Clinical Perspectives | Lung

IMRT WITH RAPIDARC BOOST FOR ADVANCED NON-SMALL CELL CANCER OF THE LUNG

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Introduction
Non-small cell lung cancer (NSCLC) is the third leading cause of cancer worldwide; however, it is the number one cause of cancer death because most cases are diagnosed at advanced stages. Nearly 40 percent of people newly diagnosed with lung cancer have Stage IV disease. To detect disease sooner, the American Association of Thoracic Surgery has recommended CT lung screening for individuals at high risk for lung cancer.¹

Stage IV NSCLC cannot be cured, but the disease may be managed by various forms of treatment, including radiation, chemotherapy, and surgery. The aim of treatment at this stage is to relieve symptoms and extend and improve the quality of life. In the Comprehensive Cancer Center at Catawba Valley Medical Center, lung patients comprise approximately 15 percent of our total caseload. Nearly half of these are considered to be advanced cases, many of which we treat using external beam radiation, often in combination with concurrent radio-sensitizing chemotherapy.²

All forms of external beam radiation treatment for the lung are available at the Catawba Valley Medical Center, including 3D conformal therapy, IMRT, volumetric arc therapy (RapidArc® radiotherapy technology), and stereotactic body radiotherapy (SBRT). We prepare and compare multiple plans for each patient and select the one that provides the optimal balance of dose distribution to the target and sparing of the esophagus, trachea, heart, spine, and healthy lung tissue.

Case Report
On May 1, 2012, a 49-year-old male with a 40 pack-year history of smoking presented in the emergency room with shoulder pain of several weeks duration. He was diagnosed with Stage IV adenocarcinoma. He began a seven-week course of radiation therapy with concurrent chemotherapy on May 16, 2012.

Diagnostic imaging
A chest X-ray taken in the ER, which showed an upper left lobe mass, was followed immediately by CT imaging on a Siemens Somatom® Sensation 64-slice CT that confirmed a mass in the apex of the upper left lobe with spinal cord impingement. The treatment decision was aided by an additional PET-CT scan that clearly differentiated the tumor from an area of lung collapse. (See Figures 1A and 1B.) The initial tumor volume was 4 x 6 cm, with associated edema.

Figure 1A. Diagnostic image (PET-CT) showing part of primary lung tumor. Results will vary.


Whenever possible, diagnostic PET-CTs are taken with the patient in the position for radiation therapy, so that the same scan can be used for treatment planning. This coordination enables us to speed planning and start therapy within days of diagnosis. A bone scan revealed the patient to be clear of metastases. We recently acquired a Siemens Biograph™ mCT, which will provide images already phased and prepared for 4D planning. This will help us understand tumor motion, evaluate whether respiratory gating is indicated, and streamline the planning of precise treatments with narrower margins.

Surgery is sometimes performed for palliation in late stages of lung cancer. However, this patient was determined to be a poor candidate for surgery because of the partial collapse of his left lung and the impingement of the tumor on the spinal cord.

Treatment planning
Treatments are planned using the Varian Eclipse™ treatment planning system. They are simulated and verified using the Varian Acuity™ system. Treatments are delivered on one of two Varian machines, the TrueBeam™ system or the Trilogy® system. Both are equipped for IMRT, IGRT, RapidArc, and SBRT.

A total dose of 70 Gy was prescribed to be delivered in 35 fractions. Studies suggest that hypofractionation (SBRT) and standard fractionation schemes afford similar symptom relief. In this case, we opted for standard fractionation, with lower dose per fraction, because of the close involvement of the spinal cord. In this case, the dose to the patient’s spinal cord was the limiting factor in how much radiation we could deliver safely.

We routinely do alternative treatment plans to compare and select the optimum plan. For this patient, we compared 3D conformal plans with conventional field arrangements to an IMRT plan. We were primarily concerned with not exceeding dose constraints to the spinal cord. The IMRT plan provided the better dose distribution to the tumor while sparing the spinal cord. The IMRT plan was significantly better than the conventional plan in excluding the spinal cord.

In this case, respiratory gating was unnecessary because respiration-induced motion of tumors in the upper lobes is minimal and the tumor was anchored to the spinal cord.

In addition, our experience shows that tumors of this type usually shrink significantly over the seven-weeks of treatment (note: these results are the experience of Catawba and actual results may differ). For this reason, we planned to deliver the first 40 Gy in 20 IMRT fractions and then replan for a 30 Gy boost in 15 fractions to the smaller target. (See Figure 2.)

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Treatment delivery
Radiation treatment began as soon as the concurrent chemotherapy was scheduled. The patient received weekly chemotherapy with Taxol and Carboplatin.

The IMRT plan was delivered on the Varian TrueBeam system. We selected the TrueBeam system because it allowed us to use a 10 MV radiation beam, an option that we didn’t have on our Trilogy system. It is generally recommended to use 6 MV rather than 18 MV for lung tumors because of the physics of the interactions between 18 MV and the air in the lungs. However, when the tumor is deep within the body, the dose to the skin and normal tissues can be higher with 6 MV. For this reason, 10 MV is a good compromise because it can reduce the skin dose without the problems associated with the lungs and higher energies.

There was significant tumor change during the course of the IMRT treatment. As expected, the tumor shrank significantly. The change in size and position of the tumor in relation to the spinal cord, trachea, and esophagus necessitated an adapted plan.

For the 30 Gy boost, we once again prepared multiple plans, comparing 3D conformal, IMRT, and RapidArc plans. The RapidArc plan was more conformal, providing better dose to the tumor volume with lower dose to the spinal cord and other organs at risk. (See Figure 3.)

The remaining 15 fractions of RapidArc treatment were also delivered on the TrueBeam system, using the 10 MV beam and two rotations of the gantry.

Results
The patient completed the seven-week course of radiation treatment, tolerating it well. His pain began to resolve during the first four weeks of treatment. He experienced mild esophagitis and also experienced a sore throat from treatment to the trachea. The patient was planned for follow-up PET-CT scans after 3 months, which is our normal protocol.

4 As with all radiation treatments, side effects can occur. Systemic side effects can include fatigue, nausea, or low blood counts. Localized side effects can include skin erythema, hair loss, mucositis, shortness of breath, irritation of bowel and bladder function, or diminished sexual function.
About Catawba Valley Medical Center
The Catawba Valley Medical Center, in Hickory, North Carolina, has a comprehensive cancer center, one of the earliest to be accredited by the American College of Surgeons. Offering every accepted clinical protocol, the Radiation Oncology department treats 50 patients a day with some form of radiation treatment, including IMRT, IGRT, RapidArc, SBRT, and HDR brachytherapy. The Comprehensive Cancer Center draws patients from a population of 300,000 people in the small communities of the foothills of the Blue Ridge Mountains of western North Carolina.

The medical center is equipped with Siemens systems for CT, PET, and MR imaging for diagnosis and radiotherapy planning. It also has a complete Varian solution for external beam radiation, including Eclipse treatment planning system, Acuity system for simulation and verification, TrueBeam, and Trilogy systems for delivery, RapidArc radiotherapy technology and the ARIA oncology information system.

The information presented is intended to provide an informative case study example only. Varian is not endorsing the specific actions or treatment protocols of the clinical team involved in the delivery of radiation treatment of the specific patient. Health care professionals must always rely on their professional clinical judgment when deciding whether a patient is a candidate for radiation therapy and how to use radiation therapy. Varian does not dispense medical advice and recommends that health care professionals using radiation therapy be adequately trained before using any Varian product.