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Rectal in-vivo dosimetry in fractionated brachytherapy of cervix cancer with HDR-Fletcher-Applicator (HDR-FA)

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Purpose: In brachytherapy (BT) of cervix carcinoma with HDR-FA, a fractionated dose schedule was derived from the LDR-based Fletcher System by division of LDR-doses into 3 fractions on 3 consecutive days. Since the dose to the rectum is a limiting factor in total dose prescription, in-vivo dosimetry was performed for each session. We tested the accuracy and reliability of rectal in-vivo measurements in fractionated HDR-brachytherapy.

Methods: In 47 patients, rectal doses were measured during 3 insertions/patient by a semiconductor detector with five diodes (Type: AM6, PTW-Freiburg) up to a total of 141 applications. All applications were documented on radiographs. We tried to place the detector in the anterior rectum, with at least one of the diodes' positions close to the applicator. The maximum measured dose/fraction was considered to be the representative rectal dose. We analysed the reproducibility of the measured doses to the rectum by comparing the 3 values for each patient.

Results: Within three consecutive fractions, the measured rectal doses showed deviations up to 61%, with less than 10% in only 45% of the applications.

Deviation [%]	−50	−40	−30	−20	−10	0	+10	+20	+30	+40	+50	>50
Frequency [%]	<1	4.2	7.1	9.2	13.2	23	8.5	8.0	11.0	5.7	4.9	3.5

Conclusion: In fractionated HDR brachytherapy of cervix cancer, the calculation of cumulative rectal doses by a single in-vivo measurement bears the risk of clinically relevant underestimations. In-vivo dosimetry is recommended for each insertion.

319 POSTER DISCUSSION

The use of an immobilisation system in the treatment of prostate cancer with conformal radiotherapy – A prospective randomised trial

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Purpose: To evaluate the impact of a customised immobilisation system on accuracy, treatment times, radiographer convenience, and patient acceptability.

Patients and Methods: 30 men recieving radical radiotherapy for prostate cancer were randomised using a cross over trial design to have radiotherapy planning and treatment given either in a conventional treatment position (CTP) or using an immobilisation system (IMS). The randomisation was to have the CTP or the IMS for the initial 3 weeks of treatment after which patients were replanned and changed to the alternative treatment setup. Treatment accuracy was measured using an electronic portal imaging device. Radiographers and patients completed weekly questionaires.

Results: Median isocenter displacement for anterior fields was 1.70 mm from the simulated isocenter for the CTP compared to 2.06 mm for IMS ($p = 0.07$). For lateral fields values were 1.80 mm and 1.77 mm ($p = 0.98$).

Median treatment time was 9 minutes for CTP, and 10 minutes for IMS ($p < 0.001$).

Ten of the 14 patients who expressed a preference reported IMS to be more comfortable than CTP. Radiographers reported greater difficulty in positioning 23 of the men using the IMS and in 18 there was increased difficulty aligning skin tattoos.

Conclusions: Although the IMS was preferred by patients because of its comfort, the system failed to improve treatment accuracy, took longer and patient set-up was more difficult.

320 POSTER DISCUSSION

Treatment of malignant pericardial effusion with 32P-colloid

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Purpose: Malignant pericardial effusion is usually treated only when signs of cardiac tamponade develop. Several methods of treatment have been reported with an overall response rate of approximately 75%. Since our initial study (Firusian 1980) using intrapericardial 32P-colloid instillation as a treatment modality for pericardial effusion demonstrated a significant higher response rate, this study was conducted to further evaluate the efficacy of intrapericardial 32P-colloid in terms of response rates and duration of remissions.

Methods: The patients treated comprised: breast cancer (23), lung cancer (8), other cancers (5). All patients had multimodal treatment including chemotherapy and external radiotherapy. Prior to 32P-colloid application the pericardial effusion was removed completely. A single dose of 32P-colloid (5 mCi) was administered in 21 patients via an intrapericardial catheter. In 14 patients, two injections of 32P-colloid within two weeks were necessary due to rapid fluid formation.

Results: Intrapericardial instillation of 5–10 mCi 32P-colloid in 36 patients with malignant pericardial effusion resulted in a complete remission rate of 94.5% (34 patients) whereas 2 patients did not respond to treatment due to a foudroyant formation of pericardial fluid. The mean duration time of response was 8 months. No side effects were observed.

Conclusions: These results suggest that intrapericardial instillation of 32P-colloid is a simple, reliable and safe treatment strategy for patients with malignant pericardial effusions. Therefore, since further evidence is provided that 32P-colloid is significantly more effective than external radiation or non-radioactive sclerosing agents, this treatment modality should be considered for the management of pericardial effusion.

321 POSTER DISCUSSION

Stereotactic irradiation of uveal melanoma at a 6 MV-linear accelerator – Technical considerations concerning movement verification by video recording

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Purpose: To investigate a reproducible stereotactic method using non invasive eye fixation techniques of irradiation at a 6 MV-LINAC to treat uveal melanoma.

