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April Case Study

April 30, 2012

3D Conformal Radiation Therapy for Invasive Ductal Carcinoma of the Left Breast

**History of Present Illness:** KT is a 64 year-old patient who detected a palpable lump in her left breast. She reports that she felt the lump for more than one year. Just recently, the mass was seen on a screening mammography, prompting diagnostic evaluation. The preoperative size of the tumor was difficult to determine. The estimates were 5.5 centimeters (cm) on a clinical breast exam, 5cm on mammography and ultrasound, and at least one 13 millimeter (mm) nodule had malignant appearance. She also had an abnormal left axillary lymph node that was biopsied by core needle technique under ultrasound guidance and was negative. She underwent a left total mastectomy. The final pathology found the patient had identification of 1 of 7 sentinel nodes positive with a 4 mm maximum size deposit and a single positive node. All 7 nodes were negative on frozen section, but now 1 of 7 has returned positive. The patient was staged with a T2N1aMO, Stage IIb invasive ductal carcinoma. The patient was informed of the node positive prognosis and further options for local regional treatment. Additionally, she was presented at tumor board. The National Comprehensive Cancer Network (NCCN) guidelines of both completion of axillary dissection and radiation were offered to the patient. Adjuvant systemic treatment including chemotherapy and endocrine therapy were offered to the patient.

**Past Medical History:** The patient has an extensive past medical history. She has suffered from chronic kidney disease and congestive heart failure, in addition to cardiomyopathy, hypertension, hyperlipidemia, hypothyroidism, leg edema, obstructive sleep apnea, pruritic dermatitis, gout, and deep venous thrombosis. The patient has had atypical squamous cells of undetermined significance on Pap smear. She does not have a history of prior cancer or radiation treatments.
**Diagnostic Studies:** The patient had a screening mammogram on 11/10/2011 that showed a focal density in the left breast. Additional imaging confirmed the abnormality in the left breast, which was palpable by the radiologist. Ultrasound revealed an abnormal appearing left axillary lymph node. The patient underwent biopsy of the axillary lymph node as well as the lesion in the left axillary tail. This occurred on 11/22/2011. The specimen from the left breast revealed infiltrative ductal mammary carcinoma, grade 2 out of 3. The greatest linear dimension of the tumor was 12 mm. There was some low-grade ductal carcinoma in situ (DCIS) present, intermediate grade with no necrosis. The biopsy of the left axillary lymph node was benign.

Regarding the specimen from the breast, estrogen receptor (ER) was positive and progesterone receptor (PR) was negative. Human epidermal growth factor receptor 2 (HER2 neu) was negative.

The patient met with the surgeon and ultimately decided for a left mastectomy. The surgeon did note some crustiness on the left nipple, possibly representing early Paget’s disease. The patient did have an ultrasound of the right upper quadrant that revealed hepatic steatosis, or an adipose degeneration with no discrete mass. She had a computed tomography (CT) of the abdomen on 11/29/2011 that revealed no evidence of metastatic disease. She ultimately opted for left mastectomy and was brought into the operating room on 12/05/2011, undergoing left axillary sentinel lymph node biopsy and left total mastectomy. Sentinel lymph nodes from level 1 were removed. There were some remaining counts at level 2, and these lymph nodes were not removed. Frozen section of the lymph nodes was negative; however, the permanent sections did reveal a single positive lymph node out of 7 evaluated, 4 mm in extent, without extra nodal extension. Regarding the mastectomy specimen, this revealed invasive ductal carcinoma, grade 2, 3 cm in greatest dimension. Peritumoral intralymphatic tumor emboli were present and dermal lymphatic involvement was absent. There was no involvement of the skin or nipple. Coexistent DCIS was present, 3 cm in dimension, high grade, solid and comedo type. The volume of DCIS was not considered to be extensive. Regarding margins, all margins were negative for invasive carcinoma with the closest margins being the medial and inferior margins, 4 mm. The patient was felt to have pathologic T2N1aM0 disease. The patient was discussed at tumor board, and additional surgery in the form of a completion of axillary dissection was offered.
**Family History:** No family history of cancer according to the patient.

**Social History:** The patient lives in Minnesota, approximately 45 minutes from the Gundersen Lutheran hospital. She drives and is comfortable getting to and from her daily treatments. She is married, and her spouse appears to be able to help with driving as well. She is not and never was a smoker. She rarely drinks alcohol.

**Medications:** The patient uses the following medications: Allopurinol, aspirin, atorvastatin, betamethasone dipropionate, cholecalciferol, vitamin D3, cinnamon bark, digoxin, enalapril, furosemide, glucosamine-chondroitin-vitamin C-MN, hydrocodone-acetaminophen, levothyroxine, metoprolol XL, omega-3 fatty acid, senna-docusate, spironolactone, triamcinolone acetonide, warfarin, and zolpidem.

