evaluate the dose volume histograms (DVH) of rectum and bladder in high dose proton therapy for prostate cancer.

Material and methods: Thirty patients with localized prostate cancer treated by combination of photon/proton therapy (Tx1) were included in this study. *Tx1* consisted of 50 Gy/25 fx photon beam to the prostate and bilateral seminal vesicles (P/SV) by conformal technique of 240 degree-arc followed by proton boost of 26 GyE/13 fx to the prostate (P). For the same patients, we made three different plans of proton therapy as follows; *Tx2*: 50 GyE/25 fx to P/SV followed by 26 GyE/13 fx boost to P, *Tx3*: 76 GyE/38 fx to P/SV, *Tx4*: 76 GyE/38 fx to P. All proton beams were planned in lateral opposed fields. The rectum including filling was contoured from sigmoid flexure to anal verge. The DVHs of rectum and bladder were respectively compared between 4 treatment plans.

Results: V40 (%volume that receives $\geq$ 40 Gy) - V75 of rectum and bladder in 4 treatment plans are shown in Table 1. Percent volumes of three proton plans (Tx2-4) were lower than those of the photon/proton plan (Tx1) in both rectum and bladder, over all dose levels. The DVHs of the plan to deliver full dose to P/SV (Tx3) were similar to those of the other proton plans.

Table 1. % Volume

		V40	V45	V50	V55	V60	V65	V70	V75
Rectum	Tx1	68.3	63.8	60.4	55.1	48.9	43.7	19.4	2.3
	Tx2	33.6	29.5	26.8	22.4	17.7	14.2	8.4	3.5
	Tx3	35.6	31.0	28.3	23.5	18.5	14.6	8.5	3.4
	Tx4	29.9	26.6	23.9	20.2	16.2	13.3	8.1	3.5
Bladder	Tx1	80.4	76.5	73.9	69.9	65.4	62.1	56.5	46.3
	Tx2	56.1	52.8	50.6	47.2	42.6	38.8	32.6	23.6
	Tx3	55.8	52.7	50.4	46.8	42.2	38.8	32.3	23.7
	Tx4	56.8	53.1	51.1	48.0	43.2	38.9	33.1	23.3

Conclusions: Percent volumes of rectum and bladder were reduced in the proton treatment plans, compared with the photon/proton plan. It is suggested that dose escalation for prostate cancer is feasible by proton therapy.

535 POSTER

Verification of Fluence Map (FM) in dynamic radiotherapy techniques

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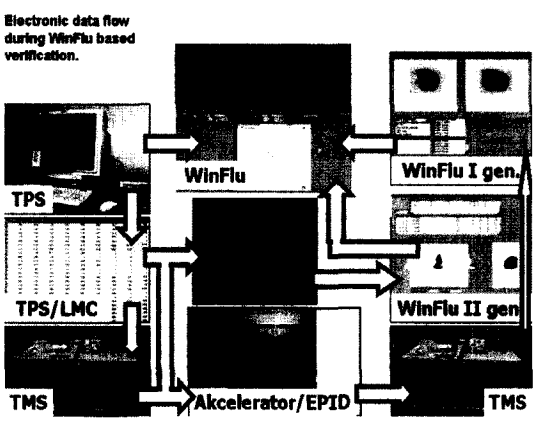
Background: Comparing to conformal radiotherapy, the Quality Assurance (QA) program for dynamic techniques (Intensity Modulated Radiation Therapy IMRT, Intensity Modulated Radiation Surgery - IMRS) requires some additional procedures. The purpose of the paper is to develop the method for FM assessment obtained from planning, data management and treatment. Presented method is based on WinFlu software originally developed in Treatment Planning Unit in Center of Oncology Institute in Gliwice, Poland.

Material and methods: First FM is imported from Leaf Motion Calculator (LMC) in TPS (CadPlan or BrainSCAN). Second one is obtained from TMS. The WinFlu generates FM to get digital image from static MLC segment positions there. Several images are imported from EPID, then blended by WinFlu generator to obtain third FM. Subsequently images are modified using the gray scale gradient and resolution for comparable conditions. The WinFlu verify three obtained FM by their profiles and gray scale intensity to find out differences. Results are stored to database for future checks and documentation.



Results: The verification method of Fluence Map enables to check dynamic MLC or mMLC plans for any inaccuracy among planning, data management and treatment (LMC/TPS, TMS, EPID).

Conclusions: Verification of the FM based on WinFlu software might constitute a useful method in QA improvement.

536 POSTER

A four dimensional simulation model of the response of solid tumours to radiotherapy in vivo: advances and validation.

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Current radiotherapy (RT) treatment planning (TP) is based on physical optimisation of the dose distribution and on rather crude biological models of tumour and normal tissue response. The introduction of advanced biosimulation methods is expected to substantially improve the RT efficiency. To this end a 4-D patient specific simulation model of the response of malignant tumours to RT schemes *in vivo* has been developed [1,2]. Substantial improvements are presented in this paper.

