

CASE REPORT

Proton-based chemoradiation for synchronous bilateral non-small-cell lung cancers: A case report

Wenyin Shi¹, Romaine C. Nichols, Jr², Stella Flampouri², Zuofeng Li², Wen Hsi², Soon Huh², Meng Wei Ho², Randall H. Henderson², Nancy P. Mendenhall^{1,2} & Bradford S. Hoppe²

¹ Department of Radiation Oncology, University of Florida College of Medicine, Gainesville, FL, USA

² University of Florida, Proton Therapy Institute, Jacksonville, FL, USA

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Correspondence

Romaine C. Nichols, University of Florida, Proton Therapy Institute, 2015 North Jefferson Street, Jacksonville, FL 32206, USA.

Tel: +1 904 588 1245

Fax: +1 904 588 1300

Email: rnichols@floridaproton.org

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Abstract

In this case report, we present the history and treatment of a 70-year-old man with synchronous bilateral non-small-cell lung cancers with proton-beam radiation. Surgical treatment was not feasible and optimized photon intensity-modulated radiotherapy (IMRT) to the primary tumors would have resulted in unacceptably high normal-tissue exposures. Proton-beam radiation enabled radiation dose escalation and concurrent chemotherapy while maintaining normal-tissue tolerance.

Case report

A 70-year-old white male underwent a staging workup for a localized low-risk prostate cancer. Computerized tomography (CT) of the chest demonstrated a 5.1 × 6.3-cm mass in the posterior basilar segment of the left lower lobe and a 5.8 × 5.0-cm mass in the posterior segment of the right upper lobe. Positron emission tomography (PET)/CT demonstrated increased fluorodeoxyglucose (FDG) activity in both masses. There was no other suspicious area of increased radiotracer activity on PET/CT (Fig 1). Bilateral CT-guided biopsies were performed with histopathology revealing non-small cell carcinoma/adenocarcinoma of pulmonary origin. Prostate specific antigen (PSA) stains were negative. Brain imaging was negative for metastasis. He was staged as having synchronous bilateral stage IB (T2N0, T2N0) non-small-cell lung cancers (NSCLC).

The patient's medical history was significant for type II diabetes, pernicious anemia, and hypothyroidism. His Karnofsky Performance Status (KPS) score was 90. He experienced no weight loss. Given his excellent performance status and negative systemic workup, the decision was made to offer definitive treatment. He was deemed a poor surgical

candidate because of the size and locations of the tumors. Concurrent chemoradiation was recommended.

Optimized 3-D conformal (3DCRT) X-ray and intensity modulated photon-based radiotherapy (IMRT) plans were generated with the intention of delivering a planning target volume (PTV) dose of 75.60 gray (Gy) to both lesions. PTVs were established based on 4-D CT treatment planning. An internal gross tumor volume (IGTV) was generated from the 4D CT scan. A 7-mm CTV expansion on the IGTV was utilized with a 5-mm PTV expansion. Because X-ray plans were associated with substantial normal lung exposures, proton plans were generated for comparison purposes. Specifically, while limiting the spinal cord to a dose of 45 Gy, the mean lung dose (MLD) and pulmonary V20 of the best 3-D conformal X-ray plan was 29.13 Gy and 50.76%. The mean heart dose (MHD) was 15.50 Gy. The optimized IMRT plan was somewhat better with an MLD of 21.13 Gy, a pulmonary V20 of 34.47%, and an MHD of 14.91 Gy. The optimized 3-D conformal proton plan achieved the desired PTV dose while limiting the MLD to 12.76 Cobalt Gray Equivalent (CGE), the V20 to 24.25%, and the MHD to 0.67 CGE. The color wash dose distributions and dose volume histograms (DVHs) for each plan are shown in Figure 2.

