Monitoring Systemic and Local Response – Use of Breast MRI and PET/CT

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Message

- Breast MR and PET-CT have complementary roles in the evaluation of breast cancer patients. Breast MR is currently the imaging study of choice for evaluating response to neoadjuvant chemotherapy in locally advanced breast cancer.

Workshop Format

- This workshop will integrate a combination of didactic slides (syllabus) with case presentations and Q&A formats to highlight the major teaching points.

Workshop Outline

- Fundamental differences between MR and PET
- Locally Advanced Breast Cancer Evaluation
  - Rationale for neoadjuvant chemotherapy
  - Initial staging with MR and PET
  - Predicting pathologic complete response
  - Potential for predicting disease-free survival
- Evaluation of Metastatic Disease (PET-CT)
- False Positive and Negatives: MR and PET-CT

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What are the fundamental differences between breast MR and FDG-PET/CT?

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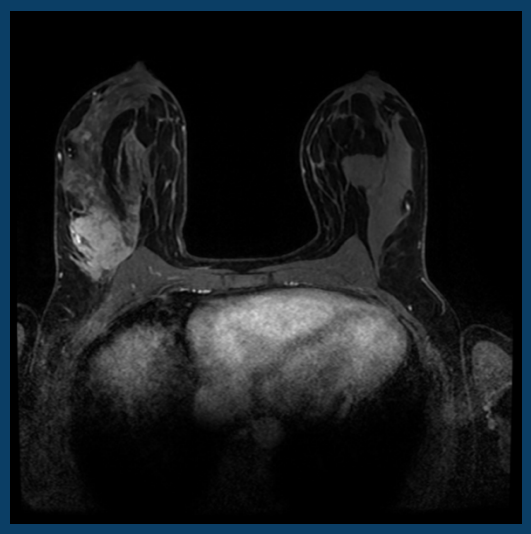
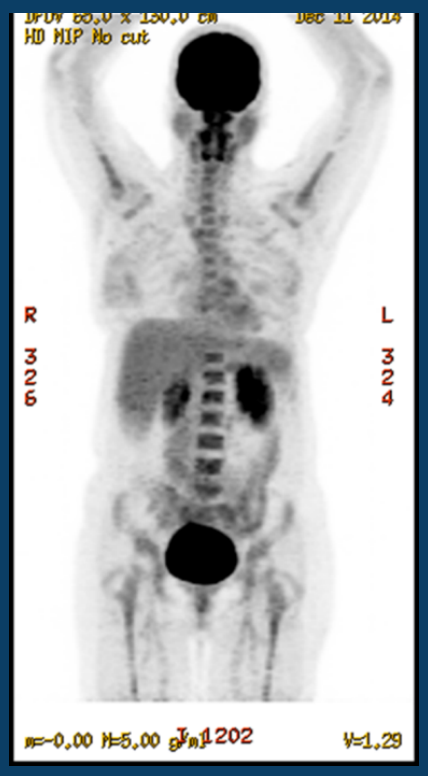
Fundamentals: Breast MR

- Provides high spatial resolution anatomic imaging
- Gadolinium enhancement of most breast cancers
- Dedicated coil to image breasts
  - Local coverage, not whole body
- Prone positioning
- No ionizing radiation



Fundamentals: FDG-PET

- Metabolic imaging using glucose analog
  - 18F-2-fluoro-2-deoxy-D-glucose or “FDG”
- High sensitivity
- Whole body coverage
- Limited anatomic detail and spatial resolution
  - best for > 1cm lesions
- Supine positioning
- Ionizing radiation



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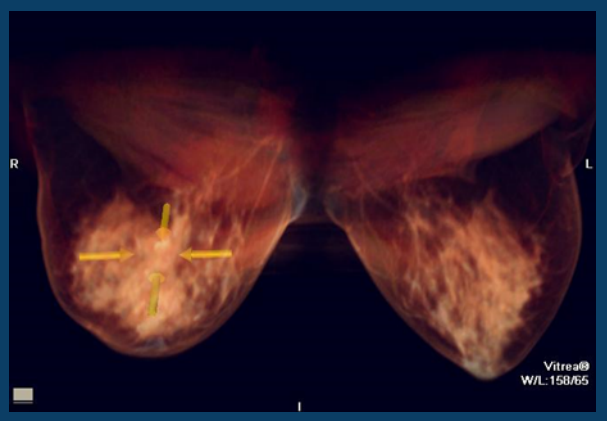
Integrated PET-CT: Advantages

