Conclusions: Our study demonstrated that lymph node size is a strong independent prognostic factor for patients undergoing chemoradiotherapy for esophageal squamous cell carcinoma. The results indicate that revisions of the current staging system for esophageal cancer should include N staging based on lymph node size, as is currently practiced for head and neck cancer.

6530 POSTER

Dosimetric Comparison of Liver Tumour Radiotherapy in All Respiratory Phases and in One Phase Using 4DCT

D. Gabrys[1], R. Kulik[2], K. Trela[1], L. Michalecki[1], K. Slosarek[2]. [1]*Center of Oncology Maria Sklodowska-Curie Memorial, Department of Radiation Oncology, Gliwice, Poland;* [2]*Center of Oncology Maria Sklodowska-Curie Memorial, Department of Radiotherapy and Brachytherapy Planning, Gliwice, Poland*

Liver tumours exhibit significant intrafractional motions due to respiration therefore 4DCT as well as gated radiotherapy are introduced into treatment. We could delineate target volume on all respiratory phases and radiation is delivered during free breathing cycle. However the 4DCT technique synchronizes image acquisition with respiratory phase what allows us to delineate our target on the basis of one respiratory phase and deliver gated treatment choosing specific phase for irradiation. Up to now littlie is know about comparison of both techniques in terms of target and normal tissue dose distribution.
In the present paper we analyzed data of 20 patients treated for liver metastases, irradiated to the total dose 36 Gy in 3 fractions. We chose only tumours, which were clearly separated from the liver tissue. We used 4DCT to characterize tumour motion and create treatment volumes. For all patients we delineated two GTV, one based on all 10 respiratory phases (GTV 4D) and based on one phase (GTV GAT). To create PTV's we added the same 0.5 mm to GTVs. Two treatment plans were performed (4D and GAT) and dose volume distributions were analyzed in respect to target and normal tissue. Various tumour motions was included, motion along the superior–inferior direction was greatest mean 1.5 cm (range 1−3), to the side mean motion was 0.9 cm (0.6−1.3). GTVs volumes were larger in 4D than in GAT, mean 14.9 vs 27.6 cm3, also PTV 37 vs 61 were larger.
We achieved similar dose distribution in PTV4D mean 36.7 Gy SD $\pm$ 0.2 and minimum 34.9 Gy $\pm$ 0.3 for 4D plan, and PTVGAT for GAT plan mean 36.7 Gy SD $\pm$ 0.3 and minimum 34.9 Gy $\pm$ 0.3, but when we look at the dose distribution in PTV4D in the GAT plan, we found decrease in minimum dose to 12.3 Gy (2.2–24.3), and mean 33.9 Gy $\pm$ 2.3, what could be explain by differences in target volumes related to tumour movement. Radiotherapy delivered using GAT gave lower liver doses than using 4D with reduction of mean volume receiving 5 Gy by 9.3% SD $\pm$ 4.7, V10 Gy 6.7% SD $\pm$ 4.2, V20 Gy 4.8% SD $\pm$ 2.7 and reduction of mean kidney volume receiving 5 Gy by 12% SD $\pm$ 10, V10 Gy 7% SD $\pm$ 9, V20 Gy 2.8% SD $\pm$ 5.6. Moreover doses to the other normal tissues were also lower. We also found correlation between GTV volume reduction with GAT, GTV motion and doses to the normal tissues.
Gated radiotherapy allows us to decrease GTV and PTV volumes in comparison to volumes delineated on all respiratory phases. Decreased target volumes are responsible for improvement in dose distribution in normal tissue especially in the liver and kidney.

