

was performed to determine whether Hb is also of prognostic importance in postoperatively irradiated patients.

Methods: Between 1970 and 1990, 486 male patients with UICC '92 stage III or IV (distant metastasis free) SCC of the H&N were irradiated to 60 Gy following radical resection. From this group selected for homogeneity patients were entered into this retrospective study if a pre-radiotherapy Hb value could be obtained ($n = 420$). Local recurrence rates stratified by tumor location, stage and Hb (rounded to integers from 11 to 16) were estimated by the Kaplan Meier method.

Results: Higher Hb levels were consistently associated with better locoregional control. This was highly significant, i.e. by stage (III/IV): oral cavity $p = 0.02$ ($p = 0.0001$), larynx ($n.s./p = 0.0001$), oropharynx ($p = 0.004/p = 0.0001$) and hypopharynx ($p = 0.0002/p = 0.0001$). In a multivariate analysis using a proportional hazards model Hb had more impact than stage, grading or clean margins.

Conclusion: Hb content can be measured effortlessly. Yet it is a most important prognostic factor for local regional tumor control in H&N cancer treated by radiotherapy. The present study shows that this also holds for postoperative irradiation of locally advanced disease.

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POSTER

Image resolution and geometric accuracy of digital reconstructed radiographs (DRR) in conventional and helical computed tomography

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Purpose: Conventional and/or Helical Computed Tomography (CT) is the basic imaging modality for virtual simulation and 3D conformal radiation therapy. In how far is the quality of the DRR's (resolution, geometric accuracy) depending on the slice parameters?

Methods: The influence of slice thickness, table speed and increment on resolution and geometric accuracy of the DRR's was studied at a SOMATOM PLUS S using conventional and helical imaging. Spheric phantoms and patients with bronchus carcinoma, infradiaphragmatic irradiation of Hodgkin's disease with CT-angiography and interstitial brachytherapy of the floor of mouth and pelvis have been studied.

Results: Good quantitative geometric accuracy and an excellent DRR-resolution is obtained by the use of small values for slice thickness, table-speed and increment. In patient examinations, Helical CT offers excellent reduction of breath and motion artefacts. Interstitial implants are visualized in an excellent manner.

Conclusions: Helical CT is a powerful tool for virtual simulation by offering improved DRR image quality and improved geometric accuracy within a minimum of time. It is superior to conventional CT.

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POSTER

Electron beam portal imaging for routine documentation in radiation therapy

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Purpose: For quality assurance in radiotherapy, portal imaging of photon beams has become a common standard. Electron beams are usually documented at the X-ray simulator, which leads to an increase in the simulators workload. The image quality and the feasibility of portal electron beam documentation with high sensitive film-foil combination was evaluated.

Methods: In 30 patients with cancer of the head&neck, thoraxwall and pelvic region treated at a Clinic 20 with electron beams from 6 to 16 MeV Photons prior to electron treatment, from the linac with the X-ray-images from the simulator.

Results: In all 30 patients, anatomic structures were visible in portal images and x-rays pictures. Identification of soft tissue structures was better in the portal imaging mode than in the X-rays. Only for small fields with no characteristic structures inside, X-ray simulation is still recommended for its better demarcation of surrounding tissues.

Conclusions: Electron portal imaging with high sensitive film-foil combination is a very powerful method in quality assurance for documentation of electron beams with various energies. The workload of the simulation staff is reduced.

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POSTER

Postoperative radiotherapy in endometrial cancer: Analysis of 325 cases

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Purpose: In this retrospective study endometrial cancer cases who had postoperative radiotherapy were evaluated and the prognostic factors affecting disease-free and recurrence-free survival rates were assessed.

Methods: Three hundred twenty-five cases with endometrial cancer who referred to our department between January 1986 and January 1996 for postoperative radiotherapy were evaluated retrospectively to assess the prognostic factors affecting survival.

Results: The age range was between 35–83 (median 56). Histologically 83.4% were adenocarcinoma. 5.8% were adenocarcinoma with squamous component, 5.5% were clear cell carcinoma and 5.2% were serous papillary adenocarcinoma. 63.2% of the patients had Stage I, 18.2% had Stage II, 15.7% had Stage III and 2.8% had Stage IV disease. External radiotherapy was given with 1.8–2 Gy daily fractions to a total of 45–64.8 Gy (median 54 Gy) and 54.2% of the patients were applied intracavitary RT. Local recurrence, distant metastasis and grade III–IV late morbidity rates were 8%, 19.5% and 3.6% respectively. Five year overall, disease-free and recurrence-free survival rates were 79.5%, 75.2% and 93.9% respectively.