- Overall time savings for patient
  - Use of CT for attenuation correction shortens PET acquisition
  - 30 minutes to 1 hour for combined exam
  - No need to obtain separate diagnostic CT (if iv contrast used)
  - Better localization of areas of FDG uptake

Why focus on locally advanced breast cancer?

Locally Advanced Breast Cancer

- Stage III disease
- Large tumors relative to size of breast
  - > 5cm in a large breast
  - 3-5cm in a smaller breast
- Any tumor with skin or chest wall involvement
- Regional adenopathy (level I, II, III)
- No distant metastases



Rationale for Neoadjuvant Chemotherapyin Locally Advanced

- Neoadjuvant chemotherapy(NAC) is given *prior* to definitive surgery
  - Adjuvant Rx is given after surgery
- Allows monitoring of treatment response of the primary tumor
  - Treatment may be altered based on response
  - Accepted indication for breast MRI

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Rationale for Neoadjuvant Chemotherapyin Locally Advanced Breast Cancer

- Reduces size of primary tumor to make patient a candidate for lumpectomy
- Provides prognostic information
- Allows more time for patient to consider surgical options

Initial Staging

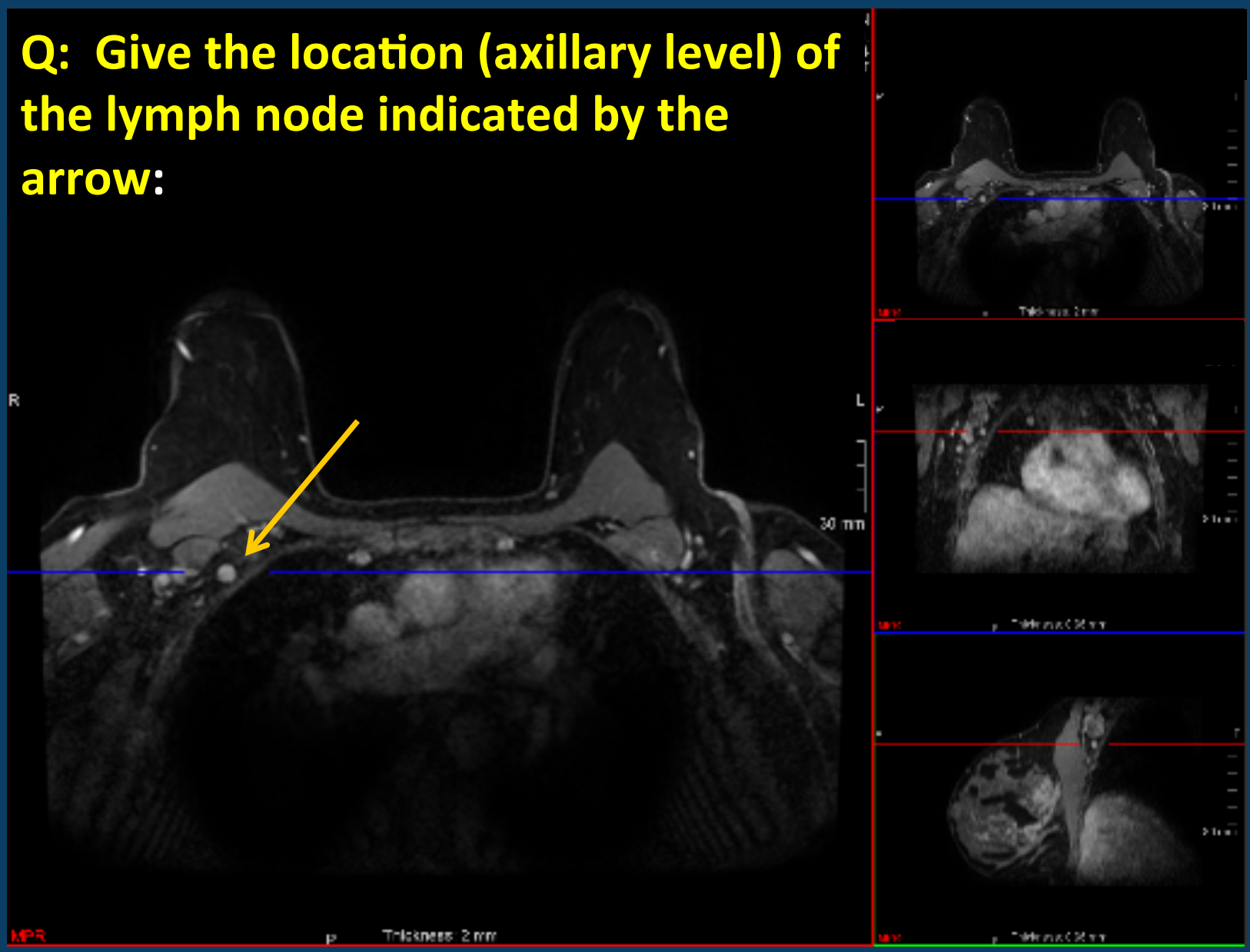
- Extent of disease
- Contralateral screen
- Axillary and internal mammary adenopathy
- Exclude distant metastases

