Supine verses Prone
Intact Breast
Treatment: The OSU
Approach

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June 2016
Disclosures

- I have no disclosures relative to the presented material

- The following presentation is a reflection of studies, protocols, and opinions

- No Honorarium has been received in regards to the subsequent material
Meet the Speaker

- Karla Kuhn, CMD RT(R)(T)
- 9 years Radiation Therapist
- 10 years in July as a Dosimetrist
- Lead Dosimetrist at SSCBC in August 2014
Radiotherapy at OSU

- The James Cancer Hospital – “The Main”
  - All sites except Breast
  - 7 Vaults
  - 1 PET/CT
  - 1 CT
  - 1 MRI
  - 1 HDR Unit
  - 1 Gamma Knife Unit
  - 13 Radiation Oncologists
  - 12 Radiation Physicists
  - 11 Medical Dosimetrists
  - 36 Radiation Therapists

The James
Radiotherapy at OSU

- SSCBC
  - All Breast and Breast metastasis
  - 2 Vaults
  - 1 CT
  - 5 Radiation Oncologists
  - 1-2 Radiation Physicists
  - 2 Medical Dosimetrists
  - 8 Radiation Therapists
  - 3 Nurses
The Stefanie Spielman Comprehensive Breast Center (SSCBC) at the Ohio State University

Opened in January 2011
Comprehensive Patient-Centered Care

Staff at SSCBC always receives high patient satisfaction scores quarterly & yearly.

300-450 patients come to SSCBC each day.
Analytic Breast Cancer patient by Fiscal Year [July 1-June 30]

FY11: 555
FY12: 709 (+27.7%)
FY13: 765 (+7.9%)
FY14: 809 (+5.8%)
FY15: 858 (+6.1%)

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Evolution of Breast Planning

Supine 2D

- Done by Simulator
- Borders marked visually by MD with wire
- Used borders to indicate field size using half-beam blocked technique
- Gantry angle chosen from crossing of medial and lateral wires
- Standard of 2 cm of lung treated
- Used mobile contour plotter to achieve a 2D treatment plan
Evolution of Breast Planning (cont’d)

3D

- Free Breathing → DIBH → Prone
- Done by CT Simulator
- Border is marked visually by MD with wires to use as a guide when contouring
- Dosimetrist contours Organs at Risk; MD contours target volumes
- Dosimetrist utilizes all 3D tools: Conformal, and if necessary, IMRT planning to achieve our Dosimetric goals
Evolution of Breast Planning (cont’d)

- Post-Op External Beam Partial Breast Irradiation
- IORT & HDR Partial Breast Irradiation

- Future of Breast Planning:
  Protocol OSU 13282 – Feasibility of assessing Radiation Response with MRI/CT Directed Pre-Op Accelerated Partial Breast Irradiation in the Prone Position for Hormone Response early stage Breast Cancer
Images of Breast Anatomy

http://fitsweb.uchc.edu/student/selectives/Luzietti/Breast_anatomy.htm
Breast Anatomy

Clinical Borders of Breast
Medial: Sternum
Lateral: Midaxillary line
Cranial: 2\textsuperscript{nd} Rib
Caudal: 6\textsuperscript{th} Rib

Most Breast Cancers are located in the upper outer quadrant of the breast
Greatest Percentage of breast tissue
Left sided breast cancers are more common
Lymphatics of Breast Anatomy

**SupraClav Borders:**
- **Cranial** to Cricoid Cartilage
- **Caudal** to edge of Clavicular Head
- **Lateral** Junction 1\(^{st}\) rib & clavicle
- **Medial** Excludes Thyroid & Trachea

**Axilla Borders (I-III):**
- **Cranial** Pec Minor insert on coracoid process
- **Caudal** Pec Major insert on Ribs
- **Lateral** Latissimus Dorsi
- **Medial** Chestwall

**Internal Mammary:**
- **Cranial** Top 1\(^{st}\) intercostal space
- **Caudal** Bottom 3\(^{rd}\) intercostal space
Levels of Axillary Nodes (I-III) – Primary Drainage

