levels normalized during treatment (Log Rank = 22.0; df = 3; p = 0.001). Cox regression analysis considering stage, age and body mass index confirmed these findings. Local recurrences were also less frequently observed in patients with normal hemoglobin levels (p = 0.044).

Conclusions: Hemoglobin levels at diagnosis may lack prognostic value perhaps due to the incidence of severe vaginal bleeding even in cases with favorable outcome. However, hemoglobin levels prior to and during radiotherapy seem to be important with respect to treatment outcome for endometrial cancer. This finding supports the use of measures to maintain adequate hemoglobin levels (transfusions, erythropoietin) to improve local control and patient survival.

509 POSTER

Definition of vaginal doses in intrauterine high dose rate brachytherapy

A. Kuten[1], A. Nevelsky[1], Y. Gokcen[2], R. Bar-Deroma[1]. [1] *Rambam Medical Center, Oncology department, Haifa, Israel;* [2] *Ege University Medical School, Izmir, Turkey*

Introduction: The proximal vagina has been traditionally considered resistant to high radiation doses relative to the rectal and bladder mucosa in gynecological LDR and HDR brachytherapy. The aim of this study was to evaluate dosimetric aspects of HDR intrauterine brachytherapy applications and to propose a definition of vaginal points for dose reporting.

Patients and methods:HDR brachytherapy was performed using the MicroSelectron system (Nucletron ®, Holland) using the Fletcher-like tandem and ovoids applicators. Doses were prescibed at points A, and ICRU rectal, bladder and point B doses were recorded for each treatment. Doses to the vaginal mucosa were assessed using 2 sets of points for each ovoid as follows: 5 points on the uppermost surface and 5 points on the lateral suface of each ovoid opposite the five active dwell positions at a distance equal to the radius of the ovoid. Fifty treated patients were chosen for the analysis. Repeatability and reproducibility was analized using the ANOVA method. For each patient the total vaginal dose for the whole treatment was calculated. The average dose for both ovoids was determined and the ratio of this dose to point A dose was calculated.

Results: Repeatability and reproducibility were found to be less than 1% compared to patient-to-patients variations (> 99%) for all points. The number of fractions, as well as the number of patients in which the middle ovoid point was representative was calculated for the lateral (94%, 98%) and upper (71%,83%) surfaces respectively. The calculated vaginal-average to point A dose ratio was found to be (lateral and upper surface) 175% and 130% for the 20mm and 25mm ovoids respectively.

Conclusions: The proposed method has been validated and allows calculations of vaginal doses according to the given definitions. The use of the middle ovoid point on the lateral surface remains optimal in real applications and is the most suitable for comparisons. Vaginal-to-point A dose rations were found for the intra-uterine HDR brachytherapy applications and shown to allow a fast estimation of the vaginal dose for 20mm and 25mm ovoids. **Acknowledgement: The authors acknowledge the support of the NCI/Middle East Consortium, for the fellowship of Dr. Y. Gokcen from the Ege University Medical School, Izmir,Turkey at the Rambam Medical Center, Haifa, Israel

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Levels of antioxidant proteins in serum of patients with cancer during radiotherapy

M. Koc[1], S. Taysi[2]. [1] *Ataturk University Medical School, Department of Radiation Oncology, Erzurum, Turkey;* [2] *Ataturk University Medical School, Department of Biochemistry, Erzurum, Turkey*

Background: The acute phase response also involves changes in plasma concentrations of a number of liver-synthesized proteins. Some of them are C-reactive protein (CRP), ferritin (FER), transferrin (Trf) and ceruloplasmin (Cp).

Aim: To investigate serum serum CRP, FER,Trf, and Cp levels in patients with cancer before, 3rd week and completion of radiotherapy (RT).

Material and Methods: Determination of serum CRP, FER, Trf, and Cp were performed in 52 patients with inoperable head and neck cancer (n = 11), inoperable esophageal cancer (n = 10), rectal cancer (n=9; operation was performed = 5, inoperable=4), and lung cancer (n = 23) who were treated with radical radiotherapy between February 2001 and March 2002. All patients received 50-64 (median: 60) Gy RT with 2 Gy/fraction using Co^{60} treatment machine. Serum CRP, FER, Trf and Cp levels were determined nephelometric method (Beckman Coulter, Image Immunochemisty System, USA). The statistical comparison of results has been performed by using paired samples Student's *t* test.