6531 POSTER

Impact of Planned Dose Distribution on Sites of Locoregional Failure for Oesophageal Cancer Patients After Exclusive Chemoradiotherapy

N. Vulquin[1], M. Gauthier[1], G. Truc[1], K. Casasnovas[1], E. Martin[1], A. Petitfils[1], J. Chamois[1], C. Khoury[1], P. Maingon[1], G. Crehange[1]. [1]*Georges-Francois Leclerc Cancer Centre, Radiation Oncology, Dijon, France*

Background: Nearly half of the patients (pts) with an oesophageal cancer (OC) have locoregional failure (LRf) after exclusive chemoradiation (eCRT). We aim to evaluate the patterns of LRf with respect to the initial dose distribution at time of planning CT (t0).
Material and Methods: Twenty three pts with an OC who failed locally and/or regionally in their follow-up were exclusively reviewed. All the pts have been initially treated in a curative intent with Platin-based eCRT. Among them, 19 patients had available imaging performed at time of failure (tf). Co-image registration of CT or PET-CT at tf and planning CT at t0 was made for image fusion considerations. Each nodal failure (Nf) and each local failure of the primary tumour (Lf) has been outlined, as well as each nodal station (NS) including Nf. The dose planned to the PTV at t0 was compared to the recalculated dose delivered to invaded NS at tf using a non-parametric Wilcoxon's test.
Results: Fifteen pts had a squamous cell cancer and 4 pts had an adenocarcinoma. Clinical T-stage at t0 was either T2 (4 pts) or T3 (15 pts). Five pts were clinically staged N0 and 14 pts had N1 disease. The median number of involved NS at t0 was 2 (0−4). The median Dmean planned to the PTV was 50 Gy [42.7 Gy-64 Gy]. In the follow-up period, 12 pts were in complete response, 3 pts in partial response, 3 pts had a progressive disease (1 pt unknown). The median delay between diagnosis and LRF was 12.6 months [4.27–48.46]. Nine pts had a Lf, 6 pts had a Nf, 4 pts had Lf with Nf and 6 pts had a concomitant distant failure. All Lf were located at the epicenter of the primary tumour. Nf occurred inside NS included in the CTV at t0 for 7 pts. Among them, 5 pts had additional recurrent NS outside the CTV (3 pts in 1 NS, 1 pt in 2 NS and 1 pt in 4 NS). Nonetheless, 3 pts had Nf in NS outside the CTV only.
The mean doses recalculated to the NS at tf were more likely to be lower than the planned dose delivered to the PTV at t0: Dmean = 34.7 Gy vs. 48.6 Gy ($p = 0.0015$), Dmax= 41.3 Gy vs. 48.9 Gy ($p = 0.013$), Dmin = 23.1 Gy vs. 38.6 Gy ($p = 0.031$), D95= 28.0 Gy vs. 44.8 Gy ($p = 0.003$).
Conclusions: Our preliminary results suggest that patients with Nf could suffer from geographic misses when performing elective nodal irradiation (ENI). Moreover, increasing the dose to the primary tumour above 50 Gy could decrease Lf rates.

6532 POSTER

Phase I/ II Study of Concurrent Chemoradiotherapy With Gemcitabine and S-1 for Unresectable Locally Advanced Pancreatic Adenocarcinoma

T. Ioka[1], N. Arimoto[1], R. Ashida[1], R. Takakura[1], S. Nakamura[2], K. Nishiyama[2], S. Tanaka[1]. [1]*Osaka Medical Center for Cancer and CVD, Hepatobiliary and Pancreatic Oncology, Osaka, Japan;* [2]*Osaka Medical Center for Cancer and CVD, Radiation Oncology, Osaka, Japan*