Levels of Axillary Lymph Nodes:

**Level I:** Lateral to the pectoralis minor muscle. Usually involved first.

**Level II:** Posterior to the pectoralis minor muscle.

**Level III:** Medial to the pectoralis minor muscle.
- Unlikely to be involved if levels I & II are negative
Epidemiology, Pathology, and Risk Factors of Breast Cancer

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THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER
Epidemiology

- Most commonly diagnosed cancer among women
- 182,000 women diagnosed annually in the US
- Yearly ~40,000 women die of Breast Cancer
- Second leading cause of cancer death among women after lung cancer
- Lifetime risk of dying from Breast Cancer 3.4%
Pathology

- **Fine Needle Aspiration**
  Very small needle to extract fluid or cells from the abnormal area

- **Surgical Biopsy**
  Whole abnormal area, plus some surrounding normal tissue, is removed

- **Core Needle Biopsy *Recommended***
  Large hollow needle to remove one sample of breast tissue per insertion
Pathology

- Estrogen (ER) & Progesterone (PR) assays routinely performed on biopsied tissue
  - Correlate with prognosis & tumor response to chemo & hormonal agents

- Her-2+ – proto-oncogene assay used to assess overexpression in invasive breast carcinomas. Outcomes have improved with targeted therapy (Herceptin)
  - Her-2+ is associated with poorer prognosis, historically. Outcomes have improved with targeted therapy
  - Her-2- is encouraging when hormone assay is positive
Inherent Risk Factors

- Female (100 times more likely than men)
- Age 55+
- Inherited Genes (BRCA1 & BRCA2)
- Strong Family History of Breast Cancer
- Race & Ethnicity (White women)
- Dense Breast Tissue
- Menstruation prior to age 12
- Menopause after age 55
- Prior radiation to chest
Lifestyle Risk Factors

- Consuming alcohol
- Overweight/Obese
- Reduced Physical Activity
- First child born after age 30
- Birth Control (oral & Depo-shot)
- Hormone therapy after menopause
Stage 0 – DCIS (in situ)

Stage I – Invasive (IA & IB)
  - Tumor up to 2cm
  - Cancer not spread outside breast (no lymph node involvement)

Stage II – Invasive (IIA & IIB)
  - Tumor 2-5cm
  - Spread to local Lymph Nodes
Stage III – Invasive (IIIA, IIIB, & IIIC)

- Numerous positive lymph nodes
- Tumor is larger than 5cm
- Location of positive lymph nodes & skin involvement may change stage from IIIA to IIIC

Stage IV – Spread beyond breast & lymph nodes to other organs of the body (Lung, bone, liver, brain)
Staging – TNM

T – Size of the primary Tumor
  - TX, T0, Tis, T1, T2, T3, T4

N – Lymph Node Involvement
  - NX, N0, N1, N2, N3

M – Metastasis
  - MX, M0, M1
Staging – Treatment Modalities

Lower Stage – Surgery & Radiation

Higher Stage – Chemotherapy & Radiation

BRCA+ - Mastectomy
Rationale Supine vs. Prone in Breast Radiotherapy

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Challenges of Breast Radiotherapy for Patients with Large BMI

- Radiotherapy for WBI in the supine position is standard
- Large, pendulous breasts can be problematic
  - Displacement of breast laterally, inferiorly
  - Accentuates skin folds
- Excessive lung & heart included in some cases
- Contour extends beyond CT field-of-view
Large Patient BMI: Technical Challenge for Radiotherapy

Irradiation of skin folds: - Moist Desquamation  
- Telangiectasia

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Facility Challenges

CT Bore Diameter
- Standard ~80 cm.
- Wide ~65 cm.
Cuts off patient contour
Error in dose model
Indications for Prone Breast Radiotherapy

- Patients with larger and/or pendulous breasts to reduce the toxicity and improve breast appearance long term
- Left sided breast cancer patients to avoid the heart & lung
- Small Breast benefits due to decrease in lung dose
- Cases where maximal lung avoidance is desirable such as smokers, severe COPD

