

one for epidermoid carcinoma in 1991, the other for metastatic disease in January 1995 (in 1988 she had had contralateral breast cancer: T1 N1 as the second cancer). No correlation was found between late effects and electron energy or number of fractions. *In conclusion:* there is no correlation between early and late radiation effects, consequential late effects can give radiation therapists a hint of doses higher than prescribed; a periodic programmed linear accelerator control of energies and doses is mandatory.

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POSTER

NEUTRONS THERAPY FOR INOPERABLE OR RECURRENT PELVIC CHORDOMAS (RESULTS ON 13 PATIENTS)

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Between 1981 and 1994, 13 patients were referred to the Neutron Therapy Department for inoperable or recurrent pelvic chordoma.

Patient recruitment: Among the 13 patients, 3 were females and 10 were males; their mean age was 62 years. Two patients presented with a primary tumour and 11 with a recurrence. Three were referred for palliative treatment after previous surgery and radiation therapy (50 Gy or more). For one of the patients, the neutron treatment was interrupted after 3 fractions of 2 Gy.

Among the 12 patients suitable for evaluation, 10 had previous surgery. They underwent 1 to 5 (mean 1.9) surgical operations. The delay between initial diagnosis and neutron therapy was 46 months (median) and 45 months (average), and the delay between the last surgical operation and neutron therapy was 13 months (median).

Treatment technique: Neutrons were used alone or as boost depending on the tumour volume or treatment purpose:

- 7 patients with large tumours (mean diameter: 16.8 cm) received a photon dose of 40 Gy followed by a neutron boost of 10 to 25 Gy (photon equivalent);

- 5 patients with smaller tumours (mean diameter 8 cm) were treated with neutrons alone; 2 were given 10 Gy in 12 fractions over 21 days with a palliative intention; 3 were given 17.6 Gy in 12 fractions over 28 days with a curative intention.

Results: At three years, the crude survival according to Kaplan-Meier is 61%. The local control probability is 54%. Two patients presented metastatic evolution, but one was cured by surgery. At the time of the evaluation, none of the patients treated with neutrons has grade 3 complications.

Conclusions: Although this series is rather small, it suggests that fast neutron therapy can provide a good alternative for the treatment of inoperable sacral chordomas.

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POSTER

ONDANSETRON ANTIEMETIC PROPHYLAXIS IN PATIENTS UNDERGOING FRACTIONATED RADIOTHERAPY

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Patients (n = 109) given fractionated radiotherapy of the abdomen were studied to compare the antiemetic efficacy of ondansetron (ond) with placebo. The patients recorded daily emesis, nausea and bowel habit and graded weekly symptoms of nausea, vomiting, diarrhea and lack of appetite. The EORTC C30 questionnaire was completed. Sixty-seven percent of patients given ond had complete control of emesis compared with 45% of patients with placebo ($P < 0.05$). (Mean 18 fractions evaluated). Emetic episodes on the worst day was 1.4 for the ond group and 3.2 for the placebo group ($P < 0.01$). Patients given ond had fewer days with emesis and nausea compared with placebo ($P < 0.05$). The mean sum score of patients' weekly grading of symptoms showed that the ond group had less inconvenience than the placebo group ($P < 0.05$). This difference persisted during the first 3 weeks, but not thereafter. Similarly some quality of life measures showed significant differences in favour of the ond group. More patients (n = 13) withdrew due to lack of efficacy in the placebo group (mean 4 fractions) compared with patients (n = 8) in the ond group (mean 10 fractions). We conclude to show marked beneficial prophylactic effect.

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POSTER

LUNG FUNCTION IMPAIRMENT SECONDARY TO LOCOREGIONAL RADIOTHERAPY IN BREAST CANCER

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Radiation effects underlying lung tissue in radiation fields and causes damage. In this study, the secondary damage after radiotherapy in breast carcinoma is evaluated prospectively. In 20 patients with locally advanced breast cancer and received intensive chemotherapy, the pulmonary functions are evaluated by forced expiratory volume at 1 s (FEV1), relaxed vital capacity (VC), force vital capacity (FVC), FEV1/FVC, FEF (25-75) and regional ventilation and perfusion scintigrams are obtained, before and after radiotherapy. Patients followed-up in three month intervals (median 9 months). The reduction in FEV1 and VC was statistically significant ($P < 0.05$) but in FVC, FEV1/FVC and FEF (25-27) we have not found any statistically significant difference by comparing the values measured before and after treatment. Upper, middle and lower zones of treated and untreated lung zones compared after treatment and there was not any statistically significant difference for these values when compared by the before treatment values. As a conclusion we can say that the pulmonary function is affected by radiotherapy but this is not unacceptable. The changes in FEV1 and VC are confirmed restrictive lung disease.

