

Cost-effectiveness of proton therapy for young adults with mediastinal lymphoma: analysis of an institutional cohort

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Introduction

Proton beam therapy (PBT) decreases radiation doses to healthy tissues distal to the target when compared with intensity-modulated photon radiotherapy (IMRT). This physical property is particularly important for mediastinal lymphomas (ML), wherein tumors approximate the heart, since higher mean heart doses (MHDs) are associated with a higher incidence of coronary heart disease (CHD). Yet, PBT is more expensive than IMRT, and fewer centers offer PBT. In the absence of long-term clinical data, we pursued a cost-effectiveness analysis (CEAs) utilizing evidence-based modeling with known data to help guide decision-makers in allocating this limited resource.

Methods

We evaluated the cost-effectiveness of PBT vs IMRT for treatment of ML to 30.6 Gy. We created a Markov cohort model for which patients age 30 years would possibly experience several health states for which CHD was modified by MHD between RT modalities: health, relapse, CHD, and death. Relapse risk was informed by HD14, and MHD-CHD probability was informed by van Nimwegen et al. CHD baseline risk used Framingham data and differed between men and women. Costs, calculated from a payer perspective, were in 2018 USD. Under an institutional IRB study, 40 patients with ML had RT treatments planned with both PBT and IMRT for which MHDs were calculated for both modalities. We used these 40 separate PBT-IMRT MHD pairs to evaluate the percentage of patients for whom PBT would be cost-effective. The model terminated at age 80 years, above which Framingham rates are not reported. The model results are reported using incremental cost-effectiveness ratios (ICERs) using willingness to pay (WTP) thresholds of \$100K/QALY and \$200K.

Results

IMRT and PBT MHD averages were 13.9 (range, 1.6-26.2) and 10.2 (range, 2.0-19.8) Gy, respectively. Using these average MHDs, the respective ICERs for PBT use for men and women were \$71K/QALY and \$108K/QALY, respectively. On individual patient-level analyses of the 40 person ML cohort, using WTP=\$100K/QALY, PBT was cost-effective for 50% of women and 60% of men. Using WTP=\$200K/QALY, PBT was cost-effective for 60% of women and 73% of men.

Conclusion

This CEA compared PBT and IMRT by differential risk of CHD without evaluating other toxicities like breast cancer, sarcoma, congestive heart failure, or lung disease. In this model, PBT was cost-effective for most patients although men were favored to benefit more than women given their higher baseline incidence of CHD.

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