Materials and Methods: Individual applicators are rigid plates adjusted to anatomical shapes of patients. On it's surface catheters are placed on the preplanned positions. However the positions of the catheters are planed according to the rules established on the basis of pattern-treatment plans, prepared to learn about the influence of implant geometry (number of the catheters, thickness of the applicator) on the dosimetric parameters (maximum dose value on the surface of the applicator (Dmax), area of the 150% of isodose on the surface of the applicator). 9 pattern – treatment plans for irradiated surface 9 cm^2 were calculated. Pattern-plans were prepared for 3, 4 and 5 equidistant, parallel catheters and assumed thickness of the applicator: 3, 5 and 8 mm.
Results: It's difficult to obtain satisfactory dose distribution for small irradiated surface (below 9cm2). In order to avoid high dose values on the applicator's surface the distance between catheters should be 1 cm and applicator's thickness should be 8 mm while for 3 mm applicator plates is better to use 1.5 cm space between catheters to minimize the area of 150% isodose on the applicator's surface. Dose distributions calculated for individual applicators, prepared on the basis of those rules were used to treat different localizations of tumors e.g.: nose, cheek, forehead, ear even trachea.
Conclusion: Individual applicators allow to adjust the shape of isodoses to the dimension of PTV and to protect OAR. However, performed analysis showed how to improve applicator's geometry in order to avoid overdosed areas on the surface of the applicators. Geometric optimization allow not only to irradiate required area but also to obtain satisfactory dose profile from the applicator's surface to reference depth.

942 POSTER

Superficial dosimetry for helical tomotherapy

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Background: For examination of the feasibility of radiation therapy on a wide curved area of the skin by the helical tomotherapy and its accuracy to calculate the absorbed dose in the superficial region.
Materials and Methods: Two types of radiation therapy treatment plan were made with the 'cheese phantom' which is cylinder-shaped with diameter 30 cm. In the first trial, 2 Gy was prescribed from the surface to depth 1 cm. In the other trial, 2 Gy was prescribed from the external side of the surface by 5 mm to 1 cm depth. Additionally, the inner part of the phantom below depth 2 cm was selected to be completely blocked. To measure the surface dose and the depth dose profile, an EDR2 film was inserted into the phantom, and 6 TLD chips were attached to the surface.
Results: After irradiation, from the film, the surface dose of the former case was 118.7 cGy and the latter case was 130.9 cGy. From TLD chips, the surface dose was higher than these, but it was due to the finite thickness of TLD chips. In the former case, 95% of the prescribed dose could be obtained at 2.1 mm depth, and at 2.2 mm in the latter case. The maximum dose was about 110% of the prescribed dose. As the depth became deeper, the dose decreased rapidly, and at 2 cm depth, it became 20% of the prescribed dose.
Conclusions: As a result, it was found that helical tomography could be applied usefully to treat a wide area of the skin with curvature. However, up to 2 mm depth, the planning system overestimated superficial dose, and thus it was found that for the treatment of more shallow targets, to use a compensator such as bolus is required.

943 POSTER

IMRT based radiosurgery – a planning study

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Background: Radiotherapy is a mainstay for the treatment of brain metastasis regardless of the underlying type of cancer. In case of limited metastases to the brain radiosurgical procedures either alone or in combination with whole brain irradiation comprise the state of the art. Adequate coverage frequently requires more than one isocenter especially in those cases where more than one lesion has to be treated. The availability of IMRT technology prompted us to address the question in how far an IMRT based approach could be used to treat multiple metastases with one isocenter.
Methods: Using the CT and MRT data set of five different patients we generated individual treatment plans employing the IMRT-planning program "Hyperion" for an Elekta Synergy S LINAC. All dose distributions were calculated based on Monte Carlo algorithms and optimized using EUD models. The selected patients had one or three brain metastases with diameters between 5 mm and 27 mm. Dose prescriptions were: 15 to 20 Gy (depending on tumor size) on the tumor enclosing isodose. The steepness of the gradient was controlled by defining a 20 mm margin around the GTV in which the dose was restricted to a mean of 3−4 Gy. The maximum dose inside of the lesions was restricted to 120% of the prescribed dose
Results: Optimal dose distributions were obtained for all patients with six couch angles (30° apart from each other) and 9 gantry angles (20° apart from each other) as preset values for IMRT planning. After planning 29−51 beams, with 78–112 segments and total MUs from 3,240.4 to 4,948.8 were required for an adequate IMRT solution. Calculated radiation time was around 60 min.
Conclusions: Using the described technology single fraction IMRT for one up to three brain lesions seems easily feasible.

