

Clinical Review and Analysis of 4DCBCT Acquisitions for LUNG SABR

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Aim/Objectives:

To develop a methodology to use 4DCBCT to assess target coverage accounting for tumour motion during treatment, integrating this easily within the carepath and allowing users to feel confident with the review process and subsequent decisions.

Methods:

In Phase1, 4 patients had a 4DCBCT at their Day 0 session, acquired on a Varian Truebeam(v2.7). The 4DCBCT was visually reviewed offline to check that the lesion movement was within the PTV. This dataset was used to design/test a method for calculating PTV coverage (Eq.1[1]) and 110% dose volume coverage metrics. This included a clinician voluming the lesion on one phase, deformable propagation across all phases and a script written calculating target coverage. Ten patients are being recruited to Phase2, with visual inspection and Target Coverage calculation performed prior to treatment.

$$Target\ coverage\ (\%) = \frac{\sum_{i=1}^{10} (V_{GTV_{4DCBCT_i}} \cap V_{PTV})}{\sum_{i=1}^{10} V_{GTV_{4DCBCT_i}}} * 100\% \quad Eq1$$

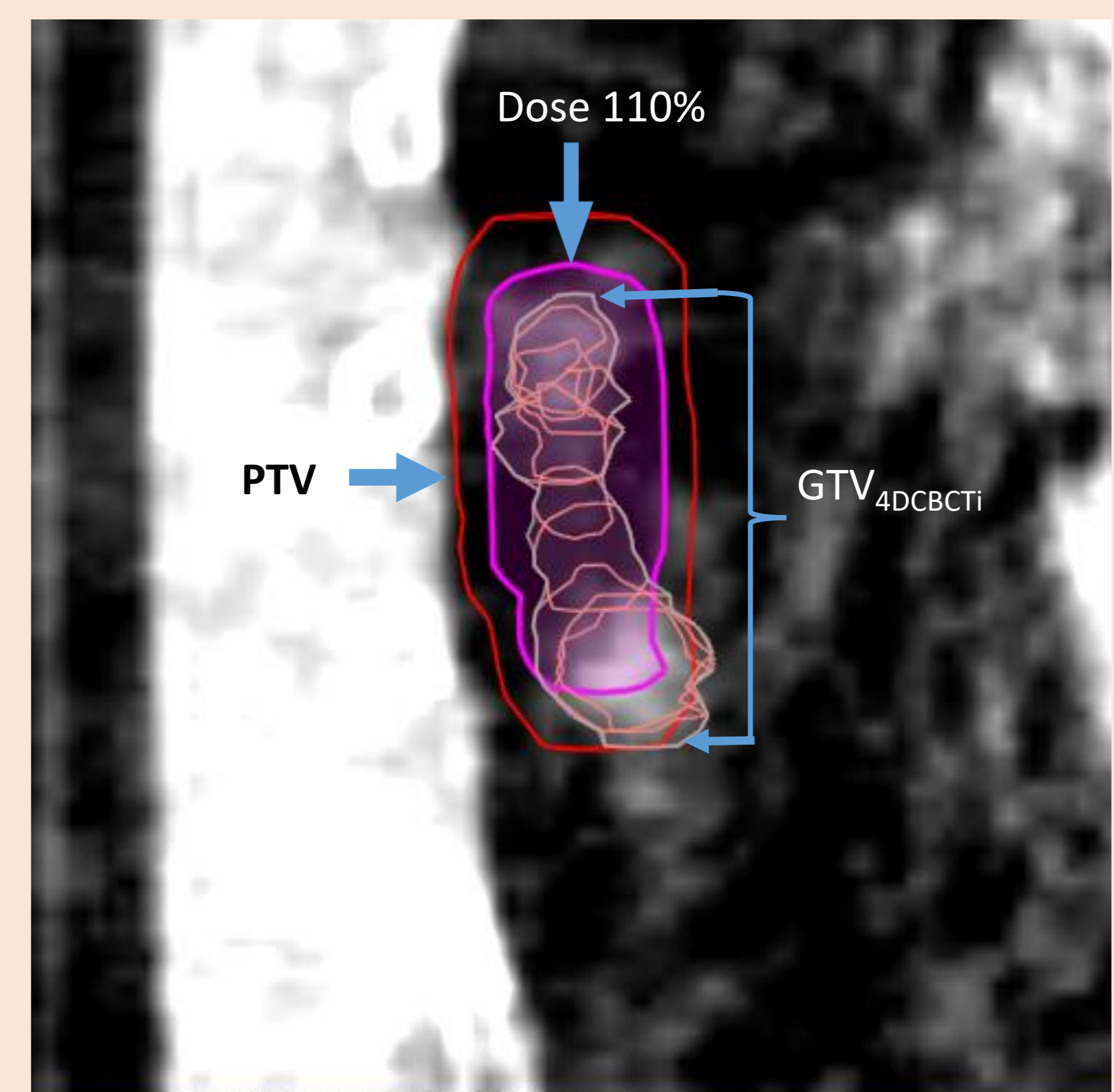


Figure 1 Patient 5 phase 0 4DCBCT, showing GTV_{4DCBCTi} from all 10 phases.

Results/Outcomes

- Table1 summarises our Phase2 results to date, with reduced 110% target coverage of 81.3% for patient 5 reflecting an incorrect match.
- Visual inspection of the 4DCBCT also suggested an alteration to the online 3D Day 0 match in patient 5.
- Overall, excellent PTV coverage results were in agreement with visual inspection.
- On completion of our Phase2 pilot, 4DCBCT will be used routinely.
- Verification of tumour motion several weeks after planning CT is possible, in line with ESTRO ACROP guidelines [2].

Patient	Tumour Location	Target Coverage (%)	
		PTV	Dose 110[%]
1	RU lobe	98.9	98.9
2	RU Lobe	99.6	98.1
3	LU Lobe	99.7	97.0
4	RU Lobe	99.7	98.6
5	LL lobe	98.0	81.3
6	RU lobe	99.5	99.4
7	RU Lobe	99.7	99.3

Table 1

Conclusions

This pilot gives us confidence that visual inspection is sufficient and PTV margins are adequate. However, if there is uncertainty, Physics will investigate using the tested method to calculate the Target Coverage metrics.

References

1. Bellec, J., Arab-Ceschia, F., Castelli, J. et al. (2020) ITV versus mid-ventilation for treatment planning in lung SBRT: a comparison of target coverage and PTV adequacy by using in-treatment 4D cone beam CT. Radiat Oncol 15(54),1-10.
2. Guckenberger M, Andratschke N, Dieckmann K, Hoogeman MS, Hoyer M, Hurkmans C, et al. (2017) ESTRO ACROP consensus guideline on implementation and practice of stereotactic body radiotherapy for peripherally located early stage non-small cell lung cancer. Radiotherapy and Oncology 124(1), 11–17.