Advanced Breast/Chest Wall Planning Challenges
A COMMUNITY BASED HOSPITAL EXPERIENCE

Objectives

- Intro to Corpus Christi Cancer Center
- Contouring
- Normal tissue dosimetric guidelines
- 18 patient case study specifics
- 3D comparisons
- 1 Retrospective replan
- VMAT
- Discussion/Closing
Intro to Corpus Christi Cancer Center
Equipment

- Elekta Synergy
- Agility MLC
- Monaco 5.11.02
- Hexipod Robotic Couch installed 03/2017
- Mosaiq
- Phillips Big Bore CT
- MIM

Personnel

- 1 Physician
- 1 Physicist
- 1 Dosimetrist
- 3 Therapist
- 1 Nurse
- 2 Medical assistant/Transcription reception
- 1 Administrator
Demographics

- 250-275 New patients per year
  - 30%-35% breasts
  - 20%-25% include lymph nodes
Contouring

Breast Cancer Atlas for Radiation Therapy Planning: Consensus Definitions
## Contouring

### Regional Nodal Contours: Anatomical Boundaries

<table>
<thead>
<tr>
<th>Region</th>
<th>Cranial</th>
<th>Caudal</th>
<th>Anterior</th>
<th>Posterior</th>
<th>Lateral</th>
<th>Medial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supravclicular</strong></td>
<td>Caudal to the acrroid cartilage</td>
<td>Junction of brachiocephalic vein/cord edge/ clavicle head</td>
<td>Sternoclavicular joint (SCM muscle)</td>
<td>Anterior aspect of the scapula</td>
<td>Caudal, lateral edge of SCM m.</td>
<td>Caudal, junction of clavicle</td>
</tr>
<tr>
<td><strong>Axilla - Level I</strong></td>
<td>Axillary vessels cross anterior edge of Pec. Minor m.</td>
<td>Pectoralis major muscle insert into ribs</td>
<td>Plan defined by anterior surface of Pec. Minor m. and Lat. Dorsi m</td>
<td>Anterior surface of subscapularis m.</td>
<td>Medial border of lat. dorsi m.</td>
<td>Lateral border of Pec. minor m.</td>
</tr>
<tr>
<td><strong>Axilla - Level III</strong></td>
<td>Pec. Minor m. insert on clavol</td>
<td>Axillary vessels cross anterior edge of Pec. Minor m.</td>
<td>Posterior surface of Pec. Minor m.</td>
<td>Ribs and intercostal muscles</td>
<td>Medial border of Pec. Minor m.</td>
<td>Thoracic inlet</td>
</tr>
<tr>
<td><strong>Internal mammary</strong></td>
<td>Suprascapular notch of the clavicle</td>
<td>Cranial aspect of the 4th rib</td>
<td>.</td>
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</tr>
</tbody>
</table>

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[Image of CT scans showing contouring areas]
Contouring

- Patient number 14
- Left Chest wall
- Contour At Risk

Contouring

RTOG Guideline

Patient 13 Left Chest wall
Contouring

RTOG Guideline

Patient 15 Left Chest Wall

Contouring

IMN Axial Patient #11

IMN Sagittal
Contouring

- At patient #5, I began drawing in the esophagus and avoidance structures. Spoiler alert Patient #5 is the one I re-planned.
- Monaco optimizes very well without avoidance structures.
- Avoidance structures most often drawn. Ipsilateral lung, and esophagus
- Started using “tuning” structures to control low doses primarily on the contralateral side

Normal Tissue Dosimetric Guidelines
Normal Tissue Dosimetric Guidelines

Quantec

- Ipsilateral Lung: V20 < 30% Dmean < 20 Gy
- Heart: V30 < 45% Dmean < 26 Gy
- Esophagus: V50 < 40% Dmean < 34 Gy

Normal Tissue Dosimetric Guidelines

RTOG 1304 Amendment 3

- Ipsilateral Lung: V20 < 15-35 Gy Range of acceptable variant
- Heart: V25 < 10% Dmean < 4 Gy
  < = 5 Gy Acceptable variant
Normal Tissue Dosimetric Guidelines

- Esophagus  V30 ≤ 10%  Dmean < 12 Gy

Normal Tissue Dosimetric Guidelines

Target Coverage

- Breast/ Chest Wall  90% - 95% ≥ 50 Gy
- At Risk Nodes  90%-95% ≥ 50 Gy
- IMN  80%-90% ≥ 50 Gy
Normal Tissue Dosimetric Guidelines

  - Marianne C. Aznar, Frances K. Duane, Sarah C. Darby, Zhe Wang, Carolyn W. Taylor

  - The average mean ipsilateral lung dose with internal mammary chain irradiation was 14 Gy.

