will be missed using MVCT for delineation. The delineation power is good enough in delineating many of the tumours.

2018 POSTER

Three-Dimensional Imaging for Radiotherapy Planning in Prostate Cancer

J. Sulé-Suso[1], K.P. Lam[2], R. Bhana[1], F. Adab[1], S. Sargeant[3], D. Collins[2], A. Patel[1], A. Moloney[1]. *[1]University Hospital of North Staffordshire, Cancer Centre, Stoke on Trent, United Kingdom; [2]Keele University, School of Computing and Mathematics, Stoke on Trent, United Kingdom; [3]Keele University, School of Psychology, Stoke on Trent, United Kingdom*

Background: The preparation of external beam 3D Conformal Radiotherapy (3DRT) and Intensity Modulated Radiotherapy (IMRT) for prostate cancer entails carrying out a CT Scan and outlining the treatment volumes and organs at risk on each of the CT scan slices. Whilst this is explained in detail to patients before starting RT during the consenting process, quite often, patients find difficult to fully understand how RT is planned and delivered.
Material and Methods: The 3 dimension (3D) VERT imaging system (VERTUAL Ltd, U. K.) was used in this pilot study. Local ethical approval was obtained prior to starting this project and 50 patients were included. Patients were informed of the study and asked to sign an informed consent form. RT planning CT Scans were transferred into DICOM to the VERT system. Patients were shown their own CT Scan planning images in 3D and taken through the different stages of RT planning and delivery. Patients were then asked to fill in a questionnaire in order to obtain their feed-back and how the whole exercise could be improved.
Results: Patients welcomed this exercise as they not only better understood how RT is planned and given but also, why they might get some side effects from the RT. Furthermore, this extra knowledge helped them to better accept side effects and to better cooperate with bladder and bowel preparation during their treatment.
Conclusions: The use of the 3D VERTUAL system to explain patients how RT is given and delivered is not only highly welcomed by patients but also, it helps to reduce the fear factor many of them have before starting RT.

2019 POSTER

Influence of High Density Inhomogeneity of Dental Prostheses in Radiation Therapy

C. De Conto[1], R. Gschwind[1], E. Martin[2], L. Makovicka[1]. *[1]Femto-st, Enisys/IRMA, Montbeliard, France; [2]Centre Hospitalier Belfort-Montbeliard, Service De Radiothérapie, Montbeliard, France*

Background: Dental prostheses made of high density material contribute to modify dose distribution in head and neck cancer treatment. The study objective is to quantify dose perturbation due to high density inhomogeneity with experimental measurements and Monte Carlo simulations.
Material and Methods: Firstly, measurements in a phantom representing human jaw with thermoluminescent detectors (GR200A, 5 mm of diameter and 0.9 mm thickness) and EBT2 Gafchromic films in the vicinity of three samples: a healthy tooth, a tooth with amalgam and a Ni-Cr crown, irradiated in clinical configuration (6 MV photons, DSP = 94 cm, sample depth = 3 cm, 5 cm × 5 cm beam size). Secondly, Monte Carlo simulations (BEAMnrc code) are assessed in an identical configuration.
Results: Experimental measurements and simulation results confirm the two well-known phenomena: the passage of a low density medium to high density medium induced backscattered electrons causing a dose increase at the interface. Instead, the passage of a high density medium to a low density medium create a dose decrease near the interface. So, the results show a rise backscatter dose and a decrease after sample (only for crown) compared to the healthy tooth (see table).

	Before sample		After sample	
	TLD	Monte Carlo	TLD	Monte Carlo
Tooth with amalgam	−2.6%	−0.5%	−4%	+0.7%
Crown	+7.4%	+25.9%	−17.5%	−17.7%

Conclusion: Although teeth with amalgam have a density of about 12−13, the changes generated are not significant. However, the results for crowns (density of 8) are very significant and the discordance observed may be due to thickness difference, 0.9 mm and 0.25 mm respectively for TLD and Monte Carlo. Now, the next step will be to evaluate algorithms implemented in clinical treatment planning system.

