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To cite this version:

E. Mylona, Oscar Acosta, T. Lizee, J. Castelli, C. Lafond, et al.. Bladder and urethra subregions predicting urinary toxicity after prostate cancer radiotherapy. Radiotherapy & Oncology, 2019, 133, pp.S449-S449. 10.1016/S0167-8140(19)31273-3 . hal-02177163

HAL Id: hal-02177163

https://univ-rennes.hal.science/hal-02177163v1

Submitted on 10 Jul 2020

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PO-0853 Bladder and urethra subregions predicting urinary toxicity after prostate cancer radiotherapy

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Purpose or Objective

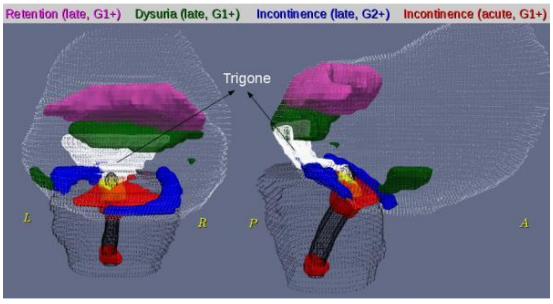
To apply a voxel-based analysis on the planning 3D dose distribution in order to identify symptom-related subregions (SRSs) of the bladder/urethra associated with acute and late urinary toxicity in prostate cancer radiation therapy (RT).

Material and Methods

Overall, 272 prostate cancer patients treated with IMRT/IGRT from two multicentric prospective phase III trials were analyzed. Each patient's organ contours (bladder, urethra and prostate) were spatially normalized to a common coordinate system (CCS) via non-rigid registration. The obtained 3D deformation fields were used to propagate the planning dose distributions from the native space of each patient to the CCS. A voxel-based statistical analysis was applied to generate 3D dose-volume maps for different urinary symptoms and identify corresponding SRSs with statistically significant dose differences between patients with/without toxicity. All the identified SRSs were propagated from the CCS back to the native space of each individual and DVHs for the SRSs and the whole bladder were computed. Dose bins of significant dose difference between patients with/without urinary toxicity were identified. Logistic regression was used to estimate the DVH prediction capability (1Gy bin-wise) of the SRSs compared to the whole bladder.

Results

A local dose-effect relationship was found in the bladder and the urethra. SRSs of significant dose differences (p-value<0.01) were identified for four endpoints: acute and late incontinence in the urethra and the trigone, late retention and dysuria in the posterior part of the bladder, with average dose differences ranging from 1.26 to 9.28 Gy. Figure 2 shows these SRSs onthe template. The DVHs of the SRSs were significantly predictive of toxicity with maximum areas under the ROC curve (AUC): 71% for acute incontinence, 80% for late incontinence, 68% for late retention and 79% for late dysuria. The DVH of the bladder was predictive only for late incontinence and late dysuria (AUC=70%). Table 1 shows the prediction capability of the DVH for the SRSs and the whole bladder in the native space.



A. Acute toxicity					
Symptom	**Region**	**Most predictive DVH bin (Vx)**	**AUC**	**p-value**	**OR (95% CI)**
Incontinence	Acute incontinence SRS	V81	70.9	<0.01	1.05 (1.02-1.09)
	Whole bladder	-	-	NS	-
B. Late toxicity					
Symptom	**Region**	**Most predictive DVH bin (Vx)**	**AUC**	**p-value**	**OR (95% CI)**
Incontinence	Late incontinence SRS	V79	79.7	0.01	1.04 (1.01-1.07)
	Whole bladder	V80	70.2	0.01	1.21 (1.05-1.41)
Retention	Late retention SRS	V37, V62	68	<0.01	1.02 (1.01 -1.04)
	Whole bladder	-	-	NS	-
Dysuria	Late dysuria SRS	V53	78.7	<0.01	1.06 (1.02-1.09)
	Whole bladder	V63	70.1	0.02	1.04 (1.01-1.07)

Abbreviations: SRS= symptom-related subregion, OR= odds ratio, AUC= area under the ROC curve, Vx= volume receiving at least x Gy, CI= confidence interval, NS= Non-significant

Conclusion

The dose delivered to the urethra, the trigone and the posterior region of the bladder was predictive of acute and late incontinence, late retention and late dysuria. These SRSs appear more predictive than the whole bladder, suggesting that identification of radiosensitive subregions can improve the prediction capabilities for urinary toxicity and may be spared in order to decrease urinary symptoms. Additionally, this study provides the first evidence that explicitly correlate the true 3D dose to the urethra with urinary toxicity following EBRT.