# Preliminary analysis of Dose-Volume & Dose-Surface Histograms (DVHs & DSHs) in Stereotactic Body Radiation Therapy for prostate cancer

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STEREOTACTIC BODY RADIATION THERAPY
Implementazione, Sostenibilità, Avanzamento Tecnologico e Risultati a Confronto

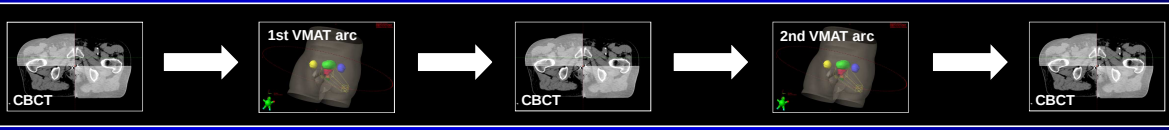
## INTRODUCTION

A ***SBRT protocol for the treatment of intermediate and high risk prostate cancer with Volumetric Modulated Arc Therapy*** (VMAT) is active at INT: prostate gland irradiation up to **18Gy (9Gy/fraction)** followed by pelvic irradiation (50Gy, 2Gy/fraction).

**MAIN CHARACTERISTICS:**

- 2mm symmetrical expansion CTV → PTV
- urethral catheter to identify urethra and to keep a constant bladder filling
- gold fiducial markers for prostate localization by means of kV-Cone Beam Computed Tomography (CBCT)
- VMAT treatment planned with 2 full arcs

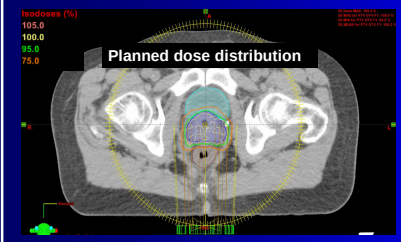
**SBRT WORKFLOW:**

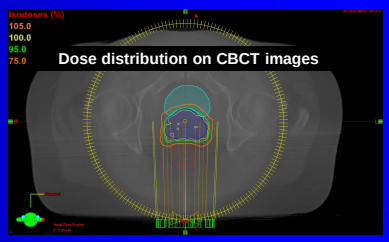



Aim of this study is to evaluate the reliability of the SBRT protocol, in terms of setup reproducibility, target coverage, dose to the main Organs At Risk (OARs) and possible toxicities.

## MATERIALS & METHODS

PTV, bladder and rectum were contoured on the CBCT images for 6 patients: variations of the PTV and displacements of its centre were compared to the planned values.




The original VMAT plans were recalculated on the pre-treatment CBCT images (relative electron density set to be water-equivalent). All plans were imported in a dedicated software (VODCA, Visualisation and Organisation of Data for Cancer Analysis, MSS, ver. 5.3) for the analysis of DVHs and DSHs, based on the following parameters:

| Main structures | Dose parameters |
|---|---|
| PTV | $D_m$ ; $V_{95\%}$ ; $V_{107\%}$ |
| Rectum | $V_{95\%}$ ; $V_{75\%}$<br>$S_{95\%}$ ; $S_{75\%}$ |
| Bladder | $V_{95\%}$ ; $V_{75\%}$<br>$S_{95\%}$ ; $S_{75\%}$ |
| Urethra | $D_{1\%}$ |

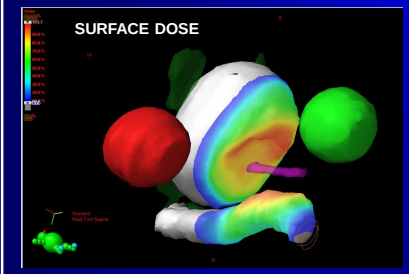
$D_m$ = mean dose
$V_{X\%}$ / $S_{X\%}$ = volume/surface receiving X% of the prescribed dose
$D_{x\%}$ = dose encompassing X% of the volume

Gastro-Intestinal (GI) and Genito-urinary (GU) acute toxicities were recorded according to the CTCAE scale.

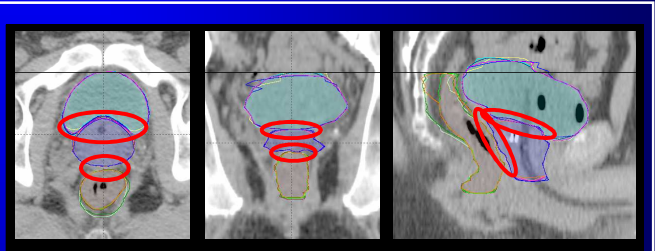
## RESULTS

The mean variation of the PTV was 2.8±1.6% compared to the planned values and the calculated displacement of its centre was on average 0.4 ± 0.4 mm

- ✓ accurate image registrations performed during the treatments
- ✓ absence of relevant deformations




| Main structures | Dose parameters | Planned values | CBCT values |
|---|---|---|---|
| PTV | $D_m$ | 17.8 ± 0.2 Gy | 17.8 ± 0.3 Gy |
| | $V_{95\%}$ | 97.9 ± 2.5 % | 98.0 ± 3.2 % |
| | $V_{107\%}$ | 0 % | 0 % |
| Rectum | $V_{95\%}$ | 0.2 ± 0.3 cm³ | 0.4 ± 0.6 cm³ |
| | $V_{75\%}$ | 2.7 ± 1.3 cm³ | 2.7 ± 1.5 cm³ |
| | $S_{95\%}$ | 3.7 ± 3.6 cm² | 3.8 ± 3.9 cm² |
| | $S_{75\%}$ | 15.2 ± 5.7 cm² | 14.8 ± 5.4 cm² |
| Bladder | $V_{95\%}$ | 1.9 ± 1.2 cm³ | 2.3 ± 2.5 cm³ |
| | $V_{75\%}$ | 8.2 ± 1.6 cm³ | 8.2 ± 3.4 cm³ |
| | $S_{95\%}$ | 15.8 ± 5.7 cm² | 12.3 ± 5.7 cm² |
| | $S_{75\%}$ | 29.3 ± 7.0 cm² | 27.2 ± 5.3 cm² |
| Urethra | $D_{1\%}$ | < 107% of the prescribed dose | |
| NO statistically significative differences between planned and CBCT values | | | |



Transversal View | Coronal View | Sagittal View

Contours of PTV, bladder and rectum drawn on the CBCT images and then transferred on the planning CT images to better highlight the good reproducibility of the high dose regions (red circles)

| | Peak acute toxicities (CTCAE Scales) | | | | |
|---|---|---|---|---|---|
| | G0 | G1 | G2 | G3 | G4 |
| GI (gastro-intestinal) | 4 | 2 | 0 | 0 | 0 |
| GU (genito-urinary) | 1 | 4 | 1* | 0 | 0 |

*during pelvic irradiation

## CONCLUSION

- ✓ Good reproducibility of the SBRT protocol
- ✓ PTV margins seem to ensure a good coverage
- ✓ DVH and DSH analysis suggests that volumes and surfaces of rectum and bladder encompassed by high dose are small enough to avoid significant toxicities, even after pelvic irradiation
- ✓ SBRT with VMAT allows to achieve homogeneous dose distributions in the target, avoiding possible hot spots in the urethra