Acute rectal toxicity: 3-Field versus 4-Field radiation treatment technique for prostate carcinoma

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Abstract
Radical radiotherapy is a common treatment for prostate carcinoma. Acute toxicity to the rectum, which lies posterior to the prostate, is dependant upon the field arrangement, dose delivered and volume of rectum that lies within the target volume. Due to technical limitations of their equipment, two different oncology centers in Durban are currently using two different treatment techniques. One uses the 3-field technique which avoids direct irradiation of the rectum, and the other uses the 4-field technique which involves direct irradiation of the rectum.

A prospective, convenience-sampling study was conducted to determine the degree of acute toxicity for these two radiation treatment techniques. Sixty participants with histologically confirmed stage B or C prostate carcinoma were recruited from two private oncology centers in Durban. Thirty participants were treated with the 3-field technique and the other 30 with the 4-field technique. All participants were treated with a daily dose of 2.00Gy up to a total dose of 60.00Gy. Weekly acute rectal toxicity was assessed using the RTOG/EORTC grading criteria.

Grade 1 toxicity was the highest in week 6 (26.7%) for the 3-field technique and in week 3 (23.3%) for the 4-field technique, grade 2 in week 6 (16.7%) for the 3-field and in week 3 (6.7%) for the 4-field technique, whereas grade 3 toxicity was constant in weeks 2-5 (3.35) for the 3-field technique and highest in week 4 (16.7%) for the 4-field technique. No participants experienced grade 4 acute rectal toxicity. A statistically significant difference exists between the techniques which was exhibited in week 2 (p=0.0002). Participants treated with the 3-field technique experienced less severe acute rectal toxicity than those treated with the 4-field technique.

Keywords: Prostate carcinoma, radical radiotherapy, acute rectal toxicity.

Introduction
Prostate cancer causes a substantial public health burden worldwide. Carcinoma of the prostate develops in approximately 300 000 males each year worldwide. It is a unique disease in that it exhibits late clinical signs and symptom, which has consequently resulted in the need for histologic and biochemical methods of detection of the disease in its early stages [1,2].

According to the National Cancer Institute (NCI) of South Africa (SA) [2], 2621 new cases were reported to the NCI between 1993-1995. One in 31 South African males has a lifetime risk of developing the disease given the prevailing incidence of 58.7 per 100000 and 13 per 100000 for White and Black males respectively (Figure 1) whereas the incidence for Colored males and Asian males is comparatively lower [2].

Methodology
This includes sample size, inclusion and exclusion criteria and ethical considerations pertaining to research.

Sample size and selection
The sample consisted of 60 participants in total. Participants from two private practice oncology departments were selected using the convenience method of sampling. Groups A and B consisted of 30 participants each. Those in group A received treatment using the 3-Field technique whereas those in group B received treatment using the 4-Field technique (Figure 3). The 3-Field technique encompasses two fields directed laterally at the pelvis with the third field directed from the anterior aspect of the patient. The 4-Field technique encompasses two fields directed laterally at the pelvis, one field directed from the anterior of the patient and one field directed from the posterior aspect of the patient.

Inclusion and exclusion criteria
All participants had to have been diagnosed with histologically confirmed stage B or C prostate cancer. The histology specimen was obtained using transurethral resection of the prostate or, transrectal or transurethral biopsy of the prostate gland. Some of the participants were on hormonal therapy but this was not an exclusion criterion. Compulsory investigations prior to being selected for the study included computed tomography (CT) of the pelvis for diagnostic, staging, planning and monitoring purposes. All participants had...
prostate specific antigen tests prior to and during the treatment for monitoring purposes.

Potential participants with hip replacements were not included in the study since these participants required alternative field arrangements in order to compensate for the metal prostheses.

Ethical considerations
The study procedure was verbally discussed with each participant. A written version of the verbal explanation was handed to each potential participant to read at home. Signed informed consent was thereafter obtained from each participant. Ethical approval to conduct the study was obtained from the Durban Institute of Technology, the hospital managers and the heads of departments of the two private practices.

Planning and treatment
After the oncologist assessed the participant and the relevant investigations were completed, the radiation treatment plan was generated. Following this the participant was simulated and field markings marked on the treatment area. Radiation therapy then commenced with the radiation treatment plan generated for each participant. The size, shape and the configuration of any tumor is unique therefore custom planning is done to ensure that the field arrangement and size is the most appropriate for that particular tumor. The oncologist selected the most appropriate treatment plan generated for each participant.

Only participants from two private practice oncology centers were included in this study. This was because the other oncology centers in the city use different field arrangements and dose regimes compared to those evaluated in the current study. Although the sample is quite representative of the population, it is not a true reflection of the general population in the Province of KwaZulu-Natal. Bias with respect to race and consequently diet, occupation and socio-economic factors may have been introduced into the study.

Conclusion
The 4-Field technique exhibited more severe acute rectal toxicity than the 3-Field technique in participants evaluated in this study. The implications of such a finding impacts on the choice of field arrangement that is more ideal in terms of decreased acute rectal toxicity. Future studies need to be conducted on a more general population rather than a restricted one.
Long-term follow-up is required to evaluate the differences between the two techniques used in the current study in terms of chronic rectal toxicity and disease free survival.

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