2020 POSTER

Dual Phosphoinositide 3-Kinase/Mammalian Target of Rapamycin Inhibitor is an Effective Radiosensitizer for the Treatment of Colorectal Cancer

Y.H. Chen[1], S.H. Kuo[1], M.F. Wei[2], S.L. Pan[3], C.W. Wang[1], H.J. Jeng[1], M. Gao[1], C.M. Teng[3], A.L. Cheng[3]. *[1]National Taiwan University Hospital, Departments of Oncology, Taipei, Taiwan; [2]College of Medicine National Taiwan University, Institute of Biomedical Engineering, Taipei, Taiwan; [3]College of Medicine National Taiwan University, Pharmacological Institute, Taipei, Taiwan*

Background: The phosphatidylinositol 3-kinase (PI3K), protein kinase B (AKT) and mammalian target of rapamycin (mTOR) (PI3K/AKT/mTOR) signalling pathway are reported to play a crucial role in the pathogenesis of colorectal cancer (CRC). Since radiotherapy became an important treatment strategy for locally advanced rectal cancer, we sought to investigate whether the use of dual PI3K/mTOR inhibitor, BEZ-235, can improve the radiation-related antitumour effects of CRC cells.
Materials and Methods: CRC cell, the KRAS mutant, HCT116 was irradiated with different dose of radiation (0−6 Gy). Determination of the therapeutic effect and cell cycle distribution of radiation alone, dual PI3K/mTOR inhibitor (BEZ-235) alone, and combining BEZ-235 with irradiation were analyzed by cell survival assay, and flow cytometry, respectively. Phospho-Akt (p-Akt), p-mTOR, p-4EBP, p-p70S6K, and p-eIF4E protein expression were assessed by immunoblotting. The treatment effect of radiation alone, BEZ-235 alone, and the combination of BEZ-235 and irradiation was further evaluated in the *in vivo* study of xenograft experiments using HCT116 CRC cells were done by subcutaneous inoculation of cells into 5−6 weeks old female C.B-17/Icr-scid-bg mice.
Results: The synergistic effects of combining radiation with different concentration of BEZ-235 were demonstrated in the cell survival assay. Cell cycle distributions showed that there was a significant increase in the percentage of cells exposing to the combination of BEZ-235 and radiation in the sub-G1 cells when comparing with cells with no treatment or treating with irradiation alone. Furthermore, the combination of BEZ-235 and radiation resulted in a caspase-dependent apoptosis in association with activation of caspase-9. In the *in vivo* effect of BEZ-235 in CRC xenograft tumour, we found that treatment with the combination of BEZ-235 and radiation had a significant inhibitory effect on tumour size ($P < 0.01$) after 4 weeks of treatment than treatment with radiation alone or BEZ-235 alone. In addition, we found that irradiation alone up-regulated the expression of p-Akt, p-mTOR, p-4EBP, p-p70S6K, and p-eIF4E, however, the up-regulation of AKT/mTOR signalling pathway was attenuated by BEZ-235.
Conclusions: These findings indicate that the dual PI3K/mTOR inhibitor, BEZ-235, down-regulates radiation-induced Akt/mTOR signaling pathway and enhances therapeutic effects of radiation in CRC cells. The major mechanism of the synergistic effect of the combination of BEZ235 and irradiation-induced inhibition of cell growth of CRC is at least through the down-regulation of PI3K/Akt/mTOR pathway. This encouraging result provides a new approach for the combination of BEZ235 and radiotherapy in the treatment of CRC.

2021 POSTER

"The Machine Fear"− Cancer Patients Undergoing Radiotherapy Treatment, an Observational Study

C. Moleri[1], M. Cabiddu[1], V. Tresoldi[1], E. Sarti[2], M.L. Bonetti[1], F. Petrelli[1], L. Bruscheri[2], A. De Stefani[2], S. Barni[1]. *[1]Azienda Ospedaliera Treviglio, Oncology, Treviglio, Italy; [2]Azienda Ospedaliera Treviglio, Radiotherapy, Treviglio, Italy*

Background: Cancer patients are often worried about both the disease and its treatments. The aim of our study is to evaluate patients' worries of the radiotherapy machine and the effects of the treatment on their mood.
Material and Methods: 46 patients in radiotherapy (58% male, 42% female; mean age: 65.5 years old, range: 46−75) were asked to undergo Profile of Mood States (McNair, Lorr, 1992) for monitoring fluctuating active mood states, Mini Mac (Watson, 1994) to value coping style and to a specific psychological interview concerning the feelings linked to the machine, the treatments and the socio-economical variables.
Results: The majority of patients is not afraid of the machine (91%), the rays (92%) and the noises (90%), only 7% complains about bad smells during treatments.
11% is worried about possible damages of machine and 13% about negative effects of the rays.
POMS analysis shows low levels of the factor depression dejection (98%), anger-hostility (93%), confusion-bewilderment (91%) and fatigue-inertia (97%).

