Pre-operative Imaging Considerations

Pre-operative Imaging and Patient Selection for Intraoperative Radiotherapy

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Pre-operative Imaging and Patient Selection for Intraoperative Radiotherapy

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DISCLOSURE OF CONFLICTS OF INTEREST

Nothing to disclose
Appropriate patient selection for IORT is challenging and tumor size on imaging is a key selection criteria

- One of the requirements for a patient being a good candidate for IORT is a tumor size <3cm

- While specificity and sensitivity of breast imaging modalities well studied very few treatment decisions are made on the basis of narrow pre-operative size criteria, IORT is an exception.

The accuracy of imaging modalities; MRI, mammogram and ultrasound; in predicting pathologic size is variable and can therefore strongly influence the inclusion or exclusion of patients from IORT
GOALS

Research Questions:

– Is our preoperative imaging doing a good job of predicting tumor size (as measured at time of surgery)?

– Which imaging modalities are the most reliable predictors of final surgical size?
METHODS

- An IRB approved retrospective analysis of 106 consecutive women referred for IORT at CUMC from September 2013 to July 2015

- Demographic, pre-operative staging, pre and post-operative pathology, surgical and radiation data were collected.

- Variability in pre-operative tumor size by imaging modalities was compared with final tumor size at surgical excision.

- Statistical analysis performed in R to compare imaging modalities and evaluate effects of tumor and patient variables
## RESULTS: Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 106</td>
<td></td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>98 (92)</td>
</tr>
<tr>
<td>Age, median</td>
<td>66 years (44-91)</td>
</tr>
<tr>
<td><strong>Preoperative pathology</strong></td>
<td></td>
</tr>
<tr>
<td>Ductal carcinoma in situ</td>
<td>33 (31)</td>
</tr>
<tr>
<td>Invasive ductal carcinoma</td>
<td>61 (58)</td>
</tr>
<tr>
<td>Invasive lobular carcinoma</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Mixed type</td>
<td>3 (3)</td>
</tr>
<tr>
<td><strong>Breast density</strong></td>
<td></td>
</tr>
<tr>
<td>Dense breasts</td>
<td>42 (40)</td>
</tr>
<tr>
<td>Fatty breasts</td>
<td>64 (60)</td>
</tr>
<tr>
<td><strong>Subtype</strong></td>
<td></td>
</tr>
<tr>
<td>Luminal A</td>
<td>55 (52)</td>
</tr>
<tr>
<td>Luminal B</td>
<td>16 (15)</td>
</tr>
<tr>
<td>Her 2+</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Triple negative</td>
<td>2 (2)</td>
</tr>
<tr>
<td>DCIS</td>
<td>29 (28)</td>
</tr>
</tbody>
</table>
RESULTS

106 patients

97 underwent IORT

9 received EBRT alone because of poor IORT candidacy or patient preference

15 received EBRT after IORT
- 9 patients with positive margins requiring re-excision
- 2 with positive sentinel lymph node biopsy
- 2 HER2 amplified
- 1 TNBC
*1 with focally positive margin who refused further RT or excision

82 received no additional radiation
RESULTS

Choice of pre-operative imaging modality was at the breast surgeons’ discretion.
- All patients underwent MMG
- 80 patients underwent Ultrasound
- 49 patients underwent MRI
- 43 patients had all three modalities

Mean size by imaging: 1.12 cm ± 0.91
Mean final pathological size: 1.01 cm ± 0.67
RESULTS

We defined disconcordance between size by imaging and final surgical size as an absolute difference > 0.5cm

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>Mean Difference between Imaging Measurement and Surgical Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammogram</td>
<td>0.13 ± 0.66cm</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>-0.07 ± 0.51cm</td>
</tr>
<tr>
<td>MRI</td>
<td>0.68 ± 1.40cm</td>
</tr>
</tbody>
</table>
RESULTS

Blue line: $x=y$
Red line: best fit line

Pearson correlation coefficient of data: 0.41 0.64 0.29
RESULTS
RESULTS

Pairwise Analysis comparing the concordance rates between imaging modalities

<table>
<thead>
<tr>
<th>Comparison</th>
<th>p-value</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concordance ultrasound vs mammogram</td>
<td>0.046*</td>
<td>80</td>
</tr>
<tr>
<td>Concordance ultrasound vs MRI</td>
<td>0.099</td>
<td>43</td>
</tr>
<tr>
<td>Concordance mammogram vs MRI</td>
<td>0.81</td>
<td>49</td>
</tr>
<tr>
<td>Overestimate MRI vs ultrasound</td>
<td>0.016*</td>
<td>43</td>
</tr>
<tr>
<td>Overestimate MRI vs mammogram</td>
<td>0.009*</td>
<td>49</td>
</tr>
</tbody>
</table>

*p < 0.05
Overestimates defined as (size by imaging – final surgical size) > 0.5cm.
Despite careful selection criteria 16.5% of our patients required EBRT after IORT.

Need for re-excision or EBRT was not associated with under/over estimation of disease on imaging.

Ultrasound produces more measurements within 0.5cm of final surgical size than mammogram.

MRI tended to overestimate extent of disease:
- likely secondary to timing of MRI after biopsies
- most notably in patients with DCIS.
LIMITATIONS

- Retrospective study so not fully controlled
  - Imaging measurements were conducted by different practitioners at different institutions

- Most patients did not receive MRI which limited statistical power

- Study only covers patients with tumor size <3cm (majority <1.5cm)
CONCLUSIONS

- Ultrasound is likely the most accurate imaging modality for assessment of appropriateness of IORT.

- MRI is likely more useful for ruling out multifocality than predicting surgical size.

- We would discourage ruling out otherwise good candidates for IORT on the basis of large size by MRI, especially if ultrasound indicates that tumor size is well within the acceptable range.
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