Multisector dosimetric analysis to determine in-vivo dosimeter positions in prostate brachytherapy

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Purpose

To perform multisector dosimetric analysis to determine the optimal positions within the prostate for in vivo dosimeters, developed as part of the EU H2020 Origin project[1] to validate dose delivery and optimise low dose rate (LDR) brachytherapy delivery.[2]

Methods

Dosimetric data from post-implant CTs were obtained for 611 men treated with LDR prostate brachytherapy 2009-2020 at the Northern Ireland Cancer Centre. Sectors were created by dividing the prostate into three equal thirds (base/midgland/apex), then each third into four axial sectors. Axial division was performed by two separate methods; plus-shape ("+") and cross-shape ("x").[3,4]

The dose to 90% of each sector (D90%) was compared to the D90% of the global prostate gland for each method.

Results

Compared to the median global D90% of 108% (interquartile range (IQR) 102-114%), the median D90% of the anterior right base was lowest (86%, IQR 77-95%) and the anterior left base was second lowest (96%, IQR 84-110%) using the plus-shaped sector division (Fig. 1), with the D90% < global D90% in 91% and 76% of cases respectively (Fig. 2).

Using the cross-shaped sector division, the median D90% of the anterior and left base were lowest at 86% (IQR 77-96%) and 96% (IQR 86-106%) respectively (Fig. 1) with the D90% < global D90% in 92% and 77% of cases respectively (Fig. 2).

The posterior right and left mid-gland sectors had the highest median D90% at 142% and 140% (IQR 130-154% and 128-153% respectively) using the plus-shaped sector division (Fig. 1), with the D90% > the global D90% in 96% of cases for both sectors (Fig. 2).

Using the cross-shaped sector division, the right and posterior mid-gland sectors received the highest median dose at 142% (IQR 131-154% and 128-155% respectively) (Fig. 1), with the D90% > global D90% in 97% and 96% of cases respectively (Fig. 2).

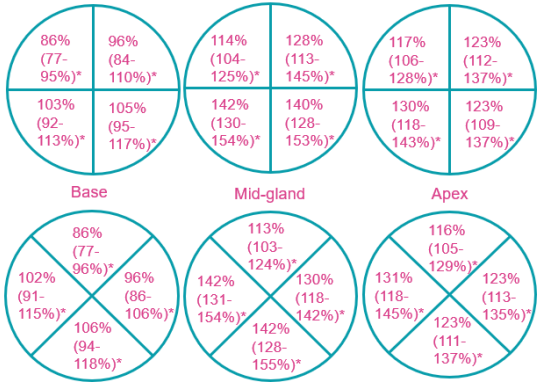

Fig. 1. Median (IQR) D90% to each prostate sector. * P < 0.05

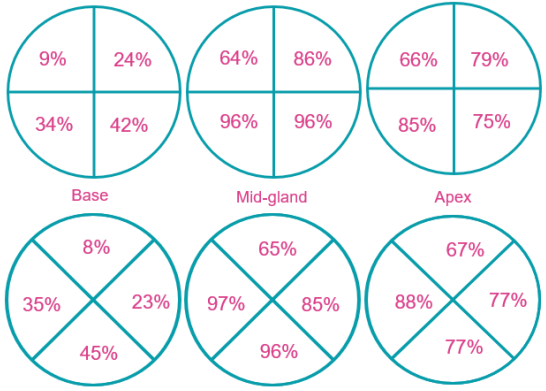

Fig. 2. Percentage of patients for which the D90% to prostate sector exceeded the global D90%.

Conclusions

The median D90% was lowest for the anterior base sectors and highest for the posterior mid-gland sectors with a significant percentage of the D90% of these sectors < or > global D90% respectively.

Lower dose at the anterior base is particularly relevant if the dominant intraprostatic lesion is located in this region. Increased dose in the posterior mid-gland may contribute to increased rectal toxicity. Overlapping sectors with the highest differences of D90% from global D90% are appropriate locations for in-vivo dosimeters to monitor radiation dose.

References

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