after irradiation. The images were analyzed visually on a DICOM viewer. Round regions of interest, corresponding to the stereotactically irradiated area and the comparable part of the contralateral lung were delineated on CT images. The ratio of CT values (irradiated part to comparable part of the contralateral normal lung) was calculated for each scanned rabbit lung image. Additionally the ratio after irradiation was divided by the ratio before irradiation and used to compare seven time course variations under the same conditions.
Results: Against expectation, slight changes in the irradiated lung were observed. Localized attenuating opacities suggesting emphysematous change appeared consistently in the irradiated parts of several rabbits 7–14 weeks after irradiation. The findings persisted after the first visualization. In only one rabbit, a localized consolidation was visualized, but the finding vanished in two weeks. The time course curve of the ratios was variable and indicated no significant regularity.
Conclusions: Though the single dose of stereotactic irradiation was high, the sequelae were subtle. At this time, the reason is unclear. Rabbit lung might be more tolerant to acute and subacute radiation effects than human lung.

1429 POSTER

A new collimator insert system for stereotactic irradiation of intracranial lesions

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Background: The objective of this study was to develop a prototype linac-based stereotactic irradiation system for clinical use. All dosimetric parameters were measured in order to be implemented in the Treatment Planning System.
Material and Methods: A new collimator insert system was designed and developed to simulate stereotactic irradiation. 3 cones made of alloy were constructed and mounted to the gantry head of a Siemens MX 6 MV linac to produce circular fields from 1–2.5 cm in diameter. Collimator concentricity test was performed to ensure that the central axis coincides with the isocentre of the treatment unit. Multi profile measurements were made for each cone, along with PDD calculations and other beam parameters such as TMR, off-axis ratios and output factors, to implement in a TPS. For in vivo verification of the planned dose distribution TLD-100 rods and Kodak EDR-2 films were used in a humanoid phantom.
Results: Collimator concentricity test showed a variation of not more than 0.5 mm, which is acceptable for Stereotactic Radiotherapy. All dosimetric parameters examined demonstrate high accuracy in dose distribution for each one of the developed stereotactic cones. Non-coplanar arcs of various angles were performed to indicate that the absorbed dose of organs at risk was in good agreement compared to the dose provided by the TPS.
Conclusions: High reliability and reproducibility of the proposed treatment process was illustrated, in terms of accuracy and dose calculation precision. The treatment of intracranial lesions demands the ability to deliver the necessary dose in a narrowly collimated beam. As a result this method can be clinically applicable when irradiating an intracranial lesion.

1430 POSTER

Analysis of application X-ray radiation up to 250 kV for stereotactic radiosurgery and radiotherapy

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Background: X-ray radiation, when delivered from many directions, seems can be in competition to high energy radiation sources in the case of small targets. To confirm this thesis X-ray device design was proposed and numerical analysis of dose distributions in typical for stereotactic radiation was performed.
Material and methods: X-ray radiation heads with energies 60, 150, 225 kV, and Co-60 point collimated source were simulated Using Monte Carlo code EGS4/Nova. Particle fluency spectra and angle distributions were analyzed and radiation source models, suitable for routing Monte Carlo treatment planning, were created. Dose distributions in the phantom, representing human head with 25 mm diameter asymmetrically located target and 10 mm thickness spherical bone ring, were simulated by Monte Carlo method. As a first step 60 kV X-ray treatment machine, capable to move radiation source along conical trajectory and using wedge filters for dose uniformity, was built. Experimental dose distributions were collected for numerical calculations verification.
Results: Dose distributions in the target vicinity. Bone structure collects high dose at smaller energies. This prevents low energy X-rays application in the presence of bones. At energies 150 kV and high spectrum filtration absorbed dose bone / soft tissue ratio drops to acceptable level. Average dose in normal tissues far a way from target almost do not depend on X-rays energy and is approximately two times higher than in high energy photons, but steel at the acceptable level. In the case of target location near the body surface and especially in lung X-rays have dosimetry advantages. Additional advantages X-rays may have in the presence of radiomodifiers, like high atomic number elements, incorporated in the target. Comparison of Monte Carlo calculations with experimental data for 60 kV radiation unit show agreement within experimental accuracy. At the present time micro MLC for X-ray unit and treatment planning system are in the process of development.
Conclusions: For targets up to 3 cm in diameter X-ray radiation is comparable to high energy radiation sources. Possible application could be treatment of brain diseases, lung metastasis, liver and other targets, located near body surface. Bones, located near the treatment volume restrict X-rays application.