Question

When using breast MR to evaluate extent of disease for a newly diagnosed breast cancer, what is the most appropriate BI-RADS assessment for a suspicious finding in another quadrant of the ipsilateral breast?

A. BI-RADS 1: Negative
B. BI-RADS 2: Benign
C. BI-RADS 3: Probably Benign
D. BI-RADS 4: Suspicious
E. BI-RADS 5: Highly Suggestive of Malignancy
F. BI-RADS 6: Known Malignancy

Q: Give the location (axillary level) of the lymph node indicated by the arrow:



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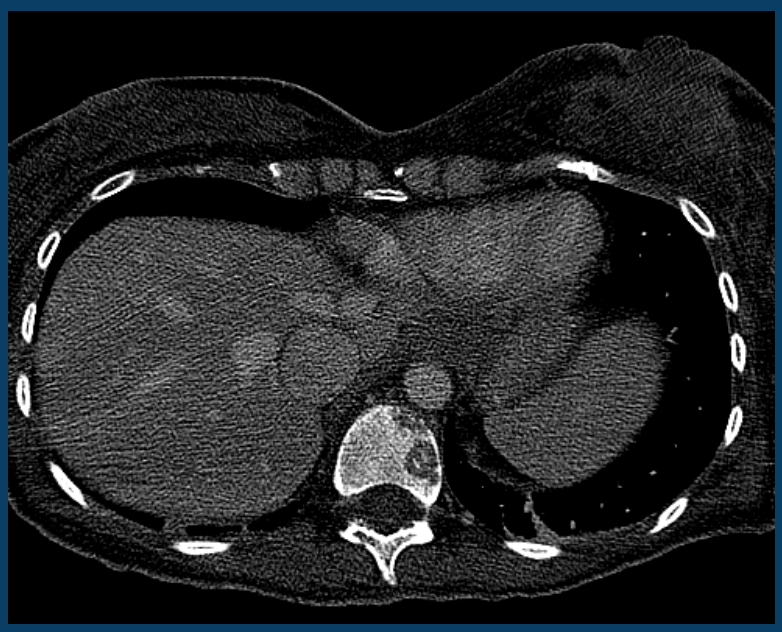
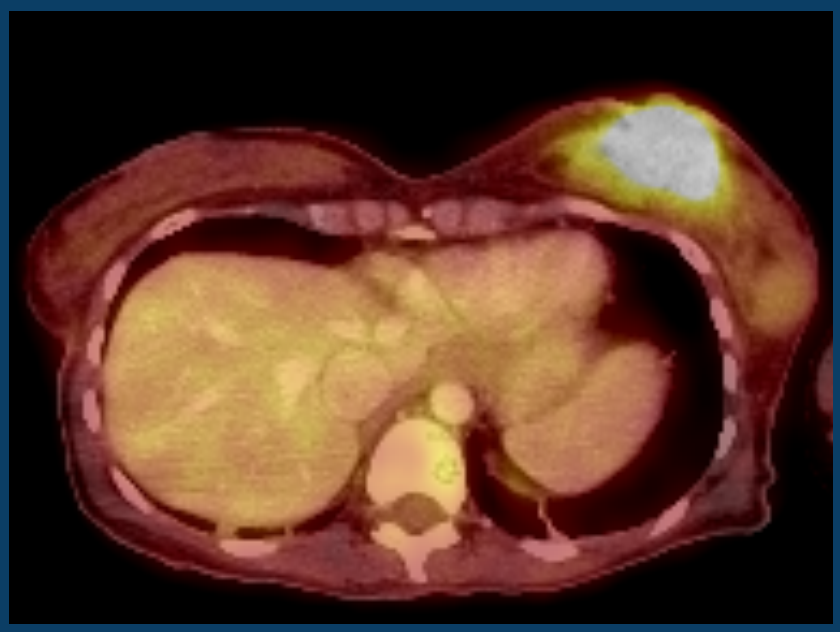
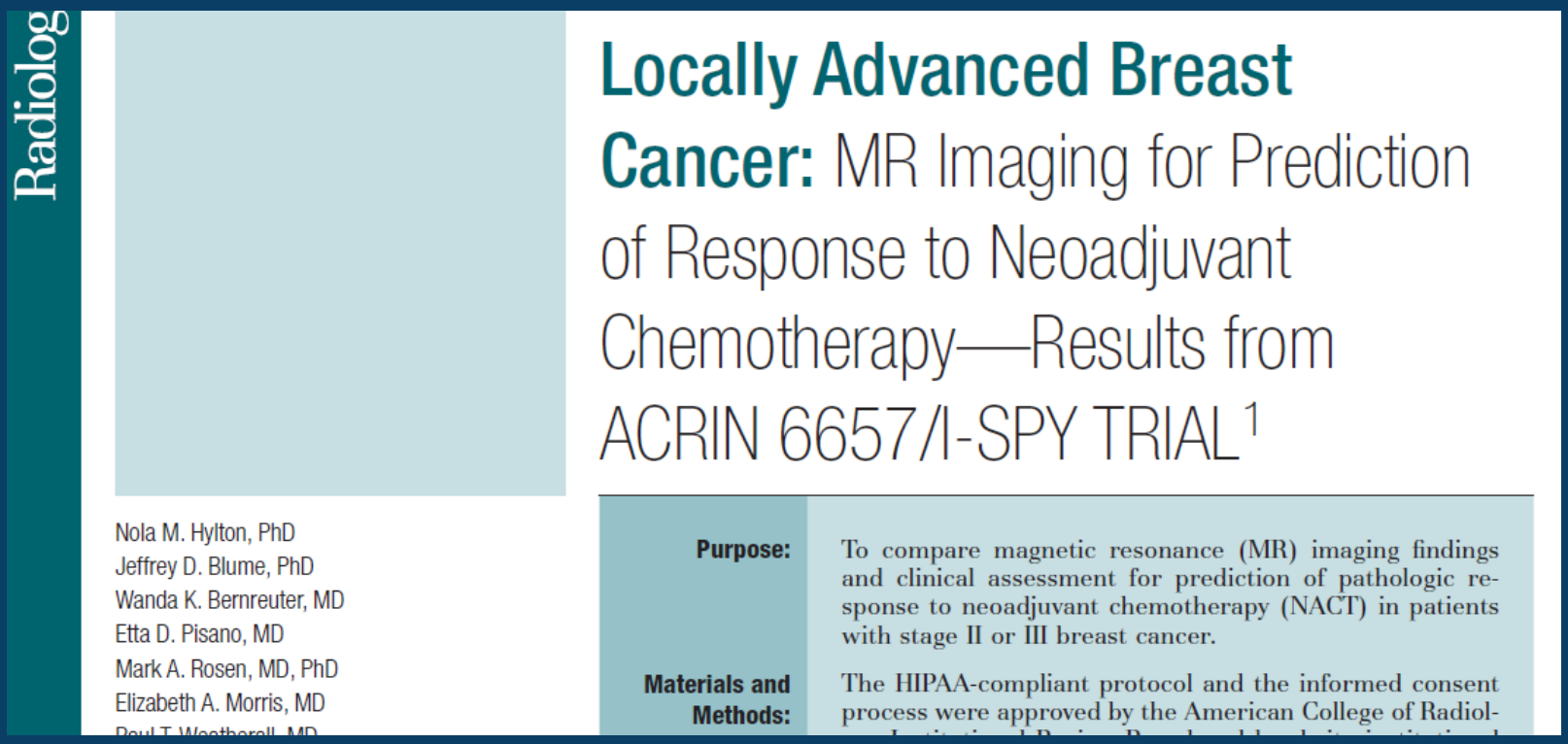
Does this patient have locally advanced breast cancer?