Method: Modification of the standard fixation mask system (BrainLAB) and direct mounting of a light source at the mask system in front of the healthy eye, allow immobilization of the globe without invasive intervention. Globe movement is controlled during irradiation with a mini-video-camera installed in front of the treated eye. Immobilization of the bulbus is verified by observation and video recording. Video tapes are analyzed by performing image fusion and evaluation of movement range. CT scans are repeated during therapy and compared digitally.

Results: Analysis of video tapes of 20 patients showed a median vertical deviation of the pupil of 0.3 mm (range 0 to 1.2 mm) and median horizontal deviation of 0.2 mm (range 0 to 1.2 mm). The analysis of 20 control CTs showed a median rostral-occipital deviation of 0.78 mm (range 0 to 1.56 mm). The median horizontal deviation was 0.4 mm (range 0 to 2.1 mm).

Conclusion: Stereotactic irradiation of uveal melanoma with a modified stereo-tactic mask system at a LINAC is feasible. Glass fiber light source allows high precise fixation. Standard hard- and software offer movement documentation during treatment and allow interruption if necessary.

322 POSTER DISCUSSION

Comparison of radiation therapy planning for proton- and photon treatment of pediatric Wilms' tumors

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Purpose: We compared Proton Radiation Therapy (PRT) with a standard photon plan in two patients, treated either for microscopic disease or positive resection margins requiring different volume coverage and radiation doses.

Methods: Two patients underwent postnephrectomy PRT for Stage III (favorable histology, age 2 years) and Stage IV (anaplastic histology, age 3 years) Wilms' tumor. Both patients received a dose of 10.8 Cobalt Gray Equivalent (CGE) at 1.8 CGE per fraction to a clinical target volume, followed by a boost dose of 10.8 CGE in the second patient. Posterior and posterior oblique proton fields were utilized and compared with standard anterior-posterior photon approaches using the same 3D planning system. Dose volume histograms were obtained for all target and non-target structures.

Results: The target volumes were encompassed by the 95%-isodose volume with both radiation techniques. Average volumes of all isodoses

(10%–90%) were by 41% (487 ccm) and 29% (747 ccm), respectively, smaller using PRT as compared to the photon plan. PRT was able to restrict liver irradiation to its postero-medial aspects. At the 95% isodose level, only 11% and 6% of liver volume were included with PRT versus 37% and 40% in the photon plan.

Conclusion: Using its unique, physical characteristics of beam stopping PRT to the retroperitoneum can achieve excellent target dose conformity with significant dose reduction of abdominal organs.

323 POSTER

Photodynamic therapy (PDT) in superficial malignomas using visible light and various photosensitizers plus minus hyperthermia

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Purpose: To treat superficial malignomas with PDT plus minus Hyperthermia to overcome hypoxia, especially in pretreated areas using various photosensitizers of the second generation.

Methods: PDT using visible light from a halogen source was applied in 9 patients in up to 5 sessions each. Superficial lesions were mostly basaliomas and chest wall recurrencies after pretreatment with radiotherapy. Photosensizers were Hypericin (Hyp), Delta-Amino-Levulinic Acid (ALA) and Folinic Acid (FA). To overcome hypoxic effects in pretreated areas Hyperthermia was intended adjusting the light source accordingly. The sensitizers were applied topically for ALA and FA and topically or subcutaneous for Hyp.

Results: Remissions were evaluated clinically and by means of our home made photodiagnostic method (presented in another presentation of our working group at this congress). At least partial remissions were achieved in all lesions treated. Hyperthermia up to 44.5 degrees C was observed. Remissions are permanent in lesions down to a depth of 3 mm, in deeper regions PDT as done in the mentioned method is not sufficient.

Conclusion: topical PDT using second gereration photosensitizers like ALA, FA and Hyp and non-coherent light from a halogen source is successful in treatements of superficial lesions such as basaliomas or lenticuli. To overcome hypoxic areas Hyperthermia may be added in heavily pretreated patients. For deeper (than 3 mm) lesions new sensitizers are to be explored.

324 POSTER

Intensity modulated radiotherapy (IMRT) for carcinoma of the thyroid and parotid gland

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Purpose: Using IMRT it is possible to deliver a radical radiation dose to a concave target volume while sparing radiosensitive normal tissues within the concavity. We have applied this technology to tumours in the head and neck region to estimate the potential benefits of IMRT over conventional radiotherapy.

Patients and Methods: Conventional radiotherapy plans were compared to IMRT plans from the CORVUS inverse planning system (NOMOS Corporation) for 4 patients treated for carcinoma of the thyroid and parotid gland.

Results: For patients with thyroid cancer the goal was to deliver 60 Gy to the thyroid bed and upper deep cervical lymph nodes (a concave target volume). The conventional treatment in two phases achieved a minimum target dose of 48 Gy limited by a maximum spinal cord dose of 44 Gy. IMRT could have achieved the goal target dose with a spinal cord dose of less than 30 Gy.