1431 POSTER

Measurement of the exposure dose to the phantom's body for LINAC-based stereotactic radiosurgery

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Introduction: LINAC-based stereotactic radiosurgery (SRS) is an effective therapy not only for malignant tumors, but also for benign tumors or benign disease like AVMs. Therefore, young patients are often treated by SRS. Because non-coplanar beams are used, it is expected that the exposure dose to the patient's body, especially the embryos of pregnant women, is larger in cases of SRS using LINAC than in cases of conventional radiotherapy for intracranial lesions using coplanar beams. We measured the exposure doses in phantom cases and investigated the safety of this treatment in terms of radiation exposure to pregnant women.
Methods: An intracranial point of the human-body-phantom was determined to be the isocenter, and we shot 90-degree rotary irradiation into the isocenter using narrow bean collimators with diameters of 1.25 cm and 4.00 cm. We performed rotary irradiations from 0- to 90-degrees and from 90- to 180-degrees of the gantry rotation, with couch rotations of 0-degrees and 90-degrees. We set a dosimeter on the navel of the phantom and evaluated the exposure doses, first using a 450 MU (5MU/degree) and second using a 900MU (10MU/degree) to the isocenter. For each case we measured the exposure doses three times, and calculated the average.
Results: When shooting 450MU using a 1.25 cm collimator and 0-degree of rotation of the couch, the mean exposure doses on the navel of the phantom with gantry rotations of 0-degrees to 90-degrees and 90-degrees to 180-degrees were 1.32 mGy and 1.26 mGy, respectively. When the couch was rotated 90 degrees, the exposure doses were 4.69mGy, and 4.14mGy, respectively. The exposure doses were 1.2–1.7 times greater when using a 4.00 cm collimator than when using a 1.25 cm collimator in cases in which the couch was rotated 0-degrees. On the other hand, when using a 4.00 cm collimator, when the couch was rotated 90-degrees with 90-degrees to 180-degrees of gantry rotation, the exposure dose was 13.6 mGy, which was 10.8 times greater than when using a 1.25 cm collimator, with the couch rotated 0-degrees with gantry rotations of 0-to 90-degrees. When shooting 900 MU, the exposure doses increased twice as high as when shooting 450 MU.
Conclusions: The exposure dose on the navel was high when the couch was rotated 90-degrees, especially when using large collimators. For treating patients, sometimes more than 450 MU per arch is given. If treatment planning for pregnant women includes 2 arcs with a couch rotation of 90 degrees and −90 degrees, the exposure dose to the embryos may exceed tolerable levels.

1432 POSTER

Hypofractionated stereotactic radiotherapy alone without whole-brain irradiation for patients with solitary and oligo brain metastasis with diameter more than 3.5 cm: a feasible and efficacy alternative

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Purpose: Efficacy, toxicity evaluation of hypofractionated stereotactic radiotherapy (HSRT) using noninvasive fixation of skull on solitary or oligo brain metastatic patients as an alternative to whole brain radiotherapy.
Patients And Methods: The subjects were 24 patients who had 3 or fewer brain metastases (18 solitary, 6 oligometastases)with maximum diameter

more than 3.5 cm and not susceptible to radiosurgery. Patients were classified belonging to RPA classe I and II (7, 17 respectively). Treatment was conducted by using linac-based stereotactic system in 16 patients and Cyberknife system in 8 patients. The frameless image-guided radiosurger system named Cyberknife uses the coupling of orthogonal pair of x-ray cameras to a dynamically manipulated robot-mounted linear accelerator possessing six degrees of freedom, which guides the therapy beam to the target without the use of frame-based fixation. The accuracy of the whole system is below 1 mm: the reproducibility of treatment plans during the different sessions is guaranteed. For all treatments the median dose was 24 Gy in 3 fractions (reference isodose 80%). Whole-brain irradiation was not applied as an initial treatment.
Results: Stable disease was defined as unchanged tumor volume at the time of radiologic follow-up (mean 2.5 months), including patients with total or partial regression of tumor size:local control was obtained in 19 (86%) patients. Only 3 patients (13%) had new metastases developed in areas not covered by stereotactic irradiation. The majority of the patients (87%) died due to progression of their extracranial disease and only 13% died as a result of brain metastases. Treatment-related complications were observed in 2 patients in the early period (<3 months). Neurological improvement was observed in 8 patients (35%).
Conclusions: Hypofractionated conformal stereotactic radiotherapy is an effective noninvasive technique for treatment of single or oligo brain metastases. Results concerning local control seem to be comparable to those of single fraction radiosurgery. Because in the vast majority of cases HCSRT is a palliative treatment, survival is determined mainly by the systemic disease. The omission of WBRT may increase the risk of developing new brain metastases outside the irradiated area but salvage therapy is available in case of relapse. Acute and late complications with this strategy are in the range of what has been reported previously for HCSRT and single fraction radiosurgery.