What information does MR provide in monitoring neoadjuvant chemotherapy?

MR for Predicting Pathologic Response



Radiolog

Locally Advanced Breast Cancer: MR Imaging for Prediction of Response to Neoadjuvant Chemotherapy—Results from ACRIN 6657/I-SPY TRIAL[1]

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Purpose: To compare magnetic resonance (MR) imaging findings and clinical assessment for prediction of pathologic response to neoadjuvant chemotherapy (NACT) in patients with stage II or III breast cancer.

Materials and Methods: The HIPAA-compliant protocol and the informed consent process were approved by the American College of Radiol-

Hylton, et al. Radiology: Vol. 263:Number 3—June 2012, pp 663-672.

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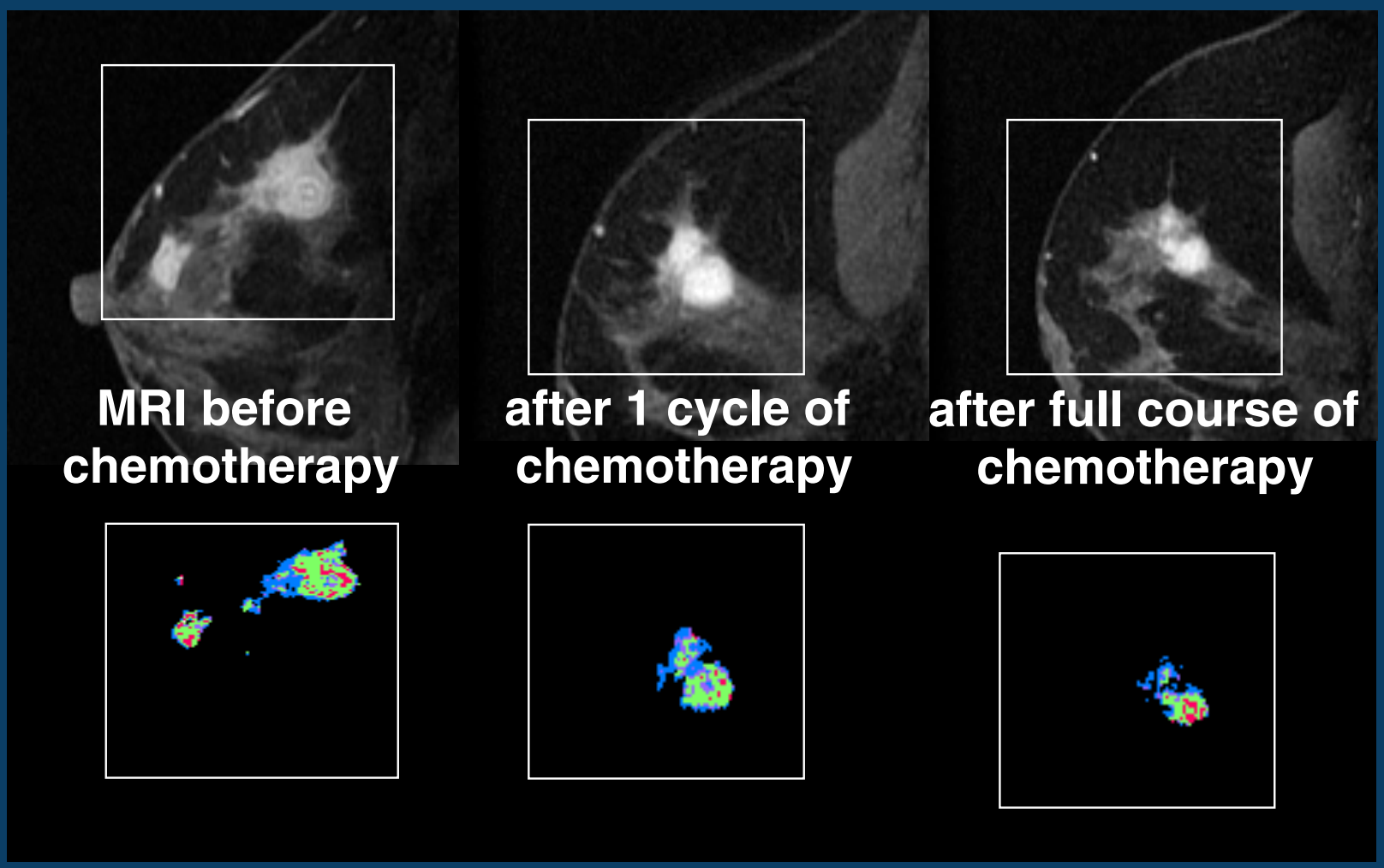
MR assessment of treatment response for locally-advanced breast cancer (SER volumes)



