Maximum intensity projection (MIP) image was generated. ITVs of the primary tumour were delineated using three methods as following:
- the GTVs on each of the ten respiratory phases were delineated and fused ten GTV to produce ITV_{10};
- the GTV delineated separately based on 0% and 50% phase were fused to produce ITV_{IN+EX}
- the visible tumour on the MIP images were delineated to produce ITV_{MIP}.

Twenty 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 tumour D, the patients were divided into E group and F group based on the 3D motion vector of the target center. The position of the target center, the volume of target, the degree of inclusion (DI) and the matching index (MI) were compared reciprocally between ITV_{10}, ITV_{IN+EX} and ITV_{MIP}, and the influence of the tumour position and 3D motion vector on the relative parameters were compared based on the grouping.

Results: The volume of ITV_{10} was larger than that of ITV_{IN+EX}, and the volume of ITV_{10} was larger than that of ITV_{MIP}, but the differences were not statistically significant. DI of ITV_{IN+EX} in ITV_{10}, ITV_{MIP} in ITV_{10} were (74.85±15.09)% and (68.87±13.69)%. MI between ITV_{10} and ITV_{IN+EX}, ITV_{10} and ITV_{MIP} were 0.75±0.15, 0.67±0.13, respectively. The median of ratio of ITV_{IN+EX}/ITV_{10} was 0.57 in group A versus 0.87 in group B, the difference between group A and group B was statistically significant ($P = 0.001$). The median of ratio of ITV_{MIP}/ITV_{10} were 0.51 in group A versus 0.72 in group B, the difference between group A and group B was statistically significant ($P = 0.001$). The median of ratio of ITV_{IN+EX}/ITV_{10} was 0.79 in group C versus 0.74 in group D, with no statistically significant difference ($P = 0.358$). The median of ratio of ITV_{IN+EX}/ITV_{10} was 0.87 in group E versus 0.68 in group F, the difference between group E and group F was statistically significant ($P = 0.004$).

Conclusions: The center displacement of the ITVs delineated separately by the three different techniques based on 4D-CT images are not obvious; ITV_{IN+EX} and ITV_{MIP} can not replace ITV_{10}, however, ITV_{IN+EX} is more close to ITV_{10} comparing to ITV_{MIP}. The ratio of ITV_{10} and ITV_{MIP} is correlated to the 3D motion vector of the tumour. When the tumour in the upper part of the liver and with a 3D motion vector less than 9 mm, ITV_{10} should be the ideal ITV.

6538 POSTER

Comparison of the Different Planning Targets Defined Basing on Three-dimensional CT and Four-dimensional CT Images for Liver Cancer

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Background: To compare positional and volumetric differences of planning target volumes (PTVs) based on axial three-dimensional CT (3D-CT) and four-dimensional CT (4D-CT) for liver cancer.

Materials and Methods: Fourteen patients with liver cancer suitable for three-dimensional conformal radiotherapy (3D-CRT) underwent axial 3D-CT and 4D-CT simulation scans of the upper abdomen during normal breathing. Three internal target volumes (ITVs) were produced based on the clinical target volume from 3D-CT (CTV_{3D}) (The GTV to CTV margin was defined as 10 mm): A conventional ITV (ITV_{conv}) was produced by adding 10 mm in superior-inferior direction and 5 mm in left-right and anterior-posterior directions to CTV_{3D}; A specific ITV (ITV_{spec}) was created using a specific margin in transaxial direction; ITV_{vector} was produced by adding a isotropic margin derived from 3D motion vector of the tumour. ITV_{4D} was defined on the fusion of CTVs on all phases of 4D-CT. Finally,PTV_{conv}, PTV_{spec}, PTV_{vector} and PTV_{4D} were generated by adding a 5 mm setup margin to ITVs. The differences in target position, volume and degree of inclusion (DI) among PTVs were evaluated respectively. The definition of DI of volume X included in volume Y [DI(X in Y)] is the percentage of the overlap between volume X and Y in volume X.

Results: Average differences between PTVs from 3D-CT (3D PTV) and PTV_{4D} in transaxial direction were less than 1 mm, with no statistically significant difference. Comparing PTV_{4D} to PTV_{conv}, PTV_{spec}, PTV_{vector} resulted in a decrease in volume sizes by 32.27%, 24.95%, 48.08% on average. The mean degree of inclusion (ID) of PTV_{4D} in PTV_{conv}, PTV_{spec}, PTV_{vector} was 0.98, 0.97, 0.99; while the mean ID of PTV_{conv}, PTV_{spec}, PTV_{vector} in PTV_{4D} was 0.66, 0.73, 0.52 respectively.