Purpose: The primary objective of this study is to assess the efficacy and toxicity of concurrent radiotherapy with a combination of Gemcitabine (GEM) and S-1 for unresectable locally advanced pancreatic cancer.
Patients and Method: Chemotherapy-naive patients with histologically or cytologically proven unresectable locally advanced pancreatic adenocarcinoma were enrolled to this trial. The patients received gemcitabine intravenously over 30 min on days 1 and 8 and S-1 orally b.i.d. from days 1 to 14. Cycles were repeated every 21 days until disease progression. Patients were scheduled to receive gemcitabine (mg/msq/week) and S-1 (mg/msq/day) at five dose levels: 600/50 (level 1), 600/60 (level 2), 800/60 (level 3), 800/70 (level 4) and 1000/70(level 5). Radiation therapy was delivered through four fields as a total dose of 50.4 Gy in 28 fractions over 5.5 weeks, and no prophylactic nodal irradiation was given. Dose-limiting toxicity (DLT) was defined as grade 4 thrombocytopenia, grade 4 neutropenia, or grade 3 non-hematologic toxicity. Every patients were evaluated for response with RECIST criteria by a radiologist.
Results: Fifteen patients were enrolled in phase I study between 05/12 and 07/05. The maximum-tolerated dose was level 2, Gem 600 mg/ S-1 60 mg. Six patients experienced DLT (four patients with anorexia and two patients with Gr4 neutropenia). Fifteen patients were added to phase II study, and finally twenty one patients treated with the recommended dose of phase I were enrolled to phase II part. Treatment was well tolerated. Response rate(RR) was 52% and one year survival rate was 76%.
Conclusion: The chemoradiation therapy with a combination of GEM and S-1 can be one of the most promising options for unresectable locally advanced pancreatic cancer.

6533 POSTER

Effective High Precision Radiotherapy in Advanced Cholangiocarcinoma/Klatskin Patients − a New Interdisciplinary Challenge

I. Ernst[1], C. Moustakis[2], F. Büther[3], J. Dullat[1], H. Eggert[1], F. Mounessi[1], S. Scobioala[1], N. Willich[1]. [1]*University of Münster, Radiotherapy and Radiooncology, Münster, Germany;* [2]*University of Münster, Radiotherapy and Radiooncology/Physics, Münster, Germany;* [3]*European Institute for Molecular Imaging, Physics, Münster, Germany*

Background: Owing to the fact that high precision radiotherapy like stereotactic body radiotherapy (SBRT) allows high dose radiation close to sensitive organs of risk phase 1 studies demonstrate good local tumour control rate in patients with advanced cholangiocarcinoma (CCC)/Klatskin tumours.
Aim of this study is to evaluate this therapy with regard to local control rate, toxicity, and overall survival in a larger cohort.
Material and Methods: 30 patients (p) with histological proven CCC/ Klatskin tumours, stage Bismuth III or IV, underwent SBRT. Planning target volume contained gross tumour volume, 2 mm set-up margin and movement margins based on 4 D list mode-detected PET/CT. All patients underwent SBRT with prescribed radiation dose to the 65% enclosing

isodose. Normally, 3 x 12.5 Gy were delivered. Tumours close to stomach or small bowel received 7.0 Gy in 5 fractions.
All patients received prophylactic antiemetic medication one hour before starting SBRT and proton pump inhibitors for three months starting with first SBRT.
Clinical history, laboratory findings, early and late toxicity scores, PET/CT, and MRI in cases of liver lesions were gathered at the 6-week follow-up visit and then at 3-month, 6-month, 9-month, and 12-month follow-ups.
Results: All patients received the planned therapy. 1/30 p developed gastroduodenal ulcera ºII, 30/30 p showed temporary elevation of liver enzymes without clinical symptoms.
Local tumour control rate is 100%, median overall survival 21.2 months. 3/30 p died due to non-tumour-related reasons, 16/30 as a result of distant metastases.
Conclusion: High precision radiotherapy like SBRT offers excellent local control rate for patients with advanced CCC/Klatskin tumours. Interdisciplinary strategies and studies should be found to prevent patients from distant metastases for further improvement of overall survival.

