A treatment planning study comparing volumetric arc modulation with RapidArc and fixed field IMRT for cervix uteri radiotherapy.

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Introduction

A treatment planning study was performed to evaluate the performance of the novel RapidArc (RA), volumetric modulated single arc radiotherapy on cervix uteri cancer patients. Conventional fixed field IMRT was used as benchmark.

Material and Methods

CT datasets of 8 patients were included in the study. Plans were optimised with the aim to assess organs at risk and healthy tissue sparing while enforcing highly conformal target coverage. Planning objectives for PTV were: maximum significant dose lower than 52.5 Gy and minimum significant dose higher than 47.5 Gy. For rectum, bladder and small bower the median and maximum doses were constrained to be lower than 30 (35 and 25) Gy and 47.5 Gy, additional objectives were set on various volume thresholds. Plans were evaluated on parameters derived from dose volume histogram and on NTCP estimates. Peripheral dose at 5, 10 and 15 cm from the PTV surface was recorded to assess low level dose bath. MU and delivery time were scored to measure expected treatment efficiency.

Results

Both RapidArc and IMRT resulted in equivalent target coverage but RapidArc had an improved homogeneity (D5%-D95%= 3.5±0.6 Gy and 4.3±0.8 Gy respectively) and conformity index (CI90%=1.30±0.06 and 1.41±0.15). On rectum the mean dose was reduced by about 6 Gy (10 for the rectum fraction not included in the PTV). Similar trends were observed for the various Dx parameters with reductions ranging from ~3 to 14.4 Gy. For bladder, RapidArc allowed a reduction of mean dose ranging from ~4 to 6 Gy and a reduction from ~3 to 9 Gy w.r.t. IMRT for the various Dx. Similar trend but with smaller absolute difference was observed for small bowel and femurs. NTCP calculations on bladder and rectum confirmed the DVH data with a potential relative reduction ranging from 30 to 70% from IMRT to RapidArc. The Healthy tissue was significantly less irradiated in the medium to high dose regions (from 20 to 30 Gy) and the integral dose reduction with RapidArc was about 12% compared to IMRT. Concerning peripheral dose, the relative difference between IMRT and RapidArc was of 9±2%, 43±11% and 36±5% at 5, 10 and 15 cm from the PTV surface respectively. The MU/Gy from RapidArc were 245±17 corresponding to an expected average beam on time of 73±10 seconds per fractions of 2 Gy. IMRT plans presented higher values with an average of MU/Gy=479±63.

Discussion

RapidArc was investigated for cervix uteri cancer and lead, to statistically highly significant improvements in organs at risk and healthy tissue sparing with uncompromised target coverage leading to improved conformal avoidance of treatments w.r.t. conventional IMRT. This, in combination with the confirmed short delivery time, can lead to clinically significant advances in the management of this highly aggressive cancer type. Clinical protocols are now advised to evaluate prospectively the potential benefit observed at planning level.

References

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