less nodal stations involved on PET vs. CT (stations 10, 5, 7; 4R and 4L, respectively); in two patients, PET identified CT-negative mediastinal stations (station 5 and 7, respectively). PET based planning thus resulted in an increased nodal GTV in 2 patients (9.5%) and a decrease in 3 patients (14.3%). Taken all patients together, however, there were no significant differences in GTV, lung, and esophageal parameters between CT and PET-based plans. For CT vs. PET: V20 25.6±12.4 vs. 25.6±12.3% (p = 1.00); MLD: 13.7±5.6 vs. 13.7±5.6 Gy (p = 0.89); MED: 24.4±8.6 vs. 24.1±8.5 Gy (p = 0.50); Dmax: 45.8±2.9 vs. 45.7±2.9 Gy (p = 0.32). For the three patients in whom the nodal GTV decreased with PET, the V20 decreased from 25.5±4.9 to 22.0±7.1% (p = 0.10); MLD from 13.2±2.5 to 11.6±3.3 Gy (p = 0.10); MED from 25.0±8.5 to 21.0±5.7 Gy (p = 0.10); Dmax from 46.2±0.21 to 45.5±0.71 Gy (p = 0.32).
Conclusions: Incorporating 18FDG-PET information in radiotherapy planning in patients with LD-SCLC changed the treatment plan in 24% of patients compared to CT. Both increases and decreases of the GTV were observed, theoretically leading to the avoidance of respectively geographical miss or a decrease of radiation exposure of normal tissues. Based on these findings, a phase II trial, evaluating PET-scan based selective nodal irradiation is ongoing in our department.

920 POSTER

Profile of radiotherapy departments contributing to the EORTC Radiation Oncology Group (ROG) in the 21st century

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Purpose: Since 1982, the EORTC-ROG has pursued an extensive Quality Assurance (QA) program of all radiotherapy (RT) centers participating in clinical trials. The first step is the evaluation of the departments' human, technical and structural resources and their ability to provide high-tech RT.
Materials and Methods: A facility questionnaire (FQ) was initially developed in 1989 and circulated to 50 centers in the early 1990s. From an analysis of these data it was possible to introduce the proposition for a first set of minimum requirements for RT departments' infrastructure and resources. Since then, the FQ was updated and adapted to the latest evolutions of the RT techniques. We report here on the facilities available at 58 centers from 18 countries currently involved in clinical trials of the EORTC-ROG and who completed the updated FQ after December 2005.
Results: The centers' equipment and staffing vary widely. Comparisons with data collected previously are shown in the table. Currently, only 9 centers still use a Cobalt unit, all centers perform 3-D Conformal RT and 74% of them can perform IMRT. 88% of the centers have access to a MRI and can plan treatment using image co-registration. 69% can perform image co-registration using PET or PET-CT. All but one center (film) uses portal imaging to verify patient set up. External dosimetry audit was performed in 79% of the centers for electrons and in 90% for photons, but it was recent (<2 years) in only 52% and 55%, respectively.

	1990–1992[1] (50 Centers) Mean (range)	2006–2007 (58 Centers) Mean (range)
nb. Cancer Pts treated/year	1452 (300–3600)	1987 (470–6969)
nb. Cancer Pts/Equipment x year		
Simulator	1192 (300–2341)	991 (251–2700)
Treatment unit	506 (234–1033)	520 (69–1675)
nb. Cancer Pts/Staff x year		
Radiation Oncologist	316 (60–1243)	259 (108–480)
Radiation Physicist	464 (166–1052)	434 (177–827)
Radiation Technologist	131 (36–420)	141 (40–1350)
% Centers using CT for RT planning	72%	100%
% Pts with planning CT	20−25%	84.2% (range: 30–100)
% Centers with In vivo dosimetry	±30%	81%

[1]Bernier et al. IJROBP 1996

Conclusion: Between 1990 and 2006, the pre-treatment workload shifted from simulator to CT. The radiation technologist's workload increased, but their work might be facilitated by the use of MLC and computerized set-up. The newest RT techniques are already widely implemented in the clinic. External dosimetry audits should be performed more often. Repeated assessment using the FQ is warranted to document the evolution of the European RT centers.
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921 POSTER

