Bowel function (BF), Bowel bother (BB), Sexual function (SF), and Sexual bother (SB). Patients were required to complete these two questionnaires before (baseline), and 1, 6, and 12 months after treatment. HDR-BT combined with EBRT (24.0 Gy in four fractions of HDR-BT within two days and 36.8 Gy in 16 fractions of EBRT during three weeks) was performed in patients with intermediate and high risk factors, whereas HDR-BT as monotherapy (37.5 Gy in five fractions within 2 days) was performed in patients with low risk factors. The average scores of both SF-36 and UCLA-PCI were calculated at every point to make clear the time-course change and the differences between those at baseline and at 12 moths after treatment were analyzed by paired t-test.
Results: Total number of patients was 165; 5 dropped out and 160 were eligible. Median age was 71 years (range: 49−84). Neoadjuvant hormonal therapy was administered in 94 patients (58.8%) with the median duration of 3 months (range: 1−36). HDR-BT combined with EBRT was performed in 92 patients (57.5%), HDR-BT as monotherapy was performed in 68 patients (42.5%). The average scores in all aspects of SF-36 at 12 months were better than those at baseline. The differences were statistically significant in PF ($p = 0.002$), RP ($p = 0.002$), VT (0.02), SF (0.005), RE (<0.001) and Mental health (<0.001). In UCLA-PCI, UF, UB, BF, and BB showed similar transition as SF-36, but SF and SB showed significant declination. SF and SB scores were 25.0 and 77.8 at baseline and declined to 16.6 and 68.7 at 12 months. Both p-values were <0.001.
Conclusion: HRQoL associated with HDR-BT seemed to be favorable, but it was found out that sexual disorder was not ignorable. Therefore more attention should be paid to sexuality to achieve better patient's HRQoL.

4047 POSTER

Evaluation of the correlation between implant dosimetry and post implant dosimetry using CT and MRI in the treatment of early prostate cancer with ^{125}I permanent seed brachytherapy

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Introduction: The use of permanent seed brachytherapy is established in the treatment of early prostate cancer. Post implant dosimetry is used for dose analysis and as a learning tool to assess the quality of a seed implant. In this study we assess the correlation between real-time dosimetry at time of implantation with CT or MRI based post implant dosimetry.
Methods: Records of all patients treated with ^{125}I brachytherapy at the Royal Free Hospital from April 2002 to November 2006 were analysed. The patients were implanted using the transperineal approach under ultrasound guidance with real-time computer dosimetry. Post-implant dosimetry was performed one month following implantation using MRI and CT. To assess dosimetry of the prostate we collected data for the prostate V100, prostate D90 and prostate V150. For organs at risk the rectal V100 and D30 and urethral D30 were collected.
Results: From April 2002 to November 2006 ninety patients were implanted with ^{125}I seed prostate brachytherapy. In nine patients post implant dosimetry data was not available for analysis. The mean prostate volume implanted was 36.3 cc and median 34 cc (range 13.7−71.14). The mean number of seeds used was 69.8 with a median of 70 (range 47–100) and median number of needles used was 21 (range 16−28). The mean activity implanted was 0.554 mCi and median 0.558 (range 0.458−0.713) and all patients had a prescribed dose of 160 Gy.
At implantation the mean prostate D90 was 196 Gy with a median of 188 Gy (range 145–220). On post implant dosimetry the mean prostate D90 was 180 Gy with a median of 180 Gy (range 113–228 Gy). On post implant dosimetry the prostate V150 mean was 55.8%, median 60% (range 9.4−85.8). At implantation the rectal V100 mean was 0.35 cc with a median of 0.115 cc (range 0−3.023), on post implant dosimetry this was 1.08 cc and 0.94 cc (range 0−6.61) respectively. At implantation the rectal D30 mean was 92 Gy and median 89 Gy on post implant dosimetry this was 68 Gy and 67 Gy respectively.
Conclusions: These results demonstrate that the dose delivered to the prostate is lower when assessed on post implant as compared with real-time dosimetry. However, the rectal doses, V100 and D30, are higher on post implant dosimetry. There is a 4% discrepancy between the D90 measured at the time of implantation as compared with post implant dosimetry. This discrepancy maybe related to seed migration following implantation, differences in image quality and anatomical delineation and organ motion. Operator variability is eliminated in this study as the implantation and subsequent volume definition were carried out by the same clinicians. Therefore, in addition to real-time dosimetry, post implant dosimetry remains an essential component of prostate seed brachytherapy. Our results demonstrate that mean and median doses delivered to the prostate are above the minimum recommended dose and the doses to the organs at risk are acceptable.

