Advances in RT techniques may allow for dose escalation and improved clinical outcome. A limitation of this strategy is the risk of small bowel toxicity. Little information exists to guide clinicians on appropriate bowel dose-volume constraints.

Methods: Dose-volume data were collected on 30 patients entered into the BC2001 phase III randomised trial from a single centre. Patients were planned with an empty bladder and allocated radiotherapy in either a single phase of 64 Gy in 32 fractions to the whole bladder (standard whole bladder radiotherapy (SRT) group) or 50 Gy in 32 fractions to the whole bladder plus concomitant tumour boost to 64 Gy (reduced high dose volume radiotherapy (RVRT) group). Dose-volume calculations were recorded and the volume of bowel receiving different doses was compared to constraints defined by Gallagher et al IJROBP 1986, utilised in our department's ongoing pelvic IMRT trial.

Results: The bowel volume receiving each dose increment is expressed, for example, as V45 for the volume of bowel in cm^3 receiving 45 Gy (Table 1). A substantial number of patients missed each dose constraint level. At each level the percentage of patients missing the constraint was less in the RVRT arm compared to the SRT arm.

Table 1

		SVRT n = 17			RVRT n = 13			All n = 30		
	Constraint (cm^3)	Median (cm^3)	Range (cm^3)	Missing constraint (n)	Median (cm^3)	Range (cm^3)	Missing constraint (n)	Median (cm^3)	Range (cm^3)	Missing constraint (n)
V45	158	98	32–217	4	57	18–173	2	79	18–217	6
V50	110	90	26–207	5	52	14–155	2	66	14–207	7
V55	28	85	21–196	15	42	5–147	8	50	5–196	23
V60	6	63	9–175	17	31	3–118	9	38	3–175	26
V65	0	12	0–91	14	0	0–21	8	7	0–91	22

Conclusions: These data suggest patients receiving bladder RT often exceed the bowel dose constraints used in other pelvic RT trials but this may occur less often if RVRT is used. Despite this, in the BC2001 trial, <6% of patients have developed ⩾grade 3 late gastrointestinal toxicity, suggesting that most patients exceeding these dose constraints do not experience excessive toxicity. A further 25 patients are undergoing analysis and dose-volumes will be correlated with prospectively collected gastrointestinal toxicity. This pilot study will be used to propose more suitable constraints for bladder RT.

2044 POSTER

Tumor growth inhibition and necrosis following treatment of experimental solid malignant tumors by intra-tumoral Ra-224 loaded sources

Y. Keisari[1], T. Cooks[1], H. Bittan[2], E. Lazarov[2], S. Reitkopf[1], G. Horev[1], L. Arazi[3], R. Etzyoni[1], M. Schmidt[2], I. Kelson[3]. *[1]Tel Aviv University, Clinical Microbiology and Immunology Faculty of Medicine, Tel Aviv, Israel; [2]Tel Aviv University, School of Physics and Astronomy Sackler Faculty of Exact sciences, Tel Aviv, Israel; [3]Tel Aviv University, School of Physics and Astronomy Faculty of Exact Sciences and Althera Medical, Tel Aviv, Israel*

Background: Alpha radiation is a lethal form of radiation whose short range limits its use for cancer treatment. We developed a method to treat the entire tumor with alpha radiation using intratumoral wires, with radium-224 atoms fixed below their surface (Ra-wires). As Ra-224 decays, it releases into the tumor, by recoil, short-lived atoms which spread in the tumor, release their lethal alpha particles, and cause tumor necrosis. We termed this treatment Diffusing Alpha-emitters Radiation Therapy (DART).

This study examines the biological and physical effects of the Ra-wires alone or with chemotherapy, on human and mouse tumors of various histotypes.

Methods: Subcutaneous tumors from squamous cell carcinoma (SCC), pancreatic, colon and lung carcinoma origin were treated with stainless steel Ra-wire(s) with or without chemotherapeutic drugs, and tumor progression was recorded. Intratumoral radioactivity dose distribution was measured by the spread of Pb-212. The sensitivity of the various cancer cells was determined by their ability to form colonies after irradiation in vitro with alpha particles.