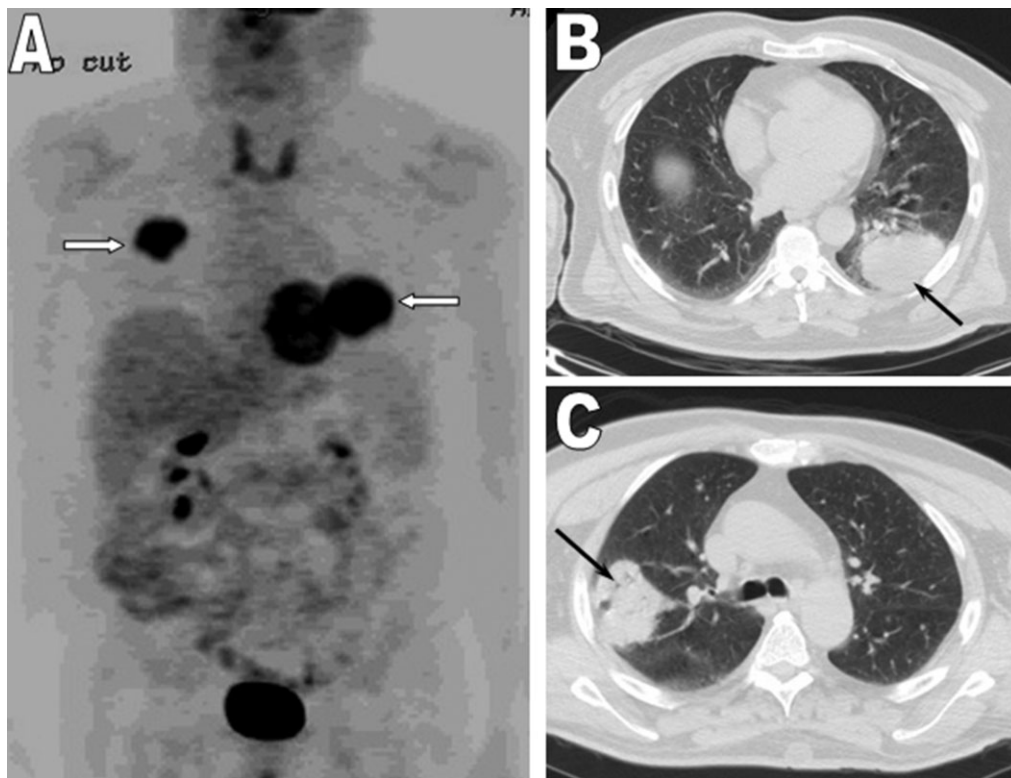


Figure 1 Positron emission tomography/computed tomography (PET/CT) scan showing the bilateral lung cancers. (a) PET maximum-intensity-projection (MIP) image of the whole body in the anterior view. (b) An axial chest CT scan demonstrating the left lower lobe mass. (c) An axial chest CT scan demonstrating the right middle lobe mass.

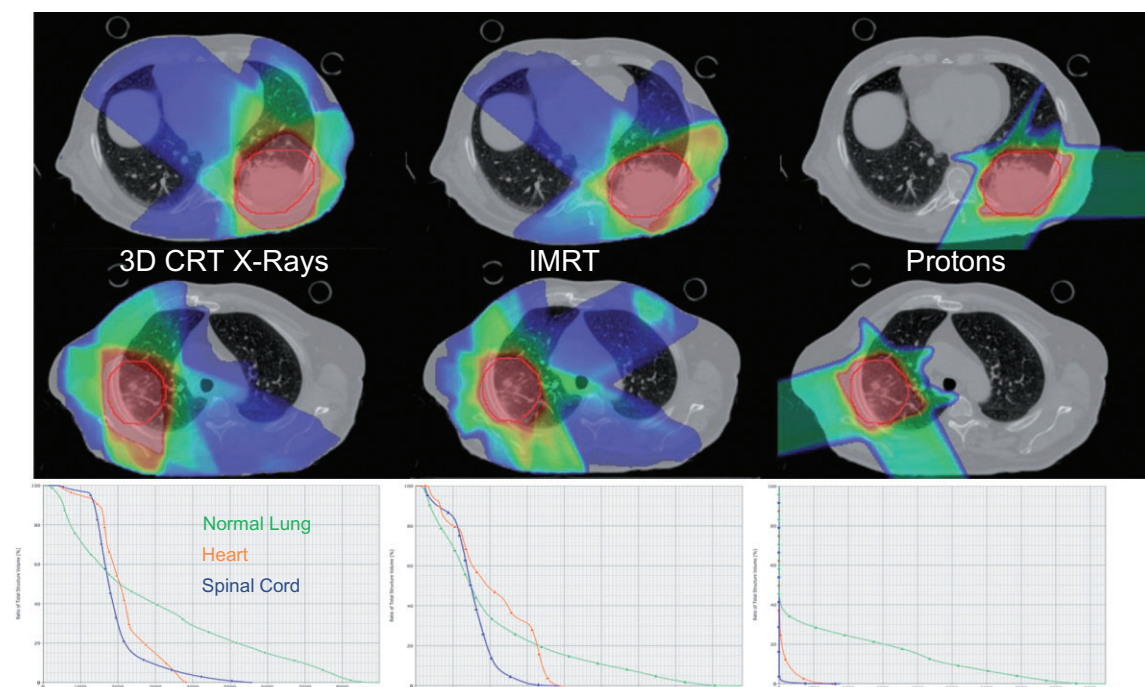


Figure 2 Axial color wash plans with associated DVHs for the 3D Conformal X-ray, intensity modulated photon-based radiotherapy (IMRT) and proton plans.

