1990 we commenced a programme of hyperfractionated accelerated radiation therapy consisting of a twice daily irradiation of 1.5 Gy with 6 h interval, to a total dose of 67.5 in 45 fractions in 4.5 weeks. Since 1992 this was escalated to 75 Gy in 50 fractions in 5 weeks. The aspect of this treatment schedule is to allow an isoeffective dose for late tissues, but an increased effective dose for tumours, compared with "standard" radical treatment. So far 320 patients have been treated and following this experience the later schedule is our current practice for radical treatment. In this report we present our results on the effects of this type of treatment regarding acute and late complications. Control rates of radical treatment of carcinomas at different sites will be the subject of future communication.

152 POSTER

NEW METHODOLOGIC APPROACH FOR IRRADIATION PARAMETERS DETERMINATION IN STEREOTACTIC RADIOSURGERY: PRESENTATION OF AN OPTIMIZATION SOFTWARE

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In stereotactic radiosurgery, a very high dose is delivered in one fraction in a small volume. This volume has often a complex form and only a multi-isocentric technique can generate acceptable dose distribution.

The optimum dose distribution obtention needs a lot of trials and time; so we have established an algorithm allowing the simple and fast calculation of each irradiation parameter. This algorithm includes 4 steps:

1. Definition of the geometric criteria of the volume to treat: length, thickness and height.

2. Definition of the irradiation geometry based on equidistant isocenters and such that the minimum dose point, corresponding to the intersection of the bisectors of the segments joining two consecutive isocenters is inside the geometry: isocenters arrangement on line, triangle, square, or complex.

3. Calculation of each irradiation parameter, based on simple formula and graphs: collimator diameter, number and position of the planes containing the isocenters, number and position of the isocenters per plane.

4. Estimation and test of the dose heterogeneity inside the target volume.

With such an approach, all the dose distribution obtained present a dose gradient outside the target volume superior to 5%dose/mm and a dose heterogeneity inside the target volume inferior to 20%dose.

This algorithm can easily be integrated to any existing dose calculation program for stereotactic radiosurgery.

153 POSTER

POST-OPERATIVE VAGINAL HIGH DOSE RATE BRACHYTHERAPY (HDRB) IN ENDOMETRIAL CARCINOMA: THE EXPERIENCE OF CENTRE FRANCOIS BACLESSE 1990–1995

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Introduction: From October 1990 to May 1995, 82 patients (pts) with localized endometrial carcinoma, all histologic grades, were treated at our institution with combination of surgery and irradiation. In all cases, surgery consisted of hysterectomy and annexectomy. Irradiation consisted of HDRB alone (Gr. I: T1a–T1b, NX, N-, M0, with limited myometrial involvement to the 2/3 internal) or in combination with external beam irradiation (Gr. II: T1a–T2 w/wo nodal, ovarian or seral myometrial involvement).

Methods: ^{192}Ir-HDRB was delivered in 4 weekly fractions of 6.2 Gy (Gr. I) or in 1 fraction of 6.5 Gy (Gr. II), defined at 0.5 cm from vaginal wall, including vagina from 1 cm of the uretral meatus to 0.5 cm above the vaginal scare. Dose delivered was measured *in vivo* using LiF included in mold vaginal template (anterior and posterior wall) and in rectal probe (anterior mucosa). External irradiation delivered 43.2 Gy to the pelvis in 18 fractions and 32 days.

Results: Gr. I included 49 pts of whom none have relapsed. Three minor complications were observed: 2 limited, superficial and transient necroses at 17 and 23 month after treatment, confined to the inferior 1/3 of the vagina, and 1 transient erythema confined to internal thigh, 2 weeks after treatment. Gr. II included 33 pts of whom none developed any rectal complication; 3 died from metastases, 1 died from cause unspecified and 3 developed peritoneal progression.

Conclusion: HDRB appears to have similar efficacy and morbidity than low dose rate branchytherapy. However, patients treated with HDRB are all out-patients.

