Therapy (IMRT) with a tumor dose of 45–50.4 Gy to the prostate. HDR prostate brachytherapy was performed as an outpatient procedure after a period of four weeks under spinal anesthesia with two fractions two weeks apart. A dose of 10 Gy was delivered to the prostate capsule within a 0–2 mm margin with a 12 Gy delivered to the peripheral zones. The dose to the rectum and urethra was limited as not to exceed 10 and 12 Gy respectively. Dose optimization was achieved using CT image based ABACUS algorithm.
Results: The results showed a substantial decrease in early genitourinary side effects when compared to another group of 326 patients previously treated at this facility with LDR brachytherapy. HDR brachytherapy enabled to deliver conformal dose distribution to the prostate and avoided areas of hot spots close to the bladder and rectum. Patients with large volume prostates could also be adequately treated which was not feasible with LDR brachytherapy. The data for 130 patients (out of 185) treated with HDR brachytherapy and external beam combination was reviewed. On the Urinary Symptom Score (Scale 1–35), 73% of patients reported normalcy, 20% mild, 6.2% moderate, and 0.8% reported severe toxicity. Two patients (1.5%) had reported episodes of rectal bleeding. One patient reported frequent fecal urgency. Preliminary results show excellent biochemical control.
Conclusions: Our experience shows that treatment of prostate cancer using external beam radiation and HDR brachytherapy results in minimal genitourinary side effects and better patient tolerance. Long term follow-up is being conducted to evaluate the outcome of this combination therapy.

820 POSTER

Cone beam CT for daily image-guidance in prostate radiotherapy

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Purpose: The use of highly conformal radiotherapy fields for the treatment of prostate cancer has permitted radiation dose escalation, with improved biochemical relapse-free survival demonstrated. One of the major limitations of conformal radiotherapy techniques (CRT) is the smaller margin of error for treatment set-up and delivery. Daily visualization of prostate position before treatment allows correction of set-up errors and reduction of radiation field margins. At Princess Margaret Hospital megavoltage electronic portal imaging (EPI) of fiducial markers implanted into the prostate is performed as a surrogate of prostate position for daily localization. Kilovoltage cone-beam CT (CBCT) is new technology that acquires 3-dimensional volumetric datasets of the patient at the time of treatment and permits visualization of soft tissue organs. This study compares the two image guidance methods.
Methods: Fifteen patients with prostate cancer received CRT (79.8 Gy in 42 fractions) with daily on-line image guidance using EPI for localization of 3 fiducial markers implanted in the prostate. CBCT images were acquired prior to set-up correction. The CBCT images were retrospectively analyzed for geometric displacement of the prostate gland. Auto segmentation was used for fiducial marker matching and a manual contour alignment tool was used for soft tissue matching (prostate contour) with markers digitally removed. The CBCT predicted shifts based on the soft-tissue and fiducial marker match were compared to the applied shifts of the EPI.
Results: There was high correlation between CBCT and EPI fiducial marker matching in all directions, with R^2 values of 0.95 right-left, 0.84 anterior-posterior, and 0.82 superior-inferior. Correlations for soft-tissue matching were 0.92 right-left, 0.49 anterior-posterior and 0.55 superior-inferior.
Conclusion: CBCT provides accurate 3D localization of prostatic fiducial markers. Greater discrepancies between EPI and soft-tissue matching were observed. This can be attributed to the inherent differences in the characteristics of each guidance system and the difficulties in accounting for rotations and deformations. This study shows that soft-tissue matching of the prostate is feasible with CBCT. CBCT also provides additional information on prostate deformation and volume changes during treatment and this is currently being evaluated.