944 POSTER

Therapeutic outcome of patients with lytic, mixed and sclerotic bone metastases managed with combined radiotherapy and ibandronate

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Background: To investigate the therapeutic response of patients suffering from different types of bone metastases, managed with combined radiotherapy and bisphosphonates.
Patients and Methods: By using computed tomography (CT), 52 patients were grouped into groups of lytic, mixed and sclerotic bone lesions. All patients were treated with concomitant radiotherapy and ibandronate (10 monthly cycles) and underwent clinical and radiological evaluations prior to therapy and at 3, 6 and 10 months post the onset of therapy.
Results: At baseline there were statistically significant differences between the 3 groups for all the evaluated parameters. At 3 months all differences were leveled out. Statistically significant improvements were noted at all time points of evaluation for all groups in parameters such as pain (0−10), quality of life (QOL-physical functioning, 0–100) and Karnofsky performance status (KPS). The average pain score for the lytic group was reduced from 8.1 to 1.5 points at 3 months. The corresponding reductions for the mixed and sclerotic groups were from 6.2 to 0.5 and from 4.4 to 0.3 points respectively. Complete pain responses (pain score of zero with no increase in analgesic consumption) were >76.4% at all time points for all groups. The percentage of patients requiring opioids for pain relief, as well as the mean opioid consumption per patient measured in oral morphine equivalents, were also markedly reduced at all time points. Overall, the highest clinical response was noted for the lytic group, even though the mean values of pain, QOL and KPS were worse than those of the two other groups at all time points (apart from pain score at 10 months). The percentage of patients of the lytic group experiencing a complete pain response was the least of the three groups during follow up. At 10 months bone density was almost tripled for the lytic and almost doubled for the mixed group.
Conclusions: Even though the therapeutic outcome for the three groups was similar, the degree of clinical response and reossification differed.

945 POSTER

High dose spatially fractionated radiotherapy (SFR) using a megavoltage GRID in advanced lung tumours. A pilot study in the UK

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Background: With increasing tumour size, the ability of conventional EBRT to achieve local control decreases. Normal tissue toxicity is one of the main limiting factors in dose escalation. Grid therapy represents fractionation in space not time. This concept was routinely used in the ortho-voltage era to deliver high doses of RT to deep seated tumours while minimizing superficial normal tissue damage. Recently, the principles of SFR have been adapted to megavoltage beams using a specially constructed grid to deliver large single fractions [1]. The local cell kill after a high-dose fraction is expected to improve reoxygenation during subsequent conventional RT. A cytokine-based bystander effect may also lead to enhanced cell kill in regions adjacent to those receiving high doses. In this phase 2 study, 10 patients with locally advanced NSCLC >6 cm in size were treated as part of a feasibility study to evaluate the tolerability of adding a grid boost to conventional palliative RT.

Material and Methods: A grid consisting of an 8 cm-thick Pb block containing cylindrical holes was constructed & dosimetry evaluated. Once attached to the head of a linac the multiple pencil beams project 1.3 cm diameter circles with centres 1.8 cm apart at the isocentre. The grid boost consisted of a single fraction of 15 Gy delivered by a direct field with 10MV photons followed the next day by 36 Gy/12#s/2.5 weeks. Acute & late toxicity was assessed using RTOG criteria.
Results: All 10 patients successfully completed the treatment protocol with no delays. The median follow up was 4 months (range 2−24 months). No grade 3/4 acute toxicities were recorded. A temporary sieve like pattern of skin erythema was noted over the grid field in 7 patients. Two patients developed grade 2 lung toxicity with moderate symptomatic fibrosis but no other late effects were observed. 71.4% of patients with chest pain had a sustained CR, with the remaining 28.5% achieving a good PR. 3 pancoast tumour patients with severe pain restricting arm abduction & chest wall numbness had complete responses by week 4. On imaging, 9/10 patients had a good PR in their lung primary, sustained till the end of follow up.
Conclusions: The megavoltage grid has enabled us to dose escalate safely in the palliative setting without any significant acute or late morbidity despite the large single dose delivered. It is an exciting new concept that warrants further research.

References

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946 POSTER

Flavopiridol enhances radiosensitivity of human laryngeal and lung cancer cells through enhancing radiation-induced apoptosis

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Background: The purpose of this study is to characterize the radiosensitizing effects of flavopiridol and investigate its mechanism of action on human laryngeal and lung cancer cells.
Methods: Human laryngeal squamous cell carcinoma cell line AMC-HN3 and human lung cancer cell line NCI-H460 were used. The cultured cells were exposed to radiation, flavopiridol, or combinations of radiation and flavopiridol. In combination treatment, 100 nM concentration of flavopiridol was administered simultaneously with irradiation, and the media was replaced after 24 hours. Irradiation was administered with 4 MV X-rays generated by a linear accelerator (Clinac 4/100, Varian). Clonogenic survival was measured using a clonogenic assay. Surviving fraction (SF) of flavopiridol-treated cells was compared with that of flavopiridol-untreated cells. Analysis of cell cycle distribution and measurement of apoptosis were assessed by flow cytometry. Western blotting of cleaved caspase-3, cleaved PARP [poly(ADP-ribose) polymerase], p53, p21, cyclin D1 and phosphorylated Akt was carried out.
Results: Simultaneous flavopiridol and radiation treatment enhanced radiation-induced cell killing in both cell lines. SF2 values of flavopiridol-treated cells were significantly lower than those of flavopiridol-untreated cells. The sub-G1 fractions of cells treated with flavopiridol and irradiation was higher than those of cells treated with flavopiridol or irradiation alone. The degree of caspase-3 activation and PARP cleavage was also increased by combination treatment. Cyclin D1 protein expressions were downregulated by flavopiridol in both cell lines.
Conclusion: Flavopiridol enhanced radiosensitivity of human laryngeal and lung cancer cells through increasing apoptosis.

