Prone Positioning for Breast Radiation Therapy

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Disclosures

• No financial relationships
• No conflicts of interest

• NCCN Breast Cancer Guidelines Panel
• ASCO Post Mastectomy Radiation Guidelines Panel
ARS #1

• Familiarity with prone positioning for breast radiation:
  1. No knowledge
  2. Some knowledge but not available at my site
  3. Some knowledge and available at my site
  4. Routinely use at my site
Prone Positioning for Breast Radiation Therapy: Outline

• Learning objectives for the panel:
  – Review prone positioning from each of our perspectives
  – Provide an overview from clinical assessment throughout treatment
  – Engage in a practical and interactive discussion
  – Present RPCI and OSU modifications
  – Provide thoughts on starting a program
Prone Positioning for Breast Radiation Therapy: Outline

• Learning objectives for this part:
  – To define early stage breast cancer and review general treatment paradigms
  – To describe various adjuvant radiation treatment options in early stage breast cancer
  – To recognize patient and clinical factors that influence selection of prone positioning for treatment
  – To describe my assessment of prone positioning
Cancer Statistics

**Estimated New Cases**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>220,800</td>
<td>231,840</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>115,610</td>
<td>105,590</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>69,090</td>
<td>63,610</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>66,320</td>
<td>54,870</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>42,870</td>
<td>47,230</td>
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<tr>
<td>Non-Hodgkin lymphoma</td>
<td>39,850</td>
<td>32,000</td>
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<tr>
<td>Kidney &amp; renal pelvis</td>
<td>38,270</td>
<td>31,200</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>32,670</td>
<td>24,120</td>
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<tr>
<td>Leukemia</td>
<td>30,900</td>
<td>23,370</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>25,510</td>
<td>23,290</td>
</tr>
<tr>
<td><strong>All Sites</strong></td>
<td><strong>848,280</strong></td>
<td><strong>810,170</strong></td>
</tr>
</tbody>
</table>

**Estimated Deaths**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>86,380</td>
<td>71,860</td>
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<tr>
<td>Prostate</td>
<td>27,640</td>
<td>40,290</td>
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<tr>
<td>Colon &amp; rectum</td>
<td>25,100</td>
<td>23,600</td>
</tr>
<tr>
<td>Pancreas</td>
<td>20,710</td>
<td>19,850</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>17,030</td>
<td>14,180</td>
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<tr>
<td>Leukemia</td>
<td>14,210</td>
<td>10,240</td>
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<tr>
<td>Esophagus</td>
<td>12,600</td>
<td>8,310</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>11,510</td>
<td>7,920</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>11,480</td>
<td>10,170</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>9,070</td>
<td>6,380</td>
</tr>
<tr>
<td><strong>All Sites</strong></td>
<td><strong>312,150</strong></td>
<td><strong>277,280</strong></td>
</tr>
</tbody>
</table>

*FIGURE 1. Ten Leading Cancer Types for the Estimated New Cancer Cases and Deaths by Sex, United States, 2015.*

Estimates are rounded to the nearest 10 and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.
Breast Cancer Survival Rates by Stage Distribution

Figure 9. Female Breast Cancer Survival Rates* and Stage Distribution, US, 2005-2011

a. Five-year Relative Survival Rates (%) by Stage at Diagnosis and Race

- Localized: Black 99, White 99, All Races 99
- Regional: Black 75, White 86, All Races 85
- Distant: Black 12, White 26, All Races 26
- Unstaged: Black 51, White 46, All Races 52

b. Stage Distribution (%) by Race

- Localized: Black 62, White 61, All Races 61
- Regional: Black 32, White 31, All Races 32
- Distant: Black 9, White 5, All Races 6
- Unstaged: Black 2, White 2, All Races 2

*Survival based on patients diagnosed between 2005-2011 and followed through 2012. Stage distribution percent may not sum to 100 due to rounding.

Source: Howlader et al.24

American Cancer Society, Inc., Surveillance Research, 2015

American Cancer Society
Breast Cancer Facts & Figures 2015-2016
Figure 11. Female Breast Cancer Treatment Patterns (%), by Stage, 2012

BCS = breast conserving surgery, RT = radiation therapy, chemo = chemotherapy and includes targeted therapy and immunotherapy drugs.