The Model The imaging data of the patient (e.g. MRI, PET), as well as his/her histopathologic, genetic (e.g. p53 status) and historical data are appropriately collected and introduced into the simulation software. The 4-D simulation procedure is based on the cell cycle, the oxygen and nutrient supply, the LQ model of cell response to RT and the mechanical properties of tissues. The model predictions are visualized using virtual reality techniques (Fig. 1).

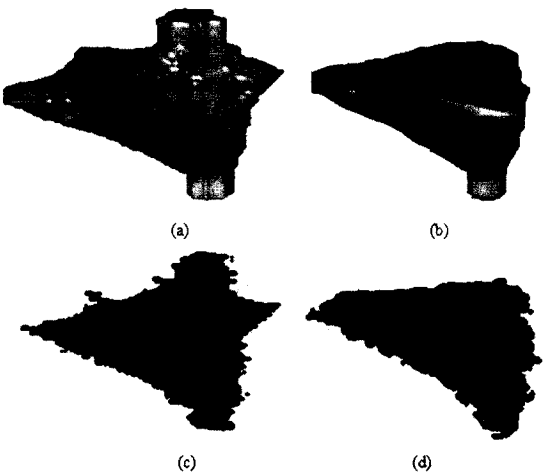

Fig 1. A 3-D visualisation of a glioblastoma multiforme tumour *in vivo*. (a) and (b): external boundary and internal structure of the tumour before RT (c) and (d): 20 days after the beginning of RT (standard fractionation scheme: 2 Gy/day, 5 d/wk, 60 Gy total). Color code: grey: "prolif. layer", dark grey: "dormant layer", black: necrotic layer. A special colouring criterion has been applied.

Improvements A new algorithm leading to conformal shrinkage of the tumour as a response to RT has been developed. Different values for the LQ parameters for each cell cycle phase and the G phase can be introduced based on the experimentally estimated oxygen enhancement ratio. Extensive use of random number generators has been made in order to better simulate the distribution of tumour cells within each given cell cycle phase. Finally, an alternative algorithm accounting for an approximately constant vascularisation field has been developed.

Results The model has been applied to the glioblastoma multiforme case. Various fractionation schemes have been simulated and qualitative agreement with clinical experience has been ensured. A preliminary clinical adaptation and testing process is in progress in the Metaxa Cancer Hospital. Large scale clinical tests have been planned to take place after completion of the preliminary testing stage.

Conclusion Qualitative agreement of the improved model with the clinical experience is followed by clinical tests. The final software is to be used as a decision support and biological TP system by performing *in silico* experiments.

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537 POSTER

The cribriforme plate on lateral radiographs- a blinded study on the accuracy of radiotherapy planning

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Background: Whole-brain irradiation is an integral part in the therapy of several brain tumors and requires coverage of the entire subarachnoid space. Numerous retrospective studies on medulloblastoma revealed frequent recurrences in the fronto-basal fossa above the cribriforme plate. Can the latter be reliably identified on lateral radiographs with sufficient accuracy?

Materials and Methods: The lamina cribrosa was localized by 5 radiation oncologists and 5 radiologists on lateral radiographs of 30 human skulls randomly selected from an anatomical collection. Reference radiographs were acquired under identical conditions except for lead markers pointing to the cribriforme plate and obvious bony edges derived from the ethmoid cells. The targeting deviations were determined by comparing the 300 estimates to the reference radiographs.

Results: In 39% (n=116) the location of the cribriforme plate was correctly estimated within 2 mm. Mislocations of 2-5, 5-10, and > 10 mm were noted in 34% (n=102), 20% (n=61), and 7% (n=21), respectively. Neither speciality nor experience (years of training) had a significant influence on targeting accuracy. If the roofs of ethmoid cells formed prominent bony edges, they were mistaken for the cribriforme plate in 37%.

Conclusions: Lateral radiographs provide ambiguous information to accurately locate the lamina cribrosa in whole-brain irradiation. Localization is significantly impaired by the ethmoid cells.

538 POSTER

Preclinical studies on the combined effect of radiation and S-1: a new oral formulation of 5-fluorouracil on human colon cancer

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Background: S-1 is a new oral formulation of 5-fluorouracil (5-FU) consist of 1M tegaful, 0.4M 5-chloro-2,4-dihydroxypyridine (CDHP) that inhibits a degradation of 5-FU, and 1M potassium oxonate (Oxo) that regulates the phosphorylation of 5-FU in the gastrointestinal tract, and has shown excellent antitumor efficacy against various murine tumors and human tumor xenografts, compared to the oral tegafur-based antitumor drug, UFT (1M tegafur plus 4M uracil), which is used for chemotherapy or chemo-radiotherapy. The therapeutic effect of S-1 on chemo-radiotherapy was evaluated with human colon xenografts.

