Purpose

The purpose of our study was to show the potential benefits of using $^{68}$Ga-PSMA-PET/CT imaging for integrated boost treatment planning or boost only treatment planning of prostate cancer patients. The potential gain of such an approach is the improvement of tumour control and reduction of the dose to organs at risk at the same time.

Material and Methods

21 prostate cancer patients (70yrs average) without previous local therapy received $^{68}$Ga-PSMA-PET/CT imaging. Body contour and organs at risk were manually defined. PTV70 and PTV5920 were defined as planning target volumes.

A PET active volume GTV_PET was segmented with a 40% of the maximum activity uptake in the lesion as threshold. Five different treatment plans were calculated for each patient (Monaco, Ver. 5.11.00):

- PETBoostOnly75
- PETBoost80
- PETBoostOnly95
- Prostate
- ProstatePET

Results

Comparing the conventional plans to integrated boost plans and plans just treating the PET-positive tumor volume, we found TCP increased to:

- (95.2±0.5)% for an integrated boost with 75.6 Gy
- (98.1±0.3) % for an integrated boost with 80 Gy
- (94.7±0.8)% for treatment of the PET-positive volume with 75 Gy
- (99.4±0.1)% for treating the PET-positive volume with 95 Gy

For the integrated boost with 80 Gy a significant increase of the median NTCP of the rectum was found, for all other plans no statistical significant increase in the NTCP (rectum & bladder).

Compared to their Prostate plan results, patients with a tumour directly adjacent to the rectum wall were found to have a significantly higher NTCPrectum if the PTV_PET was boosted. At the same time of course, these patient's median TCP of the PET-positive volume was found to be significantly improved as well.

Conclusion and Outlook

- The use of $^{68}$Ga-PSMA-PET/CT imaging would allow more individualized prostate treatment planning and better targeting of active tumour volumes
- TCP values of identified active tumour volumes can be increased, while rectum and bladder NTCP values either remain the same or are even lower
- Clinical studies should be performed to confirm the theoretical benefits of PET target optimized treatment planning

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