American Cancer Society, Inc., Surveillance Research, 2015
Breast Cancer Treatment Options

- **Surgical options:**
  - For the breast:
    - Breast conserving surgery (lumpectomy)
    - Breast Conservation Therapy = surgery + radiation
    - Mastectomy +/- immediate reconstruction
  - For lymph node assessment:
    - Sentinel lymph node biopsy
    - Axillary lymph node dissection
Breast Cancer Treatment Options

• Systemic therapy options:
  – Chemotherapy
    • Can be given either before or after surgery
      – Neoadjuvant or adjuvant
      – Selection for use depends on stage and extent of disease, type of breast cancer and features (ER, PR, Her2 status), potential for down-staging to breast conservation, assessment of response
  – Endocrine therapy / hormonal therapy
    • Examples: tamoxifen, aromatase inhibitors, ovarian suppression
Breast Cancer Treatment Options

• Systemic therapy options:
  – What are gene recurrence score tests? Ex: “Oncotype Dx”
  – There are different tests
  – For invasive cancer to predict risk for distant recurrence and benefit of chemotherapy
    • Only for ER/PR positive Her2 negative tumors
  – For ductal carcinoma in situ (DCIS) to predict risk for recurrence—controversial
Rationale for Radiation

• Role of radiation in the setting of breast conservation and post mastectomy:
  – Improvement in local or locoregional control
  – Survival benefit in invasive carcinomas and in the post mastectomy setting
    • Disease free survival
    • Overall survival
Radiation Treatment Options

• TARGETS:
  – Whole breast
  – Partial Breast
  – Chest wall
  – Regional nodes
Radiation Treatment Options

• DOSE and FRACTIONATION
  – Conventional Fractionation
    • 1.8-2 Gy per fraction to total dose 45-50.4 Gy

  – Hypofractionation
    • Shorter course utilizing larger doses per fraction
    • >2 Gy per fraction to lower total dose
      – 40.05 – 42.56 Gy given in daily fxs for whole breast
      – 34-38.5 Gy given twice daily fxs for partial breast

  – Accelerated course
    • Treatment over shorter time course
Radiation Treatment Options

• MODALITIES:
  – External Beam
    • Photons
    • Electrons
    • Protons
  – Brachytherapy
    • Radioactive source
    • Device
  – Intraoperative
    • Various means
Radiation Treatment Options

• TECHNIQUES:
  – Positioning
    • Supine vs Prone
  – CT simulation and volume based planning
  – 3D conformal, e comp, IMRT
  – Respiratory control with deep inspiration breath hold technique
    • “respiratory gating”
Radiation Treatment Options

• In summary: MANY!
Radiation Treatment Options

• How is treatment tailored to the individual patient?
  – Patient factors
  – Treatment factors
  – Disease burden
  – Biology
  – Risks for disease morbidity vs treatment morbidity
Radiation Treatment Options

• Patient factors: age, comorbidities
• Treatment factors: type and extent of surgery, type of systemic therapy, response to neoadjuvant therapy
• Disease burden: T stage / size, N stage / # / ratio, ECE, LVSI, EIC, margins
• Biology: grade, ER, PR, Her2, gene profile
ARS #2

50 year old female with 3.5 cm of calcifications seen on screening mammogram. Bx proven DCIS, intermediate grade, ER/PR positive.

Opt for breast conservation.

pTis cN0 cM0, negative margins (3mm).

Negative post excision mammogram.

Sees you for breast RT recommendations…
ARS #2

1. Mastectomy
2. Whole breast +/- boost
3. APBI
4. No radiation
5. Clinical trial
Radiation Treatment Options

• Mastectomy
  – Unlikely would need PMRT
  – If contraindication to RT
• Whole breast +/- boost
  – Conv fx (5-6.5 wks) vs hypofx (3-4.5 wks)
• APBI
  – Intraop, Brachy, EBRT (1-10 fxs)
• No radiation (omission of RT)
Radiation Treatment Options

• Mastectomy
  – Unlikely would need PMRT
  – If contraindication to RT
• **Whole breast +/- boost**
  – Conv fx (5-6.5 wks) vs hypofx (3-4.5 wks)
• APBI
  – Intraop, Brachy, EBRT (1-10 fx)
• No radiation (omission of RT)
Positioning Options:

Respiratory gating cube and glasses

Prone breast board
Use of “Respiratory Gating”

– Breath hold technique
  • Moderate deep inspiration
  • Extra time, equipment, personnel, increased planning efforts and time for treatment
Use of Prone Positioning

- Select patients with early stage disease
- Breast is target
- Minimize normal tissue doses and treatment toxicity
So why prone positioning?

