Improving Dose Homogeneity for CSI and Modeling Radiation Response for Cervical Cancer

CCTS | Center for Clinical & Translational Science

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Introduction

- Craniospinal Irradiation (CSI) is used to treat central nervous system cancers
- It covers the spinal cord and the brain
- There are two beams targeted on the brain and two beams on the spinal cord
- Usually the two spinal fields overlap, causing an area of over-radiation or areas of under-radiation
- Our purpose was to develop a new technique to improve the treatment to deliver equally distributed dose

- MRI was used to monitor tumor regression and predict the radiation therapy (RT) outcome for cervical cancer
- A kinetic model was used to describe tumor response to RT

Methods

- Radiation Therapy Treatment Planning software, *Eclipse*, was used
- Patients were placed in prone position
- The lower spine beam was rotated by 16° in order to have a divergence match with upper spine beam
- Patients were "optimized" and Intensity-Modulated Radiation Therapy (IMRT) was used

- 115 patients had four MRI scans before, during, and after radiation therapy
- A kinetic model incorporating three major effects (radiation cell killing, dead-cell resolving, and tumor repopulation) was used to analyze the tumor regression data

Results

- The minimal dose remained 169 cGy
- Mean doses normalized to 180 cGy
- IMRT had least maximum dose
- The maximum dose of the conventional plan was 237 cGy, while IMRT plan had max dose of 201 cGy
- The dose was supposed to be up to 200 cGy, so the conventional plan was putting extra radiation on the body
- Due to overlap, there were hot dips of radiation in the conventional plan (Fig. 1), but the new IMRT method had equal dose distribution

- Tumor volume data, dosimetry data of 35 patients were collected and recorded into Microsoft Excel
- Patient data records were scanned
- Tumor regression data of two typical patients are shown in Fig. 2
- The kinetic model will be adopted to fit the tumor regressions data (curves shown in Fig. 2)

Conclusion

- The IMRT with matching beam-divergence is our new technique for radiation therapy and CSI
- It is much more effective than the conventional method of CSI radiation therapy
- I learned how to do dose calculations and comparisons between different patient data
- This will benefit my future career because I will have to work with many treatment software
- I have learned how to transition from software treatment design to actual patient care

- After converting patient paper records to electronic records in excel, simulations and fast data analysis can be done
- The model parameters derived for individual patients correlated with therapy outcome. New methods based on current findings can be used to predict clinical outcome and adaptive therapy can be adopted for patients at risk of treatment failure.
- This experience showed me how to create graphs to show patterns in certain tumor behaviors during radiation therapy
- I plan on pursuing a career in medical science, and I will need to do a lot of data analysis
- This experience helped me learn how to do simulations of data, which I will need to know for future projects

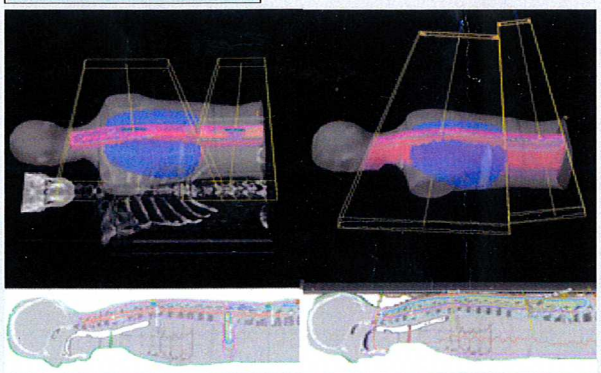

Figure 1. (a) Conventional technique and (b) IMRT technique for CSI treatment

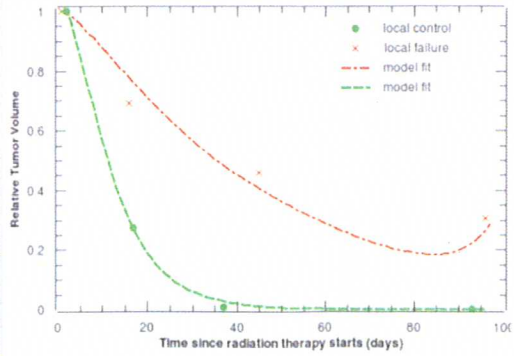

Figure 2. Tumor regression profiles and model fits.

References

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Acknowledgements

I would like to thank CCTS for all the support.
I would like to acknowledge my supervisors for their guidance on the two studies:
Jian Z. Wang, PhD, Nina A. Mayr, MD, Zhibin Huang, PhD, Joseph Montebello, MD, Department of Radiation Oncology