821 POSTER

Optimized image-guided radiation therapy protocol for the prostate

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Background: Radiation therapy typically relies on a single pre-treatment CT to measure patient anatomy. It is apparent that patients are dynamic systems, however, and can change between fractions and even during a single fraction. In contrast, modern image-guided radiation therapy (IGRT) procedures provide multiple views inside the patient and allow one to consider the statistics of organ motion. The goal of this study was to view the treatment of prostate cancer from such a 4D perspective and to design an appropriate IGRT treatment protocol balancing the need for efficiency and accuracy.
Methods: Ten patients were treated for prostate cancer using CT-based IGRT. The CT-on-rails system allows patients to be scanned on the treatment table immediately before radiation is applied. After scanning, a daily adjustment is calculated to correct for any setup variation or organ motion. The patient is then shifted using the treatment table to offset the calculated adjustment and radiation therapy proceeds as usual. Cumulative data from each of the ten patients was retrospectively analyzed to determine the statistical nature of the IGRT shifts.
Results: An average shift was calculated for each patient over all the shifts recorded during the first treatment phase (typically 25 fractions). This average was then compared to a partial average calculated from a smaller number of sequential shifts. It was shown that averaging the first five shifts predicted the true average to within 3 mm's for most cases, and averaging the first 10 shifts reliably yielded accuracy better than 2 mm's.
Conclusions: Based on these results, we recommend the following protocol. IGRT prostate patients should be scanned before and after treatment for the first five fractions. The average shift calculated from these 10 sample points can then be used to predict the average prostate position for the remaining fractions (if convergence appears likely). Scanning before and after reduces the time required to collect 10 sample points and measures any systematic intra-fraction changes such as those previously reported by us. A single CT scan once weekly can then be used for the remaining fractions to replace port films for setup verification. The total dose from daily CT scans at our clinic has been estimated to be lower than weekly orthogonal port films, and this protocol would further reduce that dose while maintaining reasonable treatment accuracy.

822 POSTER

10 Years follow-up of 665 patients with prostate adenocarcinoma treated with 3 dimensional-CT guided brachytherapy with a pararectal approach

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Background: Prostate brachytherapy is a common treatment option for prostate cancer. Transrectal ultrasound-guided transperineal brachytherapy as a monotherapy is not recommended in patients with large volume prostate glands (>60 cm^3), pubic arch interference, medial lobe hypertrophy protruding in the urinary bladder, prostate calculi, post-transurethral prostate resection (TURP), obesity, penile prosthesis and patients without a rectum due to previously excised colorectal cancer. Aim of the study is to report 10 year treatment results of prostate cancer patients (including the above mentioned subgroups), who underwent brachytherapy using a three-dimensional computer-tomography guided stereotactic system via a pararectal approach.
Material and Methods: 665 patients were treated with brachytherapy for prostate cancer (June 1994 to May 2002). A 3D-stereotactic system, posterior pararectal approach and CT guidance was used for brachytherapy in these patients. The prescribed radiation dose was 120–144 Gy with Iodine 125 seeds in rapid-strand format. The patients' age range was 42–90 years (Mean 67.2, Median 68). Patients were divided into 3 risk profile groups (Low Risk: PSA <10, Gleason <7, Stage $\leqslant$T2a No Mo, n = 172 Patients; Intermediate Risk: PSA 10–20 only or Gleason = 7 only, Stage $\leqslant$T2a No Mo, n = 87 Patients; High Risk: Gleason >7, PSA >20, Stage $\geqslant$T2b, or 2 intermediate Risk Factors, n = 406 Patients). 59 patients had biopsy proven seminal vesical invasion. Prostate Volume Range was 14–180 cm^3 (41% had prostate glands greater than 60 cm^3). Patient follow-up included clinical examination and serum PSA every 3 months the first 2 years, every 6 months up to 5 years and yearly after the 5th year. Median follow-up was 4 years.
Results: Biochemical no evidence of disease was 95% for low risk patients, 94% for intermediate risk and 89% for high risk patients. Disease free survival (DFS) was considered for patients who had no 3 consecutive PSA rises requiring androgen ablation. Median nadir was lower than 0.1 ng/ml. There was a significant difference between patient with low or intermediate risks and patients with high risk, whereas there was no significance in the DFS between the low and intermediate risk patient group (High to intermediate risk p = 0.005, High to low risk p = 0.001, low to intermediate