Data seems to be excessively positive and we suppose that a defence mechanism overturns our hypothesis.
Conclusions: Our aim is to go on with the study in order to evaluate if radiotherapy patients show a prevalence of the Type C coping style (Temoshok, 1985) wich is often associated with the oncological disease and can be considered as a precursor of cancer and so, for this reason, they do not express emotions like fear, anxiety or sadness, they are unassertive, cooperative and appeasing social and family.
Type C could be the behaviour pattern that patients use to cope with outer stress and inner distress.

2022 POSTER

Quality Improvement of Breast Irradiation Using Intensity-Modulated Radiation Therapy (IMRT) and a Simultaneous Integrated Boost (SIB) With an Instant Re-planning Radiation Therapy (IRRT) Technique

S. Merrick[1], J. Wong[1], J. Gao[1]. [1]*Morristown Memorial Hospital, Radiation Oncology, Morristown -NJ, USA*

Background: IMRT treatment coupled with IGRT produces extraordinary levels of precision and accuracy for external beam radiation therapy. In addition, IMRT techniques are capable of treating several targets simultaneously at varying levels of dose. However, despite the ability of IGRT to efficiently adjust for a single target's motion, it may be impossible to achieve setup corrections for multiple, independently moving targets. Breast irradiation that uses IMRT with SIB to the lumpectomy cavity is achievable via IMRT, but the consistent reproducible accuracy may be unobtainable even with IGRT due to the inter-fraction variations of the breast setup as well as the shape and size changes of the lumpectomy site. We therefore chose to focus our study on the inter-fraction movement of the breast tissue versus the lumpectomy site, and the benefits of a daily IRRT technique to improve the quality of IMRT-SIB breast irradiation.
Material and Methods: Two CT data sets each were obtained from 30 breast cancer patients. The first CT images were obtained prior to treatment and the second CT set was taken 4 weeks after the onset of radiation to reflect high levels of anatomical changes that may occur during the course of treatment. The IMRT plan with SIB delivers a daily dose of 1.8 Gy to the whole breast and 2.25 Gy to the lumpectomy site simultaneously. These plans were then copied onto the second CT data set and recalculated to mimic three different situations; (1) traditional setup using external marks, (2) setup using IGRT, and (3) the creation of a new IMRT plan using a re-planning computer program (IRRT) achievable by means of an in-room CT-on-rails.
Results: 20% of the cases showed significant dose degradation when mimicking a traditional setup with the targets' D95 falling below 95% and 50% of those cases had D95 falling below 90%. Implementing IGRT improved the lumpectomy site dose coverage, but consequently worsened coverage of the breast tissue and in 33% of those instances increased doses to the heart and lungs. The IRRT method was always able to improve dose coverage to the targets while maintaining all aspects of the original plan. Detailed results will be presented.
Conclusion: While IMRT is necessary to attain the SIB technique for breast treatment, dose coverage may not be consistently reproduced inter-fractionally. Also, IGRT alone was not able to correct for these dose variations and during instances of significant setup corrections due to anatomical changes, the plan delivered higher doses to critical structures. Furthermore, IRRT was the only solution that consistently reproduced the intended results of the initial IMRT plan. Our study has significant implications for hypo-fractionation radiation therapy that treat multiple targets concurrently.

2023 POSTER

Can Radiation-Induced Chronic-Oxidative Stress in Kidney and Liver Be Prevented by Dimethyl Sulfoxide? Biochemical Determination by Serum and Tissue Markers

R. Cosar[1], S. Eskiocak[2], V. Yurut-Caloglu[1], A. Ozen[1], C. Uzal[1], M. Caloglu[1], K. Ibis[1], M. Saynak[1], S. Parlar[1], Z. Kocak[1]. [1]*Trakya University Faculty of Medicine, Department of Radiation Oncology, Edirne, Turkey;* [2]*Trakya University Faculty of Medicine, Department of Biochemistry, Edirne, Turkey*

Background: The purpose of this study was to investigate the protective effects of DMSO on chronic oxidative stress in the liver, kidney, and serum with biochemical parameters such as malondialdehyde (MDA), advanced oxidation protein product (AOPP), catalase, glutathione (GSH), free-thiols (F-SH).
Material and Methods: Thirty Wistar-Albino female rats were randomly divided into three groups. Group I (control, n = 10), Group II (irradiation alone group, n = 10), Group III (DMSO and irradiation group, n = 10). Rats in groups II and III were irradiated with a single dose of 6 Gy to entire liver and right kidney. Group III received DMSO 4.5 g/kg by intraperitoneal injection 30 minutes before the irradiation. At the end of 24th week, the rats were sacrificed and their trunk blood and kidney, liver tissues were collected.
Results: Rats in group II showed increased levels of lipid peroxidation and protein oxidation, GSH, F-SH and catalase were significantly lower in liver, kidney, and serum than controls (Table 1).
Conclusion: DMSO is protector on chronic oxidative stress in the serum and kidney tissue.