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POSTER

INTERSTITIAL PNEUMONITIS INCIDENCE DURING A FRACTIONATED TOTAL BODY IRRADIATION: RESULTS OF AN ORIGINAL DIGITIZED IMAGE PROCESSING

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Interstitial pneumonitis (IP) is a major toxicity problem after Total Body Irradiation (TBI). The aim of this retrospective study was to evaluate the irradiated lung volumes (ILV) despite shielded blocks to try to correlate the effective ILV with IP incidence. From 1984 to 1994, 146 patients with acute leukemia (AML or ALL) or chronic myeloid leukemia, received TBI prior to Bone Marrow Transplantation (120 Allo, 26 Auto). The IP incidence was 27% in Allo group and 6% in the Auto group. Two groups were comprised: "IP" group (n = 35) versus "non-IP" group (n = 111). The median follow-up was 32 months. It was given a fractionated TBI (12 Gy/3 fractions/3 days) with customized shielded lung blocks in order to reduce the pulmonary dose to 8 Gy. To calculate the ILV, we used an original digitized image processing with 3D mathematical model applied from the portal films. For every patient, each daily portal film was digitized with 3CCD-camera and improved with image processing. ILV and protected lung volumes were determined from the digitized portal films. The 3D calculations was automatically computed from their measurements to calculate the ILV. The median ILV in both groups was 466 cm³. In the "IP" group, the ILV was 484 cm³ versus 407 cm³ in the "non-IP" group ($P = \text{NS}$). The median dose-rate was similar between the two groups (0.045 Gy/min).

Although the difference was not significant, our findings suggest a higher incidence of IP when the ILV increased. This hypothesis needs to be confirmed by a prospective study.

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POSTER

CLINICAL IN VIVO DOSIMETRY USING OPTICAL RADIATION SENSOR FIBERS

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Purpose: As our previously reported basic investigations indicated, optical loss in silica induced by ionizing radiation may be used for dosimetric purposes. We tested a novel optical fiber radiation sensor in clinical settings.

Methods: A lead doped silica fiber (diam ≤ 0.5 mm, L ≈ 0.6 m) was rolled up to a circle (diam ≈ 15 mm). This ring sensor was put on the closed eye lid during orbital irradiation in order to estimate the surface dose (SD) close to the eye lens due to scattered radiation. Patients were treated with bilateral parallel opposed fields (8 MV x-rays, size $\approx 4 \times 4$ cm²) by reason of Graves' disease, uvea metastases and nasopharynx carcinoma.

Results: We were able to determine the SD in all patients in real time. Results are compared with phantom measurements using TLD.

Conclusions: Optical fiber sensors are suitable for clinical *in vivo* dosimetry. They may become a valuable tool in quality assurance, IORT and conformal therapy. Other applications are discussed.

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POSTER

THE ASSISTANCE OF PET AND MRI IN 3-D RADIATION TREATMENT PLANNING FOR PRIMARY BRAIN TUMORS

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MR imaging has been shown to be superior to CT in the treatment planning for malignant brain tumors. However, even with MR after administration of Gd-DTPA it remains often difficult to differentiate between tumor tissue and surrounding normal tissue and edema. Therefore, we evaluated whether the functional metabolic information provided by F-18-FDG-PET would allow for a better delineation of the target volume. In 10 patients with primary brain tumors (2 oligodendrogliomas, 3 anaplastic astrocytomas and 5 glioblastomas) MR imaging with gadolinium contrast and F-18-FDG-PET were performed in radiation treatment position within the same week. Tumors were histologically proven by biopsy in 2 patients and by subtotal resection in 8 cases. A computer program based on an external Z-shaped marker was developed for fusion of the PET and MR images. On corresponding axial slices FDG-uptake was compared to contrast enhancement in T1 weighted images and to signal hyperintensity in T2 weighted MR-images. Based on the combined PET and MRI data three-dimensional treatment planning was performed. Afterwards all patients underwent LINAC radiotherapy. In all cases tumor and surrounding edema were visible as hyperintense lesions in the T2 weighted images, 8/10 tumors showed Gd-contrast enhancement. Nine out of 10 tumors showed hypometabolism compared to normal gray matter, 6/10 tumors hypermetabolism compared to normal white matter. The area of increased uptake correlated in 5/6 cases with Gd-contrast enhancement, only in 1/6 cases the area of increased FDG-uptake was larger than the area of Gd-contrast enhancement. White matter edema was associated with decreased FDG-uptake in all patients. The authors conclude that only in a minority of patients F-18-FDG-PET provides additional information for radiation treatment planning. This is mainly caused by the high intensity of FDG uptake in normal brain tissue. PET may be of greater value in the definition of viable tumor tissue using different tracers, especially amino acids or thymidine.

