

An Overview of Proton Therapy
Dr. Lane Rosen-Willis Knighton Cancer Center

1. A History of Proton Therapy?
 - a. Proton therapy has been used for a long time in the US; used more commonly in the 1990's and early 2000's.
 - b. Proton vs photon---protons are particles; the proton is very heavy particle; high mass; requires cyclotron
 - c. X-Ray has no mass; passes right through patient, entrance and exit
 - d. When proton begins to slow, it will deposit all energy at target
 - e. No exit dose; that trait of proton therapy [Bragg Peak] separates proton and x-ray
2. Differences in production between radiation from linear accelerator and proton?
 - a. Compton effect, photoelectric effect
 - b. To accelerate a proton to high speed, cyclotron
 - c. Much more expensive and larger
 - d. Cyclotrons are expensive; gantry is very large
 - e. Building and beam path previously were very large [football field size]
3. Differences in physics, delivery, facility -- can you use proton therapy to treat same sites as conventional radiation therapy?
 - a. Patient selection is key for proton therapy
 - b. Historically used for tumors close to spine, pediatrics, and prostate
 - c. Good for peds due to low exit dose
 - d. Integral dose--amount of dose received
 - e. Future has expanded beyond; new data for lung, esophageal, anal/rectal, sarcoma, gyn [uterine]
 - f. Can treat lymph nodes but protect surrounding bowel
 - g. Breast cancer--reduce coronary artery dose and lung/heart dose
 - h. Brain tumors
 - i. If it is a candidate for IMRT, proton therapy may have role
4. Is there any available training or education necessary to go from conventional to proton?
 - a. Does require additional training for entire staff
 - b. Limited opportunities, but they are available
 - c. PTCOG
 - d. In house training
 - e. Proton therapy is extremely sensitive to breathing, set-up
 - f. Set-up is critical
 - g. Treatment planning requires training to work with moving targets etc
 - i. QA
 - ii. No light fields to see
 - iii. No port films--no exit dose
 - iv. Embed physicians in successful proton facilities
 - h. Proton therapy is demanding of every aspect of department
5. Team has to bring A-game? What is the difference in set-up? How does patient care differ? And why?
 - a. Bladder or rectal filling--come with a full bladder

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- b. Proton--precise filling procedures for reproducibility
 - c. Everything that can remove motion [breath hold]
 - d. Imaging needs to be better--CBCT
 - e. Breath hold and immobilization--taken into account
 - f. Can not put large device under pelvis--irregular shape
 - g. Anything that is in beam path has to be accounted for
6. 1 room proton therapy machines and expansion of patient treatment sites? How has delivery changed?
- a. Proton therapy deemed impractical in early years
 - b. Hodgkin's lymphoma--conventional delivers large dose to heart and lungs--proton delivers no dose beyond the tumor
 - c. Transitioned from double scatter/passive scatter to pencil beam or IMPT
 - d. Old passive scatter--custom compensators or custom blocks, prevented treatment of certain tumors
 - e. Pencil beam is like IMRT; you scan a target layer by layer, fluctuate depth at which Bragg Peak is deposited
 - f. New 1 room machines--size of tennis court, image guidance, and ability to modulate or scan beam
 - g. Some patients are candidates for proton and some are not
 - h. Children should be treated with proton when possible [2018], healthy tissue side effects and development
 - i. Proton for prostate results in better PSA control rate with less side effects
 - j. 1 in 4 patients could benefit from proton therapy
7. Bad press? Large randomized trial for breast. Reimbursement models have negative effect on availability of proton therapy?
- a. No data said 3D conformal was better than fluoro
 - b. Then IMRT over 3D, but no randomized trials confirmed this
 - c. Dosimetry and QA proved that this was better option
 - d. Insurance demands prospective randomized data
 - e. Ethical dilemma with trials
 - f. What patients and what disease sites would benefit from proton therapy?
 - g. Proton therapy has an advantage for certain patients
8. International markets? Help with acceptance and research?
- a. Europeans have financial models that support
 - b. Collaborate on data and trials
 - c. US doing more trials, collecting serious data, published
9. What case impacted you?
- a. Bulky 7cm prostate--traditional RT would have resulted in terrible toxicity--proton saved from worst side effects
 - b. Esophageal cancer--proton [IGPT]
 - c. Have this technology that has the ability to deliver precision radiation with dramatic sparing of surrounding tissue