6534 POSTER

Stereotactic Body Radiation Therapy for Liver Metastases − Preliminary Results

R. Pocinho[1], D. Roberge[2]. [1]*Instituto Português de Oncologia de Lisboa Francisco Gentil, Radiotherapy, Lisboa, Portugal;* [2]*Montreal General Hospital − McGill University Health Centre, Oncology − Division of Radiation Oncology, Montreal, Canada*

Background: Liver metastases represent a common site of life limiting metastatic spread. Stereotactic body radiation therapy (SBRT) is an emerging local treatment option. We report our preliminary results of liver metastases treated with SBRT.
Material and Methods: We reviewed 23 consecutive patients treated with SBRT for 27 liver metastases: 8 women and 15 men, median age 69 years (26 to 87). Patients were selected for SBRT when the disease was considered life limiting and unsuitable to resection or radio-frequency ablation. The median radiation dose was 40 Gy (20 to 50 Gy) delivered in 1 to 10 fractions. Response to treatment was measured according to RECIST criteria on post-treatment CT, MRI and/or PET imaging. Acute and late toxicities were graded according to CTCAE v4.0.
Results: 22 patients completed SBRT. One stopped treatment after 3 fractions due to biliary obstruction from progressive tumour. Treatment was well tolerated, with 3 (13.6%) patients presenting grade I and 2 (9%) presenting grade II acute gastrointestinal toxicity. One patient was lost to follow-up. One patient had symptomatic colitis that resolved with conservative treatment, no other late toxicity was reported. Complete response was initially achieved in 8 of 25 (32%) lesions, partial response in 4 (16%), disease stabilization in 12 (48%) and continued progression in 4 (16%). With a median follow up of 15 months (3.3 to 42.9), six of 21 patients (28.6%) had progression of a treated lesion. Overall actuarial 1-year and 2-years survival rates were 93.8% and 59.5%, respectively. Median survival was 30.1 months.
Conclusions: SBRT is a promising well-tolerated treatment for non-resectable liver metastases.

6535 POSTER

A Study on Different Methods for Internal Margin Expansion of Esophageal Cancer Based on 4D-CT

Y. Zhang[1], J. Li[1], W.E.I. Wang[1]. [1]*Shandong Cancer Hospital & Institute, Radiation Therapy, Jinan Shandong, China*

Objective: To evaluate the difference of internal margin expansion measured by contouring the whole or layers parallel to the level of the adjacent vertebra (top and bottom edge and center level)of esophageal cancer based on 4D-CT.
Methods: Based on T0 phase of 4D-CT scanned for 13 patients with esophageal cancer,an irradiation oncologist contoured the gross tumour volumes of 10 respiratory phases in treatment planning system, the center coordidates of target volumes were recorded. Then based on the adjacent vertebra level (top and bottom edge and center level), target volumes on CT slices of 10 respiratory phases were contoured, the center coordidates (X?Y) and maximum diameters (d) were recorded. Internal margins of esophageal cancer layers accorging to the adjacent vertebra were caculated by IM = $X(Y)_{T0-10} - X(Y)_{T0} \pm (d_{T0-10} - d_{T0})$, then the maximum data of the same direction were filtered. The relationship of three dimensional movement of esophageal cancer and the difference of internal margin expansion measured by the whole or layers of esophageal cancer were analyzed.
Results: The motion range of the whole esophageal cancer was 1.32±0.73 mm in LR,1.09±0.77 mm in AP, and 2.92±2.10 mm in CC. There was a significant relationship between motion range in LR and AP ($r = 0.597$, $p = 0.04$), in LR and CC ($r = 0.662$, $p = 0.019$) and in AP and CC ($r = 0.723$, $p = 0.008$). There was a significant difference of internal margin expansion measured by contouring the whole or layers of esophageal cancer in thee dimensions ($p < 0.01$).
Conclusions: There was a significant relationship between motion range in three dimensions, internal margin expansion measured by the whole esophageal cancer less than that by layers.

