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

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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

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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

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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*

value of 0.502, 0.518, 0.826 and 0.203. In the other hand, the γ values of lens and optic chiasma were smaller than MatriXX's with *p* value of 0.014 and 0.022. In the comparison, the γ value of PTV were in good co-ordinate with MatriXX's, with *p* value of 0.838.
Conclusion: The comparison data showed that, because of small volume, lens and optic chiasma didn't represent uniform. However, the COMPASS as 3D QA tool could achieve good measurement totally as traditional 2D planar technique dose. As the lightspot, multi-organ dosimetric analysis could be very helpful for physicists and clinical oncologists.

2025 POSTER

Electron Energy Monitoring Using a 2D Ionisation Chamber Array and a Metallic Wedge Shaped Absorber

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Background: The purpose of this study was to implement a 2D ionisation chamber array and metallic wedge shaped absorber as a quality assurance device for linear accelerator electron beams.
Materials and Methods: Water tank measurements of the electron depth dose were performed and beam adjustments were made to match the depth dose data in the planning system. Following this, electron beam profiles for all energies were obtained with a 2D ionization chamber array (MatriXX, IBA) and a wedge shaped absorber placed on the surface of the array. The maximum ionisation on the profiles was normalized to 100% and the chamber position values corresponding to 90% and 50% ionisation were calculated using the OmniPro ImRT (IBA) software. Difference in the chamber position values (K-value) was used as an indicator of electron energy constancy. Monthly electron beam profiles were obtained for three consecutive months to obtain average K-values for each of the six electron beams with similar setting as described earlier. These K-values were compared with the K-values obtained from water tank measurements. The resulting average K-values for all energies were also plotted against the depth of 50% dose (R_{50})obtained from water tank measurements for all the energies to obtain the energy variation tolerance limits for each electron beam.
Results: Table 1 shows the average of three K-values obtained from the 90% and 50% ionisation values measured with 2D array and metallic wedge. The figures in parenthesis are standard deviations of each measurement. The K-values obtained from 2D array and metallic wedge shaped absorber and those measured with water tank and ionisation chamber show similar trend of variation with energy. The reproducibility of the K-values was approximately 2% for all beams. Since the metallic wedge has higher atomic number than water, the magnitude of variation of K-values from lowest to highest energy is not of similar proportions but still sensitive enough for the purpose of monthly quality assurance of electron beam energies.

Table 1. Measured K-values and comparison with Water Tank measurements

Energy	R_{50} (mm)	K-value			
		As obtained		Normalised to 6 MeV beam	
		Array & wedge	Ionisation chamber & water tank	Array & wedge	Ionisation chamber & water tank
6 MeV	22.6	1.54 ($\pm$0.031)	5.4	1.00	1.00
8 MeV	30.5	1.94 ($\pm$0.058)	6.9	1.26	1.28
10 MeV	39.2	2.12 ($\pm$0.042)	8.7	1.38	1.61
12 MeV	46.0	2.29 ($\pm$0.057)	9.8	1.49	1.81
15 MeV	58.9	2.99 ($\pm$0.045)	13.9	1.94	2.57
18 MeV	70.9	3.49 ($\pm$0.070)	19.1	2.27	3.54

Conclusion: The device described above is simple and gives excellent agreement with water phantom measurements and can be used to perform monthly quality assurance of linear accelerator electron beam energies.

2026 POSTER

A Correlation Study on Position and Volume Variation of Primary Lung Cancer During Respiration by 4D-CT

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Objective: To investigate the correlation of position movement of primary tumour with interested organs and skin markers, and to investigate the correlation of volume variation of primary tumours and lungs during different respiration phases for patients with lung cancer at free breath condition scanned by 4D-CT simulation.
Materials and Methods: 16 patients with lung cancer were scanned at free breath condition by simulation 4D-CT which connected to a respiration-monitoring system (RPM). A coordinate system was created based on image of T5 phase, GTVs and normal tissue structures of 10 phases were contoured. The three dimensional position variation of them were measured and their correlation were analyzed, and the same for the volume variation of GTVs and lungs of 10 respiratory phases.
Results: Movement range of lung cancer in different lobe differed extinctly: 0.8−5.0 mm in upper lobe, 5.7−5.9 mm in middle lobe and 10.2–13.7 mm in lower lobe. Movement range of lung cancer in three dimensional direction was different: Z-axis 4.31$\pm$4.34 mm; Y-axis 2.19$\pm$1.04 mm; X-axis 1.73$\pm$1.5 mm. There was no statistical significant correlation for movement vector of GTV and interested structures, nor for volume variation of tumour and lung.
Conclusions: Based on 4D-CT, statistically significant differences of GTVs centroid movement were observed at different pulmonary lobes and in three dimensional directions. So individual 4D-CT measurement is necessary for definition of ITV margin for lung cancer.

