A comparison of CT imaging protocols for diagnostic and radiotherapy applications

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A- Background and aims

CT continues to be the fundamental imaging modality used in radiotherapy planning. However, it suffers from poor soft tissue contrast which causes challenges in delineation of treatment volumes and organs at risk for some treatment sites. The aim of this study was to estimate the imaging dose contribution to total concomitant doses in external beam radiotherapy and to make a comparison between diagnostic and radiotherapy CT imaging doses with the aim of enabling mAs boosting for radiotherapy image quality enhancements.

B- Materials and Methods

Concomitant doses to organs at risk including the contribution from scattered and linear accelerator head leakage as well as imaging doses (planning CT, Simulation and on-board kV verification) were estimated for head and neck, chest and pelvic regions.

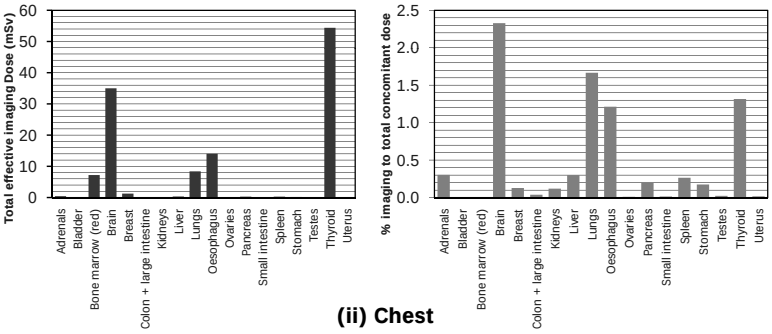
Typical radiotherapy imaging regimé of a single planning CT, two kV simulation images and two on-board kV images for each of the first three treatment fractions were assumed.

The increase in imaging dose contribution (relative to scatter and linac head leakage) arising from boosts to CT mAs contribution was estimated. Also calculated were total imaging doses arising from additional on-board kV verification exposures.

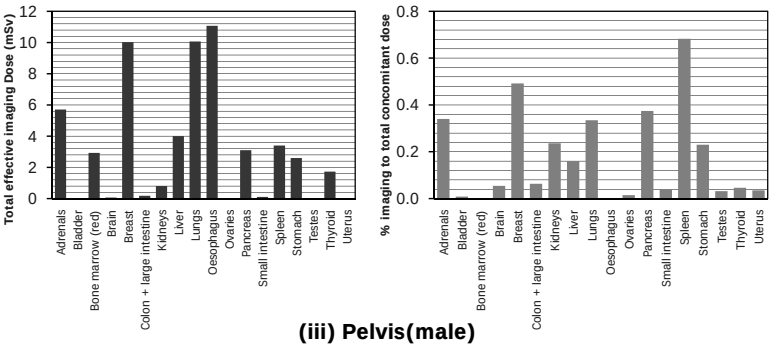
Finally, existing diagnostic and radiotherapy CT imaging protocols from manufacturers were compared.

C- Results 1: Organs at risk concomitant doses

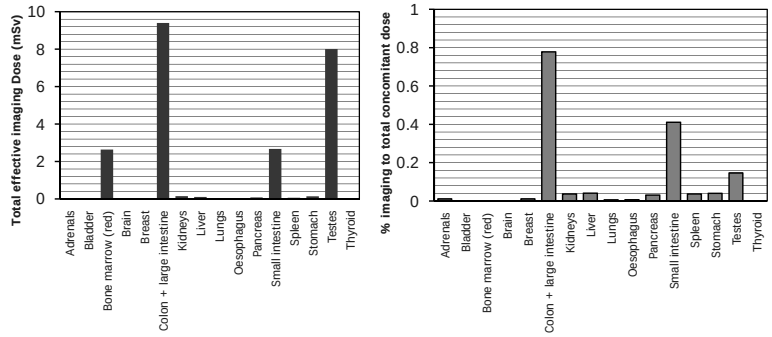
(i) Head and Neck



(ii) Chest



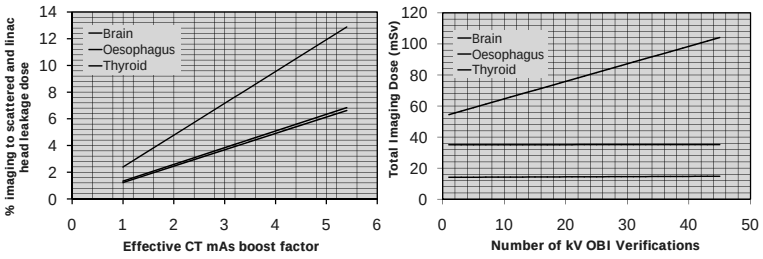
(iii) Pelvis(male)



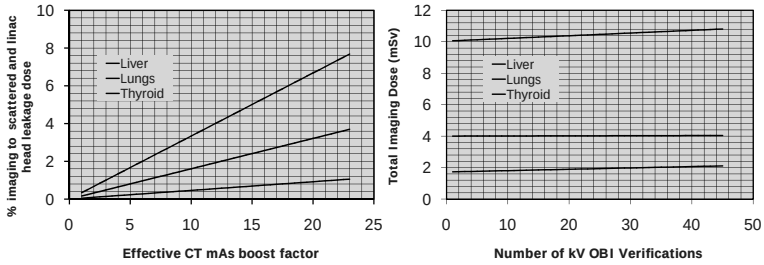
D- Results 3: Imaging doses & CT mAs boost factors

Imaging doses from on-board kV verification and radiotherapy planning CT exposures are relatively small compared to the more significant doses from linear accelerator head leakage and scattered radiation. The number of verification and the mAs of planning CT procedures may therefore be increased for the benefit of the patient when necessary:

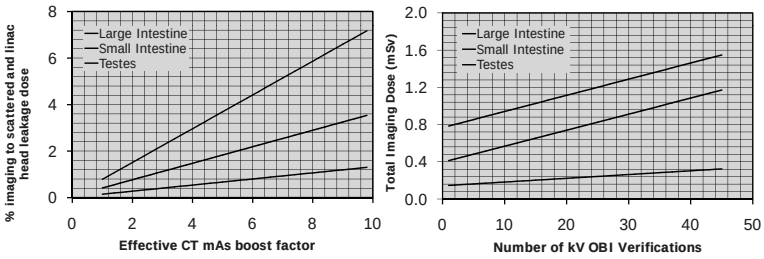
(i) Head and Neck



(ii) Chest



(iii) Pelvis(male)



E- Results 2: Radiotherapy vs Diagnostic CTDIvols

Predicted CT imaging doses for typical manufacturer recommended protocols indicate significantly higher imaging doses may be acceptable for radiotherapy planning CT than for diagnostic procedures:

Site	CTDIvol (Radiotherapy)	CTDIvol (Diagnostic)
Head and Neck	65	10
Chest	40	8
Abdomen/Pelvis	62	11

F- Conclusions

- Total imaging doses arising from typical radiotherapy imaging regimé may range from a few to tens of mSv depending on the treatment site and the number of imaging procedures
- Imaging doses for typical regimé constitute a relatively small proportion of the total concomitant doses compared to the scattered and linear accelerator head leakage contributions
- The mAs of radiotherapy planning CT procedures and the number of on-board kV image verification may be increased if required for the benefit of the radiotherapy patient