Approximately 60% of patients at SSCBC undergoing post-lumpectomy breast radiotherapy are treated in prone position

Expertise in prone WBRT varies widely between institutions, resulting in mixed findings regarding the degree of heart sparing with this technique\(^6\,^7\)

Indications for Prone Breast Radiotherapy (Cont’d)

- Better dose homogeneity due to smaller separation
- Reduces skinfolds
- Distances the breast from the chestwall
- Reduction in chestwall Motion

However, WBRT has also been associated with excess non-breast cancer mortality, predominantly related to ischemic cardiac disease*

Incidental Dose to Coronary Arteries is Higher in Prone Than in Supine Whole Breast Irradiation

- $n = 46$
- WBI – Field-in-field (5-6)
  - WB dose: 50.4 Gy/1.8 Gy/28 fx
  - boost: supine
- Left Anterior Descending Artery (LAD) dose:
  - V20 & V40 significantly higher in the prone position versus supine

Wurschmidt et al, Strahlenther Onkol 2014

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Patient population: women diagnosed with stage I-II invasive carcinoma or DCIS of the left breast who received WBRT in the prone position post-lumpectomy

- Cohort 1: first 20 patients treated consecutively beginning in January 2014
- Cohort 2: last consecutive 20 patients treated prior to August 2015

Breast and lumpectomy target volumes, heart, and lungs contoured following CT simulation

LAD contoured retrospectively on each case

<table>
<thead>
<tr>
<th>Results</th>
<th>Cohort 1</th>
<th>Cohort 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Heart Dose (Gy)</td>
<td>1.5</td>
<td>1.1</td>
<td>0.007</td>
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<tr>
<td>Mean LAD Dose (Gy)</td>
<td>9.6</td>
<td>5.5</td>
<td>0.01</td>
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<tr>
<td>Mean Lung Dose (Gy)</td>
<td>5.0</td>
<td>3.8</td>
<td>0.12</td>
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<tr>
<td>Ipsilateral Lung V(20) (%)</td>
<td>0.29</td>
<td>0.18</td>
<td>0.43</td>
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</tbody>
</table>
Stage IA (pT1cN0) ER+/PR+/Her2- G1 IDC
BMI = 31
Breast PTV (cm$^3$) = 710
Dose: 50 Gy + 10 Gy boost

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RTOG 1005 & 1304; Organs at Risk

- Heart
- Left Lung
- Right Lung
- Contralateral Breast
- Sternum
- Thyroid
Breast CTV – Includes palpable breast tissue demarcated with radio-opaque markers at CT simulation, the apparent CT glandular breast tissue visualized by CT, consensus definitions of anatomical borders, and the Lumpectomy CTV from the breast cancer atlas.

Breast PTV – Breast CTV + 7mm 3D expansion (exclude heart and does not cross midline)

Breast PTV Eval – Edited copy of Breast PTV limited anteriorly to exclude the part outside the patient and the first 5 mm of tissue under the skin and posteriorly is limited no deeper to the anterior surface of the ribs

*In Prone (and Supine DIBH) at SSCBC the CTV to PTV expansion is reduced to 5mm due to limited chestwall motion

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Lumpectomy GTV – Includes excision cavity volume, architectural distortion, lumpectomy scar, seroma and/or extent of surgical clips

Lumpectomy CTV – Lump GTV + 1cm 3D expansion

Lumpectomy PTV – Lump CTV + 7mm 3D expansion (excludes heart)

Lump PTV Eval – Copy of Lump PTV which is edited. Limited to exclude the part outside the ipsilateral breast and the first 5mm of tissue under the skin.
Targets Contoured:
Goal: 95% Dose to 95% Volume
## Constraints & Goals

### RTOG 1005 & 1304

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<tr>
<td>50% Breast PTV Eval</td>
<td>&lt;108%</td>
<td>&lt;112%</td>
</tr>
<tr>
<td>VBreast Receiving Boost Dose</td>
<td>30%</td>
<td>35%</td>
</tr>
<tr>
<td>Heart Mean</td>
<td>&lt;400cGy</td>
<td>&lt;500cGy</td>
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<tr>
<td>Lung V20</td>
<td>15%</td>
<td>20%</td>
</tr>
<tr>
<td>Contra Breast Max</td>
<td>&lt;300cGy</td>
<td>&lt;330cGy</td>
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### SSCBC

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*Boost (when indicated) & Whole Breast planned simultaneously in Prone Position. Constraints & Goals evaluated in Plan Sum.

