Radiation Therapy: The Promise of Proton and Stereotactic Radiation for Lung Cancer

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Evolution of Radiation for Lung Cancer
Early Stage Disease and the Challenges from 15 years ago

- Radiation is used when surgery is too risky or is refused
- Standard is 7 weeks of daily treatment
- This can be a major challenge for sick patients
- Treatment works about 70% of the time

What Can We Do to Improve the Standard of Care?
Stereotactic Radiation

80% isodose line ➞
30% isodose line ➞
Radiation Therapy is an outpatient treatment: evolved over the last 15 years.
RTOG 0236 (Timmerman JAMA 2010)

Stereotactic Body Radiation Therapy for Inoperable Early Stage Lung Cancer

36 month local control = 98% (CI: 84-100%)

Initial goal
SBRT = 7 wks RT

What we found
SBRT >> 7 weeks

Less side effects
A real WIN WIN

Fail: 1
Total: 55

Patients at Risk
55 54 47 46 39 34 23
The Impact of Stereotactic Radiation

Stereotactic Therapy has dramatically changed how lung cancer is managed:
- Improving quality of life
  - Reducing time at a radiation facility
  - Reducing side effects
- Improving cancer outcomes
- In addition, …
In the more advanced setting, …
Better Imaging has led to Major Benefits

Tumor =

CT =

PET =
3 Dimensional Radiation
Benefits in treatment Delivery:

Intensity Modulated Radiation (IMRT)
RTOG 0617: Quality of Life

- **3DCRT vs. IMRT:**
  - IMRT more commonly used for larger tumors (p<0.001), higher stage disease (p=0.04)
  - Greater decline in QOL at 12 months for 3DCRT (46% vs. 21%, p=0.003)
  - For a given PTV volume, IMRT was associated with **lower lung** V20 (p=0.08), **lower heart doses** (p<0.05)
  - Heart dose predicted for survival (p<0.001)
  - IMRT had **fewer grade ≥3 pneumonitis** (3.5% vs. 7.9%, p=0.0653) [adjusted p=0.046]
  - IMRT was associated with **higher compliance with full dose consolidative chemotherapy**
  - **High volume centers** had longer overall survival
    - more likely to treat with IMRT (p=0.002) and had RT plans with **lower mean esophageal dose** (p=0.03), lower median heart dose (p=0.006)

Can We Do Better?
Why Protons Can be Superior to Photons

An NEXT Evolution of Change
PROTONS Delivery is Complex

1. Cyclotron
   Using magnetic fields, the cyclotron can accelerate the hydrogen protons to two-thirds the speed of light.

2. Electromagnets
   The magnets focus the proton beams toward the gantry.

3. Gantry
   The gantry can rotate 360° around the patient to position the nozzle.

4. Nozzle
   A 21,000-pound magnet guides the beam to the patient through a nozzle.
PROTONS Delivery is Complex
Purple isodose line represents 5 Gy NOT 45 Gy
Definitive Chemoradiation Case
• RTOG 1308: Phase III Randomized Trial Comparing Overall Survival After Photon Versus Proton Chemoradiotherapy for Inoperable Stage II-IIIb NSCLC