4048 POSTER

Distribution of prostate sentinel nodes – a SPECT derived anatomic atlas

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Background: The randomised RTOG 94−13 trial revealed that coverage of the pelvic lymph nodes in high risk prostate cancer confers a bNED advantage in patients with $\geqslant$15% lymph risk of node involvement. In order to facilitate an improved definition of the adjuvant target volume a precise knowledge regarding the localisation of the relevant lymph nodes is necessary. Therefore we generated a three-dimensional sentinel lymph node atlas based on SPECT imaging.
Materials: In 50 patients with prostate cancer a three-dimensional (3D) visualization of the sentinel lymph nodes was performed using a double-headed gamma camera with an integrated X-ray device (Millennium VG & Hawkeye®, GE) after transrectal intraprostatic injection of ~250 MBq ^{99m}Tc-Nanocoll (1.5−3 h p.i.) followed by an anatomic-functional image fusion. Numbers and 3D-localisations of the sentinel lymph nodes were analysed.
Results: A total of 282 sentinel lymph nodes in 49 of 50 patients (98%) were detected with 0 to 16 nodes per patient (median 5.5, mean 5.6). The anatomic distribution of the sentinel nodes (Martinez-Monge) was as following: external iliac 33%, internal iliac 18.1%, common iliac 13.1%, sacral 8.5%, perirectal 5.7%, left paraaortic 5.7%, right paraaortic 4.6%, seminal vesical lymphatic plexus 3.9%, deep inguinal 1.8%, superior rectal 1.8%, perivesical 1.1%, internal pudendal 1.1%, retroaortic 0.4%, inferior rectal 0.7%, superficial inguinal 0.4%, periprostatic 0.4%.
Conclusion: The distribution of sentinel lymph nodes as detected by SPECT imaging correlates well with the distribution determined by intraoperative gamma probe detection. The lower rates of sentinel nodes in close proximity to the bladder and seminal vesicles are probably caused by the radionuclide accumulation in the bladder. In regard to IMRT radiotherapy techniques the presented anatomic atlas may allow optimised target volume definitions.

4049 POSTER

Prospective evaluation of intestinal quality of life in patients with conformal radiation therapy for prostate cancer

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Background: To evaluate intestinal quality of life (QOL) in patients with conformal radiation therapy for prostate cancer.
Materials and Methods: 110 patients were entered into the study. 78 (71%) received definitive CRT at a median dose of 70 Gy to the prostate (64.8−74 Gy) and 32 (29%) were treated with adjuvant CRT after radical prostatectomy at a median dose of 59.4 Gy (55.9−64.8 Gy). Patients were assessed before CRT, at 40 Gy and 60 Gy, as well as 2, 12 and 24 months after CRT. Ano-rectal symptoms and fecal bother were analyzed with standardized questionnaires and QOL was assessed with the EORTC QLQ-C30 and the prostate cancer module PR25. The Friedman test was carried out to detect changes in ano-rectal symptoms and QOL during and after CRT. When significant, the Wilcoxon test was performed to determine the differences to pretreatment values.
Results: The response rate was high with >90% of the patients responding to the questionnaires at the different time points. Stool frequency, defecation pain, mucous discharge and tenesmus increased significantly during CRT but returned to baseline levels within one to two years after radiotherapy. Rectal bleeding, fecal urge and fecal incontinence increased during CRT and stayed significantly above baseline levels during follow-up. Fecal bother and PR25-bowel symptoms deteriorated during CRT and remained inferior to the baseline throughout follow-up. Global QOL and emotional functioning did not change significantly during CRT, however, scores were superior to baseline levels at one and two years after CRT. Role functioning, fatigue, PR25-urologic symptoms and PR25-sexual activity deteriorated significantly during CRT but recovered as soon as 8 weeks after treatment and stayed within baseline levels throughout further follow-up. In multivariate analysis the following variables were associated with lower global QOL values two years after CRT: hormonal therapy for biochemical recurrence ($p = 0.001$), increasing number of concomitant diseases ($p = 0.002$) and a higher fecal incontinence score ($p = 0.017$).

