Prostatic Urethral Length on MRI as a Predictor of Late Genitourinary Toxicity After Prostate Cancer Radiation

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Introduction

Radiation therapy (RT) is a widely used treatment for prostate cancer.[1] While effective, some patients develop late genitourinary (GU) toxicity, which can impact quality of life.[2,4] Identifying pre-treatment factors that predict toxicity risk may help improve clinical decision-making. Recent studies suggest that prostatic urethral length (PUL) seen on MRI is associated with an increased risk of late GU toxicity.[3] Understanding this relationship could enhance risk stratification before treatment.

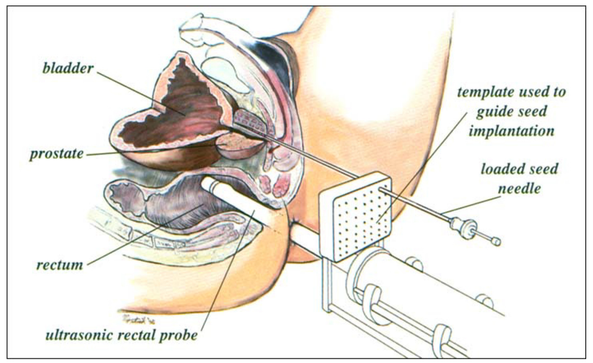

Figure 1. Brachytherapy treatment for prostate cancer

Aims and Objectives

The purpose of our study was to evaluate pretreatment prostate magnetic resonance imaging (MRI) measurements and clinical characteristics in predicting genitourinary (GU) toxicity after radiotherapy for prostate cancer.

Methods

•Retrospective analysis of 361 men treated with prostate cancer radiation therapy.
•Median follow-up: 15 months (IQR: 9.0–28.0).
•Late toxicity defined as Grade ≥2 GU toxicity occurring beyond 180 days post-treatment.
•Multivariable logistic regression model was used for grade ≥2 acute toxicity, and Cox proportional hazards regression was used for late toxicity

Patient Selection:
•Identified from an institutional database (June 2016 – February 2023).
•**Inclusion Criteria:**
- Prostate adenocarcinoma.
- Underwent diagnostic prostate MRI within 6 months of definitive RT.
- Documented GU toxicity data.

•**Exclusion Criteria:**
- History of previous prostate radiation, radical prostatectomy, TURP, or ablation.
- Lack of clinical, RT, or follow-up data.

Results

Acute Toxicity					**Late Toxicity**			
Variable	Univariable OR (95% CI)	P-value	Multivariable OR (95% CI)	Multivariable P-value	Univariable HR (95% CI)	HR P-value	Multivariable HR (95% CI)	Multivariable HR P-value
Age	0.99 (0.95-1.03)	0.63	-	-	0.99 (0.95-1.03)	0.81	-	-
Anticoagulation	1.06 (0.57-1.96)	0.84	-	-	1.04 (0.58-1.86)	0.87	-	-
AUA score	1.02 (0.97-1.07)	0.39	-	-	1.04 (0.99-1.09)	0.06	-	-
BMI	0.97 (0.91-1.02)	0.23	-	-	1.06 (1.01-1.11)	0.01	-	-
Diabetes	0.91 (0.44-1.81)	0.79	-	-	1.02 (0.53-1.95)	0.94	-	-
HDR brachytherapy	**2.44 (1.32-4.47)**	**<0.01**	**2.91 (1.47-5.78)**	**<0.01**	0.75 (0.41-1.37)	0.35	-	-
Prostatic urethral length	0.89 (0.62-1.28)	0.54	-	-	**1.54 (1.17-2.04)**	**<0.01**	**1.59 (1.20-2.10)**	**<0.01**
Membranous urethral length	**0.38 (0.18-0.82)**	**0.01**	**0.41 (0.18-0.92)**	**0.03**	0.96 (0.49-1.88)	0.92	-	-

Table 1. Univariable and multivariable logistic regression for acute grade ≥2 toxicity and Cox proportional hazards model analysis of time to late GU grade ≥2 toxicity[3]

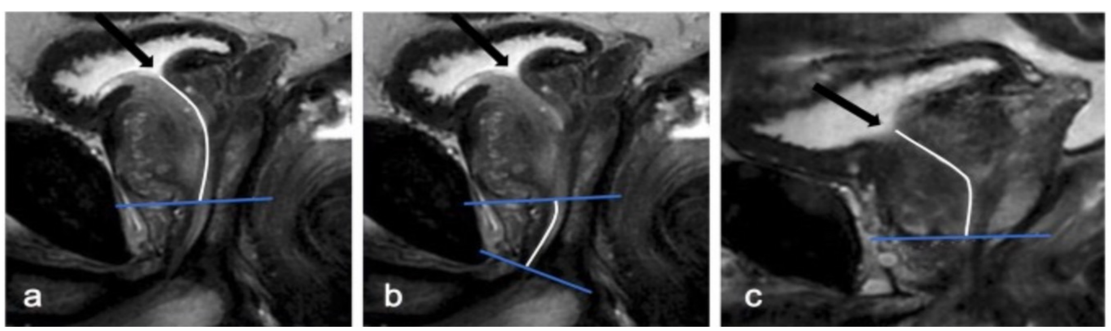

Figure 2. Quantitative MRI measurements of the prostatic and membranous urethra: (a) A 63-year-old male with Grade 2 late retention after SBRT had a prostatic urethral length of 4.4 cm, illustrated by a **white line**, **blue line marking the apex**, and an **arrow indicating the internal urethral orifice** on a sagittal MRI image. (b) The same patient's membranous urethral length measured 2.3 cm, illustrated by a **white line**, **cranial blue line at the prostate apex**, and **caudal blue line at the bulbous urethra**. (c) A 67-year-old male without late toxicity symptoms had a prostatic urethral length (**white line**) of 3.3 cm on a sagittal MRI image.[3]

Conclusions

•MRI-derived prostatic urethral length may serve as a pre-treatment risk stratification tool.

•The strong association between longer PUL and late GU toxicity suggests anatomical differences influence radiation exposure to the urethra.

•Integrating MRI-based anatomical assessments into clinical decision making may help personalize treatment planning.

•Future research should validate these findings and explore dose modifications to reduce long-term toxicity risks.

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