

CTV delineation for rectal cancer treatment: Ambiguities defined by a national review project

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Objective

Within a national quality assurance project, we previously showed central review improved clinical target volume (CTV) delineation for rectal cancer radiotherapy. However, 909 of the 1224 (74.2%) centrally reviewed CTVs needed modifications despite the availability of delineation guidelines (*Roels et al, IJROBP 2006*). This observation may point to an inaccurate description of the anatomic boundaries in the delineation guidelines. As a first step to clarify these guidelines, we quantified the modifications and identified the rectal CTV subregions at risk for divergent delineation.

Material and Methods

With in-house developed software, 3D surface distance analysis was performed on 896 cases that were modified in the review project (13 could not be analyzed due to technical problems). The surface of the original and modified CTV was sampled with around 10000 equally distributed dots. The 3D CTV was divided into eight subregions: the upper and lower border, high anterior, low anterior and posterior regions, high lateral region, the ischiorectal fossa, the high lateral part (including the iliac vessels) and the obturator region. For each subregion the maximum normal distance between the original and the modified CTV was calculated. Fischer's exact testing was used to assess differences by gender.

Results

The highest proportions of modifications were seen at the high anterior border and at the high lateral part of the CTV (59.9% and 60.7% respectively). The obturator region and posterior border were modified in only 27.8% and 27.6% of the cases respectively. Mean modifications (\pm SD) were largest at the ischiorectal fossa, the lower border, the high anterior border and the upper border of the CTV (12.5mm (\pm 6.9), 11.9mm (\pm 8.1), 10.6mm (\pm 5.8) and 10.1mm (\pm 7.5), respectively). Stratification by gender showed significantly more modifications at the obturator region in males compared to females (30.2% vs. 22.8%, $p=0.03$).

Conclusion

Our results highlight ambiguities in current delineation guidelines and stress the need for their further improvement. More accurate delineation guidelines for the upper border and for the high anterior and high lateral regions will help to decrease the dose to the small bowel. The largest modifications at the ischiorectal fossa illustrate the lack of consensus on inclusion of this region in the CTV. The difference in anatomy in the lower pelvis between males and females (e.g. narrow male pelvis, presence of seminal vesicles) might be the reason for the higher uncertainties in the obturator region.

Table 1: Proportion and extent of modifications per subregion

Subregion	Number of modifications (%)	Mean (SD) (mm)	Min (mm)	Max (mm)	10-90 percentile (mm)
Upper border	372/896 (41.5)	10.1 (7.5)	2.0	68.0	3.0-18.6
Lower border	355/896 (39.6)	11.9 (8.1)	2.0	48.0	3.0-22.0
High anterior region	537/896 (59.9)	10.6 (5.8)	2.0	41.5	4.4-18.8
Low anterior region	398/896 (44.4)	6.9 (4.3)	1.8	26.7	2.9-12.3
Posterior region	247/896 (27.6)	6.2 (3.2)	1.8	19.0	2.9-10.9
High lateral region	544/896 (60.7)	8.2 (4.3)	2.0	77.7	4.4-12.2
Ischiorectal fossa	420/896 (46.9)	12.5 (6.9)	1.9	38.7	4.6-21.5
Obturator region	249/896 (27.8)	6.0 (2.4)	2.0	16.3	3.3-8.6

SD=standard deviation