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.