Results: Postradiotherapy CRP levels were significantly higher compared to the preradiotherapy levels ($p<0.001$). We found decreased serum Trf levels while acute-phase proteins such as CRP, FER, and Cp levels increased during RT period (Table). We compared CRP, FER, Trf, and Cp levels in lung cancer patients (n=21) and other patients group (n=31). Statistical analysis did not show any significant diffrence in CRP levels between two groups. Before, 3rd week and postradiotherapy ferritin levels were higher in the lung cancer patients group ($p<0.001$). Transferrin levels significantly lower in lung cancer patients compared with others before and 3rd week of radiotherapy ($p<0.01$). The statistical analysis yielded a significantly higher levels in only Cp at 3rd week of radiotherapy ($p<0.01$).

Table. Changes acute phase proteins during radiotherapy in all patients

	Beginning of radiotherapy (Mean± SEM)	At 3rd week of radiotherapy (Mean± SEM)	End of radiotherapy (Mean± SEM)
CRP	0.70± 0.12	1.82± 0.66	2.74± 0.61[c]
FER	213.61± 28.07	299.48± 39.80[c]	420.55± 50.96[c]
Transferrin	194.15± 6.24	186.57± 6.24	173.81± 7.33[c]
Ceruloplasmin	43.88± 1.17	46.71± 1.46[a]	48.73± 1.33[b]

a, $p<0.05$; b, $p<0.01$; c, $p<0.001$, compared with beginnig of radiotherapy.

Conclusion: External beam RT decreased serum Trf levels during irradiation period while other acute-phase proteins such as CRP, FER, and Cp levels increased. Further studies on the roles of the other acute phase reactants and above mentioned parameters in large patients with cancer group during radiotherapy are required to understand the role of markers which alter during radiotherapy.

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Respiratory gated radiation treatment system using a 3-D ultrasound device

M. Kokubo[1], A. Sawada[2], K. Yoda[2], Y. Nagata[3], M. Hiraoka[3]. [1] *Institute of Biomedical Research and Innovation, Department of Image-based Medicine, Kobe, Japan;* [2] *Mitsubishi Electric Corporation, Advanced Technology R&D Center, Amagasaki, Japan;* [3] *Graduate School of Medicine, Kyoto University, Department of Therapeutic Radiology and Oncology, Kyoto, Japan*

Background: We have developed a new respiratory-gated radiation treatment system using a three-dimensional (3-D) ultrasound device, which allows us to detect the real-time location of the moving tumors in the abdomen. The proposed system is consisted of the 3-D ultrasound device, a 3-D digital localizer, and an image-processing computer.

Material and methods: Both CT images and the 3-D ultrasound volume data are acquired at the treatment planning time. The ultrasound data and the position and orientation of the 3-D ultrasound probe are transferred and stored in the image-processing computer, because the 3-D ultrasound probe is tightly attached to the 3-D digital localizer which is fixed on the CT couch. The coordinate system of the CT images is correlated to that of the 3-D ultrasound volume data through the 3-D digital localizer coordinate system. Therefore, the target ROI position delineated on the CT images is transferred to the ultrasound volume data by obtaining the transformation matrix between the CT coordinate system and the ultrasound coordinate system. Real-time ultrasound data of three orthogonal planes are acquired at the treatment time and also transferred to the image-processing computer. Subsequently, the real-time ultrasound image correlation in the target ROI is calculated using the treatment planning phase ultrasound data and the treatment phase ultrasound data, after performing real-time coordinate transformation by employing the 3-D digital localizer. A trigger pulse to the linear accelerator is generated only when the correlation index between the treatment planning phase and the treatment phase ultrasound image data exceeds a predetermined threshold level. We have made a dynamic phantom which has several balls embedded having different radii. The balls are moving within 2 cm according to virtual respiratory cycles.

Results: Experiment has been performed on this system with the dynamic phantom to determine its feasibility. The trigger pulses were completely generated only when the tumor position in the treatment is the same position as the treatment planning phase without significant errors.

Conclusions: This system can improve the accuracy of the radiation therapy for the moving tumors in the abdomen and allows us to perform stereotactic irradiation for them.

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Local superficial radiotherapy in the management of primary cutaneous lymphoma.