Non-respiratory stomach motion in healthy volunteers

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Background and Purpose: Intrafraction organ motion refers to the change of organ position during radiation therapy (RT) delivery. In the chest and upper abdomen, it is dominated by respiratory displacement. Peristalsis, cardiac motility and variable filling of hollow organs are other physiologic sources of organ motion, but less is known about their influence on planning target volume (PTV). Currently, patients receiving RT for gastric carcinoma or lymphoma are treated 1 hour after a standard meal. The aim of the study is to characterize stomach displacement in the fasting state and during the hour after a standard meal.
Methods: Ten consenting healthy volunteers (8 female, 2 male) underwent 2D Fiesta cine MRI studies on 1.5T GE scanner in 30-second voluntary breath hold. At each time point, series were acquired in axial, coronal and two oblique planes. Fasting series (T0) were followed by a standard meal. Scanning was performed at T5, T15, T30, T45 and T60 minutes after the meal. For each series, conversion to a Pinnacle compatible format (ie. time coordinate converted into Z) using RMP Dicom Viewer [Graham Wilson] was followed by contouring of the stomach. Deformable perimetric analysis was conducted on Matlab v 7.1 [The MathWorks, Inc]. Each 2D contour was sampled with 200 evenly spaced points and matching points were found for all contours in the same 30-second acquisition. For each patient, the mean magnitude and standard deviation (SD) of displacement of each point was determined. Maximal, minimal and median values are provided to summarize the population, both in any direction and in 6 cardinal directions.
Results: Median displacement (pooled across time) in the right-left (RL), sup-inf (SI) and ant-post (AP) directions was 0.3; 0.8; and 0.3 mm, respectively. The extreme values for deviations in each direction were 4.4; 7.7; and 3.6 mm. The greatest extreme of motion was seen in the SI direction, but differences by direction were typically small. Median standard deviation (SD) is shown in the table for each direction and time point. No statistical difference in the range of the displacement or in variance was found when comparing between fasting and all postprandial phases using the Kruskal-Wallis test.
Conclusions: Non-respiratory intrafraction stomach displacement is small with extreme values usually in the range 4−8 mm for the SI direction and rarely exceeding 4 mm for RL and AP. The stability of stomach position does not differ between the fasting and postprandial states when a small, standard meal is taken. Radiotherapy may be delivered at any time within the first hour after eating without significant compromise of planned PTVs.

Median SD	RL	SI	AP
T0	2.6	2.7	2.8
T5	2.2	3.3	2.2
T15	2.9	3.5	2.9
T30	3.2	3.3	2.7
T45	3.1	3.6	2.7
T60	2.5	3.5	2.1
p-value	0.09	0.55	0.71

922 POSTER

Estimated dosimetric impact of IGRT in liver SBRT with breath-hold

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Background: Active breathing control (ABC) for liver immobilization and image guided radiation therapy (IGRT) can be used to improve setup accuracy for liver cancer stereotactic body radiation therapy (SBRT). A simple IGRT strategy, using orthogonal imaging with the diaphragm as a surrogate for liver often places the liver within 5 mm of its planned position.
Purpose/Objective: Estimate dosimetric impact of IGRT in patients undergoing liver cancer SBRT with ABC.
Materials and Methods: 21 patients treated in exhale breath-hold on a 6-fraction SBRT liver protocol were evaluated. All had daily image guidance with orthogonal images and repositioning for offsets >3 mm. The diaphragm was used for cranial-caudal (CC) alignment and vertebral bodies for anterior-posterior (AP) and left-right (LR) alignments. Offsets