Conclusions: Fecal symptoms and intestinal QOL deteriorated during CRT for prostate cancer while global QOL was not affected. Although a number of ano-rectal symptoms improved after radiotherapy, fecal bother and EORTC PR25-bowel symptoms continued to be inferior to pretreatment values throughout follow-up. Reducing ano-rectal symptoms in CRT for prostate cancer might have a positive impact on QOL.

4050 POSTER

Proton radiotherapy for patients with prostate cancer – in the Hyogo Ion Beam Medical Center (HIBMC) experience

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Background: Proton radiotherapy (PRT) is sophisticated treatment modality for prostate cancer that is increasing in Japan. The purpose of this study is to examine clinical results of prostate cancer treated with PRT.
Materials and Methods: From Apr 2003 to Oct 2004, 291 males aged 48−85 (average 69) with histologically-proven cT1−3N0M0 prostate cancer (1997 UICC TNM) received PRT at the HIBMC. Clinical T stage was classified T1a/T1b/T1c/T2a/T2b/T3a/T3b as 2/3/112/80/38/36/20. Initial prostate specific antigen (PSA) level was distributed 1.2 to 222 (mean 17.8 ng/ml). Patients were stratified into three prognostic risk groups: Group A patients had a T1-T2a, PSA < 20 ng/ml, and the percentage of positive prostate biopsies (PPPB) <50%; Group B: T2b-T3, or 20 ng/ml < PSA < 50 ng/ml, or PPPB < 50%; and Group C: PSA > 50 ng/ml irrespective of T factor. 83 of 170 patients in group A received PRT with neoadjuvant androgen ablation (NAA) for 6 months. 101 of 102 in group B were treated by NAA followed by PRT. All of 19 in group C were treated by NAA, PRT and adjuvant androgen ablation. PRT was planned with a 3D planning system using bilateral 2 fields; patients received 74 GyE (gray equivalent, using a relative biologic equivalence factor of 1.1) of protons (190 to 230 MeV) at 2.0 GyE per fraction. GI and GU toxicity was scored according to the RTOG/EORTC Late Morbidity Grading Scale. Overall survival (OS) and biochemical disease free survival rate (Houston definitions: absolute nadir plus 2 ng/ml dated at the call) were calculated by Kaplan-Meier estimates.
Results: Five patients died from other disease in the follow-up period ranging from 28 to 47 months (median 36 months). Biochemical disease free survival rates/OS rates at 3 years was 92%/98% in all cases and was 98%/99%, 90%/97%, 57%/100%, in the group A, B, C, respectively. According to MSKCC risk criteria, three year biochemical disease free survival rates in favorable (n = 62) /intermediate (n = 106) /unfavorable (n = 117) were 100%/98%/83%, respectively. The GI/GU toxicity rates of grade 2 and grade 3 were 4.1%/4.1% and 0%/0%, respectively.
Conclusions: Our proton radiotherapy showed excellent OS and biochemical disease free survival rates in patients with prostate cancer with minimum late morbidities.

4051 POSTER

Long-term effect of radiotherapy of the healthy prostate on Serum-PSA levels

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Background: Prostate-Specific antigen (PSA) is a 34 kilodalton protease exclusively secreted by the epithelium of the prostatic ducts to lyse seminal vesicular protein. Its concentration in the seminal fluid is about 100x higher than in the blood. PSA concentration in serum (s-PSA) is a common indicator for diagnosis, treatment monitoring, and relapse in prostate cancer. Irradiation of the healthy prostate may impair its exocrine function and consequently impact on serum PSA level. On the other hand, prostate cancer regression due to irradiation also affects s-PSA. PSA kinetics after radiotherapy for prostate cancer is a combined result of both. Surprisingly, scarce data exists on radiation induced s-PSA changes in the absence of prostate cancer. Here we present long-term follow-up data of a previously published study (1) on the effect of pelvic irradiation on s-PSA levels.
Materials and Methods: We examined s-PSA in 33 men (median age 62.9 y) who had undergone pelvic irradiation for rectal and anal cancer. These men had no prostatic diseases. The prostate has been inadvertently irradiated in all patients as confirmed by CT-based treatment plans. 26 patients received conventional radiotherapy with 50.4 Gy/1.8 Gy, and seven patients 25 Gy (5 × 5 Gy fractions). Total (free and bound) s-PSA was measured with an immunoassay using monoclonal anti-PSA antibodies (Elecsys PSA assay, Roche; Diagnostics, Mannheim). Blood samples were drawn before, during, and after radiotherapy in regular intervals. In the meantime 9 patients deceased and 14 patients were lost to follow up. In 10 patients long term data were available with a median follow-up of 7.9 (7.2−8.5) years from study entry.
Results: Serum-PSA levels increase steadily within the first weeks of irradiation, peaking at 2−3 weeks with a lg(PSA) excess of 0.37 ($p < 0.01$), i.e. a 2.3 fold increase. At the end of radiation therapy, PSA levels decrease, but are still slightly elevated. On the long term, serum PSA decrease below the initial level, but this decrease is not significant [lg(PSA) = 0.19, $p = 0.26$].
Conclusions: Irradiation of the healthy prostate causes a significant transient increase of serum PSA levels. In comparison to the elapsed time the accumulated dose is of minor importance. On the long term 7−8 years after radiotherapy s-PSA decreased gradually, but this trend was not significant. This decrease may indicate a radiation-induced glandular insufficiency.

