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Beam arrangement in 3D conformal radiotherapy for localized prostate cancer

KEYWORDS: Prostatic Neoplasms; Radiotherapy Dosage; Radiotherapy, Conformal

INTRODUCTION

With completion of equipment, immobilization devices, and the chain in the process of planning and delivery of 3D Conformal Radiotherapy (3D CRT), together with existing 2D radiotherapy, on the Radiotherapy Department of Military Medical Academy there was a need to choose a propriety standard way to treat the patients with localized prostate cancer.
There is a consensus that 3D CRT is standard therapy for T1-T3N0M0 prostate cancer with doses higher than in pelvic irradiation used before in 2D technique.
However there are differences in number of fields, beam arrangements and grade of escalating of dose in different Radiotherapy Centers. It is used three, four, six and more beam techniques with different beam angles and the doses are in range from 70 to 80 Gy.

MATERIAL AND METHODS

In addition to choose our standard modality for treat that patients we, in the beginning of 2002, evaluated on the treatment planning system (PrecisePlan, Elekta) conformal plans on demonstration patient and first ten patients with three and four fields using Dose Volume Histograms (DVH) for planning target volume (PTV), rectum and bladder (Figure1A,B).

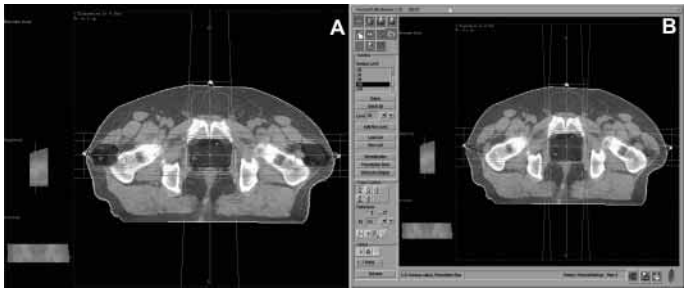

Figure 1. A) Three-field plan, B) Four-field plan

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Prescribed dose was 70 Gy in 35 fractions. Used energy was 10MV. Beams are created with multileaf collimators without wedges.
Delineation of volumes is made according the ICRU-50 conclusions. Margins (PTV) around the prostate (CTV) are 10mm in all directions except posterior wall in front the rectum where was 6mm. We follow the RTOG P-1026 definition of rectum, which is solid organ from anus (level of ischial tuberosities) for a length of 15 cm or to the rectosigmoid flexure (average 86.9 cm, in our case).The margins for rectum was generated on outer wall shown on CT slices. The range of delineated rectal volumes was from 53 to 87ccm and for PTV from 96 to136ccm.

RESULTS

In comparing the two common beam arrangements: three-field plans (gentry angles of 0˚, 90˚, 270˚) and four-field "box configuration" (0˚, 90˚,180˚, 270˚) the greatest rectal sparing was achieved by a three-field plan (43.4±13.1 Gy vs. 50.9±14.0 Gy). It is 20% more average dose on rectum volume by using four-field technique.
As we except Average Dose in PTV is little beat higher in 4F-box: 72.2±1.8 Gy vs. 70.4±1.6 Gy. In both case coverage of the PTV fall between -5 and +7% of the prescribed dose (70 Gy).There is no clinical difference in covering the PTV between two plans (Figure 2 A,B).

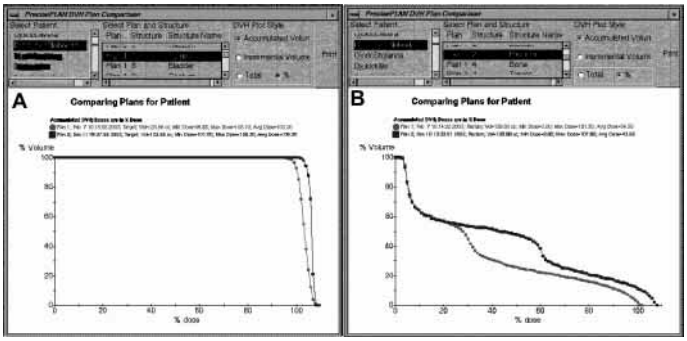

Figure 2. A) DVH for PTV, B) DVH for rectum

Evaluation of DVH for bladder showed difference less than 5% comparing three and four fields plans.
The percentage of rectum volume receiving certain part of prescribed dose is another important parameter for late toxicity besides the values of dose only (V50-V70). Retrospective analysis on 60 realized 3D conformal treatment plans confirmed the results of comparison done in the time on introduction of this therapy and follow up for rectal toxicity found most of the patients without symptoms and only three with toxicity grades 1-2.

CONCLUSION

The rectal complications during the radiotherapy of prostate cancer are of the greatest importance, and the fact that use of one more field is time consuming we decided and since than treated all our prostate cancer patients with three field technique without any serious complications during follow-up period.

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