were measured from daily imaging acquired following setup using external setup marks ('non-IGRT'), and verification imaging obtained after IGRT and repositioning ('IGRT'). Treatment plans were exported from the treatment planning system to Matlab using Computational Environment for Radiotherapy Research (CERR) software tools. For each fraction, the planned dose distribution was shifted by the measured AP, LR, CC offsets (for 'non-IGRT' and 'IGRT' situations). For each patient, the daily dose distributions were summed to produce an estimated composite delivered dose with and without IGRT. These plans were compared to the prescribed plan, evaluating differences in liver effective liver volume (Veff), liver mean dose, minimum dose to the target and maximal duodenum and stomach doses.
Results: 435 images (242 AP: 193 LR) acquired from MV EPIDs (14 patients, 316 images) or kV CBCT (7 patients, 117 images) projections were evaluated. Residual offsets in non-IGRT and IGRT groups are shown in Table 1. Compared to the prescribed plan, the liver Veff was increased in 10 of 21 non-IGRT plans (mean 10.5%) and 6 of 21 IGRT plans (mean 4.8%). The minimum target dose was <93% of prescribed in 14 of 21 (67%) non-IGRT and 5 of 21 (24%) IGRT plans. Mean liver doses were increased >1% in 8 non-IGRT plans (mean 11.6%) and 5 IGRT plans (mean 2.8%). Duodenum max. dose was >5% of prescribed in 8 of 21 non-IGRT and 2 of 21 IGRT. Stomach max. dose was >5% of prescribed in 6 non-IGRT and 2 IGRT plans.
Conclusions: IGRT leads to delivered doses more similar to planned doses compared to a non-IGRT strategy.

Table 1

	Non-IGRT (mm)		IGRT (mm)	
	σ	Σ	σ	Σ
C-C	8.0	6.7	2.2	1.1
A-P	5.4	4.0	2.4	1.4
R-L	5.1	3.8	2.8	2.1

923 POSTER

Collection and comparative analysis of events in a department of radiation oncology

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Radiation treatment (RT) is susceptible of events: errors, incident, and accident. Some of them are of certain gravity; some of them seem to be of little or no importance. It can be also said that what ever the event, it could be of importance because it is premonitory of an incident or an accident. That is why we decided to report on ROSIS data base all the events that we detected in our department. We report here the analysis of the year 2003.
Method: Every event detected during the preparation, the control or the realizations of RT are collected and reported in ROSIS Data Base and are registered in the department. The gravity of the events was according to Macklis (JCO1998) and analysed according to the potential gravity (i.e. if the event was not detected and not corrected) and to the real gravity (ie if detected and corrected or if detected but not corrected).
Results: 609 patients were treated with linacs or cobalt. 13142 sessions of RT were done and 37880 beams treated. 46 patient-events were reported (i.e. 7.5% of the patients treated; 0.35% of sessions. In 4 patients 2 different events were reported. 93 beam-events were reported ie 0.025% of beams. Events were detected by a physician in 33% of the cases, by a physicist or a dosimetrist in 33%, by a technician in 25% and in 10% by other. 48% were detected on the chart; 25% on film-control before the first session; 10% by the record system; 12% at the time of treatment; and 5% in other conditions. All the events were of human origin. The types of events were: dose in 23 cases, blocks in 10 cases, beams in 8 cases, modification of the beam in 1 case, energy in 1 case and in 10 cases other types. The origin of the conditions which impacted on the dose were: physician (5 cases), dosimetry (7 cases), at time of treatment (16 cases). The impact according the Macklis classification was: potential LI 6cases, LII 2 cases, LIIa 8 cases, LIIc 2 cases, LIII 32 cases; the real impact was: L0 9 cases, LI 20 cases, LIIa 18 cases, LIIc 1 cases, LIII 2 cases.
Interpretation: if an event is detected at the beginning of the chain of treatment and precociously, it can be corrected and the treatment is delivered normally. If the event arrived at the time of the treatment it cannot be corrected. In our mind we attributed the left shift of the gravity of the events to our strategy of organization: pluridisciplinary daily meeting, no treatment without control of the dosimetry, of the control film and monitor units calculation by a senior physician and a senior physicist. In the 2 LII cases, this strategy was not respected.
Conclusion: reporting events, even very little, in a radiation department is of great importance to avoid incident or accident and to help continuous improvement of the quality

924 POSTER

Radiosensitization of chlorogenic acid in Lewis lung carcinoma through inhibiting NF-κB mediated cIAP2