6536 POSTER

Comparison of the Gross Tumour Volume Based on Three-dimensional CT and Four-dimensional CT Simulation Images of Primary Liver Cancer

J. Xing[1], B. Li Jian[1], J. Zhang Ying[1], X. Li feng[1], P. Shang Dong[1], Q. Shao[1], M. Xu[1], Y. Fan Ting[1], Q. Liang Chao[1]. [1]*Shan Dong Cancer Hop, Department of Radiation Oncology, Jinan, China*

Objective: To compare positional and volumetric differences of the gross tumour volume (GTV) delineated basing on three-dimensional computed tomography (3D-CT) and four-dimensional computed tomography (4D-CT) images of primary liver cancer.
Methods: Twenty patients with primary liver cancer suitable for three-dimensional conformal radiotherapy (3D-CRT) sequentially underwent 3D-CT and 4D-CT simulation scans of the thorax and abdomen under normal free breathing. During 4D-CT scanning, real-time position management (RPM) system simultaneously recorded the respiratory signals. The CT images with respiratory signal data were reconstructed and sorted into 10 phase group in a respiratory cycle. Data sets for the 3D-CT and 4D-CT scans were then transferred to Eclipse treatment planning software. GTV-3D from 3D-CT, GTV-0%, GTV-20%, GTV-50% and GTV-70% from end-inspiration, mid-expiration, end-expiration and mid-inspiration of 4D-CT, and IGTV-10 from fused phase of 4D-CT were delineated based on the 50% phase images. And the patients were divided into A group and B group based on the location of the target center and were divided into C group and D group based on the three-dimensional (3D) motion vector of the target center. The position of the target center, the volume of target, the matching index (MI) and the degree of inclusion (DI) were compared between 3D and 4D volumes based on different groups.
Results: The difference of the center of GTV from different phases of 4D-CT and GTV-3D on three dimensional direction induced by respiration motion was not statistically significant ($F = 1.174$, $P = 0.327$). The ratios of GTV-0%, GTV-20%, GTV-50%, GTV-70% to GTV-3D were 0.76±0.16, 0.73±0.20, 0.71±0.20 and 0.77±0.18 respectively, while the ratio of IGTV-10 to GTV-3D was 1.41±0.31, which showed a statistically significant correlation to the motion vector ($r = 0.321$, $P = 0.001$). The median of ratio of IGTV-10 to GTV-3D was 1.49 in group A versus 1.31 in group B, the difference between group A and group B was not statistically significant ($z = -1.783$, $P = 0.075$). The median of the ratio for IGTV-10 to GTV-3D was 1.23 in group C versus 1.58 in group D, the difference between group C and group D was statistically significant ($z = -2.773$, $P = 0.004$). MI of IGTV-10 to GTV-3D was 0.56±0.11, which showed no statistically significant correlation to the motion vector ($r = 0.084$, $P = 0.406$). ID of IGTV-10 to GTV-3D was 0.64±0.12, which also showed no statistically significant correlation to the motion vector ($r = -0.216$, $P = 0.375$).
Conclusions: The beginning time of 3D-CT axial scan is random in the breathing cycle, there is not intrinsic correlation between the beginning time of 3D-CT and any phase of 4D-CT. The volume of GTV-3D is more than that of GTV delineated basing on ang single phase images of 4D-CT, but statistically significantly less than that of IGTV-10. As the amplitude of tumour motion increases, the degree of GTV-3D covering IGTV-10 becomes less, while the motion information included by IGTV-10 increases.

6537 POSTER

Comparative Study Between the Three Methods to Delineate Internal Target Volume of the Primary Hepatocarcinoma Based on Four-dimensional CT Simulation Images

J. Xing[1], B. Li Jian[1], J. Zhang Ying[1], X. Li feng[1], M. Xu[1], Q. Shao[1], P. Shang Dong[1], J. Han Jian[1], Q. Liang Chao[1]. [1]*Shan Dong Cancer Hospital, Department of Radiation Oncology, Jinan, China*

Objective: To compare the position and magnitude of ITV of the primary hepatocarcinomas delineated by the three methods based on 4D-CT and to investigate the relative factors affecting the position and magnitude.
Methods: Twenty patients with primary hepatocarcinoma underwent 4D-CT simulation scan of the thorax and abdomen assisted by RPM system. The CT images with respiratory signal data were reconstructed and sorted into 10 phase group in a respiratory cycle, with 0% phase corresponding to end-inhale and 50% corresponding to end-exhale.