Results:

i. Insertion of Ra-wires into solid tumors resulted in significant reduction of tumor growth. Tumor local control was dependent on tumor size and the amount of radioactivity of the wires.
ii. An augmented level of local control was achieved when a combined treatment of Ra-wires and chemotherapy was applied.
iii. Dosimetric measurements of the intra-tumoral spread of radioactivity in different tumor models revealed biologically significant doses (>10 Gy) of Pb-212 over a region a few mm in size around the wires. The average region diameter was largest in SCC, smallest in pancreatic and intermediate for colon and lung tumors.
iv. Intratumoral tissue necrosis and tumor growth retardation were in correlation with the distribution of released alpha emitting isotopes and with the radiosensitivity of tumor cells.
v. Measurements of the mean lethal dose (D0) for human and mouse pancreatic, SCC and colon carcinomas irradiated by alpha particles, showed that SCC cells are the most radiosensitive compared to all other cell lines examined. Further attempts are made to correlate radiosensitivity with DNA repair mechanisms.

Conclusions: DART is an effective treatment to treat solid malignant tumors, and can be further potentiated by chemotherapy. This combined treatment modality holds significant potential for the treatment of non-resectable human cancers.

2045 POSTER

Demonstration of dose-response relations for a series of tumours and normal tissues after external radiotherapy

G. Komisopoulos[1], K. Sotiriadou[2], G. Soulimioti[2], N. Papanikolaou[3], B.K. Lind[4], P. Mavroidis[4]. *[1]University Hospital of Larissa, Medical Physics, Larissa, Greece; [2]University Hospital of Larissa, Radiotherapy, Larissa, Greece; [3]University of Texas Health Sciences Center, Radiological Sciences, San Antonio Texas, USA; [4]Karolinska Institutet & Stockholm University, Medical Radiation Physics, Stockholm, Sweden*

Background: Radiobiological models have been developed for the performance of radiotherapy treatment plan optimization. The delivered treatment and the clinical outcome are associated by these models. It is necessary to determine the radiobiological parameters of these models from clinical patient databases, for the clinical implementation of radiobiological treatment plan evaluation. The purpose of this study is to setup a database with the parameters, which characterize the dose-response relations of different tumors and normal tissues for different radiobiological models.

Material and Methods: Investigation and analysis of a large number of dose-response relations for tumors and normal tissues has been performed based on data from patient materials that have been collected from the literature. The dose-response models for which radiobiological parameters were collected are the Poisson, relative seriality, k-model, LKB, critical volume and parallel. The parameters that characterize the shape of these dose-response relations are the dose, which cause response to 50% of the patients (usually denoted as D_{50}), the steepness of the dose-response curve (usually denoted as γ or m) and the volume dependence of the tissue (usually denoted as *s-relative seriality*, k or n). The values of these parameters are derived for a certain reference volume of the examined tissue. Since these values are related to a certain fractionation regime, the determination of the α/β ratios is also important to be performed.

Results: It has been reported and demonstrated that in well defined tumor stages, which are characterized by a uniform size the γ values, are rather high. The volume of the irradiated tissue and the acceptable treatment complication rates are related to the part of the dose-response curve, which is covered by the clinical data. The volume dependence, which is related to the spatial internal structural organization of their functional subunits, affects significantly the response of normal tissues. Dose-response curves are used to illustrate the radiobiological characteristics of tumors and normal tissues. The collected radiobiological parameters are schematically expressed by these curves, which show the expected rates of tumor control or normal tissue complications for a range of uniform doses. The clinical data are plotted on these diagrams in the same approach they are registered in the patient follow-up records.

Conclusions: A large number of clinical factors (e.g. radiation modality, beam energy, clinical endpoint definition) influence the determination of dose-response relations. Therefore, the clinical verification and validation of reported parameters is a prerequisite for their implementation.

2046 POSTER

Interruptions in fractionated radiotherapy: incidence, causes and impact in tumour control probability

M.B. Rios Pozo[1], R.E. Pacios[1], D. Guirado[1], I. Castillo[1], M.T. Delgado[1], R. Guerrero[1], J.L. Garcia-Puche[1]. *[1]Hospital Clinico San Cecilio, Oncology, Granada, Spain*

Background: Overall treatment time (OTT) in fractionated radiotherapy plays an important role in certain tumour types, specially in head and neck squamous cell carcinoma, cervix, lung and breast cancer. In fact, tumour control probability (TCP) can be reduced if OTT is increased. We conducted an evaluation of any potencial interruption in treatment, both scheduled and unscheduled, in terms of incidence, main causes and management of prolongation of time schedule. Finally, we propose recommendations to minimise the impact of interruptions on treatment outcomes.

