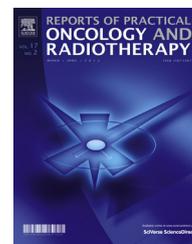


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Original research article

Target volume definition for post prostatectomy radiotherapy: Do the consensus guidelines correctly define the inferior border of the GTV?



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ABSTRACT

Aim: We compare urethrogram delineation of the caudal aspect of the anastomosis to the recommended guidelines of post prostatectomy radiotherapy.

Background: Level one evidence has established the indications for, and importance of, adjuvant radiotherapy following radical prostatectomy. Several guidelines have recently addressed delineation of the prostate bed target volume including identification of the vesico-urethral anastomosis, taken as the first CT slice caudal to visible urine in the bladder neck. The inferior border of clinical target volume is then variably defined 5–12 mm below this anastomosis or 15 mm cranial to the penile bulb.

Methods and materials: Thirty-three patients who received adjuvant radiotherapy following radical prostatectomy were reviewed. All underwent planning CT with urethrogram. The authors (MM, JC) independently identified the CT slice caudal to the last slice showing urine in the bladder neck (called the CT Reference Slice), and measured the distance between this and the tip of the urethrogram cone. Five patients also had a diagnostic MRI at the time of CT planning to better visualize the anatomy.

Results: Sixty-six readings were obtained. The mean distance between the Bladder CT Reference Slice and the most cranial urethrogram contrast slice was 16.1 mm (MM 16.4 mm, JC 15.8 mm), range: 6.8–34.2 mm. The mean distance between the urethrogram tip and the ischial tuberosities was 19.9 mm (range 12.5–29.8 mm). The mean distance between the CT Reference Slice and the ischial tuberosities was 36.9 mm (range 28.3–52.4 mm).

Conclusions: Guidelines for prostate bed radiation post prostatectomy have been developed after publication of the trials proving benefit of such treatment, and are thus untested. The anastomosis is a frequent site of local relapse but is variably defined by the existing guidelines, none of which take into account anatomic patient variation and all of which are at variance with urethrogram data. We recommend the use of planning urethrogram to better delineate the vesico-urethral junction and minimize the potential for geographic misses.

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1. Background

For maximum efficacy, post prostatectomy radiotherapy must accurately define the post-operative clinical target volume (CTV). Results from 3 mature randomized trials have demonstrated the benefits of adjuvant radiotherapy for men at high risk of recurrence, leading to a combined American Society of Therapeutic Radiation and Oncology (ASTRO) – American Urologic Association (AUA) guideline.¹ The guideline recommends that men with adverse pathologic findings, including extra capsular extension, seminal vesicle invasion or positive surgical margins, be informed of the potential benefits of post-operative radiotherapy to reduce biochemical recurrence, local recurrence and clinical progression. However, the trials indicating benefit in this clinical scenario accrued and treated patients 1–2 decades ago. Not surprisingly, target volumes were defined differently at that time. The Southwest Oncology Group study mandated that the inferior border of the field be at the ischial tuberosities and required retrograde urethrography for all patients to ensure that a particularly low anastomosis would not be missed.² The EORTC trial also required retrograde cystography, with the field covering from the seminal vesicles to the apex of the prostate with a safety margin.³ ARO96 specified 3D treatment planning to cover the surgical bed from the seminal vesicles to the apex with a 1 cm margin.⁴

Several groups (Radiotherapy Oncology Group [RTOG], European Organization for the Research and Treatment of Cancer [EORTC], Genito-Urinary Radiation Oncologists of Canada [GUROC] and the Australian and New Zealand Faculty of the Radiation Oncology Genito-Urinary Group [FROGG]) have undertaken consensus guidelines for CTV delineation for post-prostatectomy radiotherapy; none requires a urethrogram as part of the simulation process.^{5–8}

2. Aim

This paper reports the relationship of the former landmark for the vesico-urethral anastomosis (VUA), i.e. the tip of the urethrogram cone, and the current consensus guidelines.