B. Navalpotro[1], C. Conill[1], I. López[2], I. Toscas[1], J. Fernández-Ibiza[1], S. Jorcano[1], T. Estrach[2]. [1] *Hospital Clínic i Universitari, Radiation Oncology, Barcelona, Spain;* [2] *Hospital Clínic i Universitari, Dermatology, Barcelona, Spain*

Background: We evaluate the recommendation and response to local superficial radiotherapy in primary cutaneous lymphomas.

Material and methods: Between 1992 and 2000, 27 patients diagnosed with cutaneous lymphomas were treated with local superficial radiation. The mean of age was 53 years (range 25-90). There were 17 males and 10 females. Thirteen cases corresponded to cutaneous T-cell lymphomas (CTCL) and 14 to cutaneous B-cell lymphomas (CBCL). Orthovoltage radiotherapy of 100 Kv (8 mA, filter 1,7 mm Al, source skin distance 10 cm) was used, with a safety margin of 1 cm of clinical normal skin. The mean total dose of irradiation was 24 Gy (median 20 Gy; range 15-30 Gy), 200 cGy daily fractions, 5 days a week.

Results: The immediate response to the treatment was satisfactory in all the cases. In 24 patients (89%) complete response was obtained in the irradiated lesion and in 3 cases (11%) the response was partial. Local recurrence was not observed in the treated area during the follow-up period, except in 1 case who relapsed after 7 months coinciding with the appearance of new lesions outside the irradiated area. With a mean follow-up of 25.4 months (range 1-100 months), 14 patients (52%) were alive without evidence of disease (6 CTCL and 8 CBCL), 5 patients (18%) had relapse cutaneous disease or systemic progression (3 CTCL and 2 CBCL) and 8 patients died (30%), 7 due to progression (26%) and 1 the cause was not related with the disease.

Conclusions: Local superficial radiotherapy is highly effective in cutaneous lymphomas, well tolerated and produces good cosmetic results.

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Total body irradiation; the translation technique: the moving beam approach.

C. Zabatis[1], T. Koligliatis[2], S. Xenofos[3], K. Pistevou-Gobakis[4], E. Kypraiou[1], A. Fotopoulou[1], G. Soulimioti[1], E. Grigoriadis[1], G. Tsimopoulos[5], K. Beroukas[1]. [1] *St.Savvas Anticancer Hospital, Radiaition Oncology Dept, Athens, Greece;* [2] *St.Savvas Anticancer Hospital, Medical Physics Dept, Athens, Greece;* [3] *St.Savvas Anticancer Hospital, Medical Physics Dept, Athens, Greece;* [4] *Ahepa University Hopsital, Radiaition Oncology Dept, Thesaloiniki, Greece*

Introduction: In TBI, the critical organs are the lungs. Attenuators have to be prepared and used for lung sparing. The transmission through each attenuator depends on the anatomy of each patient and on the protocol followed. According to our protocol, the lung must receive 7.5Gy out of 12Gy in five successive sessions.

Materials and method: Once the necessary data, obtained under TBI conditions, are implemented to a commercial 3D-TPS, the dose distribution inside each lung can be studied in detail. In the moving beam approach, which simulates the moving couch technique, anterior and posterior, partially overlapping beams are employed, scanning the full length of the patient. The average lung dose increase, relative to the midline dose at the level of the umbilicus, is then accurately determined. The ratio of the clinically allowed lung dose to the computed average lung dose dictates the beam transmission through an individually tailored lung attenuator. This transmission then dictates the thickness of the Cerroben lung attenuator.

Results: This approach has been applied to 35 patients. In-vivo diode measurements show very good agreement (less than 3% accuracy) with the computed lung dose. A varying thickness attenuator (maximum thickness variation of 2mm Cerroben), taking the patient's external contour and lung anatomy into account, further improves the lung dose distribution. For the patients studied so far, the lung attenuator thickness is 10±2 mm of Ceroben.

Conclusions: Once the data under TBI conditions are implemented to a commercial 3D-TPS, reliable lung sparing in TBI can be achieved. Also, electron beam simulation results in a combined dose distribution both from photon and electron beams, the latter ones being used to compensate for the reduced thoracic wall dose due to the presence of lung attenuator.

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Influence of initial electron beam characteristics on Monte Carlo calculated absorbed dose distribution for linac photon beam.

