Incremental Cost Effectiveness of Proton Therapy

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Justin Bekelman, MD
Department of Radiation Oncology
Leonard Davis Institute for Health Economics
University of Pennsylvania
No financial conflicts of interest
Proton therapy is expensive

- “A huge investment.”
  – WSJ
- “The price tag is mind boggling.”
  – Cancer Network
- “A price tag as intimidating as its size.”
  – National Association for Proton Therapy
Evidence

“Proton beam therapy is not cost effective for most patients with prostate cancer using the commonly accepted standard of $50,000/QALY”
• “Proton beam therapy is both less effective and more costly than either brachytherapy or IMRT.”
Limitations to current evidence

• Cost-effectiveness modeled not observed
• Assumption-based
  – Assumed substantial differences in cost
  – Assumed no or nominal differences in effect
  – Answer pre-determined by these assumptions
• Important and high quality efforts, but limited by lack of evidence for the models
Incremental Cost Effectiveness

\[
\frac{\text{Cost}_{\text{PROTON}} - \text{Cost}_{\text{IMRT}}}{\text{Effect}_{\text{PROTON}} - \text{Effect}_{\text{IMRT}}}
\]
Incremental Cost Effectiveness

\[
\frac{\text{Cost}_{\text{PROTON}} - \text{Cost}_{\text{IMRT}}}{\text{QALY}_{\text{PROTON}} - \text{QALY}_{\text{IMRT}}}
\]
Direct Costs

• Proton therapy 2x – 3x IMRT

Diffusion
• Costs decline with adoption and diffusion
• New proton technology a 10 fold discount to current facilities
• May lower costs by 50% over ten years

Fractionation
• Hypofractionation may be a wash, but could favor proton therapy
• Needs to be clinically evaluated first, though

Indirect Costs: Productivity Loss

- Absenteeism
- Presenteeism
- Productivity loss may be substantial
  - During therapy
  - Following therapy
- Example: Irritable Bowel Syndrome
  - 8.4 to 13.8 hours lost productivity per 40-hour workweek, attributable to presenteeism
- Has not been examined in cancer

Pare 2006
Incremental Cost Effectiveness

\[
\text{Costs} = \frac{\text{only direct costs}}{\text{QALY}}
\]
Costs

• Favor IMRT

• Economic analyses of proton therapy have not accounted for long term cost estimates
  – Long term costs of proton therapy will fall

• Economic evaluations within clinical trials can measure costs and productivity
Effect - QALYs

- Treatment benefits offset by complications
- Affect patient preferences about QOL
- Health state utilities measure preferences
  - Range from 0 (death) to 1 (perfect health)
- Utilities can be transformed to QALYs
  - Combine preferences for both the length of survival and its quality into a single measure
- Prostate cancer . . . long survival
  - The quality of that survival is measurable
Utilities and Radiotherapy

• Bowel problems worse than impotence, urinary difficulty or urinary incontinence.

• Radiotherapy-induced bowel dysfunction
  – General public: 0.40 to 0.55 utility decrement
  – Patients: 0.02 to 0.13 utility decrement
    ✓ Non-healing leg ulcer: 0.03 decrement

• Has not been measured for IMRT or proton therapy

Stewart 2005; Krahn 2003
Measurement of QALYs in Trials

Area = 0.723
Measurement of QALYs in Trials

Treatment A - Treatment B = QALYs gained (lost)

Area = 0.723

Area = 0.897
Summary

• Are protons expensive? You bet.
• Are protons worth it (for prostate cancer)?
• Depends
  – Are costs and productivity measured?
  – Are long-term costs projected?
  – Does RT toxicity translate into QALY decrements?
• Only way to answer the question?
  – Formal clinical and economic evaluation within a trial (randomized or registry)
Next Step

• A randomized trial to compare the clinical and cost-effectiveness of IMRT and proton therapy for low-risk prostate cancer
  – University of Pennsylvania
  – Massachusetts General Hospital
  – Midwest Proton Radiotherapy Institute
  – American College of Radiology

• Feasibility study submitted to NIH

• Coordination with already proposed registry study