Technological Advances in Radiotherapy

1980-90s

3 Dimensional Conformal RT

1990-2000s

Intensity Modulated Radiotherapy

2000-2010s?

Image-guidance during RT

Reasons for IG during RT

- IMRT leads to and requires increased geometrical precision
- Improved knowledge of tx uncertainties and need for further reduction
- Commercial advanced imaging systems, especially linac-based cone-beam CT

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Special commentary

From IMRT to IGRT: Frontierland or Neverland?

C. Clifton Ling[a,*], Ellen Yorke[a], Zvi Fuks[b]

[a]*Department of Medical Physics, and* [b]*Department of Radiation Oncology, Memorial Sloan Kettering Cancer Center, New York, NY, USA*

An Ideal IGRT system:

- 3D volumetrics of tumor / soft tissues
- Efficient comparison of 3D images
- Clinically meaningful intervention

A NCI Workshop on IGRT

Why

Research needed to define proper use

What

Xray-based and linac-integrated

How

Experts to address specific questions

Specific Questions

IGRT tools are site-specific

H/N, prostate, lung, breast, etc

kV vs MV

MV may be adequate for boney structures (H&N)
kV needed for 3D image of soft tissues

2D vs 3D

2D with markers may be adequate for tumor center
3D needed to visualize critical organs

Use of radio-opaque markers

More Specific Questions

Metrics for intervention

- Tumor center of mass
- Boundary of tumor and critical organs
- How to deal with deformable objects?

Process of intervention

- Manual or Computer-assisted
- Frequency of imaging / intervention
- Who makes the decision

Nomenclature

Other topics

Thank you for your attention!

Fractionated Radiotherapy

- Empiricism - circa 1920-30

- 4 R of fractionated radiotherapy
  - 1970's

More questions on IGRT

Systematic vs random error

- 3-5 imaging sessions sufficient for systematic error
- Random error included conventional PTV
  - (daily imaging unnecessary for conventional PTV)

New definition – IGTV?

- Adaptive treatment to reduce systematic error
- Daily correction to reduce random error
- CTV – IGTV: account for residual error with IG

A testable hypothesis

- IGTV will permit further dose escalation
  - (a continuation of the 3DCRT IMRT processes)

Food for thought

- IGIMRT greatly reduces normal tissue doses
- Is fractionation still needed – how much?
- Number of Fractions vs Level of Precision

Hypofractionation

Good physics compensates for bad biology!?