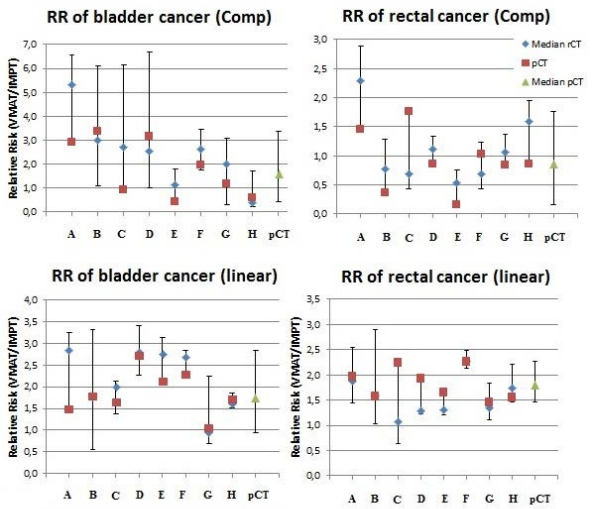

Figure 1. Relative Risks of radiation-induced bladder and rectal cancer VMAT/IMPT for patients A-H. Median of repeat CTs (range), planning CTs and Median of all planning CTs (range)

Conclusion: The choice of model contributes to SC risk fluctuating in favour of either IMPT or VMAT. Large variations were seen across rCTs, indicating that day-to-day variations in anatomy lead to fluctuations in SC risk estimates that are at least of the same magnitude as the inter-patient variations. Organ motion effects should therefore also be accounted for in SC risk estimates.

Electronic Poster: Physics track: Treatment plan optimisation: algorithms

EP-1625

A dosimetric analysis of semi-automated knowledge-based VMAT planning for rectal cancer patients

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Purpose or Objective: To compare the dosimetric features of the semi-automated knowledge-based vs. conventional experience-based VMAT planning for pre-operative rectal cancer patients treated with simultaneous-integrated-boosting (SIB) radiotherapy.

Material and Methods: Created by experts following consistent contouring and planning protocols, clinically approved SIB VMAT plans for 150 patients were selected, 80 which were added to the library of Varian RapidPlan to train the DVH estimation model. The other 70 plans were duplicated whose MLC sequences were re-optimized using the model-generated DVH objectives. All plans were normalized to PTV95%≥ 41.8 Gy and PGTV95% ≥ 50.6 Gy before comparing: dose coverage of GTV and CTV; homogeneity index (HI), conformal index (CI), hotspot volume receiving over 107% of prescription (V107%_PGTV), mean dose and dose to 50% volume of femoral head (Dmean_FH and D50%_FH) and urinary bladder (Dmean_UB and D50%_UB) respectively. Average DVHs of 70 patients were plotted. The normally and non-normally distributed data sets were analyzed using paired samples t-test and Wilcoxon signed ranks test respectively, setting P<0.05 as significant.

Results: Identified as potential outlier or influential data points, the plans of 4 FH and 11 UB were reviewed yet abnormality was excluded. The DVH's and geometry-based expected dose's principal component average fit were 0.999126 and 0.999481 for FH, 0.999585 and 0.999429 for UB respectively. More under-dosed GTV and CTV were found in original than the RapidPlan group, but all V100% were over 99% hence were clinically negligible. Difference of CI was insignificant (P=0.051 and P=0.900 for PGTV and PTV respectively), yet RapidPlan improved HI of PGTV and PTV significantly (Mean ± 1SD = 0.05 ± 0.006 for PGTV, and 0.255 ± 0.008 for PTV) relative to the original plans (0.06 ± 0.008 for PGTV and 0.263 ± 0.011 for PTV). Positive V107%_PGTV were observed in 18 original plans, which was significantly higher than the RapidPlan group (none). Table 1 shows RapidPlan significantly reduced the D50%_FH, Dmean_FH, D50%_UB and Dmean_UB respectively. The mean DVH of the 70 testing plans (Figure 1) indicates on the basis of comparable target dose coverage, superior dose falloff and organ sparing were achieved by RapidPlan group.

Table 1. Statistics of dose metrics (Gy) of femoral head (FH) and urinary bladder (UB)

		Mean	SD	95% Confidence Interval		P
				Lower	Upper	
$D_{50\%\ FH}$	Original	15.52	2.17	15.00	16.03	<0.001
	RapidPlan	13.99	1.16	13.71	14.26	
$D_{mean\ FH}$	Original	16.59	2.07	16.10	17.08	<0.001
	RapidPlan	15.30	0.70	15.14	15.47	
$D_{50\%\ UB}$	Original	28.17	3.07	27.44	28.90	<0.001
	RapidPlan	23.24	2.13	22.74	23.75	
$D_{mean\ UB}$	Original	29.34	2.34	28.78	29.89	<0.001
	RapidPlan	25.40	1.36	25.08	25.73	

Abbreviations: SD = standard deviation; $D_{50\%}$ = dose to the 50% volume of the structure; D_{mean} = mean dose; FH = femoral head, and UB = urinary bladder.

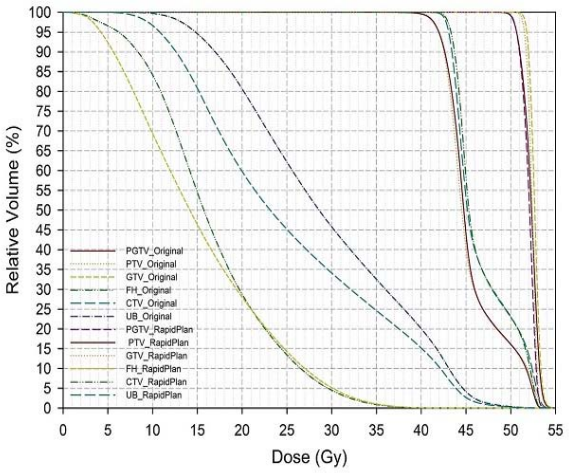

Figure 1. Average DVHs of the 70 testing plans

Conclusion: Knowledge-based radiotherapy significantly enhanced the consistency of the plan quality by improving the target dose homogeneity, hotspot control and normal tissue sparing. The semi-automated process also reduced the planning time.

EP-1626

4D Energy-based minimisation in lung cancer

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Purpose or Objective: According to published guidelines if tumor motion exceeds 0.5 cm, motion management should be utilized in planning and delivery for NSCLC. Dose-volume-based (Dvh) optimization is the most commonly used treatment planning approach in NSCLC IMRT. Energy-based inverse optimization is a novel IMRT planning framework, which is a rival to Dvh optimization. The purpose of this work is to compare Dvh and Energy IMRT planning for time resolved (4D) in NSCLC.

Material and Methods: Sixteen lung cases were studied. In each case, the target range of motion was over 0.5 cm. For each patient five breathing phases were reconstructed from the pre-planning 4D CT. All anatomical structures were outlined on a reference breathing phase and contours were propagated to the other breathing phases. For each phase inverse optimization was performed with Dvh and Energy based objective functions for the organs at risk (OARs), while target objectives were dose based. Each plan utilized seven