Material and Methods: A retrospective analysis of 277 patients treated between January 2007and November 2007.Of the 277 patients, 36.06% treated with palliative intent and 63.95% with radical intent.
Results: 85% of patients interrupted their treatment at least once, 62% twice and 20.58% four times. 87.5% stopped for 1−2 days, only a patient stopped for 9 days by acute toxicity. Public holidays were the main cause of stops (52.2%), machine breakdown supposed 33.5%, unknown reasons 9.5% and acute toxicities less than 5%. In the most part of treatment reviewed, interruptions was compensated by adding extra fractions what supposed to prolong OTT. In patients with head and neck squamous cell carcinoma the prolongation of the overall time supposed to reduce TCP on 10.5%.
Conclusions: Prolongation of the overall time has an important impact in terms of local tumour control. We don't recommend additional fractions as standard. We suggest as compensatory measures: to transfer the patient to another machine, twice daily fraction (minimum 6 h interval), weekend treatment, to use biologically equivalent dose (BED) and foresee potencial interruption before to prescribe the treatment.

2047 POSTER

Audit of management of metastatic spinal cord compression

C.E. Lee[1], V. Misra[1], D. Corgie[1]. [1]*Christie Hospital, Clinical Oncology, Manchester, United Kingdom*

Background: Metastatic Spinal Cord Compression (MSCC) is an oncological emergency with devastating outcomes. The ability to walk at presentation and prompt treatment predicts eventual outcomes. Here we present an audit of management of MSCC in our network.
Material and Methods: Our population was all patients with suspected MSCC in 3 hospitals from May to November 2007. Our audit standards were set out by our hospital's MSCC working group members using a combination of published evidence and best practice.
Results: The number of patients with suspected MSCC was 98 and 49% of these had confirmed cord compression. 35% had previously known spinal metastases. Pain was reported in 90% cases. Weakness was reported in 70%. 41% were walking with assistance. An MRI was performed in 99% of patients; the majority (71%) within 24 hours (range 1–113 days). The use of steroids was documented in 77%. For confirmed MSCC 71% had radiotherapy, 23% surgery and 12% best supportive care. 3 patients had both surgery and radiotherapy. Only decompression surgery was performed and none had stabilisation. Median time to surgery was 7 days and 1 day for radiotherapy. Most patients received a single fraction of radiotherapy (46%) (range 4−15 fractions). Of patients treated with radiotherapy the pre and post treatment percentages for independent walking, walking with assistance and not walking were 25% and 7%, 36% and 50%, and 21% and 18% respectively. For surgery these figures were 18% and 0% for independent walking, but for walking with assistance and not walking, these remained the same pre and post treatment at 36% and 18% respectively.
Conclusion: MSCC frequently presents outside tertiary care. This can lead to subsequent delays in investigation, diagnosis and treatment. Mobility and function is dependant on the initial function and the appropriate treatment. Early surgery followed by radiotherapy in suitable patients gives the best outcome. Only 44% of our patients were referred for surgery. None of our patients received optimum surgery. Overall we only managed to achieve compliance in 2 out of our 9 standards. There were delays in MRI scanning and a delay to surgery. Documentation was poor, especially regarding functional status pre and post treatment, and steroid use. At our hospital we have developed and published guidelines for the management of MSCC. These provide a step-wise, multidisciplinary, evidence based approach to managing this condition. We will re-audit our performance 12 months post introduction of the guidelines.

2048 POSTER

Adjuvant radiotherapy of endometrial carcinoma − 6-field vs. 4-field acute toxicity

G. Liposits[1], J. Hadjiev[1], A. Kovacs[1], F. Lakosi[1], D. Gugyeras[1], G. Antal[1], C.S. Glavak[1], I. Repa[1], P. Bogner[1]. [1]*Diagnostic & Oncology Institute, Oncoradiology, Kaposvar, Hungary*

Background and Purpose: To compare the additive benefit of the 6 field planning technique over the 4 field box technique in the postoperative radiotherapy of patients with endometrial carcinoma. The examined parameters were the following: dose delivery of the target, organs at risk (OARs) and the rate of acute side effects.
Material and Methods: Between 2006 and 2008, 40 patients (pts) with I-III stage endometrial carcinoma received surgery and postoperative radiation therapy. 13 pts received 3D conformal external beam radiotherapy (3D EBRT) alone, while 27 pts were treated with combined irradiation (3D EBRT +vaginal brachytherapy). The prescribed dose of EBRT was 50.4 Gy in 28 fractions.
20 pts were planned using the 4-field box technique, while in the other half of the pts the 6-field beam arrangement was used. The defined OARs were the urinary bladder, rectum, bowels and femoral heads. We recorded and classified the acute side effects according to the CTCAE version 3. scoring system.
Results: Acute side effects were noted in 77.5% of the cases. In the 4-field group, the observed acute gastrointestinal (GI) and genitourinary (GU) toxicity were the following: GI Gr. 0−1: 19 pts (Gr. 1:10), Gr.2: 1 pts; GU Gr. 0–1: 17 pts, Gr. 2: 3 pts. In the 6-field group, the toxicity rate was quite similar: GI Gr. 0−1: 19 pts (Gr.1:7), Gr. 2: 1 pts; GU Gr. 0–1: 17 pts, Gr. 2: 3 pts. No Grade 3 or worse acute side effects were observed in either group.
Conclusion: Based on our experiences the routine use of the 6-field planning technique in adjuvant radiotherapy setting may not have a significant advantage over the conventional 4-field box technique in terms of acute toxicity in patients with endometrial carcinoma. Inclusion of a higher number of patients is planned in the near future.