For patients with malignant parotid tumours 60 Gy was delivered to the parotid bed. For conventional treatment the mean dose to the cochlear, contralateral parotid gland, oral cavity and spinal cord were 48 Gy, 2 Gy, 20 Gy, 20 Gy. Using IMRT they were 27 Gy, 2 Gy, 16 Gy, and 20 Gy.

Conclusion: The dose that can be delivered to the thyroid bed and adjacent nodes with conventional radiotherapy is limited by its proximity to the spinal cord. IMRT improved the dose distribution and could allow dose escalation. For parotid gland tumours, IMRT conformally avoids radiosensitive normal tissues which may reduce complication rates.

325 POSTER

Patient diode dosimetry for electron beam treatments: Clinical implementation and dosimetric considerations

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Purpose: To implement a clinical electron diode dosimetry program and quantitatively assess the effect of using diodes on patient prescribed doses.

Methods: A commercial diode dosimetry system was used for dose measurements. Film dosimetry was used to study the magnitude of beam perturbations caused by diodes. Beam profiles at 90% iosdose depths were measured with and without the diode on the beam central-axis for 6–20 MeV electron energies and for electron applicator/insert sizes from a 3 cm circle to a 25 × 25 cone. A total of 809 in-vivo dose measurements were performed on 360 patients treated on our Clinac-2100C/D. Deviations larger than ±6% were investigated and corrective measures were taken, if necessary.

Results: Patient dosimetry revealed the following range of deviations from the prescribed dose: Breast (222 patients, 461 readings) −20.3 to +23.5% (median 0%); Head and Neck (63 patients, 167 readings) −21.5 to +14.8% (median −0.7%); Other sites (75 patients, 181 readings) −17.6 to +18.8% (median +0.5%). Eighty-one measurements (10%) in 69 patients (19%) showed deviations larger than 6%, but in every case the difference was found to be due to diode positioning, which was the most difficult in areas with rapidly changing contours and/or sloping surfaces. In 38% of the head and neck (posterior neck) patients initial dosimetry resulted in false readings compared to breast (15.8%) and other sites (13.3%). The diodes themselves caused beam perturbation and dose reduction, particularly with small fields and low energies. The dose reduction at the depth of 90% isodose along the beam central axis ranged from 16% (for a 6 MeV/3 cm diameter circular field) to 4% (for a 12 MeV/10 × 10 field).

Conclusion: With some caveats, diode dosimetry for electron therapy was found to be valuable for verifying the accuarcy of dose delivery in real-time. Electron diode dosimetry appears unreliable in situations where the surface contours are irregular and action levels must be modified accordingly. Frequent use of diodes on a small field treated by low energy electrons is undesirable because it might result in appreciable underdosage due to perturbation of the isodoses.

326 POSTER

Pulsed dose rate brachytherapy in the treatment of head and neck carcinoma

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Purpose: PDR BT is a new treatment that combines radiobiological advantage of LDR BT with advantages of HDR BT due to the use of stepping source.

Methods: From 6/94 to 2/99, 38 pts. received 41 treatment for head & neck carcinoma. Indications: 1. boost after EBT (12 pts.), 2. primary BT (4), 3. recurrence after prior RT (25). Localisations 1. tongue (14 T2N0; 9 T3N1), 2. floor of the mouth (5 T2N0; 2 T3N0; 1 T3 N2), 3. soft palate (1 T1N0; 4 T2N0), 4. buccal mucosa (2 T2N1; 1 T3N1), 5. maxillary gingiva (2 T2N0). Interstitial plastic tube technique was used for 39 and mould for 2 applications. 2–8 tubes were inserted with 12–20 mm spacing. CTV encompassed GTV with about 10 mm safety margins. 3D-CT planning was done for 37 and 3D-MRI for 5 applications according to the Paris rules. One pulse/hour was given continuously with prescribed dose of mean 0.5 Gy (range 0.4–1.0). The mean treated volume was 21 ccm (11–62). Total dose for boost has been 25 Gy (9–30), 60 Gy for primary BT and 30 Gy (20–60) for recurrences. Follow-up is median 32 mts. (1–57).

Results: BT was tolerated well, no major problems with BT equipment occurred. CR had 27/41 (65.8%) and PR 14/41 (34.2%) pts. 6 weeks after BT. 15/41 (36.5%) developed recurrence (all have received PDR BT for recurrence after prior RT). Side effects: acute (RTOG score): mucositis-grade II 8/41 (19.5%), III 6/41 (14.6%), IV 3/41 (7.3). Late side effects: mucosa-grade II 8/41 (19.5%).

Conclusion: Although the number of patients in our study is small, we can conclude that PDR BT enables good local tumor control for both curative and palliative intention with acceptable side effects.