  - Published 2017 Radiotherapy and Oncology

Normal Tissue Dosimetric Guidelines

- Post mastectomy intensity modulation radiated therapy of chest wall and regional nodes
  - Retrospective analysis of the performance and complications up to 5 years
  - Qiong Wang PhD, Wuyun Jie MD, Zhiwen Liang MD, Hongge Wu PhD, Jing Cheng PhD

  - Heart Doses  V20  8.28% +/- 6.55%
  - Dmean (Gy)  6.99 +/- 3.01

  - 200 patients in the study, only 101 received IMN irradiation
  - 3 patients in this study were noted to have acute radiation esophagitis

  - Published 2017 Medicine
References


18 Case Specifics
18 Case Specifics

- Laterality Breakdown: 5 Intact Right Breast, 4 Intact Left Breast, 5 Right Chest wall, 4 Left Chest wall. Total 18 patients
- Age range: 31-74 years
- Technique: DMLC 7-9 fields
- Energy: 6X and/or 10X
- 1 to 1.5 cm fluence was added to achieve “flash”
- We do DIBH on left sided breast or chest wall
- All scars and drain sites are included
- All patients received a tumor bed boost/scar boost of 10 Gy

Why did I do this?

- The physician put in his intent prescription include IMN “if possible.”
- 3 of the early patients had PET+ IMN disease before chemo, and 1 had PET+ disease in the IMN upper mediastinum and supra clavicular nodes after chemo
- When compared, 3D mono-isocentric techniques were essentially inferior in basically every measure. Junction and transition areas between the nodes areas and the Breast/Chest wall volumes are particularly problematic with 3D.
- Once you start doing them with volumes it is hard to be satisfied with the results you get with 3D plans
18 Case Specifics

Left Intact Breast Axial

Left Intact Breast Coronal

Left Intact Breast Sagittal
18 Case Specifics

Target Coverage
Patient #1 Left Intact Breast
- Left Breast 95.1% @ 50 Gy
- At Risk Nodes 99.7% @ 50 Gy
- IMN Dmean 49.7 Gy

OAR
- Left Lung V20 = 21.1%
  Dmean = 14.4Gy
- Heart V25 = 3.9%
  Dmean = 7.1 Gy

Left Chest Wall Axial
Left Chest Wall Coronal
  Patient #8
Left Chest Wall Sagittal
18 Case Specifics

Target Coverage
Patient # 8 Left Chest Wall
- Left Chest Wall 95.6% @ 50Gy
- At Risk Nodes 95.0% @ 50Gy
- IMN Dmean 50.9 Gy

OAR
- Left Lung
  - V20 = 29.8%
  - Dmean = 15.5 Gy
- Heart
  - V25 = 8.2%
  - Dmean = 8.6 Gy

18 Case Specifics

Right Chest Wall Axial
Right Chest Wall Coronal
Patient # 16
Right Chest Wall Sagittal
18 Case Specifics

Target Coverage

Patient # 16 Right Chest Wall

- Right Chest Wall 98.5% @ 50Gy
- At Risk Nodes 97.1% @ 50Gy
- IMN Dmean 50.5 Gy

OAR

- Right Lung V20 = 21.3%
  Dmean = 12.6Gy

18 Case Specifics

Right Intact Breast Axial

Right Intact Breast Coronal

Patient # 17

Right Intact Breast Sagittal
18 Case Specifics

Target Coverage

Patient # 17 Right Intact Breast
- Right Breast 99.6% @ 50Gy
- At Risk Nodes 95.7% @ 50Gy
- IMN Dmean 50.4Gy

OAR

Right Lung
- V20 = 23.8%
- Dmean = 14.8Gy

18 Case Specifics

Objective

- 90%-95% of Breast / Chest Wall @ 50Gy
- 90%-95% of At Risk Nodes @ 50Gy
- Dmean of IMN @ 50Gy

Target Coverage Averages

- Breast/ Chest Wall 95.9%
- At Risk Nodes 97.25%
- IMN 50.1 Gy
18 Case Specifics

Dose Constraint Goals
- Ipsilateral Lung V20 ≤ 15-35%
  Dmean < 14 Gy
- Heart V25 ≤ 10%
  Dmean < 4-5 Gy

Results OAR
- Ipsilateral Lung V20 = 25.7 Gy
  Dmean 14.006 Gy
- Heart V25 = 5.6%
  Dmean 7.6 Gy

