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Rectal cancer guidelines

Do refined consensus guidelines improve the uniformity of clinical target volume delineation for rectal cancer? Results of a national review project

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ABSTRACT

In a previous national central review project, 74% of the rectal cancer clinical target volumes (CTVs) needed a modification. In a follow-up initiative, we evaluated whether the use of refined international consensus guidelines improves the uniformity of CTV delineation in clinical practice.
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The multidisciplinary management of rectal cancer has drastically improved outcome and many patients have become long-term survivors [1–8]. Nowadays, efforts are made to increase the quality of life and to minimize the treatment-related toxicity of rectal cancer patients. Highly conformal radiotherapy techniques such as intensity modulated radiotherapy (IMRT) and volumetric modulated arc therapy (VMAT) have shown to effectively reduce the radiation dose to the small bowel, resulting in less gastrointestinal toxicity [9]. The steep dose gradients of IMRT and VMAT mandate an accurate delineation of the clinical target volume (CTV) to ensure maximal tumor control with minimal normal tissue toxicity. However, a high interobserver variability in CTV delineation for rectal cancer exists [10–12]. Within a national project, we previously demonstrated that central review increased the uniformity in rectal cancer CTV delineation [12]. Despite the availability of delineation guidelines, a modification was suggested for 909 of the 1224 (74%) reviewed cases [12,13]. This observation indicates that the interpretation of delineation guidelines is not straightforward and guidelines need to be further refined.

Recently, experts from the European Society of Radiotherapy & Oncology (ESTRO), the American Society for Radiation Oncology (ASTRO), the Trans Tasman Radiation Oncology Group (TROG) and the European Organization for Research and Treatment of Cancer (EORTC), joined forces to develop international consensus guidelines for rectal cancer CTV delineation [14]. These guidelines precisely describe the anatomical boundaries of each CTV subsite and provide a clear overview of the indications when to include a specific CTV subsite.

The aim of the current study was to investigate whether refined consensus guidelines improve the quality of CTV delineation for rectal cancer in daily practice.

Materials and methods

Patient population and study design

CTV delineations were retrieved from an earlier national review project, which ran between March 2010 and September 2012.

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Details on the study set-up have been published before [12]. In brief, CTVs were delineated according to the delineation guidelines of Roels et al. [13]. They were centrally reviewed and feedback was given to the individual centers within 24 h. If necessary, the modified CTV was sent back to the center. Modifications were explained by e-mail. Twenty of the 25 Belgian radiotherapy centers participated and uploaded 1255 rectal cancer CTVs onto a secured server. Thirty-one cases were excluded because of lacking central review ($n = 25$) or inguinal irradiation ($n = 6$), leading to a total of 1224 CTVs delineated by 20 centers.

A follow-up project with a similar study design was conducted from June 2015 until December 2015. All centers that participated in the first project, were invited at a training meeting in which refined international consensus delineation guidelines were presented [14]. A single observer centrally reviewed the uploaded CTVs within 24 h and, as in the previous study, feedback was provided by e-mail if modifications were needed according to the updated guidelines. Seventeen centers participated and delineated 175 CTVs according to the refined consensus delineation guidelines. CTVs of centers uploading less than five patients were excluded, leading to a total of 165 CTVs delineated by 14 centers.

To compare the modifications between both projects, only CTVs from centers that participated in both projects were retained, leading to a total of 1151 CTVs from 14 centers.

Analysis of CTV modifications

The modifications that were suggested in the review projects were identified and quantified with 3D-surface distance analysis. Using in-house developed software, the stack of CTV contours as delineated on consecutive slices of the planning computed tomography scan (before and after modification) was converted into a 3D-surface mesh. The meshes were sampled at around 1000 equally distributed points and the 3D-surface distance was calculated as the Euclidean distance between the closest point on the original and the modified CTV mesh. This was represented on the reviewed CTV surface by a color scale (Supplementary Fig. 1). A single observer divided the CTV surfaces into eight subregions: the cranial (CrB) and caudal border (CaB), the high anterior region (above the femoral heads) (HAR), the low anterior region (below the femoral heads) (LAR), the posterior region (PR), the ischiorectal fossa (IRF), the high lateral region (including the external iliac vessels) (HLR) and the obturator region (ObR). The maximal distance between the original and the modified CTV was determined for each subregion.