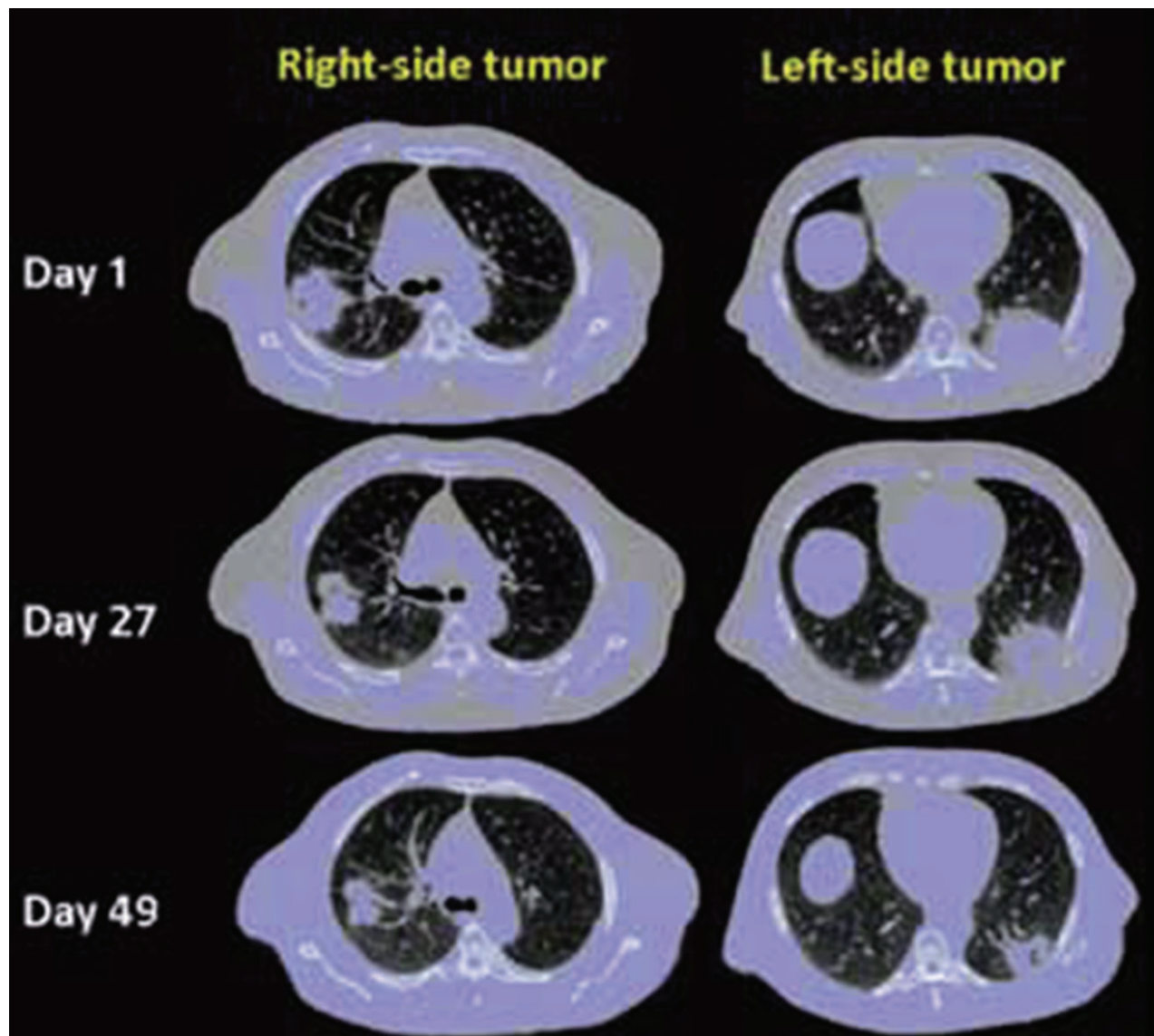


Figure 3 Images taken during treatment demonstrate tumor shrinkage over the course of proton therapy.

The patient was treated with 3D conformal proton radiotherapy to a dose of 75.60 CGE in 42 fractions, five days per week, with concomitant weekly chemotherapy (paclitaxel 50 mg/m² and carboplatin AUC 2). Both tumor masses demonstrated significant shrinkage over the course of radiotherapy (Fig 3), resulting in the need for adaptive replanning, which is the subject of an earlier communication from our group.¹

The patient finished chemoradiation without hematologic, pulmonary, cutaneous, or esophageal toxicity. There were no treatment breaks or chemotherapy dose reductions. He received two additional cycles of full-dose paclitaxel and

carboplatin after completion of chemoradiation. At three years after treatment he was without pulmonary toxicity. PET/CT imaging at 36 months after treatment demonstrated no evidence of persistent or recurrent intrathoracic disease (Fig 4).

