When Should an MRI be Ordered?

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Role of MRI

- Screening
  - increased sensitivity in cancer detection
- Pre-operative staging
  - identifies additional foci of cancer not seen by other imaging modalities
- Surgical planning

GOAL – improve patient outcomes

Diagnostic Ability of MRI

- Sensitivity 90%
- Specificity 72%
- False positives 28%
- In 16% of cases MRI can find additional ipsilateral focus of cancer
  - 66% of these lesions were malignant


Diagnostic Ability of MRI

- MRI detected suspicious findings occult to conventional imaging 9.3%
- Incremental cancer detection rate 4.1%
- Positive predictive value 47.9%
- MRI is limited in distinguishing between benign and malignant lesions

MRI and Surgical Outcomes

- COMICE trial - addition of MRI to triple assessment (clinical exam, mammography, ultrasound) was not significantly associated with a reduced re-operation rate
  - Both groups had 19% of their patients needing reoperation


MRI and Surgical Outcomes

- Monet trial - randomized control trial in patients with non-palpable suspicious breast lesions detected on mammogram or ultrasound
  - Primary breast conserving surgery was similar in both groups
  - Number of conversions to mastectomy did not differ significantly
  - Number of re-excisions for positive margins higher in the MRI group


Take Away Points

- MRI has high sensitivity, but low specificity
- MRI only incrementally increases cancer detection rates both in the ipsilateral and contralateral breast
- MRI in the pre-operative setting does not affect short term surgical outcomes
- MRI should not be used for routine screening or routine pre-operative staging

Current Clinical Indications

- High risk patients
- Invasive lobular carcinoma
- Neoadjuvant chemotherapy
- Occult primary
High Risk Patients

• Women who are BRCA 1 or BRCA 2 gene mutation carriers
• Untested first degree relatives of BRCA gene mutation carriers
• Women with greater than 20-25% lifetime risk of developing breast cancer based on family history


MRI has higher sensitivity than mammography for detecting breast cancer
– MRI not affected by breast density
• MRI has the ability to detect smaller tumors than mammography
• No data on outcome or survival


American Cancer Society Guidelines

<table>
<thead>
<tr>
<th>TABLE 2 Published Breast MRI Screening Study Results</th>
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<tbody>
<tr>
<td>The Netherlands</td>
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<tr>
<td>-----------------</td>
</tr>
<tr>
<td>No. of women</td>
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<tr>
<td>No. of cancers</td>
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<tr>
<td>Sensitivity (%)</td>
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<tr>
<td>Mammogram</td>
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<tr>
<td>Ultrasound</td>
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<tr>
<td>Specificity (%)</td>
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<td>Ultrasound</td>
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Sensitivity of MRI in high risk patients ranges from 77-100% compared with mammography which ranges from 16 to 40%

High Risk Patients

- No consensus on when to start screening in high risk patients
  - 5 years younger than the first relative who presented with breast cancer
  - Starting at age 30
- No consensus on when to stop MRI screening

American Cancer Society Guidelines

- Insufficient evidence to recommend or discourage MRI screening of women with 15-20% lifetime risk of breast cancer or women with LCIS, ALH, ADH, dense breasts, or a personal history of cancer

High Risk Patients

- Mutation carriers (>50%)
  - Cancer detection rate of 26.5 per 1000 patients
- High risk (30-49%)
  - Cancer detection rate of 5.4 per 1000 patients
- Moderate risk (15-29%)
  - Cancer detection rate of 7.8 per 1000 patients


Current Clinical Indications

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- Occult primary
Invasive lobular carcinoma

- 2nd most common breast cancer, but only 5-15% of all breast cancers
- More likely to be multi-centric, multi-focal and/or bilateral compared to other types
- Often more difficult to detect
- Can be difficult to determine extent of disease


Invasive Lobular Carcinoma

- MRI found to more accurately determine tumor size compared to mammography
- Mammography underestimated the tumor size significantly more frequently than MRI
- Overestimation of the tumor size happened with equal frequency
  - Usually due to extensive LCIS around the tumor


Scatter plots of tumor size


Invasive Lobular Carcinoma

- Significantly fewer patients in the MRI group had a re-excision
  - Odds ratio for re-excision – 3.29
- No significant difference in initial mastectomy rates

Current Clinical Indications

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Neoadjuvant chemotherapy

• Increased use of neoadjuvant chemotherapy has led to the need for a tool to assess tumor response to treatment
• MRI offers a non-invasive way to assess tumors before, during, and after neoadjuvant treatment to help determine the appropriate surgical therapy for patients

MRI Phenotypes

1—well defined, uni-centric mass
2—well defined, multi-lobulated mass
3—area enhancement with nodularity
4—area enhancement without nodularity
5—septal spreading.
Neoadjuvant Chemotherapy

- MRI is more accurate than clinical exam, mammography, and ultrasound for determining residual tumor size
- MRI can predict clinically meaningful tumor reduction
  - Well defined MRI phenotypes have higher rates of tumor reduction than diffuse MRI phenotypes
  - Her2 positive and triple negative tumor have higher rates of tumor reduction than hormone receptor positive and Her2 negative tumors


- Assessment of tumor volume with MRI has been shown to be a strong predictor of pathologic response to neoadjuvant chemotherapy
- Multiple studies have shown that the ability of MRI to predict pathologic complete response is related to tumor subtypes


<table>
<thead>
<tr>
<th>Study</th>
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<th>Findings</th>
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<tbody>
<tr>
<td>Hayashi et al. 2013</td>
<td>260</td>
<td>- Sensitivity/Specificity highest in TN tumors</td>
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<td>- PPV decreased in order TN, ER-/Her2+, ER+/Her2+, ER+/Her2-</td>
</tr>
<tr>
<td>Ko et al. 2013</td>
<td>166</td>
<td>- Size prediction less accurate in ER+ tumors</td>
</tr>
<tr>
<td>Cruz et al. 2013</td>
<td>205</td>
<td>- Better correlation between MRI measured response and pathologic response in TN and Her2+ tumors</td>
</tr>
<tr>
<td>Loo et al. 2011</td>
<td>188</td>
<td>- MRI size change associated with path residual disease for TN and Her2+ tumors; not for ER+/Her2-</td>
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<tr>
<td>Kuzucan et al. 2012</td>
<td>54</td>
<td>- Among Her2+ tumors, MRI accuracy higher in high-proliferation (high Ki-67) tumors</td>
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<tr>
<td>McGuire et al. 2011</td>
<td>203</td>
<td>- MRI accuracy for predicting pCR lowest in luminal tumors; highest in TN and ER-/Her2+ tumors</td>
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Greater MRI-pathology agreement and more accurate prediction of pathologic complete response in triple negative and Her2+ hormone receptor negative breast cancers

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Occult Primary

• MRI recommended in case of axillary nodal metastasis or metastatic disease with unknown primary and negative breast imaging
• MRI found on average 72% of the tumors with a mean sensitivity of 90%
  — Specificity of 31%


Occult Primary

• MRI found tumors in 70% of the patients with metastatic axillary adenocarcinoma from an unknown primary site
• Of the patients who underwent surgical excision, cancer was identified by MRI in 95% of the cases


Conclusions

• Screening with MRI should be used only in very specific patient populations
• MRI has a role in the detection and staging of invasive lobular carcinoma and in cases of occult breast primaries.
• Interpretation of MRI findings in the setting of neoadjuvant chemotherapy should be done in the context of MRI phenotype and tumor receptor subtypes

Thank you!