A Novel Multileaf Collimator-based Photon-Proton Involved-Field Technique for Treatment of Hodgkin’s Lymphoma (HL) of the Neck and Mediastinum

B. Goldsmith, S. Both, B. Shinkle, P. James, C. Hill-Kayser, Z. Tochner, J.P. Plastaras
Department of Radiation Oncology, Hospital of the University of Pennsylvania

Objective

- To maximize the safety of HL treatment without compromising efficacy using novel proton therapy
- To limit radiation dose to normal tissue
- To develop a technique for matching proton and photon fields to cover classic involved-field nodal volumes

Methods

Between May and December 2011, 7 consecutive patients were treated with combined photon-proton modified mantle radiation for HL.

- Photon plans used opposed AP-PA 6 MV photon fields. Photon beams were half beam blocked at the isocenter to eliminate divergence inferiorly. (Images 1 and 2)

- To treat the axilla, individual leaves of the multileaf collimator (MLC) were opened inferiorly to the level of the isocenter.

- Single or multi-angle 235 MeV proton beams in either the AP or PA direction using a gantry-mounted MLC were used for treatment of the mediastinum. (Images 3 and 4)

- As a result of the photon half-beam block, a cold region was created at the match line. Utilizing anterior photon segments, this region was “heated” to >95% of the prescribed dose while simultaneously regulating hotspots throughout the remainder of the plan.

- Photon treatment setup consisted of skin tattoos, leveling laser and orthogonal kV images with MV portal images of the anterior MLC arrangement

- A light field corresponding to the anterior MLC arrangement was projected onto the patient and a marker line was drawn at its most inferior aspect.

Method Images

Image 1: Photon treatment field delineated by MLC and a hand-cut block, matchline in red
Image 2: Photon dose in color wash at matchline
Image 3: Anterior proton field showing matchline and proton MLC arrangement
Image 4: Proton dose in color wash at matchline

Results

- Following photon treatment, a radio-opaque wire was placed on the marker line.

- Orthogonal kV imaging for proton setup was followed by kV imaging of the field shape with MLC to confirm alignment of the wire with the most superior portion of the proton field.

- All fields on both photon and proton machines were successfully treated daily.

- Of the 7 patients, 2 received posterior proton beams to optimize dose to breast tissue.

- Two patients were treated with feathered matchlines and one with a shrinking field technique.

- There were no grade 3 acute toxicities. The most common toxicity was grade 1 radiation dermatitis.

Images 7 – 11: Sagittal dose distribution for patients treated with AP proton field. Color wash minimum of 500 cGy.

Conclusion

Combined photon-proton radiation represents a novel approach to treatment of the modified mantle in order to reduce integral dose to normal tissue.