Discussion

The patient described in this case report was the first patient with non-small cell lung cancer treated definitively with proton therapy at our institution. At the time of his presenta-

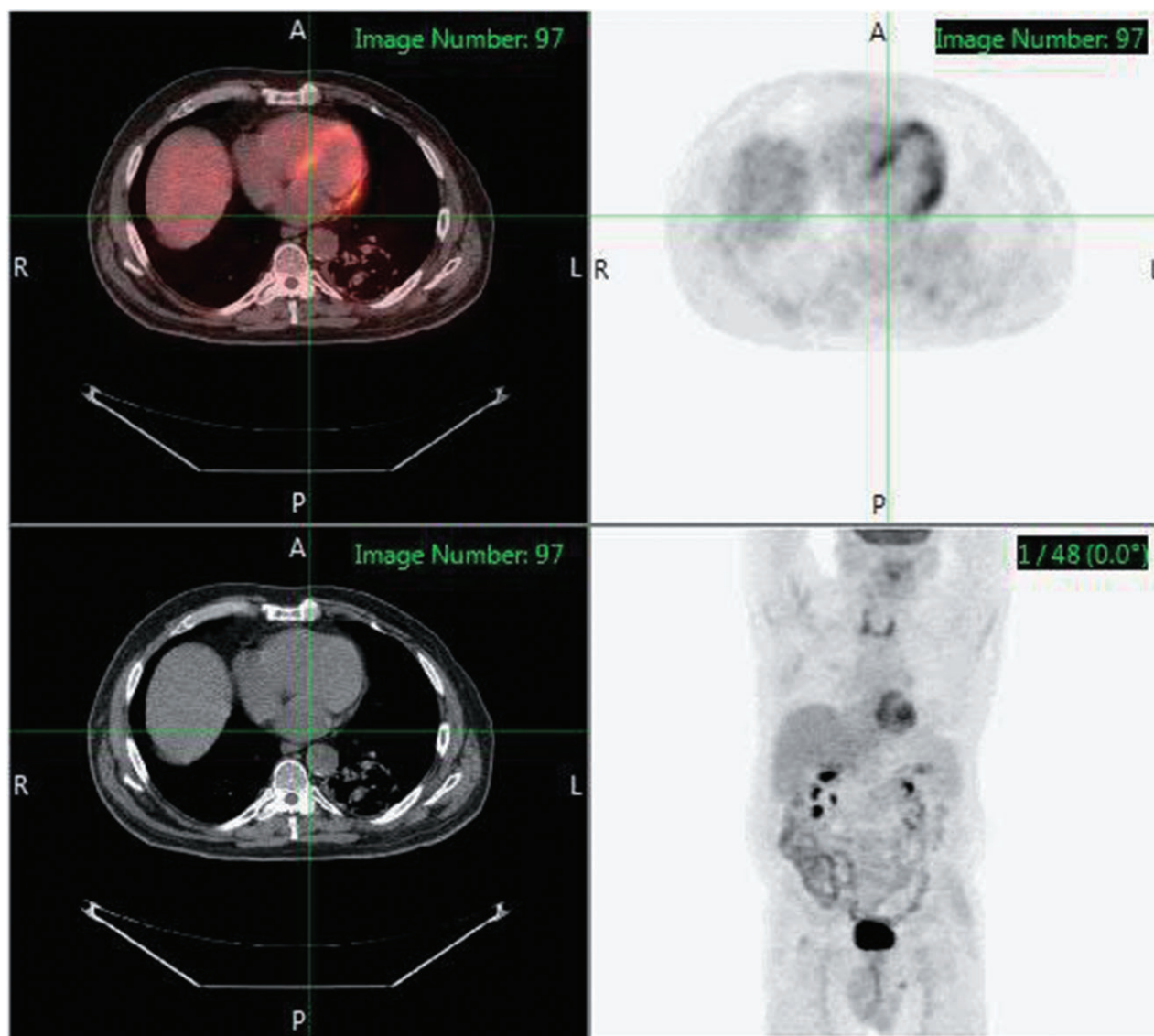


Figure 4 Positron emission tomography/computed tomography (PET/CT) imaging at 36 months shows no evidence of disease.

tion, although our experience with proton therapy for lung cancer was limited, given his disease distribution and the substantial normal lung exposure associated with X-ray-based therapy, we concluded that this was a medical situation where we were obligated to utilize proton therapy. A number of dosimetric studies have emerged in the literature that demonstrate the ability of proton therapy to improve the therapeutic index for patients with lung cancer as compared to treatment with X-rays.^{2–12} Additionally, early clinical data is now available that indicates that proton therapy is therapeutically effective and can be delivered with acceptable toxicity.^{13–22} These studies are presented in a recently published review article.²³

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Disclosure

No authors report any conflict of interest.

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