Statistical analysis

To study the extent of modifications, descriptive statistics were applied to the CTVs in which at least one modification was suggested. Univariate and multivariate logistic regression models were used to evaluate the relation between "old" versus "new" guidelines and the proportion of delineations that were compliant with the guidelines per subregion, adjusted for other potential confounding factors that we disposed of (i.e. gender, tumor location, T-stage, N-stage, patient ranking and center volume). All tests were 2-sided, and p-values below 0.05 were considered statistically significant. Statistical analyses were performed using SAS software package version 9.3 (SAS institute, Cary, NC).

Results

Proportion and extent of modifications per subregion

Delineations were assessed in 986 CTVs from the original review project and in 165 CTVs from the follow-up project, leading to a total of 1151 analyzed CTVs. Modifications were more frequently suggested in the original project than in the follow-up project (698/986 (71%) vs. 88/165 (53%) respectively). For each subregion, less modifications were suggested when the refined consensus guidelines were used (Fig. 1).

In both projects, modifications were most frequently suggested at the high anterior and the high lateral regions, while less modifications were needed for the cranial and caudal border and for the posterior and the obturator region.

The extent of the modifications per subregion can be found in Supplementary Table 1. For all subregions, modifications were smaller in the follow-up project. In both projects, the caudal border, the high anterior region and the ischiorectal fossa needed largest modifications (maximal modification 48 mm and 27 mm, 42 mm and 26 mm, 39 mm and 31 mm, respectively). Adaptations to the ischiorectal fossa were frequent reductions, while

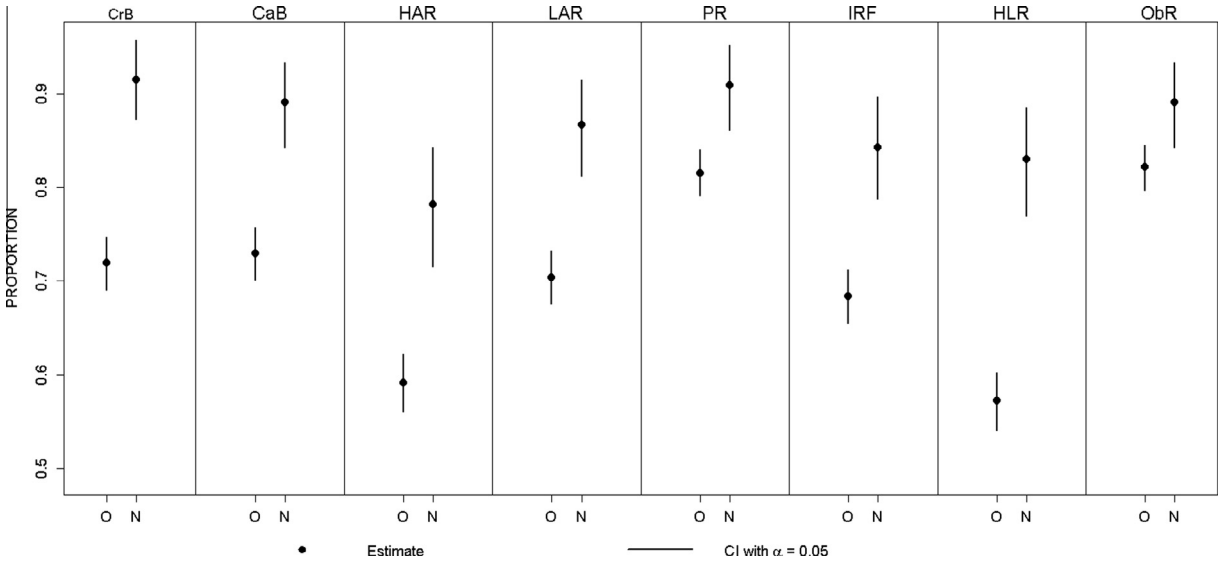

Fig. 1. Proportion of delineations that were compliant with the guidelines per subregion, before (O) and after (N) the use of refined consensus guidelines. Data are presented as estimates and confidence intervals. Abbreviations: CaB = caudal border; CrB = cranial border; HAR = high anterior region; HLR = high lateral region; IRF = ischiorectal fossa; LAR = low anterior region; N = new; O = old; ObR = obturator region; PR = posterior region.