A. Tzedakis[1], J. Damilakis[2], M. Mazonakis[1], J. Stratakis[2], H. Varveris[3], N. Gourtsoyiannis[4]. [1] *University Hospital of Heraklion, Medical Physics, Heraklion - Crete, Greece;* [2] *University of Crete, Depart. of Medical Physics, Heraklion - Crete, Greece;* [3] *University of Crete, Depart. of Radiotherapy, Heraklion - Crete, Greece;* [4] *University of Crete, Depart.of Radiology, Heraklion - Crete, Greece*

Background: the aim is to investigate how the initial electron beam characteristics affect the relative adsorbed dose distribution, obtained from a full Monte Carlo simulation of a linear accelerator treatment head.

Material and methods: The EGS4 user-codes BEAM and DOSXYZ were used for simulation of the treatment head and the delivered dose in a water phantom, respectively. Several initial electron beams with different radial distribution and energy spread (Gaussian distribution) were studied. Calculated percent depth doses (PDD) of 10x10 cm^2 at 100 cm SSD and dose profiles curves of 35x35 cm^2 at 100 cm SSD for 10 cm depth, were compared with measurements. Local dose differences were used, instead of differences normalized to maximum dose, as a more sensitive measure of dose difference, especially at deeper depths.

Results: For the radial distribution of initial electron beam that we examined, the PDD's have been shown to be insensitive. On the contrary, the dose profiles were affected up to 8% in the umbral region (80% of the field) and up to 20% in the fall-off region of the field. For the energy distribution of initial electron beam, the build up region of PDD's was affected by 3% for energy distribution greater than 10% FWHM. On the other hand, dose profiles have negligible effect on energy distribution of initial electron beam.

Conclusions: The radial distribution of electron beam has a great effect on the relative absorbed dose distribution. On the contrary, dose distribution past the build up region, were unaffected from energy spread of initial beam of electrons.

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Radiotherapy of primary cutaneous B-cell lymphoma - a clinical follow-up study of 35 patients

H.T. Eich[1], D. Eich[2], O. Micke[3], R. Skripnitchenko[1], H. Stuetzer[4], T. Krieg[2], R.-P. Mueller[1]. [1] *University of Cologne, Department of Radiation Oncology, Cologne, Germany;* [2] *University of Cologne, Department of Dermatology, Cologne, Germany;* [3] *University of Muenster, Department of Radiation Oncology, Muenster, Germany;* [4] *University of Cologne, Medical Statistics, Cologne, Germany*

Background: Primary cutaneous B-cell lymphomas (PCBCL) are rare and constitute approximately 25% of all cutaneous lymphomas. In the literature conflicting data exist on the optimal treatment modality regarding the efficacy and the relapse rate after radiotherapy (RT) or polychemotherapy. In order to evaluate the efficacy of RT, patients' data of two centers were analysed with reference to new reports in literature.

Materials and methods: From April 1984 to June 2001, 35 patients with PCBCL, 17 men and 18 women aged between 27 and 86 years, were treated with definite RT (29/35 patients) or postoperative RT (6/35 patients). According to the EORTC classification for PCBCL, this study group included 21 patients (60%) with primary cutaneous follicular center-cell lymphoma, 7 (20%) with primary cutaneous immunocytoma, 4 (11%) with primary cutaneous large B-cell lymphoma (PCLBCL) of the leg and 3 (9%) provisional types.

Results: 34 patients achieved an initial complete response after RT. In one additional patient RT was interrupted after 16 Gy because of fulminant pneumonia. 11/35 (31%) patients developed cutaneous relapse after a median of 11 months. 3 patients developed an in-field, 8 patients an out-field relapse. After a median follow-up period of 52 months 27/35 patients are alive, whereas 8/35 patients died (3 resulting from PCBCL and 5 unrelated to PCBCL). The 5-year overall survival rate was 75% (95% CI: 65-85%). The five-year relapse-free survival was 50% (95% CI: 32-68%). Uni- and multivariate analysis revealed the histologic subtype PCLBCL as an unfavorable prognostic factor.

Conclusions: RT of all visible skin lesions is an effective treatment for localized PCBCL. In patients presenting with skin lesions at multiple non-contiguous anatomic sites and with cutaneous relapses RT is recommended as well as the preferred treatment.