3 D Comparisons
3D Comparison

3D Left Breast Patient 4 Axial  IMRT Left Breast Patient 4 Axial

3D Comparisons

3D Patient #4 Coronal  IMRT Patient #4 Coronal
3D Comparison

3D Patient #4 Sagittal

IMRT Patient #4 Sagittal

3D Comparison

3D Coverage Patient #4

- Left Breast  81.1% @ 50Gy
- At Risk  66.8% @ 50Gy
- IMN Dmean  44.4 Gy
- Left Lung V20  30.6%
- Heart V25  1.2%

IMRT Coverage #4

- Left Breast  95.5% @ 50Gy
- At Risk  96.6% @ 50Gy
- IMN Dmean  50.3 Gy
- Left Lung V20  25.4%
- Heart V25  4.2%
3D Comparison

3D Right Chest Wall Patient #11
Axial

IMRT Right Chest Wall Patient # 11
Axial

3D Right Chest Wall Patient #11
Coronal

IMRT Right Chest Wall Patient # 11
Coronal
### 3D Comparison

#### 3D Right Chest Wall Patient #11
- **Sagittal**

#### IMRT Right Chest Wall Patient #11
- **Sagittal**

### 3D Comparison

#### 3D Coverage Patient #11
- **Right Chest Wall**: 79.2% @ 50Gy
- **At Risk**: 85.9% @ 50Gy
- **IMN Dmean**: 57.3 Gy
- **Right Lung V20**: 48.2%

#### IMRT Coverage #11
- **Right Chest Wall**: 95.1% @ 50Gy
- **At Risk**: 98.6% @ 50Gy
- **IMN Dmean**: 51 Gy
- **Right Lung V20**: 21.9%
Retrospective Replan

- Patient #5 Right Intact Breast
- Was the only plan of the 18 that I did not 100% meet all of my dose goals
- IMN Dmean in the original plan was 38.6 Gy
- R Lung V20 went from 29.9% to 24.7%
- This patient was also re-planned to reduce esophageal dose at fraction #8 of 25
- In hind sight the optimization process was flawed from the beginning
- From this patient the esophagus/trachea is contoured and optimized to minimize pharyngitis
Retrospective Replan

Original Plan

Retrospective Replan

Replan

- **Right Breast**: 95% @ 50 Gy
- **At Risk**: 97% @ 50 Gy
- **IMN Dmean**: 38.6 Gy
- **Right Lung**: V20 = 29.9%

- **Right Breast**: 96.4% @ 50 Gy
- **At Risk**: 97.5% @ 50 Gy
- **IMN Dmean**: 49.7 Gy
- **Right Lung**: V20 = 24.8%
**VMAT**

### Target Coverage
- Bilat Breast 99.2% @ 50 Gy
- Bilat Nodes 99.2% @ 50 Gy

### OAR
- Bilat Lung
  - V20 = 22.5%
  - Dmean = 16.5 Gy
- Heart
  - V25 = 2.2%
  - Dmean = 13.7 Gy

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**VMAT**

- Patient # 20 Bilateral Chest Wall
- Inflammatory carcinoma on the right
- Invasive ductal carcinoma on the left
- Suspected skin nodularity starting on the right
- Incision infection on the left
- Right side must start ASAP, Left to follow
VMAT

- Bilat Chest Wall Axial
- Bilat Chest Wall Coronal
- Bilat Chest Wall Sagittal

This case was so recent that it has not completed treatment.
The left side will be treated with DIBH and with the DMLC technique.
Considerations, questions and observations

- From the community perspective this area is very open to interpretations. It is difficult to discern from the literature whether you are comparing apples, oranges or bananas
- There are questions on contours, set ups positioning, immobilization
- DMLC/ VMAT vs 3D
- DIBH for the left side
- I am right in the learning curve of the next evolution.
Discussion/Closing

- After compiling this data, and based on our results we continue to abide by the OAR and Target levels in RTOG 1304.

Dose Goals
- Breast/chest wall Target 90%-95% >/= 50 Gy
- Ipsilateral Lung V20 </= 15-35%
- Heart V25 </= 10% Dmean <4-5 Gy

All in all I feel really good about what we did for this group of patients.

I am interested in seeing if I can use VMAT in all cases.

In the words of Oprah, “when you know better, do better.”

I am very interested in knowing what other people are doing, and exchanging experiences and ideas.

Special thanks to: Gerard J Voorhees, MD
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Discussion/Closing