1433 POSTER

Verification of the therapeutic stereotactic irradiation (STI) dose for early lung cancer

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Stereotactic irradiation (STI) therapy has recently been reported to be effective for early lung cancer and possible to be decreased in harmful side effects. This treatment included a high dose per flaction (12 to 15 Gy) with hypoflactionation compared to a dose of conventional irradiation (2 Gy). If the dose-precision of STI for lung cancer was not corrected, the treatment possibly resulted in the decline in the therapeutic effect and the increase in a harmful matter. The lung is a hypodensity structure consists of the air and the irregular alveolar organization. It is very difficult to calculate the correct therapeutic dose in STI therapy using non-coplanar, irregular fields and multi-direction. So, we originally produced an irregular density phantom which was on-line taken in the treatment planning system as computed tomographic images. Then, the plan was rewrited and recalculated on the phantom, and we compared the calculated doses with the exposed doses. We start the STI treatment, when the discrepancy is within plus/minus 3%. In conclusion, our STI treatment for early lung cancer has been performed in a high precision with a new original phantom.

Surgery

Oral presentations (Mon, 31 Oct, 9.15–11.15) Surgery

1434 ORAL

Local recurrences in the TME trial: can we reduce the radiotherapy field?

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Introduction: The number of local recurrences (LR) in rectal cancer has significantly reduced with the introduction of preoperative (chemo) radiotherapy. As known from the literature, reduction of the irradiated volume will diminish both early and late toxicity. This study was undertaken to evaluate where local recurrences occur and whether the upper border of the treatment fields can be adjusted to the level of S1/S2.
Methods: All LR occurring in the Dutch TME trial patients were studied to determine their exact localisation. CT or MRI scans of LR were reviewed by three observers in consensus and the upper border of the recurrent tumour was determined in 70 patients so far. If the LR originated below the level of S2, adjustment of the cranial border of the treatment field was considered possible.
Results: In total 118 LR occurred; 78 recurrences were confirmed at cytology or histology and in 36 patients, the diagnosis of LR was based on imaging only. The distance of the primary tumour to the anal verge was <5 cm in 42%, 5–10 cm in 42% and >10 cm in 16% of the patients. Primary tumours were TNM stage I in 5%, TNM stage II in 20% and TNM stage III in 64%.
Six percent (4/70) of the recurrences had an upper border at the level of S1/S2, and 13% (9/70) was at the level of S2/S3 and 81% was located at a lower level. LR with the upper border above the level of S3 had their primary tumour in the upper part of the rectum (>10 cm, n = 3), but also in the midrectum (5–10 cm, n = 4) and in the lower rectum (<5 cm, n = 6). In 5/11 patients, the cranial border of the treatment field could have been lowered, because the LR occurred over the whole presacral area and probably originated from a lower level. Of the six remaining patients, 3 were irradiated and had apparently an in-field recurrence.
Conclusions: Eighty-one percent of the LR occurred under the level of S2, and in 91% the upper border could have been lowered to the level of S1/S2. Initial tumour height is not strictly correlated with the localisation of the recurrent tumour and cannot be used to select patients at risk for a high located recurrence. Therefore, lowering the upper border of the RT field is questionnable.

1435 ORAL

Continence and quality of life after salvage techniques to avoid colostomy: coloanal anastomosis versus perineal colostomy, in cases of very low rectal cancer

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Background: In cases of very low rectal carcinoma, 2 major techniques have been proposed to avoid abdominal colostomy: coloanal anastomosis (CAA) or a perineal reconstruction after abdominoperineal resection (APR). In our institution the perineal reconstruction technique adopted was the perineal colostomy (PC) with an auto-transplant of a free flap of colonic muscle around the colon a few centimeters upstream of the perineal stoma. The aim of this study was to compare the functional results and the quality of life (QoL) of these two salvage techniques.
Patients and methods: 50 patients were operated on from 1991 to 2002 for rectal adenocarcinoma and analyzed: they had a follow-up of more than one year, and neither relapse nor treatment. A group of 38 patients had a CAA, including: J pouch (n = 10), coloplasty (n = 2) and intersphincteric resection (n = 3). The two groups, CAA versus PC, were comparable for: mean age 61(44–76) versus 56(37–75), preoperative radiotherapy 84% versus 75%, T3 tumor stage 52% versus 50% and T4 0% versus 0%.
Results: The global Vaizey score was equivalent for the two groups, CAA 12(0–22) versus PC 11 (8–13). The only differences reported were more