3. Materials and methods

Thirty-three patients receiving post prostatectomy external beam radiotherapy (EBRT) had a urethrogram performed at the time of CT simulation (GE Light speed, 2.5 mm slices, no gap). Patients were positioned supine, with a leg rest, and were advised to have an empty rectum and a comfortably full bladder. Urethrograms were performed by retrograde injection of 5–10 cc of Hypaque sterile X-ray contrast and applying a Cunningham clamp to the penile shaft to retain the contrast during the subsequent scan.

Eight patients were treated in an adjuvant fashion for adverse pathologic features, while 25 were treated for biochemical recurrence or persistently elevated PSA. Median age was 63.5 years (range: 52–76). Pathologic stage at surgery was pT2c in 4 patients, pT2a in one and the remaining 28 were all stage pT3. The median PSA at time of treatment was 0.15 ng/ml

(range 0.01–1.6; mean: 0.4 ng/ml). None had clinical evidence of local recurrence. The median interval from radical prostatectomy to radiation was 0.8 years (range 0.25–13.9; mean 1.77 years).

Treatment planning closely followed the RTOG guideline for post prostatectomy radiotherapy planning except in delineation of the inferior margin.⁵ The CTV inferior border was taken 5 mm caudal to the tip of the urethrogram cone. The median radiation prescription dose was 6600 cGy in 33 fractions over 6.5 weeks with one patient prescribed 64 Gy in 32 fractions, one 65 Gy in 35 and 3 receiving 67 Gy/36 fractions. A 4-field conformal technique was most commonly used with only 2 patients treated using IMRT.

Retrospectively, images and contours were reviewed independently by 2 observers, MM and JC. In all cases, the Bladder CT Reference Slice was determined working from cranial to caudal on transverse slices, without prior knowledge of the urethrogram results. The distance from the tip of the urethrogram cone to the Bladder CT Reference Slice was then measured independently by the 2 observers as a horizontal

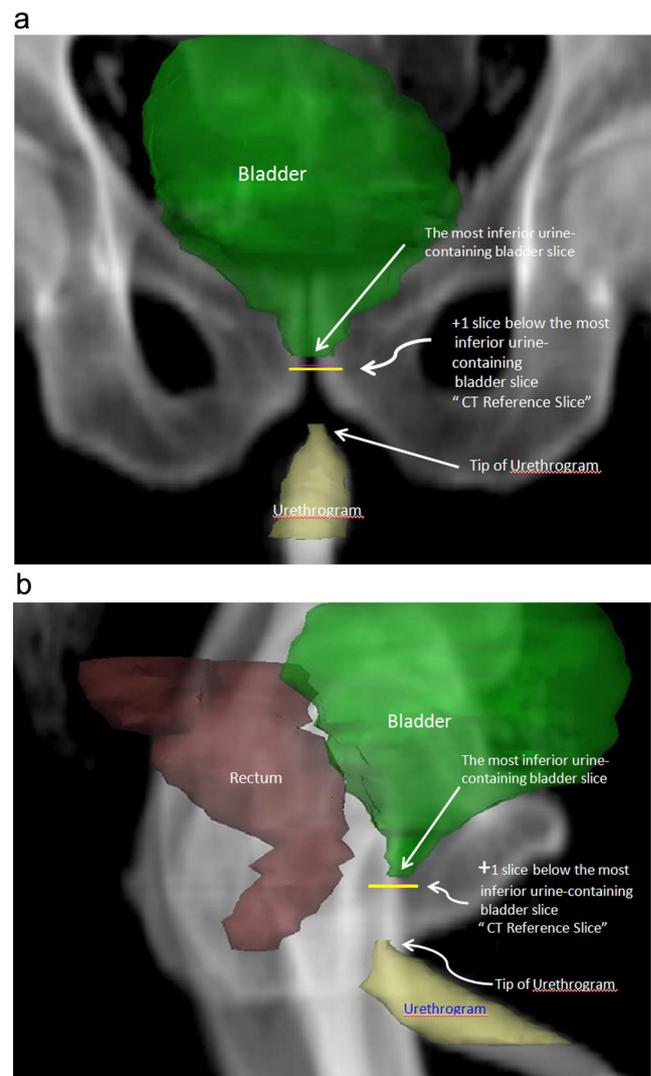


Fig. 1 – Comparison of Bladder CT Reference Slice to urethrogram. (a) Digitally reconstructed radiograph from CT simulation: anterior view; (b) lateral view.

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