154 POSTER

ANALYSIS OF A POSSIBLE CANCER TREATMENT BASED ON THE RADIOACTIVE CAPTURE REACTIONS PROVIDED BY SM, GD, I-INCORPORATED RADIOSENSITIZERS

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The boron neutron capture is a nuclear reaction which has been used in a suitable technique for cancer treatment. A radiosensitizer for this technique implies in a common amino acid with a boron atom incorporated. A higher thermal capture cross section than one found for boron-10 makes other special isotopes, such as samarium, gadolinium, or iodine which produces xenonium, good candidates to be also used for cancer therapy. However, in these cases, the radioactive capture (n, γ) is the main reaction. The efficiency of the possible radiosensitizers carrying those elements needs to be evaluated through the dose deposition in the tumor region. A possible cancer treatment based on Sm, Gd, I-incorporated radiosensitizers is debated and compared with BNCT. The dose evaluation on simulated cases has been done. The perspective results on this technic show that low activity sources of neutrons can be satisfactorily used in order to produced a level of dose in the tumor region similar to the conventional radiotherapy however using high activity gamma sources.

155 POSTER

CERVIX CARCINOMA: TREATMENT AND RESULTS

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In 1984 we treated 391 patients with cervix carcinoma of all stages (FIGO: st. I—108, st. II—144, st. III—136 and st. IV 3) using Cathetron (HDR Co-60) for brachytherapy and Linear accelerator (10 MeV) for external beam therapy.

The treatment regimen were:

Cathetron: (a) radical irradiation—4 × 1000 cGy/.A. 1 fraction/week, (b) irradiation after surgery—4 × 750 cGy/0.5 cm, 1 fraction/week. Linear accelerator: (a) radical irradiation—4600 cGy, 22 fractions, 2 opposite fields with central lead shields after 2000 cGy, (b) irradiation after surgery—3600 cGy, 18 fractions, 2 opposite field without central shields. The 5-year survival of patients was: st. I—89/108 (82.4%), st. II—104/144 (72.2%), st. III—55/136 (40.4%), st. IV—0/3 (0.0%) and all stages—248/391 (63.4%).

Late post-irradiation sequelae were: 41/391 (10.5%). Local recurrences were: 35/391 (9.0%). Distant metastases: 6.75%.

156 POSTER

ACCIDENTAL OVER IRRADIATION IN BREAST CANCER PATIENTS

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In the Department of Radiation Therapy Vicenza Hospital, in Italy, where the author was working at the time, in September–October 1989 18 breast cancer patients (pts) were treated with electrons of a linac CGR Saturne 20: 12 after limited surgery (stages T1–2 N0 in 9 and T1–2 in 3 pts) and 6 after radical mastectomy (T2–3 N1–2 in 3 treated with radical mastectomy, 1 pt had inflammatory carcinoma and 2 local recurrence, both 5 years after radical surgery). Median age was 50 years (range 38–65). Because of an ionization chambers breakdown, the electron doses were higher (from 78% to 148%) than proposed (50 Gy/25f and boost of 10 Gy/5f). Twelve/18 pts had 25–30 fractions, 3/18 23–24 f, 2/18 22 f and 1/18 19 f. At the end of radiotherapy erythema was noted as follows (ROTG score): grade 1 in 1 pt, grade 2 in 12, grade 3 in 4 and not indicated in 1. Since no dosimetric control was done during the two months, the total dose for each pt is unknown. A dosimetric control was asked for because of consequential late effects (i.e. worsening or persistence of erythema several weeks after the completion of radiotherapy) in pts treated with electrons. In the same period no abnormal affect was noted with photons (18 MV). Late effects were: skin necrosis requiring plastic surgery in 12/18 (6/12 pts had mastectomy after limited surgery); rib fractures in 11/18; pulmonary fibrosis in 12/18; pericardial or cardiac damage (all had left breast cancer) in 5/18. Until now 2 pts died:

one for epidermoid carcinoma in 1991, the other for metastatic disease in January 1995 (in 1988 she had had controlateral 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.

157 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 (men 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.

158 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 fever 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.

159 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 reducement 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.

160a 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 cm^3. In the "IP" group, the ILV was 484 cm^3 versus 407 cm^3 in the "non-IP" group (P = NS). The median dose-rate was similar between the two groups (0.045 Gy/mn).

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

160b 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 dosimetrical purposes. We tested a novel optical fiber radiation sensor in clinical settings.

Methods: A lead doped silica fiber (diam $\leqslant$ 0.5 mm, L $\approx$, 0.6 m) was rolled up to a circle (diam $\approx$ 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 $\approx 4 \times 4$ cm^2) 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.