2049 POSTER

CyberKnife radiosurgery for metastatic spine tumours: clinical experience in 231 cases

I.B. Choi[1], S.H. Lee[2], Y.J. Kim[1], J.H. Seo[1], H.J. Shin[1], M.H. Kim[1], J.M. Shim[1], H.J. Lim[1], J.S. Jang[2], J.H. Jeong[3]. [1]*Seoul Wooridul Hospital, Radiation Oncology, Seoul, Korea;* [2]*Seoul Wooridul Hospital, Neurosurgery, Seoul, Korea;* [3]*Seoul Wooridul Hospital, Institute for Biomedical Science and Technology, Seoul, Korea*

Background: The authors conducted a retrospective study for preliminary analysis of the results from CyberKnife radiosurgery for metastatic spine tumours.
Material and Methods: The authors analyzed the treatment records of 231 cases of CyberKnife radiosurgery for metastatic spine tumours between December 10, 2007 to December 10, 2008 in Seoul Wooridul Hospital (Seoul, Korea). The total number of patients was 115 (55 males and 60 females) and their mean age was 59 years (range, 25−79 years). Cases of primary tumours consisted of 36 breast cancer, 26 lung cancer, 16 hepatoma, 8 renal cancer, 6 prostatic cancer, 5 colon cancer, 5 sarcoma, 4 stomach cancer, 4 rectal cancer, and 5 unknown primary cancer patients. They received single or fractionated radiotherapy 3 times on average (range, 1−5 times) and the marginal tumour dose ranged from 800 cGy to 4000 cGy (mean, 2000 cGy), which was delivered at mean 80% (range, 70−90%) of marginal tumor isodose line. The irradiated tumors volume was 0.46 cc-428.5 cc (mean, value 13.07 cc).
Results: The follow-up results for 231 cases were analyzed. The mean Visual Analogue Scale was 4.5 before treatment, which improved to 3.3 after treatment. The mean Oswestry Disability Index decreased from 26.5% before treatment to 23.4% after treatment. The 98 patients were evaluated in the follow up PET-CT study, in which there was overall 85% CR change in cyberKnife treatment. For complications, five patients experienced temporary nausea and three patients were attacked by radiation pneumonitis, but fully cured by appropriate symptomatic therapy and steroid therapy. No patient experienced radiation myelitis.
Conclusions: This study found that CyberKnife radiosurgery for metastatic spine tumours can relieve the pain of the patients by non-invasive method and effectively manage spinal disability. According to the results of this follow up study, PET-CT had a significant impact on cyberKnife treatment.

2050 POSTER

Treatment planning comparison of tangential coplanar beams versus non-coplanar beams in whole breast irradiation

G. Mazzarella[1], A. Bufacchi[2], A. Bonanni[1], A. Petrone[1], F. Tortoreto[1], C. Guidi[1], O. Caspiani[1], M. Leone[1], R. Capparella[2], L. Marmiroli[1]. [1]*Ospedale "S. Giovanni Calibita" Fatebenefratelli Isola Tiberina, U. O. di Radioterapia, Rome, Italy;* [2]*Ospedale "S. Giovanni Calibita" Fatebenefratelli Isola Tiberina, U. O. di Fisica Sanitaria, Rome, Italy*

Background: To evaluate dose homogeneity, target coverage, organs at risk irradiation by comparing two irradiation techniques for whole breast irradiation: tangential wedged coplanar beams versus tangential wedged non-coplanar beams.
Materials and Methods: We selected 4 patients with breast cancer who had to undergo to only whole breast irradiation, after quadrantectomy, without nodes irradiation, with relatively large breast volume. For each patient, two treatment plans were created and compared, using Varian Eclipse 6.5 planning system: a 3D two-field tangential coplanar treatment (CT) and a 3D two-field tangential non-coplanar treatment (NCT, rotated coach in the range 14–20 degrees), both wedged, with collimator rotation