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.

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Definition of vaginal doses in intrauterine high dose rate brachytherapy

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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

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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

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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.