Material and methods: KM20C, human colorectal cancer cells, grown in the right hind leg of female BALC/cA nu mice was used when tumors had reached 100-150 mm^3 in size. S-1 was administered orally at a dose of 8 mg/kg/day (as tegaful) for 2 weeks (Day 0-13). 5Gy was given to tumors by 4MV X-rays locally on the first day of experiment (Day 0). Tumor response to the treatments was assessed by calculating relative tumor volume (RTV; mean tumor volume during therapy / mean tumor volume at the start of the drug administration). The anti-tumor effect of the treatment was measured by using the following equation: relative inhibition of the tumor growth (RI, %) = [1-(mean RTV of treated group / mean RTV of control group)] x 100. Apoptosis in tumors was detected by TUNEL assay. The concentration of 5-FU in tumors was determined by HPLC.

Results: The antitumor effect of irradiation was enhanced by the combination of S-1 administration. RI of its combination treatment (5Gy/S-1 group) increased markedly till Day 14 (one day after the last administration of S-1) and this level was maintained for over 30 days. RI for 5Gy group was 6.7%, 18.6%, 29.5% and 41.0% on Day 7, Day 14, Day 30 and Day45, respectively. RI for S-1 group was 21.8%, 33.9%, 28.0% and 16.8%, respectively. RI for 5Gy/S-1 group was 33.2%, 61.4%, 63.8% and 63.9%, respectively. The frequency of apoptosis became maximum at 1 week after 5Gy-irradiation and decreased gradually. This radiation-induced apoptosis was also enhanced by the combination of S-1 administration.Tumor 5-FU levels was found to be various by its administration schedule of S-1. When S-1 was administered after irradiation, tumor 5-FU levels was quite lower than that from oppositely combined schedule: its AUC was decreased to 70%.

Conclusions: These preclinical study suggested that chemo-radiotherapy with S-1 can potentially be used to treatment tumors in place of 5-FU. S-1 administration before irradiation can be expected the higher tumor 5-FU levels and also effective radiosensitization.

539 POSTER

Reproducibility and importance of the bladder status for pelvic irradiation

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Purpose: The aim of this investigation is to define the impact of the bladder status on internal organ motion and on geometric displacement of defined volumes: organs at risks, gross tumour volume (GTV) and PTV, furthermore on urinary side effects. Moreover to develop a simple way of decrease the physiologic variability and monitoring its reproducibility for conformal irradiation at the pelvic region.

Method: Planning CT of 21 patients has been performed using thermo p lastic mask fixation and belly board with full bladder, t hereafter with empty one. The bladder, rectum, small bowel, GTV and PTV including the elective lymph node regions were indicated and controlled. Using a 3D planning system a conformal dose distribution was planned and evaluated in correlation to the position of the denoted organs. During the course of radiotherapy the patients were educated to come with full bladder and the amount of the urine has been measured after each session. Acute side effects were assessed weekly using NCIC CTC 2.0 toxicity scale.

Results: The V full /V empty = 4,1 ± 2,4 (for bladder). The mean volume irradiated under 80% and 60% isodose curves were near 10 percent higher with empty bladder. The difference was lower comparing the bladder volume irradiated within the 40% isodose curve. The dose homogeneity in PTV was not significantly influenced by the bladder status. The average daily urine amount of 28 patients was 145.8 ml. On the basis of multiple CT and urine measurement the correlation of urine amount to bladder geometry has been established. Interpatient variation was in the range of 0-50ml and 300-650 ml. The adverse events on the bladder were in7% grade3, 3% gr2 and 43% gr1, no toxicity in 47% respectively. The toxicity showed correlation to the urine volume: if the daily average was under 200ml the side effects has increased significantly

Conclusion: In conclusion full bladder is recommended for curative irradiation in the pelvic region. The individual variability of the bladder maximal fullness should be taken into account. The small bladder volume proved to be associated with higher frequency of bladder toxicity. Daily measurement of the urine volume after defined correlation to the organ status leads to better cooperation of the patients and higher quality assurance by conformal pelvic irradiation.

540 POSTER

The informational needs of the multidisciplinary audience attending monthly radiation oncology palliative care rounds at the Toronto Sunnybrook Regional Cancer Centre - needs assessment

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Background: Palliative radiotherapy plays a significant role in symptom control in patients with advanced cancer. At the Toronto Sunnybrook Regional Cancer Centre, a Rapid Response Radiotherapy Program was developed to meet patients' needs and a continuing education (CE) program in the form of monthly rounds was developed to meet the educational needs of its multidisciplinary audience.

Purpose: Our primary objective was to evaluate this CE program. The secondary objective was to learn about the informational needs of the multidisciplinary audience attending this CE program.

Methods: A self-administered questionnaire, designed specifically for this project, was used. The questionnaire consisted of two parts. In Part one of the questionnaire, we addressed familiarity, evaluation forms, attendance, and satisfaction level with the educational content and satisfaction with presenting speakers. In part two of the questionnaire, we looked at the educational needs of the multidisciplinary audience and their likelihood of attendance at the sixteen educational topics suggested.

Results: Thirty-two questionnaires were returned out of 50 distributed (response rate 64%). Fifty percent of the respondents were very familiar