Conclusion: The center displacement of PTVs derived from 3D-CT and 4D-CT are not obvious. The size of patient-specific PTV based on 4D-CT is less than those of 3D PTVs. The treatment plans based on 3D PTVs would result in more normal tissues being necessarily irradiated. 3D PTVs generated using anisotropic expansions contribute to reducing the size of normal tissues, but a geometric miss should be focused on.

6539 POSTER

Radiotherapy of Anal Carcinoma − Outcome in an Unselected National Cohort

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Background: This study presents treatment results in a large unselected national cohort. The purpose was to evaluate our treatment results, elucidate whether national guidelines were followed, and identify areas demanding further treatment optimization.

Materials and Methods: In Norway, between July 2000 and June 2007, a total of 328 patients were treated with curatively intended (chemo)radiotherapy for squamous cell carcinoma in the anal region, according to national treatment guidelines based on tumour stage. The median age was 63 years (range 33−91), 72% were females. T stage distribution: T1 12%, T2 40%, T3 22% and T4 26%. Regional lymph node metastases were present in 35%, and inguinal lymph node metastases in 21%, no patients with distant metastases were included.

Results: Complete response after (chemo)radiotherapy was obtained in 286 (87%) patients. After salvage surgery, a total of 306 (93%) patients achieved primary locoregional control. Eighteen (43%) patients with residual tumour did not receive salvage surgery, mainly due to frailty and comorbidity.

The 3-year rate of recurrence-free survival (RFS) was 79%. Recurrence occurred in 73 (24%) patients after a median follow-up of 49 months. Locoregional recurrences were predominant, occurring in 56 (18%) patients, most commonly in the primary tumour site. Despite receiving radiation to the groins according to guidelines, 10 (3%) patients had recurrence in inguinal lymph nodes. Eleven of 20 patients initially salvaged due to residual tumour, recurred during follow-up. Treatment of recurrence had curative intent in 33 (45%) patients.

At the time of analysis, 111 of 328 patients were dead, 68 due to anal cancer. The 3-year rates for overall survival and cancer specific survival (CSS) were 79% and 84%, respectively.

The risk of adverse outcome increased significantly with more locally advanced tumours and in male gender in both uni- and multivariate analyses for RFS and CSS.

Conclusions: This study reports the outcome in an unselected national seven years cohort. Treatment results after (chemo)radiotherapy is satisfactory for patients with early-stage tumours. Still, it is essential to improve results for patients with locally advanced disease, in particular measures to reduce the rate of locoregional recurrence. Male gender as a potential risk factor for inferior outcome requires further investigation.

6540 POSTER

The Impacts of Intraoperative Radiotherapy With Image-guided Enzyme Targeting Radiosensitization (KORTUC-IORT) for Stage IVa Pancreatic Cancer

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Background: Based on our experimental results that demonstrated hydrogen peroxide to be a strong radiosensitizer in a highly radioresistant osteosarcoma cell line, we developed a new radiosensitizer injection technique in which hydrogen peroxide and sodium hyaluronate are injected immediately prior to intraoperative radiotherapy (IORT) for advanced pancreatic cancer, named KORTUC-IORT (Kochi Oxydol-Radiation Therapy for Unresectable Carcinomas + IORT). The purpose of this study was to evaluate the safety and efficacy of KORTUC-IORT in pancreatic cancer patients.

Patients and Methods: Twelve patients with stage IVa locally advanced pancreatic cancer were enrolled in the KORTUC-IORT trial after providing fully informed consent. They were treated with KORTUC-IORT, external-beam radiotherapy (EBRT), and systemic chemotherapy. KORTUC-IORT involved injection of a maximum of 9 ml of solution into tumour tissue just prior to administration of IORT under ultrasonic guidance. The solution is composed of 0.5% hydrogen peroxide and 0.83% sodium hyaluronate. For IORT, tumours were irradiated at a dose of 25 Gy in a single fraction with a 12 or 15 MeV electron beam; no tumour resection was performed. For EBRT, patients received radiation to the abdomen 5 times a week at a dose of 2 Gy/day in 15 fractions (total dose: 30 Gy) with a 10 MV x-ray. Chemotherapy was initiated at the same time as EBRT, and was continued for as long as possible. Gemcitabine hydrochloride was given intravenously