JULY 12–16 2020 VIRTUAL JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

Evaluation of a novel automated treatment planning tool for cervical cancer in IMRT

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INTRODUCTION

uRT-TPS is a commercial treatment planning system provided by Shanghai United Imaging Healthcare (UIH), which includes a novel automated treatment planning tool. It is part of the uRT-Linac 506C system, which was installed at our institution since 2016 for clinical trials. The automated treatment planning tool supports customized protocols for various radiotherapy sites and treatment techniques.

uRT-Linac 506C, an one-stop radiotherapy solution which includes an integrated CT-linac, an oncology information system, and a treatment planning system.

AIM

Evaluated the performance of the automated treatment planning tool in UIH uRT-TPS by comparing the automatically generated plans with the manual plans in intensity modulated radiotherapy (IMRT) for patients with cervical cancer in terms of plan quality and planning efficiency.

METHOD

- Ten definitive cervical cancer patients were involved.
- Prescription: PTV1 1.8x25 Gy, PTV2 2x25 Gy.
- Treatment technique: static simultaneous integrated boost (SIB) IMRT.
- For each patient, three plans were generated:
  - Manually, in uRT-TPS by UIH (UIH-M)
  - Manually, in Monaco by Elekta (Monaco-M)
  - Automatically, using UIH automated planning tool (UIH-AP)
- A list of critical clinical goals was derived from our institutional requirements and was used as input to build the customized protocol for automated planning.
- Monte Carlo dose calculation algorithm was used for all plans.
- Dose endpoints of targets and organs at risk were calculated for plan quality comparison.
- The effective planning time were recorded for UIH-M and UIH-AP.

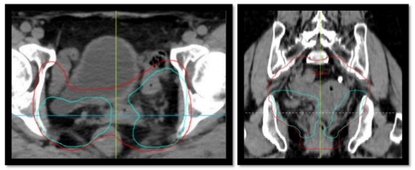


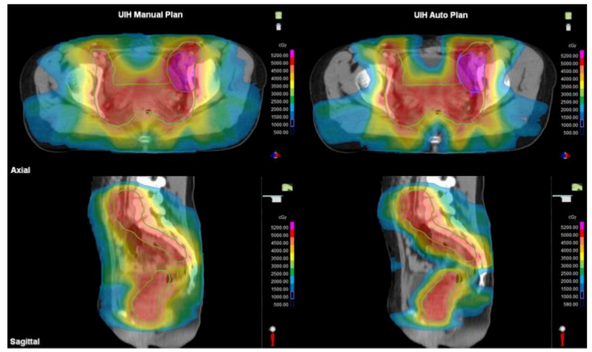
Illustration of a definitive cervical cancer patient target:
- ☐ *PTV1, red*
- ☐ *PTV2, cyan*

RESULTS

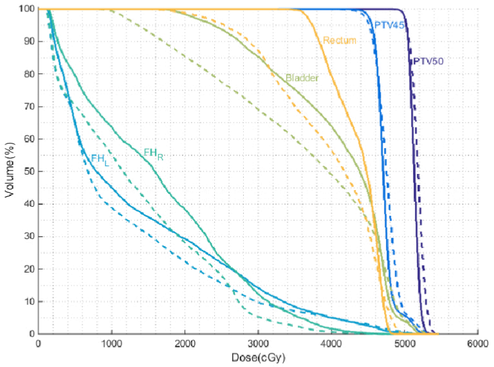
Structure		Monaco-M		UIH-M		UIH-AP		P value*	P value**
		Mean	SD	Mean	SD	Mean	SD		
PTV2 50Gy	Dmean(cGy)	5211	43	5142	35	5170	17	<0.05	0.06
	Dmax(cGy)	5445	100	5285	96	5314	31	<0.05	0.42
	CI	0.539	0.064	0.750	0.088	0.738	0.089	<0.05	0.69
	HI	0.081	0.019	0.050	0.013	0.055	0.005	<0.05	0.25
PTV1 45Gy	Dmean(cGy)	4841	131	4799	87	4815	77	<0.05	0.09
	CI	0.834	0.039	0.862	0.035	0.848	0.025	<0.05	0.05
Bladder	Dmean(cGy)	4267	423	4176	428	4037	466	<0.05	<0.05
	V30Gy(%)	86.1	10.7	83.9	11.4	80.0	12.7	0.09	0.05
Rectum	Dmean(cGy)	4568	277	4526	296	4439	284	0.48	0.16
	V30Gy(%)	96.4	3.2	97.0	5.9	93.2	5.4	0.73	0.07
FH-L	Dmean(cGy)	1850	176	1696	120	1475	158	<0.05	<0.05
FH-R	Dmean(cGy)	1793	156	1611	75	1390	144	<0.05	<0.05

FH-L, left femoral head; FH-R, right femoral head.
*CI, conformity index, CI=(TVPIV2/TV*PIV); TVPIV, target volume receiving more than prescription dose; TV, target volume; PIV, prescription isodose volume;*
HI, homogeneity index, HI=(D2%-D98%)/DP; Dx%, minimal dose to the x% highest irradiated target volume; Dp, prescription dose.
**: UIH-M vs Monaco-M; **: UIH-M vs UIH-AP; a P value of <0.05 was considered statistically significant.*

- All plans fulfilled the clinical goals set for targets and organs at risk, and were acceptable for treatment.
- UIH-M achieved preferred PTV dose conformity (CI), homogeneity (HI) and OAR sparing, while Monaco-M achieved higher PTV mean dose.
- Compared to UIH-M, mean dose of bladder, rectum and femoral heads were improved by 3.33% (p=0.01), 1.93% (p=0.16), 13.03% (p<0.01, left) and 13.69% (p<0.01 right) with UIH-AP. PTV dose conformity and homogeneity of UIH-AP were worse, but the differences were not significant.
- The average effective planning time was 13.4±3.1 minutes using UIH-AP, compared to 23.3±1.3 minutes in UIH-M.



Dose distribution of a treatment plan: left, UIH-M; right, UIH-AP.



Dose-volume histogram comparison: solid, UIH-M; dotted, UIH-AP

CONCLUSION

- uRT-TPS by UIH can be used to generate clinical acceptable plans for cervical cancer radiotherapy both manually and automatically.
- Plans generated by the automated planning tool of uRT-TPS showed significantly improved OAR sparing and comparable target coverage, in comparison with the manual plans.
- The effective planning time of automated planning was substantially lower than that of manual planning.
- Using the automated planning tool has the potential to improve clinical work efficiency without compromise the treatment plan quality.

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ACKNOWLEDGEMENTS

Thanks to Dr. Juying Zhou for her valuable advice on this study.

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