- Thoughts on implementing prone positioning
- Important to have as an option for breast cancer treatment to minimize toxicity
- TEAM approach
- Requires active physician involvement and engagement throughout care (clinic, simulation, planning, verification, treatment)
- Learning curve
Rationale for Prone Positioning

• Prone position used for stereotactic core biopsy and breast MRI

• Technique adopted and modified for radiation treatment delivery

Images from WebMD and GE Healthcare
Rationale for Prone Positioning

• Displacement of breast tissue away from chest wall and torso

• Minimize acute and late skin effects
  – Minimize skin folds
  – Particularly in women in large pendulous breasts
  – High BMI/obesity

• Minimize dose to normal tissues
  – Lung
  – Heart
  – Medical co-morbidities: underlying pulmonary disease (COPD, smoker), cardiac disease, collagen vascular disease, prior RT
Early Experiences with Prone

- MSKCC, USC, NYU, MCW, OSU, and others
- Whole breast
- Partial breast
- Concomitant boost
- Ongoing investigations for nodal regions, extended fields
- Lower lung doses
- Often lower heart doses
- Less skin toxicity
- No increased recurrences
- Reproducibility
Patient Selection for Prone

• Early stage disease
  – Stage 0, I, II
• Following breast conserving surgery

• Target = breast tissue
  – not chest wall
  – not lymph nodes
  – not post-mastectomy
RTOG Contouring Atlas

Definitions:

- Breast contour:
  - Clinical breast tissue
  - Includes lumpectomy CTV
  - Excludes pectoralis muscles, chest wall, ribs

- Chest wall contour:
  - From skin to rib/pleural interface
  - Includes pectoralis muscles, chest wall, ribs

- Breast + chest wall:
  - For more locally advanced / high risk patients

- Regional nodal volumes
Breast + Chest Wall Contour

White et al, RTOG Breast Cancer Contouring Atlas
Regional Nodal Volumes Contours

White et al, RTOG Breast Cancer Contouring Atlas
Patient Selection for Prone

• Need to be able to get into the prone position and maintain stable position
  – Arm and neck range of motion
  – Back pain
  – Agility and flexibility
  – Body habitus
  – Respiratory status
  – Performance status
Patient Selection for Prone

- Need to be able to get into the prone position and maintain stable position
  - Asking the patient about she tolerated prior biopsy procedure and / or MRI can be helpful
Patient Selection for Prone

• Other considerations:
  – CTV Location
    • Inner quadrants, particularly upper inner, can be challenging
    • Anterior/skin extent
    • Posterior extent of disease and proximity to chest wall/pectoralis muscles
Use of Prone Positioning

- Select patients with early stage disease
- Breast is target
- Minimize normal tissue doses and treatment toxicity
Limited Nodal Coverage with Tangents in Prone Position

Figure 1 (A and B) Left-sided whole-breast irradiation. (A) Beam’s eye view of the right anterior oblique field, with 3-D reconstruction of axillary levels I–III and internal mammary lymph-node regions in the prone and supine positions. (B) Typical field arrangements and their relation to the node regions.

Csenka et al, Therapeutics and Clinical Risk Management 2014
Limited Nodal Coverage with Tangents in Prone Position

Figure 1 Axial and coronal images of Level I contoured (violet) for a patient treated in the (a) prone and (b) supine position.

Leonard et al, Radiation Oncology 2012
Options to Minimize Cardiac Dose

**FIGURE 1** | Example of (A) free breathing and (B) deep inspiration breath hold plans for a single patient.

**FIGURE 2** | Examples of (A) prone breast and (B) external beam APBI plans.

Beck et al, Frontiers in Oncology 2014
Positioning and Heart Location

FIGURE 7 | (A) Initial set up with the sternum lateral to the edge of the mattress and the contralateral breast creating a wedge at the midline. To avoid the contralateral breast the angle of the tangents would include part of the heart and LAD. (B) Once correctly aligned with the sternum more medial toward the edge of the mattress and the contralateral breast better displaced, the angle of the tangents permits exclusion of the contralateral breast, heart, and LAD, while including the entire parenchyma of the index breast (lateral edge is just anterior to the latissimus dorsi).

Huppert et al, Frontiers in Oncology 2011
Review of breast MRI can be helpful
Assessment at Simulation
Assessment at Simulation
Assessment at Simulation

• Physician presence to check set up wires, marks, positioning and reproducibility, anticipated tangent fields and heart and lung dose

• Set up, positioning, simulation, verification, daily treatments to be addressed by our next speaker...
Questions?

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