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4052 POSTER

MRI-based preplanning in low-dose-rate prostate brachytherapy

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Background: TRUS-based preplanning is inconvenient and uncomfortable due to the insertion of a probe into the rectum and a catheter into the urethra. If similar results as accurate as those obtained through TRUS-based preplanning could be obtained by MRI-based preplanning, then it would be comfortable and convenient for patients. To compare the dosimetric results between MRI-based and TRUS-based preplanning in permanent prostate brachytherapy, and to estimate the accuracy of MRI-based preplanning by comparing with CT/MRI fusion-based postimplant dosimetry.
Methods & Materials: Twenty-one patients were entered in this prospective study with written informed consent. MRI-based and TRUS-based preplanning was performed. The seed and needle locations were identical according to MRI-based and TRUS-based preplanning. MRI-based and TRUS-based preplanning was compared using DVH-related parameters. This analysis included a comparison of the prostate volume, prostate V100(%), prostate D90(%), urethral D30(%), urethral D5(%), urethral V150(cc), rectal V150(cc), and rectal V100(cc). Following brachytherapy, the accuracy of the MRI-based preplanning was evaluated by comparing it with CT/MRI fusion-based postimplant dosimetry. The group comparisons for the volumes and dosimetric parameters were performed using a t test and a p value of <0.05 was considered statistically significant.
Results: Mean MRI-based prostate volume (19.26±8.15 cc) was slightly underestimated (0.73 cc in mean volume) in comparison to TRUS-based volume (20.00±8.71 cc). There were no significant differences in the mean DVH-related parameters except with rectal V100(cc) between TRUS-based and MRI-based preplanning. Mean rectal V100(cc) was 0.74 cc in TRUS-based and 0.29 cc in MRI-based preplanning, respectively, and the values demonstrated a statistical difference.
The postimplant prostate volumes increased by prostatic edema in comparison to preplanning. Postimplant prostate V100 and D90 were decreased in comparison to the MRI-based preplanning. However, there was no statistical difference in the urethral V150(cc), rectal V150(cc), and rectal V100(cc) values between MRI-based preplanning and CT/MRI fusion-based postimplant dosimetry. The rectal V100(cc) value between MRI-based preplanning and CT/MRI fusion-based postimplant dosimetry showed a correlation.
Conclusion: Prostate volume estimation and DVH-related parameters in MRI-based preplanning were almost identical to TRUS-based preplanning. MRI-based preplanning can more accurately predict postimplant rectal dose than TRUS-based preplanning.

4053 POSTER

Comparison of image guidance by megavoltage computed tomography versus simple bone alignment during radiation of prostate cancer

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Background: Helical tomotherapy delivers intensity-modulated radiation therapy and allows image-guidance based on an integrated megavoltage CT (MVCT). Aim of this study was to evaluate the benefit of this image-guidance versus simple bone alignment in radiation of prostate cancer.
Methods and Materials: 10 patients treated for localized prostate cancer with tomotherapy were included. A total dose of 76 Gy was delivered to prostate (GTV). Before each of the 363 fractions a MVCT was performed and the patient was positioned (shift in *x*/*y*/*z*-direction and roll) to match