Conclusion: In univariate analysis the prognostic factors which influence disease-free survival rate were histologic type other than adenocarcinoma ($p < 0.001$), advanced stage ($p < 0.001$), high histologic grade ($p = 0.013$), myometrial invasion more than 1/2 ($p = 0.004$) and positive peritoneal cytology ($p < 0.001$). The same prognostic factors except histologic type also influence the recurrence free survival rate. In multivariate analysis the prognostic factors which influence disease-free and recurrence-free survival rates were histologic grade and histologic type respectively.

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POSTER

Intraoperative HDR brachytherapy of Ewing's sarcoma

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Background: Non mutilating surgery for Ewing's sarcoma often has to resect the tumor with narrow margins. An additional HDR brachytherapy may improve local control.

Methods: From 4/91 to 3/95, 20 patients (mean age 18.7 y., m:f = 13:7) were treated with an additional intraoperative brachytherapy boost after preoperative radiochemotherapy. 9 tumors were located in the pelvis, 6 at the upper and 5 at the lower extremity. There were 10 Ewing's sarcomas, 5 atypical ES, 3 PNET and 2 extraosseous ES. Brachytherapy was performed using a flab technique. The applied doses were 10 to 20 Gy. Mean follow up is 24 m.

Results: No complications were noted during and after brachytherapy. On average, the duration of surgery was prolonged for 2 h 20 min. Postoperative complications were seen in 40%. 2 patients needed a surgical revision after the first operation. Postoperative chemotherapy could be continued in time, on average after 19 days. Up to now, 1 patient had a combined local and local relapse.

Conclusion: Intraoperative HDR brachytherapy seems to be a well tolerated possibility to boost the tumor bed in case of narrow resection margins.

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POSTER

Histopathological and biochemical evaluation of wound healing following preoperative irradiation, chemo-irradiation and intra-peritoneal 5-fluorouracil (5-FU) in the rat

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Purpose: Neo-adjuvant chemo- and radiotherapy for colo-rectal carcinoma could affect mechanical and biochemical parameters of anastomotic healing. Therefore, the aim of this study was to investigate the effects of such protocols on colonic anastomotic healing.

Methods: 160 male Wistar rats were divided into six groups; a control (I, n = 20); a saline (II, n = 30) which received 1 ml intra-peritoneal (i.p.) NaCl; a sham irradiated (III, n = 20); a 5-FU (IV, n = 30), which received i.p. 5-FU (20 mg/kg) for five consecutive days; an irradiated (V, n = 40) which received fractionated irradiation to the whole pelvis to a total dose of 22 Gy, 5.5 Gy per fraction, in four consecutive days; and a concomitant 5-FU + irradiation (VI, n = 20) which received 5-FU as in group IV and irradiated as in group V. All groups underwent left colonic segmental resection and primary anastomosis 3 to 4 days following therapy. Within each group one half of the animals were sacrificed on the third postoperative day and one half on the seventh postoperative day. After the resection of the anastomotic segments, histopathological examination, hydroxyproline content (HP) and myeloperoxidase (MPO) activity were evaluated.

Results: Apposition of the wound edges of the mucosa and the muscularis were not influenced by the therapy. The amount of granulocytes was high, exudate and necrosis persisted, granulation tissue formation was delayed, and the amount of macrophages and fibroblasts were low, additionally MPO, and HP content were also influenced in groups IV, V, VI when compared to the other groups.

Conclusion: Anastomotic healing can be affected by the administration of pre-operative chemotherapy, irradiation and chemo-irradiation.

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POSTER*

Standards of reference in early breast cancer post-operative irradiation: The Italian association for radiation oncology (AIRO) document

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Purpose: According to the indication of the ESTRO document on "Quality assurance in radiotherapy", it is essential to establish clinical and technical guidelines to optimize radiotherapy practice. To this aim an AIRO Committee was charged to determine the standards of reference for early breast cancer (EBC) post-operative irradiation in Italy.

Methods: The AIRO Committee, supported by the Italian Association for Biomedical Physics (AIFB), was composed of radiation oncologists and medical physicists. Current management guidelines were derived from Committee's combined experience and knowledge, from review of the literature and from a Northern Italy 1996 survey. As their own general and specific standards of reference, the Committee widely utilised the 1991 European report on "Quality assurance in conservative treatment of EBC" and the 1996 Italian document on "Quality assurance in radiotherapy".