Courtesy: Nola Hylton, PhD (UCSF)

MR Assessment of NAC Response

- Change in breast tumor size at MR superior to clinical assessment
- Volumes superior to diameters for predicting pathologic outcomes
- Greatest relative advantage in predictive ability of MR occurs early in treatment
- MR is one of the biomarkers for the I-SPY2 (multi-site neoadjuvant therapy) trial

Evaluation of metastatic disease

- Is PET/CT the best test?

Breast Cancer Metastases: Common Sites

- Bone (most common distant metastatic site)
  - Osteolytic mets (more common) PET more sensitive
  - Osteoblastic mets (less common) bone scan more sensitive
- Liver: MR better than PET or CT
- Lung: CT better than MR or PET
- Brain: MR better than PET or CT

PET vs MR

- MR able to detect more and smaller (<1cm) liver lesions than PET
  - *High resolution scans using liver specific agent
- PET better able to detect remote sites of disease

*Sahani, et al, AJR 2005;185:239-246

How to improve on PET/CT?

- Consider iv contrast

Integrated PET-CT? with or without iv contrast

- Giving iv contrast for CT can produce artifacts on PET because CT used for attenuation correction
- UCSF approach: benefit of diagnostic CT with iv contrast outweighs the problems of attenuation correction
  - UCSF Protocol: CT performed with iv contrast, oral water
  - Multiphase abdominal CT as needed

Diagnostic Value of Contrast

Noncontrast CT

Contrast Enhanced CT

Give iv contrast unless contraindicated

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False positives and negatives

- MR and PET/CT

MR is not perfect

- False negatives—absence of enhancement may relate to chemotherapy diminishing tumor vascularity without complete response
- False positives—residual enhancement may represent inflammation, fibrosis, BPE

PET Pitfalls: False Positives

- Inflammatory uptake of FDG mimicking tumor
  - Recommend to wait 4 weeks after surgery, 3 weeks after radiotherapy if clinically possible
- Physiologic uptake of FDG
  - muscle, uterus, corpus luteum cyst
  - correlative CT imaging helpful to exclude tumor

PET Pitfalls: False Negatives

- Diabetic patients
  - High circulating glucose levels compete with FDG
  - Fasting blood glucose <130 mg/dl (ideal), <200 mg/dl (accepted in some clinical trials)
- Small lesion size
  - Resolution limit 5 mm to 10 mm
- Mucinous adenocarcinomas

Message

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