2027 POSTER

Comparison of the Patient-specific Internal Gross Tumour Volume for Primary Esophageal Cancer Based Separately on Three-dimensional and Four-dimensional CT Simulation Images

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Background: Using four-dimensional (4D) CT scans for individual patients allows for the design of patient specific margins by drawing on each 4D-CT phase. We compare the position, volume and matching index (MI) of patient-specific internal gross tumour volume(IGTV) delineated by 4 different approaches based on 3D and 4D CT image data sets for primary esophageal cancers.
Materials and Methods: Thirteen patients with primary esophageal cancer underwent the 3D-CT simulation scans followed by respiration-synchronized 4D-CT simulation scans during free breathing, and the patients were divided into group A (whose cancer located in the proximal thoracic esophagus) and group B (whose cancer located in the mid- and distal thoracic esophagus). In 3D-CT and 4D-CT date sets, the IGTV were delineated using four approaches: (1) The gross tumour volume (GTV) contours from 10 respiratory phases were combined into $IGTV_{10}$; (2) $IGTV_2$ was acquired by combining the GTV contours from 0% and 50% phases; (3) $IGTV_{MIP}$ was delineated the GTV contour using the maximum intensity projection (MIP); (4) $IGTV_{3D}$ consisting of the 3D-CT-based GTV enlarged for each spatial direction by the 95% upper bound of confidence interval amount of motion measured in the 4D-CT. Compare the volume, position and MI between IGTV10 and IGTV2, IGTVMIP, IGTV3D.
Results: The maximum displacement of proximal thoracic esophageal cancer in the X, Y and Z directions were 0.11$\pm$0.05 cm, 0.09$\pm$0.05 cm, 0.18$\pm$0.14 cm,with no statistically significant difference; mid- and distal thoracic esophageal cancer displacement in X, Y and Z directions were 0.15$\pm$0.09 cm, 0.12$\pm$0.09 cm, 0.47$\pm$0.40 cm, target movement in Z direction was bigger than in the X and Y directions. The target displacement between $IGTV_{10}$ and $IGTV_2$, $IGTV_{3D}$ were all less than 0.03 cm on three dimensions in group A, with no statistically significant difference. The median of the target motion in group B was less than 0.07 cm. There was no significant difference between $IGTV_{10}$ and $IGTV_{3D}$, but the target center coordinates demonstrated significant spatial difference in Y direction between $IGTV_{10}$ and $IGTV_2$ for group B ($P = 0.021$). $IGTV_{10}$ was bigger than $IGTV_2$, and $IGTV_{10}$ was smaller than $IGTV_{3D}$. In group A MI between $IGTV_{10}$ and $IGTV_2$, $IGTV_{3D}$ were 0.88$\pm$0.06, 0.54$\pm$0.12, respectively. MI in group B were 0.86$\pm$0.05, 0.59$\pm$0.10. The volume of $IGTV_{MIP}$ was smaller than $IGTV_{10}$ ($t = -2.838$, $P = 0.025$), but the position of $IGTV_{10}$ and $IGTV_{MIP}$ on X, Y and Z directions were with no statistically significant difference ($P = 0.809$, 0.429, 0.263), MI between $IGTV_{10}$ and $IGTV_{MIP}$ was 0.78$\pm$0.06.
Conclusion: For thoracic esophageal cancers, $IGTV_2$ and $IGTV_{3D}$ can not replace $IGTV_{10}$,and $IGTV_{MIP}$ can not contain all the patient-specific information about primary tumour position, shape, and size at different phases of the respiratory cycle.

2028 POSTER

A Study on Correlation Between Target Displacement and Volume Variation of Primary Carcinoma in the Middle and Distal Oesophagus During Normal Respiration Based on Four-dimensional CT

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Background: To investigate the correlation between the motions of gross tumour volume (GTV) and the interested organs and skin markers, and the correlation between the volume of GTV and the volume of heat and