Table 1. Serum, kidney, and liver tissue levels of oxidative and antioxidative parameters in each group

	Group I Control	Group II Irradiation-only	Group III DMSO + RT	*p* value	
				Gr.	value
Serum levels					
Malondialdehyde (MDA)Dagger;Dagger;	7.8 (4.38–8.34)	9.68(8.1–10.4)	6(4.6−6.3)	I-II II-III I-III	0.002**# 0.018**# 0.720**
Advanced oxidation protein product (AOPP)Dagger;	257.7±17	356±26	290.2±40.2	I-II II-III I-III	0.000*# 0.001*# 0.482*
Glutathione (GSH)Dagger;Dagger;	2.3(1.2−2.4)	1.2(1−1.5)	2.9(2.7−3.1)	I-II II-III I-III	0.001**# 0.000**# 0.000**#
Free-thiols (F-SH)Dagger;	36.9±2.3	37.5±2.4	47.7±2.6	I-II II-III I-III	1.000* 0.000*# 0.000*#
CatalaseDagger;	7674±3250	1655±277	5927.7±1196	I-II II-III I-III	0.004*# 0.012*# 0.573*
Kidney tissue					
Malondialdehyde (MDA)Dagger;	3.5±0.25	4.1±0.62	3.1±0.5	I-II II-III I-III	0.013**# 0.007**# 0.637**
Advanced oxidation protein product (AOPP)Dagger;	16±3.7	40.2±2.8	26.8±3.1	I-II II-III I-III	0.000*# 0.000*# 0.000*#
Glutathione (GSH)Dagger;Dagger;	12.9±0.6	8±1.2	10.8±2.5	I-II II-III I-III	0.000***# 0.006***# 0.000***#
Free-thiols (F-SH)Dagger;	23.3 (21.7–24.1)	15.2 (13.9–19.5)	18.3 (18.1–22.6)	I-II II-III I-III	0.000**# 0.001** 0.101**
CatalaseDagger;	41.2±6.3	33.2±6	31±2.7	I-II II-III I-III	0.002*# 1.00* 0.000*#
Liver tissue					
Catalase	89±21.3	71±11.4	69.5±5.9	I-II II-III I-III	.042 0.946 0.027
Malondialdehyde (MDA)	1.8±0.31	2.5±0.6	2.9±0.5	I-II II-III I-III	0.002 0.086 0.000
Advanced oxidation protein product (AOPP)	21.6±7	30.7±6	27.4±7.1	I-II II-III I-III	0.053 0.444 1.00
Glutathione (GSH)	13.6±1.2	8.9±1.7	8.8±1.0	I-II II-III I-III	.000 0.203 0.001
Free-thiols (SH)	31±4.1	17.4±3.6	21.2±5.2	I-II II-III I-III	0.000 0.075 0.000

Dagger;Mean±SD since fits to normal distribution, Dagger;Dagger;Median (Min-Max) since does not fit to normal distribution, *ANOVA, Bonferroni t test, **ANOVA, Dunnett T3, ***Kruskal–Wallis H Analysis and Mann–Whitney U test, #<0.05.

2024 POSTER

An Approach to Verify Accurate 3D Quality Assurance for Radiotherapy Plans

J. Chen[1], Y. Yin[1]. [1]*Shandong Cancer Hospital, Radiation Physics, Jinan Shandong, China*

Background: The aim was to investigate the feasibility and accuracy of 3D quality assurance (QA) software in the daily workflow.
Materials and Methods: 30 cases with head & neck tumour (2010, Oct to 2011, Feb) were enrolled. Using Varian Eclipse version 8.6 treatment planning system, radiotherapy plans were generated for each case. According to individual condition, two radiotherapy techniques were applied (IMRT: 18 cases; RapidArc: 12 cases). All plans were delivered in Varian Trilogy accelerator. Based on the same plan, 2D and 3D QA techniques were applied sequentially to measure the plan twice. The device for 2D QA is MatriXX and the 3D QA is COMPASS, which are both produced by IBA Co. After measuring the plans, the γ values ($0<\gamma<1$) both for MatriXX and COMPASS were obtained. Additionally, due to 3D analysis system, the γ values for organs were obtained at COMPASS. Then the values for organs were compared to MatriXX values respectively.
Results: Among the γ values of organs such as eyes, parotid, brainstem and spinalcord, there was no significant difference to MatriXX value, with *p*