Results: Consensus guidelines were defined on pre-treatment evaluation, on treatment prescription, preparation and execution phases, with respect to both whole breast and tumor bed irradiation, on follow up and on Quality Assurance procedures. Recommendations were given for two levels of treatment: minimum requirements and desirable treatment level.

Conclusion: Standards of reference for EBC post-operative irradiation, reflecting the current national practice and adapted to the Italian situation and resources, have been established by the AIRO Committee.

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POSTER

Focused ultrasound thermotherapy: A new promising tumor treatment principle

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Purpose: Focused ultrasound (US) thermotherapy may become an option for ablation of deeply situated tumors while monitoring noninvasively by MRI.

Method: For assessing US therapy the Dunning prostate tumor transplanted to Copenhagen rats was used in vivo and bovine muscle ex vivo. The US system consists of an MR-compatible PZT disc transducer (intensity 2.5 kW/cm²). Treatments were performed in a 1.5 T whole-body MRI imager (Siemens) employing a T1 weighted TurboFLASH sequence (acquisition time 1.3 s) for temperature mapping and morphologic measurements.

Results: Focused US induces thermal lesions deep in tissue (<1 cm³ per single shot depending on US parameters). The time course of temperature elevation in the tumor and surrounding tissues was quantitatively evaluated by MRI online during US treatment (T_{max} = 75°C). It showed good agreement with invasive thermometry. Lesion geometry inside the tumors evaluated by

histology corresponded to the MRI controlled region. Tumor suppression by US was significant (p < 0.01) compared to untreated controls and correlated with the temperature level.

Conclusion: Selective tumor ablation while sparing healthy tissue by US-induced thermal surgery is feasible. MRI allows online monitoring of lesion geometry and temperature mapping. All localizations reached by diagnostic ultrasound are possible targets in humans. This would include lesions in the liver and breast.

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POSTER

Prophylaxis by radiotherapy for heterotopic bone after acetabular fracture surgery

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Purpose: A prospective study demonstrates the value of a combined protocol of early postoperative external beam radiation (EBR) in order to prevent heterotopic bone formation after reconstructive acetabular surgery.

Methods: From January 1991 to December 1996 eighty-one patients/pts./with acetabulum fractures were treated: 44 pts. conservatively and further 37 by reconstructive surgery and early continuous passive motion therapy (CPM). Twenty-two out of those 37 pts. were additionally irradiated postoperatively with 12 Gy total dose, 2 Gy/day.

Results: Eight non-irradiated pts. and 16 irradiated pts. were examined by X-ray 6 to 24 months after therapy. 13 (81.25%) out of 16 irradiated pts. were completely free of heterotopic bone formation. 3 (18.75%) out of 16 pts. developed grade 1 ossifications according to Brooker. All non-irradiated pts. developed heterotopic bone: grade 3 or 4 in 37.5%, grade 2 in 25% and grade 1 in 37.5%, respectively.

Conclusion: The adjuvant EBR led to a substantial reduction of both frequency and Brooker grade of heterotopic bone formation after acetabular fracture surgery.

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POSTER

Late cardiac effects after adjuvant radiotherapy following mastectomy in early breast cancer

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Purpose: To assess the occurrence and degree of late cardiac abnormalities after adjuvant radiotherapy (RT) following mastectomy in early breast cancer.

Patients and Methods: Ninety women without relapse included in a former randomised trial of early breast cancer with or without RT ± cyclophosphamide were examined with myocardial scintigraphy and echocardiography 10–17 years after therapy. Thirty-four patients with left-sided RT, 33 with right-sided RT and 23 without RT. The RT had included the chest wall and regional lymph nodes, target dose 38–48 Gy. At follow up all patients were below 65 years.

Results: Abnormal findings were recorded for ECG (14 pts), exercise test (5 pts), myocardial scintigraphy (6 pts), thickening of valve cusps (14 pts) and mild valvular regurgitation (20 pts). Although no significant differences between the 3 study groups were found, higher relative frequencies of abnormal findings were observed in the RT groups. All patients had normal systolic function. Regarding diastolic function the E/A ratio was significantly lower in irradiated patients regardless of side. No difference in deceleration time or in cardiac dimensions was noted between the 3 study groups.

Conclusion: After median 13 years only minor cardiac effects which might be related to adjuvant radiotherapy following mastectomy in early breast cancer were noted.

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POSTER

Portal and verification imaging of electron beams by digital storage phosphor radiography

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Purpose: Portal or verification imaging of electron beams with various energies is often difficult due to the inadequate dose range of film material, the need of use of several film materials and the variation of the delivered dose per fraction.