Isocentre shift during radiotherapy to the prostate in overweight and obese patients

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Abstract

Background: The ability to escalate the dose to the prostate without causing normal tissue complications (e.g., rectal bleeding) may be compromised by a variety of geometric uncertainties including true target definition, inter- and intrafractional patient motion, and daily setup error. Organ motion and patient setup variation are two major concerns during radiation delivery for prostate cancer because they lead to shift of the target from its reference frame in the treatment-planning CT. Depending on the treatment margins, uncorrected target shifts may lead to under-dosage of the prostate, thus decreasing local tumor control, or over-dosage the rectum, thus increasing rectal complications.

Understanding the interfractional target shifts due to interfractional target motion and daily setup error and their management becomes a critical issue for prostate cancer radiotherapy. Image-guided radiotherapy is used for correcting interfractional organ shifts before radiation delivery with image guidance.

Purpose: To confirm the accuracy of the location of the skin markings in relation to the actual isocentre of the irradiated volume in overweight and obese patients.

Materials/Methods: In this study, radio-opaque markers are placed on the patient's anterior and lateral skin marks to define the central axis plane of the prostate gland; the planning isocenter can be triangulated from the three positions. CT studies of 10 high risk locally advanced prostate cancer patients are transferred to planning system. The target volume, rectum, and bladder are contoured. Whole pelvis irradiation is carried out using box technique. The dose of whole pelvis irradiation was 45Gy in 25 fractions to the isocenter. Then after its delivery the patient is prepared for the CT scan of the boost dose delivery. The dose of 10Gy in 5 fractions to the prostate and seminal vesicle was prescribed also to the isocenter which is placed at the center of the prostate. Then 2400 cGy are delivered in 12 fractions to the prostate (CTV). The patient is set up in the treatment position, and the radio-opaque markers are again placed on the anterior and lateral skin marks that are assumed to best define the axial plane of the prostate gland containing the planning isocenter. Then the distance between the initial planning isocenter and the boost isocenter (target shift) is calculated for three axes. All patients gave informed consent that we can study their computerized plan and do research on it.

Statistical analysis: The isocentre position was listed for each patient in the three axes for whole pelvis plan and the boost plan. Then target shift between the two isocentres in the x, y and z directions for all patients was calculated and listed. The minimum, maximum and average shift for each patient were calculated using excel sheet**.** To check if there is any correlation between target shifts in x & z axes and body weight a simple correlation test was done. The R-value is taken as an indicator for the correlation. A *P* value of less than 0.05 is taken to indicate whether the correlation is significant or not.

Results: 10 patients included in this study, their weight ranges from 88-130 kg (the average is 101.7 before whole pelvis treatment and 104.8 kg before boost). The calculated minimum shift was -2.33 cm & -0.93 cm, the maximum shift was 2.77 cm & 1.05 cm and the average was -0.31 cm & 0.39 cm in lateral direction (x) and superior inferior direction (z) respectively. So the minimum and maximum shifts in x axis are larger than that for z axis. There was a weak positive correlation between target shift and body weight in x axis (R value= 0.39) but this correlation was not statistically significant (P=0.15). On the other hand there was not any correlation between target shift and body weight in z axis (R value= 0.009).

Conclusion: Correction of the target shift is mandatory with 3DCRT in overweight and obese patients using IGRT otherwise a generous non-uniform treatment margin is required in the

lateral direction compared to that commonly used. This may result in either local control failure or high dose to the rectum with sever rectal complications.