**Recommendations:** The Radiation Oncologist recommended that the patient receive radiation therapy. She is in the 1-3 lymph node group where radiation is “strongly considered” in the NCCN guidelines. The potential benefit of radiotherapy in terms of diminishing the chance of the cancer recurring in the treated region was explained to her. Additionally, she was informed of certain groups of patients that have an overall survival benefit from radiation treatments. The risks of treatment were also discussed with the patient. After long discussion, the patient indicated she would like to proceed with radiation treatments. She will start radiation after her chemotherapy is completed.

**The Plan (Prescription):** The plan is for the patient to receive an overall dose of 5040 centigray (cGy) in 28 fractions to the left chest wall and supraclavicular nodes. She will then receive a boost dose of 1000 cGy in 5 fractions to the mastectomy scar plus 2 cm to field edge.

**Patient Setup/Immobilization:** The patient was simulated in the supine position, with both her arms up on a wingboard. A triangular sponge was placed under her knees for comfort. A treatment planning CT was completed with 2.5 mm slices through the chest region.

**Anatomical Contouring:** The CT scan was imported into the Pinnacle treatment planning computer for the physician to draw his contours. The physician contoured the axillary vessels, postoperative changes, and the drain sites. I contoured the right and left lungs, heart, spinal cord,
carina, and wires that were placed at the simulation to indicate field borders and mastectomy scar location.

**Beam Isocenter/Arrangement:** A single isocenter technique was chosen for the plan design. The isocenter was placed in proximity to the superior wire representing the superior field edge of the chest wall, and just under the clavicles. The plan was to use a single isocenter for the chest wall and supraclavicular beams. I started with the chest wall and placed a calculation point approximately half way between the superior and inferior field edges, at the thickest part of the chest wall. I added two tangential beams with angles of 311 degrees and 131 degrees. For the supraclavicular fields, I added a calculation point mid-depth within the fields drawn by the physician. I added two beams with angles of 168 degrees and 345 degrees in order to stay off the spinal cord.

**Treatment Planning:** The physician gave me a list of objectives that he wanted to achieve for this plan. He wanted to use 1 cm of bolus daily to increase dose to the skin and mastectomy scar. He wanted to use mixed energy beams for the tangents if it was necessary for better coverage. I started with two plans, one using mixed beam energies of 6 megavoltage (MeV) photons and 10 MeV photons, in addition to a plan with just 10 MeV photon beams. The plan with both 10 MeV photon beams was more homogenous, so I continued optimization with all 10 MeV. Blocks were created to block out some of the lung. I added 15-degree wedges with heels facing anterior to each of these beams in order to reduce some of the 115% hot spots as shown in Figure 1. A centimeter of bolus was added. The beams were calculated and weighted with 51.5% on the right anterior oblique (RAO) beam and 48.5% on the left posterior oblique (LPO). Additionally, segments were created in order to reduce other hot spots present as shown in Figure 2. Once the chest wall was optimized, I started working on the supraclavicular fields. The physician had previously added blocks to the fields in order to block the spinal cord and humeral head from the treatment fields. The RAO beam was an energy of 6 MeV and the LPO was an energy of 10 MeV. I shifted the weighting of the beams and ended with the RAO beam weighted 46% and the LPO beam weighted 54%. To reduce additional hot spots, I added a modified RAO field where I decreased the length and width of the Y2 and X2 jaws, and gave the beam a weight of 6%, therefore bringing the RAO beam weight down to 40%. The modified RAO field can be visualized in Figure 3.
Figure 1: Wedge orientation on tangent fields.

Figure 2: Segments (Control Points) for RAO and LPO chestwall tangent beams

Figure 3: Modified RAO sclav field
Figure 4: Transverse, Sagittal, and Coronal views of the Tangent Calculation Point

Figure 5: Transverse, Sagittal, and Coronal views of the Supraclavicular Calculation Point

Figure 6: Transverse slices of isodose lines throughout the treatment volume
**Monitor Unit Check:** Monitor unit (MU) calculations were performed to verify that the treatment planning computer was calculating properly. MU check by Oncology Data Systems, version 8.2.0, takes several factors into consideration in order to perform an accurate calculation to determine the monitor units needed for treatment. The MU result is compared to the computer MU calculation. The difference between the two should result in less than 5%, which it did for this plan. I did hand calculations for each field as well, where the RAO and LPO chest wall tangent beams were 4.68 and 4.96 percent differences respectively. The RAO, RAO modified, and LPO supraclavicular beams were 2.23, 0.5 and 1.43 percent differences respectively.

**Quality Assurance Check:** A physicist performed a second check of the treatment plan and monitor unit check. It is critical to have an independent set of eyes look over the plan and additional checks.

**Conclusion:** I chose this patient for my case study because it was the first chest wall and supraclavicular treatment plan I completed on my own. I learned how to plan two different prescriptions with a single isocenter and half beam technique. In addition, I learned how to add bolus to a plan. I realized that planning a chest wall differs significantly from an intact breast! The plan had much hotter areas, which were difficult to segment out. The dose distribution was not nearly as conformal as I am used to seeing with intact breasts. I learned a lot from this patient’s plan and feel I am capable of creating treatment plans of similar cases in the future.
Figure 7: Dose Volume Histogram

### ROI Statistics

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