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POSTER

DIFFERENTIAL EFFECT OF THE CHEMOTHERAPEUTIC AGENT TAXOL ON THE RADIOSENSITIVITY OF NORMAL HUMAN FIBROBLASTS AND HUMAN TUMOUR CELLS IN VITRO

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In order to analyze the radiosensitizing potency of taxol, *in vitro* culture studies were performed using normal human skin fibroblasts and human tumour cell lines derived from squamous cell carcinomas. Dose response curves based on clonogenic assays revealed that a concentration of 5 nM resulted in a significant inhibition of cell growth for both normal and tumour cell lines by 30–80%. When the cells were irradiated with 2 Gy or with increasing doses of ionizing radiation after preincubation of 24, 48 or 72 h with taxol a significant difference in the radiosensitivity of normal skin fibroblasts and human tumour cells was apparent demonstrating a more pronounced radiosensitizing effect on tumour cells, as compared to normal cells. Although taxol has been described to induce a G₂/M-block, ongoing cell cycle analyses revealed that the increment in radiosensitivity of human tumour cells did not necessarily correlate to a possible induction of the G₂/M-block in the cells treated. Thus, it can be concluded that taxol may exert specific radiosensitizing effects on human tumour cells, but not on normal diploid cells. Experiments are in progress to elucidate the specific cell biological and molecular mechanisms of the radiosensitizing effect of taxol on squamous cell carcinoma cells. On the basis of these data strategies for the use of taxol in radiooncology can be developed.

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POSTER

REDUCING THE INCIDENCE RATE OF THORACIC VERTEBRAL METASTASES IN BREAST CARCINOMA

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This is a report on 885 breast cancer patients studied over the period 1972 through 1987. Postoperative telegammatherapy, including the parasternal lymph portals also, is performed. The patients were distributed in two groups according to method of radiation therapy used: (1) Telegammatherapy of regional lymph pool (RPL) through three gamma fields (387), and (2) Telegammatherapy of RLP through a figure field (498). In group one parasternal irradiation was affected until total dose 46 Gy at 4 cm depth was reached. In this fashion the area exposed to radiation therapy (AERT) comprised half of the vertebral bodies of Th₄–8. With the first method total irradiation dose (TID) in the thoracic vertebrae varied in the range 27–19 Gy. In group two parasternal irradiation was effected until total dose 50 Gy. AERT comprised the vertebral bodies of Th₃–10. With the second method TID in the thoracic vertebrae varied in the range 27–20 Gy. A considerable reduction of metastases, developing in two-thirds of the thoracic segment of the spine, as compared to those involving other skeletal locations, is noted as a result of exposure to an exit dose of irradiation of the parasternal lymph portals. The obtained results corroborate the statement that relatively small doses, regardless of the radiotherapy method used, are efficient in terms of micrometastases.

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POSTER

SUBTOTAL BODY IRRADIATION (SBI) IN COMBINED TREATMENT OF ADVANCED CANCER PATIENTS

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SBI has been used as component of systemic antitumor therapy in the management of 187 advanced cancer patients with Hodgkin's disease (76), lung cancer (70), breast cancer (32) and others (9). The patients were treated at the 15 MeV linear accelerator; 1.5 Gy/min with no shielding was employed. Single dose 1–1.5 Gy to total dose 4–6 Gy (lung corrected) was given to the trunk midplane during 7–10 days in Hodgkin's disease patients. Patients showed good immediate results: discontinuance of B-symptoms (fever, night sweats), diminution of lymph nodes, decrease and disappearance of lung involvement. A dose of 1.8 Gy to total dose 19 Gy (N = 11) given every day during 2–3 weeks. There was regression of lung involvement, decrease and disappearance of bone pain, diminution of lymph nodes, regression of hepatic involvement. SBI is an effective method of radiotherapy in chemotherapy-resistant cases.

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POSTER

MRI RADIATION TREATMENT PLANNING OF BRAIN TUMORS

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From November 1993 to July 1994, in a series of 16 patients treated by radiotherapy for brain tumor (9 glioblastomas, 5 low-grade astrocytomas and 2 meningiomas), we evaluated the usefulness of MRI for the definitions of clinical target volumes (CTV) and planning target volumes (PTV).

MRI were performed under the actual conditions of treatment with a thermofixed fixation mask and we used external fiducial markers made of plexiglass squares filled with lipiodol.

The impact of MRI was evaluated by comparison with the standard techniques of simulation and CT dosimetry scans previously performed. Modifications of CTV after MRI were observed in 8 cases and modifications of beam set-up for PTV in 10 cases (1 reduction and 6 augmentations of the size of the beams, 2 modifications of the number of the beams, 1 improvement of blocks). Changes observed were in a range of 1 to 2 cm.

MRI, under the actual conditions of treatment, seems to be a useful tool of optimization for conformal treatment of brain tumors.