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Background: Chlorogenic acid (5-caffeoylquinic acid), the ester of caffeic acid with quinic acid, is one of the most abundant polyphenols in the Chinese herb Coptis chinensis. It has been found to inhibit environmental carcinogen-induced carcinogenesis through suppression of ROS-mediated NF-κB and mitogen-activated protein kinase (MAPK) activation. Radiation activates several intracellular signaling pathway mediators, including MAPK. We aim to clarify the mechanism of chlorogenic acid in radiation sensitization.
Materials and Methods: Lewis lung carcinoma (LLC) cells were used in this study. The cytotoxic effect of chlorogenic acid was analyzed by MTT assay. The apoptotic status of cells was evaluated by annexin-V staining. The levels of protein kinase phosphorylation and cIAP2 (inhibitor of apoptosis 2) were determined by western blot. The NF-κB activity was measured by promoter assay. 1×10^6 LLC cells implanted in right hind limb of C57BL/6J mice were treated with radiotherapy (4 Gy daily for 5 days) in the in vivo test. Chlorogenic acid was administered orally with 2 mg per day (100 mg/kg) three days prior to irradiation for a total of 14 days.
Results: The MTT assay revealed that chlorogenic acid itself did not affect LLC cell growth. However, chlorogenic acid could enhance the cytotoxicity of radiation in LLC cells. The quantitative annexin-V staining showed that chlorogenic acid involved anti-apoptosis signaling for radiosensitization. NF-κB promoter assay demonstrated that radiation activated NF-κB could be reduced by chlorogenic acid. The western blot also showed significant inhibition of the radiation activated NF-κB p65 subunit nuclear translocation by chlorogenic acid. Moreover, chlorogenic acid enhanced the radiation induced LLC cell apoptosis through downregulating the NF-κB mediated anti-apoptosis protein cIAP2 expression. The tumor growth curves with combined radiation and chlorogenic acid on LLC cells implanted in C57BL/6J mice, showed the significantly ($p<0.01$) reduced LLC tumor size ($702.4\pm64\ mm^3$), as compared to either radiation alone ($2370.8\pm457\ mm^3$), or chlorogenic acid alone ($5{,}038.8\pm632\ mm^3$).
Conclusions: Chlorogenic acid exerts its radiosensitization effect by inhibiting radiation induced NF-κB activation and the downstream anti-apoptosis protein cIAP2 expression in LLC cells.

925 POSTER

MVCT image-guidance derived bony setup accuracy for supine and prone pelvic radiation therapy

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Purpose: To investigate the impact of prone vs. supine patient setup on repositioning accuracy for radiation therapy of pelvic malignancies using volumetric mega-voltage CT (MVCT) imaging on a helical tomotherapy unit (TomoTherapy HiArt).
Materials and Methods: Of 30 patients treated by pelvic IMRT, setup was prone in 11 and supine in 19 patients, respectively. Prone setup always used a belly board. 829 MVCT image-guidance studies (299 prone, 530 supine) were acquired. We assessed corrective shifts for patient setup, based on mutual information fusion biased for bony alignment. Thus, patient and not target setup was assessed. Typical radiation target volumes in relationship to the pelvic bony anatomy included nodal treatments for prostate cancer, as well as rectal and anal cancer. We assessed if a no action level (NAL) protocol would provide for an effective means of limiting subsequent setup variability.
Results: Relative and absolute mean shifts along the x, y, and z axes were 1.5, −6.7, and 8.7 mm as well as 4, 7.9, and 8.9 mm for prone patient setup. The average 3D vector of displacement was 15.2 mm, with 88.5, 58.0, 27.1, and 17.5% of alignments with displacements larger 5, 10, 15, and 20 mm. For supine setup, mean and absolute daily shifts along the x, y, and z-axis were −2.1, −2.1, and 10.6 mm as well as 4.1, 4.1, and 11.1 mm, respectively. Mean length of the 3D corrective vector was 13.4 mm, with 95.1, 70.4, 36.8, and 10% of setups corrected by more than 5, 10, 15, and 20 mm.