NCI WORKSHOP ON ADVANCED TECHNOLOGIES IN RADIATION ONCOLOGY

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PURPOSE-1

- Focus on the dose-volume constraints for organs-at-risk that limit the success of 3D-CRT.

PURPOSE-2

- **Examine the evidence -- in *common* cancers -- that SRT, IMRT, PRT and C-ion RT have improved the quantify and/or quality of life of patients, in comparison with 3D-CRT.**

PURPOSE-3

- Determine the priorities and identify the opportunities for future technological development and clinical trials by answering the following key questions:

KEY QUESTION 1

- **The raison d'etre for the advanced technologies is to increase the dose to the cancer without increasing toxicity, or deliver the same dose as conventional technology but with less toxicity.**

QUESTION: In which cancers is there the most pressing need for new technology for increasing the dose or decreasing the toxicity?

KEY QUESTION 2

- **Demonstrating improved ANTICIPATED dose distributions (in-silico or in phantoms) only generates the hypothesis that a new technology may be superior. To prove that hypothesis, we must demonstrate - by controlled clinical trials - a clinically meaningful increase in survival and/or decrease in toxicity.**

QUESTION: What clinical trials are the most important for demonstrating a meaningful benefit to patients?

KEY QUESTION 3

- **Demonstrating improved ACTUAL dose distribution in the patient could be useful in phase I/II trials.**

QUESTION: What technological developments are required for demonstrating ACTUAL dose distribution in-vivo?

KEY QUESTION 4

- **Other clinical or biological intermediate end-points may be useful in clinical trials.**

QUESTION: What might those intermediate end-points be (and what lessons have we learned regarding their pitfalls from PSA, etc)?

- ***Higher radiation doses may force the PSA level down just by destroying more 'normal' prostatic tissue, with no real impact whatsoever on the cancer outcome?***

EVIDENCE OF SUPERIORITY OVER CRT: Survival

	IMRT	SRT	PRT	C-ion RT
Brain	N	Y*	N	N
H&N	N*	N	N	N
Breast	N*	N	N	N
Lung	N	N	N	N
Prostate	N	N	N*	N
Cervix	N	N	N	N
Rectum	N	N	N	N
Peds	N	N	N	N

EVIDENCE OF SUPERIORITY OVER CRT: Toxicity

	IMRT	SRT	PRT	C-ion RT
Brain	N	Y*	N	N
H&N	Y*	N	N	N
Breast	Y*	N	N	N
Lung	N	N	N	N
Prostate	N	N	N*	N
Cervix	N	N	N	N
Rectum	N	N	N	N
Peds	N	N	N	N

Summary

- Despite all the hype, IGRT is NOT ready for prime time, for the following reasons:

INADEQUATE IMAGING

- Current imaging tools are often inadequate for determining the ‘correct’ CTV.
- The current state of imaging QA leaves much to be desired.

TREATMENT PLANNING: WISH LIST

- Common atlas for delineating CTV and OAR.
- Common registration tool.
- Deformable registration tool set.
- Tools for automatic segmentation and auto contouring.
- Tools for standardized PET segmentation.
- A common heterogeneity correction algorithm.
- Monte Carlo dose calculation in treatment planning.
- Better tools than DVH for evaluating treatment plans.

TREATMENT DELIVERY – WISH LIST

- Better methods of reducing (or compensating for) target motion.
- Tools for real-time in-vivo dosimetry. Current methods are too bulky and too slow.
  - Tools for measuring exit fluence.
  - In room positron detectors for detecting positrons emitted during treatment.
- Methods of reducing low-dose radiation which poses a considerable risk of carcinogenesis for children and relatively young patients.

CLINICAL TRIALS

- Trials specifically designed for testing and implementing the needed techniques and tools are required.

Summary

- Advanced technologies may have great potential in some cancers for decreasing toxicity and/or increasing survival but they should be utilized in the context of clinical research for the most part at present -- due to their unproven value, the very demanding QA and the possibility of harm to the patients.