AbstractID: 6010 Title: Kv tomography

Purpose:
To account for geometrical uncertainties during radiotherapy, safety margins are applied. In many cases, these margins overlap organs at risk thereby limiting dose escalation. The aim of image-guided radiotherapy is to improve the accuracy by imaging tumor and critical structures on the machine just prior to irradiation. NKI collaborated in the development of a kV cone beam CT guided accelerator.

Method and Materials:
The chosen imaging dose is 3 cGy for prostate, 1 cGy for head and 2 cGy for lung, 4D scanning. The availability of high quality tomographic images and automatic image registration on the machine leads to many new clinical applications, such as high precision hypofractionated treatments of brain metastases and solitary long tumors with on-line tumor position corrections. Adaptive radiotherapy (ART) of prostate cancer is now also in routine use. We adapt to the average prostate and rectum using cone beam scans made during the first week of treatment.

Results:
The prostate is located automatically in 85% of prostate scans. Even though we use laxatives, the main confounding factor is short-term mobility due to moving gas that causes streak artifacts in the CT reconstructions. Our ART protocol allows reducing the margin from 10 to 7 mm. Patient localization with 1 mm accuracy (bony anatomy) is easily achieved with the current equipment. Pre- and post-treatment scans demonstrate negligible motion of about 0.5 mm SD, both for brain and bladder cancer patients.

Conclusion:
The availability of cone beam CT on the linear accelerator makes ART very efficient and more accurate, since problem duplicating the setup on the CT scanner are avoided. For all image-guided protocols, the residual uncertainties need to be taken into account, and the safe level of margin reduction evaluated. In conclusion, kV cone beam CT guided radiotherapy is now very much a clinical reality.

Learning objectives:
Understand strengths and weaknesses of kV cone beam CT guided radiotherapy
Understand which clinical protocols are most suitable for this technique
Understand the necessity of careful uncertainty analysis and margin selection, especially with image guidance

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