH (5/45 (11%)
  - Upgrade rate to cancer of MRI-VABs yielding ALH was low (2.6% and 2.2%) and was found with ALH associated with ADH only

*Linda A, AJR 2012, **Brennan SB RSNA 2014

## Take Home Points For a MR Biopsy

- A clearly thought-out MR-guided biopsy technique with checks for appropriate and accurate targeting of lesions, including post-biopsy marker clip placement, is crucial for evaluating radiologic-pathologic correlation.
- More data is necessary to determine whether a short-term follow-up breast MRI is necessary after a benign concordant biopsy

## Management Recommendations

- Rad-path correlation is extremely important
- Recognition of discordance decreases FN results.
- To avoid a delayed diagnosis of cancer, imaging histologic concordance is considered an integral part of MRI VAB.
- Minimize delay in diagnosis; identify cancers when they are small and, hopefully, curable

## Management Recommendations

- Although high-risk lesions should be addressed on a case by case basis, there are a few generally accepted rules:
- Excision of ADH given the high likelihood of underestimation.
- Excision of LCIS and ALH given the underestimation rate
- Radial scar with atypia and papillary lesions with atypia should be excised
- Excision of radial scar without atypia, papillary lesions without atypia, and FEA detected on MR imaging are more controversial. Excision of these lesions or close follow up is recommended.
- Recommendation may change as more data become available.