947 POSTER

Target volume reduction in the treatment of malignant meningioma by boron neutron capture therapy

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Background: Boron neutron capture therapy (BNCT) is based on the nuclear reaction that occurs when boron is irradiated with thermal or epithermal neutrons to reduce high linear energy transfer alpha particles and recoiling Li nuclei. This is a binary approach: A ^{10}B-labeled compound delivers high concentrations of ^{10}B to the target tumor, relative to the surrounding normal tissues. BNCT is tumor cell selective particle radiation therapy. Therefore if sufficient quantities of boron compounds can be made to accumulate selectively in tumor tissues, this BNCT becomes an ideal radiotherapy. We have reported the clinical experience of malignant meningioma (MM) patients treated with BNCT. In our protocol, we used simultaneously 100 mg/kg of sodium borocaptate (BSH) and 500 mg/kg of boronophenylalanine (BPA), whose accumulation mechanisms differ from each other. However, it has not reported the basic study of BNCT for MM. In this study, we reported the efficacy of BNCT using human MM cell line.
Materials and Methods: A human MM cell line, f5, and a cell line of human glioblastoma, U87 cells were inoculated subcutaneously into the athymic nude mice. Ten days after cell implantation, six mice of each cell were injected 100 mg/kg of BSH for 6 hr and 500 mg/kg of BPA for 4 hr. After the injection, they were sacrificed and organs were excised. Boron concentration of each organ was determined with the ICP-AES. Other mice were transported to the reactor (JRR4) ten days after the implantation, and randomized on the basis of tumor size, into the experimental groups of 3−5 animals. This experiment included untreated controls. Mice were irradiated for 30 min after 100 mg/kg of BSH for 6 hr administration and 500 mg/kg of BPA for 4 hr administration. After BNCT, mice remained JRR4 for observation and tumor size was measured.
Results: After injection of combination BPA and BSH, the boron concentrations of f5 and U87 was 8.86 ug/g and 9.24 ug/g and Tumor to Blood ratios were 4.24 and 4.42. 35 days after tumor implantation, the mean tumor volume of U87 in BNCT group was 1354 cm^2 in comparison to that of non irradiated group 3540 cm^2. And that of f5 was 826 cm^2 in comparison to 2064 cm^2.
Conclusion: BNCT with BPA and BSH displays growth-inhibitory effect on both glioblastoma and MM.

948 POSTER

Realizing the paperless and filmless environment in a large radiation oncology "cyber-department"

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Background: Provision of reliable, efficient resource management in today's radiation oncology requires support for a vast flow of information.
Methods: A strategy of incremental implementation was developed so as to minimize disruption to care and optimize staff expertise and adoption. User committees were formed at all stages to provide direction. The hardware infrastructure pertinent to radiotherapy activities was designed to optimize patient safety and department efficiency. We designed and built a non-clinical lab system to commission all treating software systems and upgrades.
We began with basic schedule and verify/record functions, then proceeded to electronic prescriptions (and elimination of treatment sheets) to filmless treatment review and the integration of planning system and treatment data over a single network. All electronic procedures were phased into practice on a disease site basis, in tandem with adequate staff training. A custom radiotherapy order entry and workflow system, and a web-based tool to publish and approve treatment plans were built to support the treatment planning process, since no commercial packages existed to do these functions. Administrative reports were customized, as was support for case review conferences and quality assurance. An electronic content management intranet provides access to all department source documents and policies and schedules.
Results: In all patient operations paper has been eliminated. All treatments and assessments are recorded electronically and costs per image are now close to zero despite the large increases in the number of images generated for planning and treatment. There has been no significant downtime despite some external interruptions. Function is available throughout the centre and from remote locations. Communication, commitment, and careful analysis of workflow process are essential to success. We encountered many challenges, which may be of interest to others engaged in this transformation.
Conclusions: The department is now almost entirely electronic. All radiotherapy functions are supported electronically throughout the centre and from remote locations. Communication, commitment, and careful analysis of workflow process are essential to success. We encountered many challenges, which may be of interest to others engaged in this transformation.

949 POSTER

Early adverse reactions after hemibody irradiation (HBI)

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Background: The most strenuous symptom of cancer patients suffering from multiple bone dissemination is pain. Quality of life (QL) of these