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Prone with Boost

- Boost is planned at time of Initial plan
- Boost is in Prone position as well
- Plan evaluated in Plan Sum
- Ski slope
- V54
  - 108% dose < 50% volume
- “Simultaneous Boost” hotspot placed in the Lump PTV Eval
To Boost, or Not to Boost?

Guidelines for SSCBC Boost:
- Any Stage
- No Lymph Nodal Involvement
- Hormone Receptor positive
- <50+ years old
- No prior chemotherapy
Hypofractionated/Canadian Fractionation

- SSCBC Guidelines for Hypofractionation
- Stage 1 or 2
- No Lymph Nodal Involvement
- Hormone Receptor positive
- 60+ years (sometimes women 50+ years)
- No prior chemotherapy

Standard Fractionation
2.0Gy * 25 FX = 50.0 Gy

VS.

Hypofractionated Prescription:
2.66Gy * 16 FX = 42.56Gy

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Supine vs. Prone

- Small Breasts
- Left Sided
Supine vs. Prone DVH (Small Breast, LT side)
Free Breathing VS.

Deep Inspiration Breath Hold (DIBH)
Free Breathing vs. Supine DIBH

- Free Breathing
- DIBH
DIBH vs. Prone
Supine DIBH vs. Prone

- Prone
- DIBH
Vendor Manufactured Breast Board

Extra immobilization devices are used for patient comfort

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Face Down Option
CT Prone Positioning

- Index Immobilization
- MD wires Lumpectomy scar & Breast Borders
- Patient starts low on hands & knees before laying down. Inframammary fold should fall just above the inferior opening of the insert
- Smoothing of the belly tissue may be needed
- Elbows bent in Vac-bag to ensure arm reproducibility & comfort. Location of headrest is marked
- Contra breast should be gently pulled “down & out” and rest on the sternal sponge
- Head turned toward the contra side
- Back should be as flat as possible with shoulders relaxed
5 Tattoos

Ipsilateral Tattoo

Board number on index bar in line with mid-nipple or other designated breast mark

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5 Tattoos (cont’d)

Contralateral Tattoo

3 PA Tattoos

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Verification Simulation

- Always performed with physician present
- Orthogonal films taken for isocenter verification
- Double exposure of each treatment field is acquired
- PA, lateral, and treatment SSDs are verified
- Physician clinically visualizes treatment fields on the patient
Treatment Setup

- Patient adjusted Right to Left, Sup and Inf, and rolled to align tattoos to lasers.

Board number on index bar in line with mid-nipple or other designated breast mark

*important to leave Lateral table position at 0
Daily Shifts are made to isocenter
PA and Lateral SSD is checked

Lateral SSD is checked DAILY to verify how tight the contralateral breast is pulled and verifies correct lateral position
Belly Board Technique

Egg crate opening reduces pressure to the abdomen
Custom Styrofoam Insert

- May be used to keep contralateral breast out of treatment field

- Contralateral breast is marked on Styrofoam insert
Improves set-up of contralateral breast
Key Components for Successful Prone Treatments

- Integrated Team of Specialists
- Full Patient Compliance and Understanding
  - Proper Equipment
- Established Policy & Procedure
References/Contributions

- Dr. Julia White
- Dr. Jose Bazan
- Dr. Jessica Wobb
- Dr. Ashley Sekhon
- Steven Kalister (Administrator SSCBC)
- Tina LaPaglia (Lead Therapist SSCBC)
Thank You

To learn more about Ohio State’s cancer program, please visit cancer.osu.edu or follow us in social media:

Karla.Kuhn@osumc.edu
Just a reminder that mammogramming your boobs is more important than Instagramming them.

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