

ABSTRACTS

ABSTRACT 8

ASSESSING FEASIBILITY OF A NEW FUNDICIAL MARKER (BioXmark) FOR BLADDER TUMOR LOCALIZATION AND POSITION VERIFICATION DURING RADICAL RADIOTHERAPY IN A PORCINE PHANTOM

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Introduction: Radical radiotherapy is an alternative to cystectomy in appropriately selected patients with localized muscle invasive bladder cancer as part of a multi-modality strategy. Reducing radiation dose to the uninvolved bladder while maintaining or increasing tumour dose has the potential to reduce side effects without compromise in local control. This approach necessitates accurate tumour localisation at the time of radiotherapy planning and position verification for treatment delivery in order to prevent geographical misses. We report on the first use of a novel radiographic fiducial marker (BioXmark) in an ex-vivo tissue equivalent bladder model to optimize bladder radiotherapy.

Methods: A porcine bladder with urethra attached was laid open. A 1 cm inked lesion was marked as a tumour surrogate (Figure 1a). 0.1ml ready to use BioXmark (kindly provided by Nanovi Radiotherapy A/S) composed of three constituents; sucrose acetate isobutyrate (SAIB), x-SAIB and ethanol in the ratio 50:30:20 (w/w%) was injected sub-mucosally using a 25G needle at 8 equally spaced intervals 1cm from the surrogate tumour edge. The porcine bladder was sutured, catheterised and filled with 100mls of water. This was suspended within a central cylindrical cavity and inserted into a pelvic phantom, consisting of a water filled acrylic shell containing bone density equivalent structures (see Figure 1b). The phantom was imaged on the radiotherapy CT scanner, linear accelerator (cone beam CT, kilovoltage X-rays) and 1.5T MRI scanner acquiring T1-weighted (T1w), T2-weighted (T2w) and diffusion weighted images (DWI) to determine quality of 3D visualisation.



Figure 1a. Catheterised bladder (open) with surrogate tumour marked

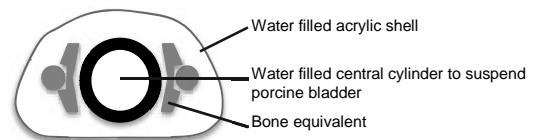


Figure 1b. Axial representation of pelvic phantom

Results: The gelation process of the BioXmark was initiated immediately, after 90 seconds shape and localization was maintained at each sub-mucosal injection site. Within 90 minutes the gelation process was completed. BioXmark was easily visualised at all injection sites on the planning CT, cone beam CT and T1w MRI. BioXmark appeared dark on MRI, therefore was less easily seen on sequences not yielding high signal from the bladder wall (T2W and DWI). Although DWI appeared distorted, disturbance to the magnetic field homogeneity was not associated with BioXmark but because of an air bubble and other phantom materials.

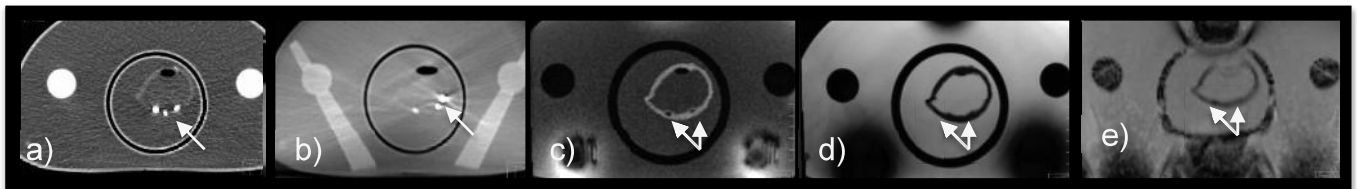


Figure 3 a) Planning CT scan (3 markers, appear bright), air bubble superiorly, seen on all images b) Cone beam CT (3 markers, appear bright), c) T1w (2 markers appear hypo-intense), d) T2w submucosal elevation relating to marker insertion site, e) DWI. Note bladder position not strictly maintained between modalities resulting in difference in the number of markers seen axially (i.e. 3 on CT, 2 on MRI).

Conclusion: BioXmark provides opportunity to aid bladder tumour localisation for radiotherapy planning and delivery. Further work in the clinical setting is now needed.