Protons in the Clinic: Another Tool or Universal Solution?

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Protons: Another Tool or Universal Solution

- The Therapeutic Ratio
- Technology
- Economics
The Therapeutic Ratio

Factors impacting the ratio of probability of cure and probability of complication:

- Total dose
- Fraction size
- Overall time
- Inter-fraction interval
- Volume of tissue
- Response Modifiers
The Therapeutic Ratio

- It’s all about dose distribution...
- Most of the dose with X rays will go to non-targeted tissue...
- Most of the dose with Protons goes to targeted tissue....
Protons: Another Tool or Universal Solution?
The Therapeutic Ratio

- With appropriate technology, protons will always produce a higher therapeutic ratio.
Timing and Technology
In some clinical situations, we must await further imaging developments to refine our definition of the target maximize the potential of proton therapy

- Nuclear imaging
- Hypoxic imaging
- MR spectroscopy and diffusion imaging
- Lymphotropice nanoparticle imaging
In some clinical situations, we must await the development of more accurate treatment planning systems to maximize the potential of proton therapy.

To maximally minimize "margins" we must have a better prediction of proton range.
In some clinical situations we must await the development of more sophisticated treatment delivery modalities to maximize the potential of proton therapy:

- Scanning beam/IMPT
- Faster delivery to reduce “margin expansion” required for organ motion
In some clinical situations, we must await the development of more sophisticated tools for measuring clinical endpoints to prove the potential of proton therapy.

- Neurocognitive
- Soft tissue growth/replacement potential
- Quality of life endpoints
- Subjective elements of toxicity grading
Economics
Economics

Ideal: focus on science and patients.
Reality: cost effectiveness of protons?

- NCI
- Medicare/3rd party payors
- Other Medical specialists
- Other Radiation Oncologists
Grander Scale
Grander view of individual health care cost

Not just the cost of an episode of treatment, but the lifelong cost of a management decision

- Cost of treatment
- Cost of disease recurrence
- Cost of complication
- Cost of less functional outcome
Foresight and Farsight
Longer Term Vision

New Partners

- Public/private partners with greater resources
- Interest in long-term health of citizens
- In many cases, non-profit
Longer Term Vision

- **Built for Efficiency**
  - Facilities with full scale applications and high throughput
  - Work organized around beam time

- **Built to last**
  - De-emphasis on rapid ROI
  - Continued re-investment in technology
  - Durable and upgradable product
  - User-vendor technology guidance
Foresight and Farsight

If proton therapy improves the therapeutic ratio...

- Actual individual patient costs will decrease
  - Fewer recurrences
  - Fewer complications
  - Fewer late effects
  - Potential for hypofractionation

- Technology will evolve...
  - More efficient
  - Less expensive
The Slide Rule

February 1, 1972: $12.50
The Hewlett-Packard HP-35

February 1, 1972: $399.00
The Hewlett-Packard HP-35

February 1, 1972: $399.00

May 4, 2009: $79.99

So...
Are protons (particles) just another tool in the clinic or a universal (external beam) solution?
Foresight and Farsight

- Protons will ultimately produce the highest therapeutic ratio because of the better dose distribution.
- Technology will increase applicability and maximize proton therapy potential for increasing the therapeutic ratio.
- Economics will evolve to focus on long-term outcomes and new financing and operational models as well as new technology will improve the "cost-effectiveness."
Protons will become the universal solution for external beam radiation therapy.
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