The LNCaP cells showed no expression of estrogen receptor α, but they did express estrogen receptor β.

Interestingly, we found a marked hypersensitivity to low doses of radiation (0,5 1 Gy) after incubating the LNCaP and PC-3 cells with different doses of the above mentioned hormones. In contrast, the control (irradiation only) followed a linear-quadratic survival curve.

The cell cycle distribution of the cells did not seem to have a major impact on clonogenic cell survival. While incubation with estrogens and phytoestrogens decreased the portion of cells in G1, low radiation doses (0,5 Gy) increased G1 arrest regardless of prior hormon-incubation. This effect could not be demonstrated with high radiation doses (4 Gy).

These *in vitro* results suggest that estrogns and phytoestrogens may induce a hypersensitivity to low radiation doses in these tumour cells. Further investigations focus on the underlying mechanisms, and experiments are currently being repeated *in vivo* using a xenograft model. If these results could also be achieved *in vivo*, this may have important clinical implications.

890 POSTER

Acute small bowel and colon toxicity after pelvic IMRT for prostate cancer

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Background: The theoretical advantage of intensity modulated radiotherapy (IMRT) in treating the pelvic nodes (PN) while sparing small bowel and colon has been reported by others (Nutting et al, IJROBP 2000). Here we report acute toxicity rates in 24 consecutive patients treated to date.

Methods: Beginning April 2002, patients with prostate cancer referred to us for definitive radiotherapy and with ≥ 15% risk of PN involvement, were treated as follows: 76 Gy/38 fractions prescribed to the prostate and 54 Gy/30 fxs to the seminal vesicles (SV) and PN. An initial boost to the prostate, delivering 16 Gy/8 fxs was given upfront using a 6-field conformal technique. This was followed by an 8-field coplanar inverse planning IMRT technique delivering an additional 60 Gy at 2 Gy to the prostate and 54 Gy at 1.8 Gy per fraction to the SV and PN. The PN region was delineated on each CT slice taking as landmark the position of major pelvic vessels up to L5-S1. Constraints were set up on the composite dose to the rectum and bladder (V50 and V70) while at least 95% of each target volume (prostate, SV, PN) received the prescription dose. Detailed information on dose distribution to the intestinal cavity (IC) was not available at the time of toxicity scoring. Patients were examined weekly during treatment, and acute toxicity was prospectively scored according to CTC 2.0. The correlation between acute GI toxicity and the absolute amount of IC receiving more than 15, 30, 45, 54, 60 Gy (ABS15&) was investigated. For a given parameter we considered both the maximum toxicity (MT) and the cumulative treatment toxicity (CTT) as the sum of each weekly score. Besides MT (grade 2-3 vs 0-1) and loperamide intake (yes vs no), covariates were categorized by median values and cross-tables were compared with chi-square test.

Results: All patients completed the prescribed treatment. Only one patient had a treatment break (1 week). Small bowel and colon acute toxicity was mild with 4 (17%) patients developing grade 2 diarrhea and 6 patients (25%) requiring loperamide for symptom control. Regarding acute rectal toxicity, 7 pts (29%), 3 pts (12%) and 2 pts (8%) developed grade 2 proctitis, grade 2 rectal bleeding and grade 3 proctalgia, respectively. At all dose intervals but 54 Gy, we recorded a significant correlation between the absolute amount of IC and CTT diarrhea. A trend was found for loperamide. No correlation was found with MT diarrhea and with any rectal toxicity domain.

Conclusions: Treatment of pelvic nodes to 54 Gy at 1.8 Gy per fraction with IMRT as part of definitive treatment to the prostate is clinically feasible with mild small bowel and colon toxicity. For most of dose intervals selected, preliminary data show the presence of a volume/response correlation between the absolute amount of IC and the duration of diarrhea during treatment that, if confirmed, will help to define dose-objectives for IC

891 POSTER

Impact of urethrography in high-precision prostate cancer radiotherapy

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Background: Urethrography is commonly used to localize the prostate apex in radiotherapy planning. Data from imaging studies suggest a negligible systematic error with urethrography, yet fiducial marker studies demonstrate a systematic displacement resulting in inadequate coverage in over 50% of cases. As doses are escalated and margins minimized, previously acceptable motion may no longer be appropriate. We aim to determine if there is a significant systematic error due to urethrography.

