Dosimetric impact of an AI-based delineation software satisfying international guidelines in breast cancer radiotherapy

M. Ung[1], S. Rivera[1,2], A. Rouyar-Nicolas[1,2], E. Limkin[1], C. Petit[1], T. Sarrade[1], A. Carre[1,2], G. Auzac[1], A. Lombard[3], E. Ullman[3], N. Bonnet[4], L. G. Assia[4], N. Paragios[3], C. Huynh[3], E. Deutsch[1,2], and C. Robert[1,2]

[1]Gustave Roussy Cancer Campus, Villejuif, France,
[2]Molecular radiotherapy and innovative therapeutics, INSERM UMR1030, Gustave Roussy Cancer Campus, Université Paris Saclay, Villejuif, France,
[3]Therapanacea, Paris, France,
[4]UNICANCER R&D, Paris, France

Marjolaine.ung@gustaveroussy.fr

PURPOSE / OBJECTIVE

- Automatic delineation (AD) allows time saving, practice harmonization and may result in qualitative improvement
- The objective of this study was to evaluate, based on a retrospective monocentric cohort of breast cancer patients treated before ESTRO delineation guidelines (1), the clinical impact of the use of an Artificial Intelligence (AI)-based solution for organs-at-risk (OAR) and target volume delineation, respecting these guidelines

MATERIAL

- A CE-marked solution for automatic delineation of 80+ organs at risk and target volumes harnessing a unique combination of anatomically preserving and deep learning delineation concept was developed (ARTPLAN™ - Annotate)
- Using transfer learning, the model was re-trained according to the latest ESTRO guidelines (1), through the integration of 256 cases randomly selected from the HYPOG-01 trial (2) (Figure 1)

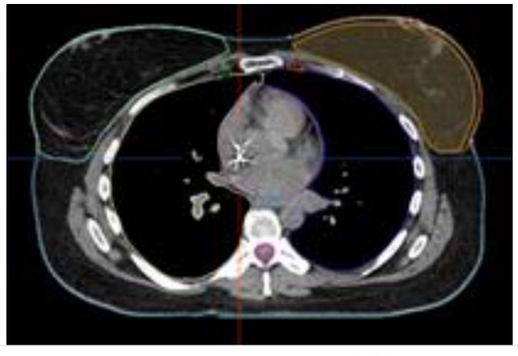

Figure 1. Edited automatic delineation by ARTPLAN™ - Annotate

METHODS

44 patient cases were retrieved

For each case :

- 3D-conformal radiotherapy (3D CRT) was prescribed (50 Gy ; 42,6 Gy or 50 Gy + boost of 16 Gy)
- AD was generated and minor corrections were applied when necessary

Dosimetric maps used in clinic were transferred without plan re-optimization on the AD

Dosimetric values were compared using a Wilcoxon test.

- Qualitative evaluation consisted in scoring each plan as :
- A : Dosimetry accepted
- B : Minor correction required
- C : Dosimetry rejected

Based on the HYPOG-01 dosimetric constraints

CONCLUSION

- Dose constraints were respected for all OARs with AD and MD
- Axillary node delineation should improve coverage of target volumes and AD could contribute to this coverage improvement

REFERENCES

1. Offersen B, Boersma L, ESTRO consensus guideline on target volume delineation for elective radiation therapy of early stage breast cancer, Radiotherapy&Oncology 114(2015) 3-10
2. ClinicalTrials.gov Identifier: NCT03127995

RESULTS

- Dosimetric objectives were met with AD and manual delineations (MD) for all OARs (Table 1)
- Target volumes showed limited coverage in MD and AD, especially for the 50 Gy prescription (Table 1) because all patients had mastectomy and 91% had axillary nodes treatment including internal mammary nodes
- All of them were scored as "B" or "C" in AD configuration (Table 2) as 3D CRT was responsible for field junction undercoverage
- 3/26 cases of 50+16 Gy prescription were scored as "C" in AD (Table 2)
- These previous cases included axillary nodes treatment which were not delineated in MD, showing that the axillary region has been underdosed in clinical practice because of the absence of node delineations

Table 1. Dosimetric comparison between MD and AD for the 50 Gy prescription (mean dose in Gy ; standard deviation) (n=11) - ND: Not Done

	Manual Delineation	Auto Delineation	p-value
CTV Breast			
D95 (Gy)	38.01 (9.44)	37.62 (12.48)	0.58
D2 (Gy)	54.45 (0.96)	54.70 (1.17)	0.06
Dmean (Gy)	49.16 (2.00)	49.23 (2.22)	0.41
Volume (cm³)	399.49 (195.09)	386.49 (204.51)	0.21
Axillary Level			
CTV Level 3 (D95, Gy)	ND	41.98 (3.64)	
CTV Level 4 (D95, Gy)	ND	44.02 (2.82)	
CTV IMN (D95, Gy)	ND	18.10 (9.09)	
Ipsilateral lung			
V20 (%)	21.75 (5.18)	17.40 (3.34)	0.10
Dmean (Gy)	11.31 (2.04)	11.67 (2.08)	0.10
Heart			
V20 (%)	2.98 (2.23)	2.78 (1.96)	0.41
V40 (%)	1.27 (1.70)	1.74 (2.23)	1.00
Spinal cord			
Dmax (Gy)	5.96 (6.03)	5.18 (4.23)	0.67

Table 2. Qualitative evaluation of all dosimetries

Prescribed dose	42.4 Gy			50 Gy			50 Gy + boost 16 Gy		
	A	B	C	A	B	C	A	B	C
Manual Delineation	3/7 (43%)	4/7 (57%)	0/7 (0%)	2/11 (18%)	3/11 (27%)	6/11 (55%)	24/26 (92%)	2/26 (8%)	0/26 (0%)
Auto Delineation	3/7 (43%)	4/7 (57%)	0/7 (0%)	0/11 (0%)	8/11 (73%)	3/11 (27%)	22/26 (85%)	1/26 (3.5%)	3/26 (11.5%)