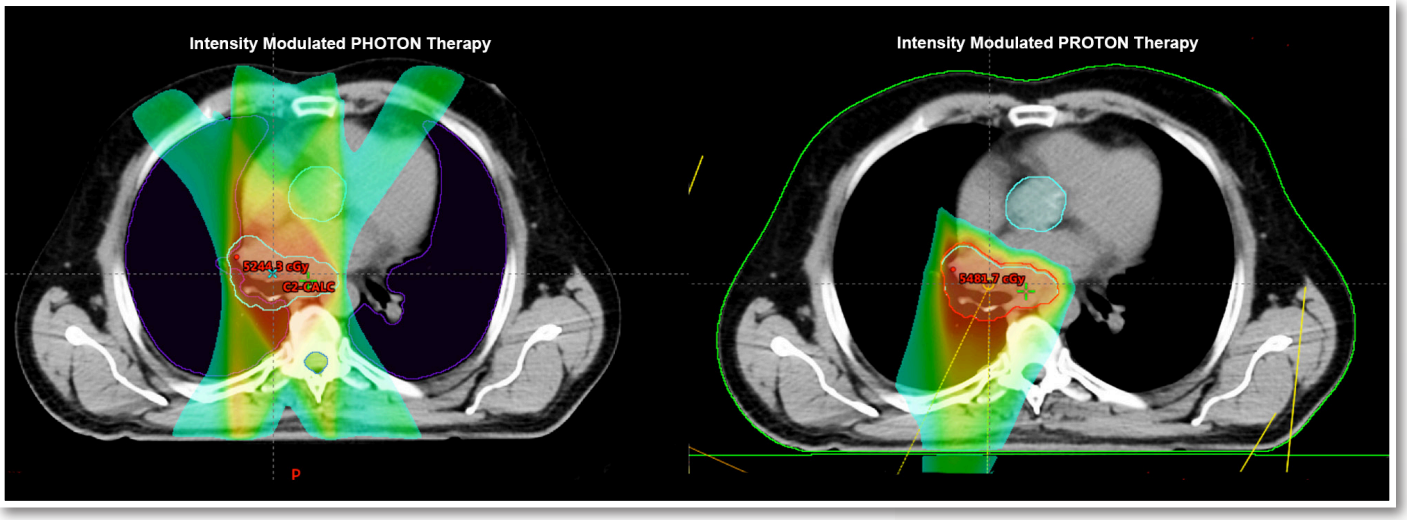
Penn Medicine

CLINICAL BRIEFING™

Department of Radiation Oncology • The Roberts Proton Therapy Center

Proton Therapy for the Patient with Complex Presentation



Radiation oncologists at the Roberts Proton Therapy Center have developed protocols, techniques and approaches expressly for patients whose complications might otherwise alter the efficacy of, or preclude, radiotherapy. These complex presentations are typically defined by cancer in proximity to radiosensitive organs in the presence of comorbidities necessitating dose reduction.

Standard radiotherapy involves an intricate balance of maximizing cure without toxicity to nearby normal tissues (also known as the therapeutic ratio). On one hand, overexposure to standard radiotherapy may increase the risk of adverse events. On the other, efforts to minimize radiation exposure may result in inadequate dose delivery, increasing the risk of cancer recurrence.

The benefits of radiotherapy are diminished when patients have comorbidities that could be exacerbated by significant radiation exposure. Although these complex patients may not be ideal candidates for standard radiotherapy, proton therapy may permit preservation of the therapeutic ratio by delivering safe treatment.

Among the important properties of proton therapy is a rapid dose fall off at the distal edge of the target (Bragg-Peak effect), a characteristic that allows for significant reductions in integral radiation dose to normal organs by comparison to standard photon therapy (Figure 1). In addition, proton therapy permits conformal, precision treatment delivery, improved dose homogeneity and the opportunity for dose escalation to achieve optimal radiation dosing to the target lesion.

In the years since the opening of the Roberts Proton Center, Penn radiation oncologists have developed protocols to carefully evaluate the intricacies of radiation dosing to radiosensitive structures with the goal of increasing the likelihood of safe, effective radiotherapy delivery.

Figure 1: The green colorwash demonstrates the 20 Gy isodose line for a 5 non-opposed co-planar field IMRT plan compared to a 2 field IMPT plan that were both prescribed to 50.4 Gy. It is obvious that the mean heart dose is substantially less, but in this case the maximum dose to the aortic valve prior to a planned replacement is less than 4 Gy.

CASE STUDY

Mr. G, a 68-year-old man, was referred to the Roberts Proton Therapy Center for post-operative radiotherapy after he was found to have mediastinal lymph node involvement at the time of his lobectomy, where the initial PET/CT showed no evidence of abnormal lymph nodes. Typically, it is recommended that patients diagnosed with stage III lung cancer undergo sequential chemotherapy followed by radiation. Mr. G's case was made more challenging, however, by a diagnosis of symptomatic severe aortic stenosis prior to surgery. As a temporizing measure, Mr. G then had a valvuloplasty with a planned valve replacement to follow the completion of his treatment for cancer. In addition to aortic stenosis, Mr. G's condition was complicated by the presence of atrial fibrillation and rapid ventricular rate (RVR) during his original lobectomy.

Post-operative radiotherapy in this situation has been a challenge causing real morbidity and mortality in the past. Improvements in techniques over the last decade have improved the safety of this treatment, but in Mr. G's case, there were several incentives for a reduction in radiation dose.

(Continued on the back)

CASE STUDY *(Continued from cover)*

Because the disease to be targeted was located in the mediastinum, a substantial decrease in dose to the heart would be appropriate. A further diminishment in dose to the aortic valve was required to decrease complications arising from the anticipated valve replacement post-radiotherapy. The presence of atrial fibrillation and RVR at his prior surgery also mandated dose reduction. A multidisciplinary discussion with Mr. G's cardiac surgeon then took place to determine which areas of the vasculature should be avoided to minimize this risk.

Mr. G received radiotherapy at the Roberts Proton Center for 5 ½ weeks, with minimal dosing to his heart and nearly no dose to the area of the aorta valve. Three weeks after the conclusion of radiotherapy, he had a transaortic valve replacement (TAVR) procedure to correct his aortic stenosis. At his one-year follow-up, he noted no deterioration in his capacity for normal daily activity. No evidence of cancer recurrence was noted at this time.

ACCESS

Penn Radiation Oncology
Perelman Center for Advanced Medicine
Concourse Level
3400 Civic Center Boulevard
Philadelphia, PA 19104

FACULTY TEAM

Among the largest and most respected programs in the world, Penn Radiation Oncology offers a variety of innovative treatment options to patients with cancer. In addition, as a national leader in basic science, translational research and clinical trials, Penn Radiation Oncology offers patients access to the latest treatment options—including proton therapy—before they are widely available elsewhere.

Steven Joel Feigenberg, MD
Vice Chair of Clinical Research & Chief of Thoracic Service, Department of Radiation Oncology

Abigail T. Berman, MD, MSCE
Associate Director, Clinical, Penn Center for Precision Medicine
Assistant Professor of Radiation Oncology

Keith Cengel, MD, PhD
Director, Photodynamic Therapy
Co-Director, Penn Mesothelioma Pleural Center
Associate Professor of Radiation Oncology

William Levin, MD
Medical Director, Penn Radiation Oncology Network
Associate Professor of Clinical Radiation Oncology

Samuel D. Swisher-McClure, MD
Assistant Professor of Radiation Oncology

FY18-18140 1.18