Methods: Ten patients with low and intermediate risk prostate cancer, treated with simplified intensity modulated arc therapy (SIMAT), were assessed. Gold seeds were placed at the apex, mid gland and base. Anaesthetic jelly and contrast agent were used during CT-simulation. Setup and organ motion were assessed using fiducial markers via weekly port films and computed tomography. A three-dimensional vector was calculated to assess for centre-of-mass displacement. Margins necessary with and without urethrography motions were calculated based on tumor control probabilities (TCP) and confidence intervals.

Results: The average systematic displacement and standard deviation (in parenthesis) of the prostate from the simulation/urethrography seed location was 0.02cm (0.24), 0.00cm (0.39), and -0.32cm (0.38) in the x, y and z directions, respectively. Urethrography resulted in a three-dimensional cephalad displacement of 0.32cm. A margin less than 6.2mm will result in a 5% reduction in TCP. With urethrography, a 95% confidence interval requires a margin of 1.0cm. Without urethrography, the margin required is 0.6cm. To yield at least a 98% equivalent uniform dose (EUD) for 90% of patients, the planning target volume with urethrography must be 0.87cm.

Conclusion: Using implanted markers and weekly CT scans, we detected a consistent shift of the prostate apex and centre-of-mass cephalad with urethrography. As margins are decreased, alternative methods of localizing the prostate apex should be employed to avoid the possibility of introducing systematic error.

892 POSTER

Partial volume irradiation in 3D conformal radiotherapy for the treatment of prostate adenocarcinoma: a poor man's solution to rectum sparing.

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Background: To evaluate the benefit of a new 3D-CRT technique for the treatment of prostate cancer, with special emphasis on the reduction of the volume of rectum irradiated.

Material and methods: a dosimetric study was carried out in 31 patients with organ confined prostate adenocarcinoma (13) or with postoperative PSA failure (18). PTV was an isotropic expansion of 1 cm from the CTV (prostate ± seminal vesicles). Rectum volume extended 1 cm above and below the PTV. The new 5-field 3D-CRT technique was compared to a standard 4-field CRT.

Study 1, five coplanar, non-coaxial, beams at angles of 0°, 100°, 260° (25 MV), 130° and 230° (6 MV) were used. The two latter beams covered the PTV only partially, with exclusion of the rectum. The weighting of the 5 beams at the isocenter was approximately 100, 100, 100, 15 and 15, respectively. The 100 and 260 beams had a wedge contribution of about 15%.

Study 2: four coplanar beams with gantry angles of 0°, 90°, 180° and 270° were conformed by MLC to the same PTV with a dose weighting to the isocenter of 100, 80, 100 and 80 respectively. 25 MV photon beams were used.

In both studies the plans were optimised to ensure adequate coverage of the PTV by the 95% isodose.

Results. Standard deviation of dose distribution in the PTV was 1.5 and 1.7 for the 4 and the 5 beams technique, respectively. Thus, the 5 beams technique excluding part of the PTV did not degrade the quality of its coverage. The volume of rectum irradiated was reduced at all dose levels. The gain was maximal around the 50% isodose (25% absolute volume reduction), but it was still significant at the 100% isodose (8.5% reduction). The benefit was significant at each isodose level above the 30% isodose ($0.01<p<0.001$). There was no patient in which a benefit could not be demonstrated.

Conclusion: the five 5 beam 3D-technique with partial PTV coverage spares significantly more rectal volume than the standard conformal plan. Insofar as rectum DVH is predictive of rectal tolerance, this technique is expected to significantly reduce rectum morbidity and to allow for dose escalation without resorting to more time-consuming irradiation techniques.