Evaluation and reporting of bladder dose is currently based on the total bladder volume with contouring of the outer wall. This study aims to investigate contouring and dose evaluation of several bladder sub-structures potentially responsible for urinary morbidity after radiochemotherapy and Image Guided Adaptive Brachytherapy (IGABT) in locally advanced cervical cancer (LACC).

Methods. The study hypothesis is that different bladder structures are related to different morbidity endpoints. Therefore, a methodology for contouring subvolumes (trigone, bladder neck, urethra) was established. Structures were contoured for all BT fraction extracting parameters: outer bladder wall ($D_{2cm^3}$, $D_{0cm^3}$), ICUR Bladder point, trigone ($D_{2cm^3}$, $D_{1cm^3}$), bladder neck ($D_{1cm^3}$), and urethra ($D_{0cm^3}$, $D_{2cm^3}$). A total of 40 LACC [FIGO Stage: Ib(3), IIb(30), IIIA(1), IIIB(1), IVB(5)] patients according to the EMBRACE protocol was selected.

Results. The reported values represent the cumulative EBRT+BT dose in EQD2. Median $D_{2cm^3}$ Values were 71.7 [59.2–81.8] and 56.2 [47.8–69.3] Gy for bladder wall and trigone, respectively. Bladder wall dose was systematically higher, and hotspots often placed outside the trigone. Median ICURM point dose was 63.0 [49.8–80.5] Gy. Median $D_{1cm^3}$ values for bladder wall, trigone, bladder neck and urethra were 85.6 [82.8–109.8], 70.9 [48.3–105.6], 61.7 [46.5–76.9], and 50.6 [45.6–64.7] Gy, respectively. Median urethra volume and $D_{2cm^3}$ dose were 3.2 [1.4–6.5] cm$^3$ and 47.9 [44.8–58.7] Gy, respectively.

Conclusion. The study showed that the parameters currently used for IGABT bladder dose reporting ($D_{2cm^3}$, ICURM point) do not fully and accurately describe the dose distribution in the lower urinary tract sub-structures. $D_{2cm^3}$ for the outer bladder wall is often higher than trigone dose and in many cases the ICURM bladder point is not a good indicator. It is interesting to note that urethra volume may be relevant for endpoints such as incontinence varied across patients. Further understanding of dose-effect relationships for the bladder may be gained by future systematic delineation of bladder sub-structures.

Reference


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[OA040] Quantifying the effect of increased tissue definition on inter-observer variation in contouring of organs at risk in lung cancer patients using motion-compensated imaging

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Purpose. The development of 4DCT imaging allows clinicians to account for movement of both the target tumour and organs at risk, although the choice of method of image reconstruction can impact how accurately observers can contour nearby organs. Motion-compensated (MC) image reconstruction is a technique that reduces blurring compared to standard averaged reconstruction. This study aims to quantify the presence of sharper boundaries by taking the value of the image gradient at contour lines, and link this increase in tissue definition to lower inter-observer variation.

Methods. Eight patients with early stage non-small lung cancer were imaged with 4DCT, and these scans were reconstructed using both motion-compensated and averaged techniques. These two sets of scans were then each delineated by five clinicians, who contoured nearby organs at risk. The mean distance between observers’ contours was calculated and compared to the image gradient value at each point on the delineation.

Results. Drawing on results by McWilliam et al. [1], the use of motion-compensated CT image reconstruction results in a reduction in inter-observer variation across all sites delineated. The use of MC increases definition of boundaries between organs, represented by an increase in the image gradient at the delineation boundary. This result was particularly pronounced around the trachea, where preliminary results show the use of motion-compensated reconstruction reduced delineation separation by 50%; across all patients, the heart saw very little improvement between imaging techniques.

Conclusions. The use of motion-compensated CT reconstruction produces images with more well-defined boundaries between tissue, and higher values of image gradient. When delineating organs at risk, the presence of large gradients is a statistically significant (p < 1E–4) predictor of inter-observer agreement. Regions where this effect was not seen—specifically the heart—is thought to be due to additional organ motion not accounted for when reconstructing the scan.

Reference


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[1041] Spatial distortions in MRI

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Purpose. MR images inherently suffer from spatial distortions. Spatial distortions play an important role particularly in quantitative MRI, where MRI parameters are employed as quantitative biomarkers, and in MRI-based treatment planning for advanced radiotherapy applications, which require high spatial accuracy in target localization and definition.

Methods and results. Spatial distortions stem from sources which either relate (sequence dependent distortions) or do not relate (non-sequence dependent distortions) to the measurement conditions (field strength, pulse sequence, scanning parameters, etc.). Non-sequence dependent distortions arise from gradient field non-linearity and, thus, are related to the MRI system. Although MRI scanners utilize post-imaging correction algorithms which reduce gradient field non-linearity distortions, residual distortions may still be considerable at areas distant from the isocenter. These can be estimated and corrected with the aid of specially designed phantoms. Sequence dependent distortions arise from static magnetic field inhomogeneity ($\Delta B_0$), magnetic susceptibility ($\Delta B_X$) and chemical shift ($\Delta B_\phi$) phenomena, collectively referred to as field inhomogeneities, which may be machine-related ($\Delta B_0$), or patient-induced ($\Delta B_X$ and $\Delta B_\phi$). Sequence dependent spatial distortions scale linearly with $\Delta B_0$ and can be partly controlled through the optimization of the scanning parameters and conditions that affect them. How-