Inter-observer delineation uncertainty in radiotherapy of peripheral lung tumours

Introduction: Delineation uncertainties are important as they contribute to systematic errors and can lead to geographical miss of the target. As the true gross tumour volume (GTV) is unknown, delineation error can only be estimated. In this study we evaluate the inter-observer delineation variation for peripheral lung tumours in our clinic with the aim of designing appropriate population based treatment margins. Patients and methods: A cohort of 22 (all) patients referred for stereotactic radiotherapy of early lung cancer or lung metastasis (total of 26 tumours) in our clinic in 2008 was included in the study. In our clinical protocol the contrast enhanced PET/CT scan is primarily analysed by a specialist in nuclear medicine and a radiologist together. The PET positive volume is delineated by the specialist in nuclear medicine and only the CT scan and this contour is imported to Eclipse (Varian Medical Systems) where GTV delineation is done by an oncologist and a radiologist together. In this study delineations were done independently, with a fixed broad window (-1000 to 700 HU), by three clinical oncologists and three radiologists. For each slice the centre of volume (CoV) of all contours was identified. For each patient the standard deviation of the distances from the CoV to each contour in 24 equally spaced angles in all slices (SDtrans) was considered a measure for inter-observer delineation uncertainty in the transversal plane. For the cranio-caudal (CC) direction the centre of the CoV of all contours was calculated and the distance from this centre of CoV to the most cranial and the most caudal slice of each contour was found. For each patient the SD of the absolute value of these distances (SDcc) gives a measure of the inter-observer delineation variation in the CC-direction. The means of SDtrans and SDCC respectively for all tumours were considered measures of the inter-observer delineation uncertainties for our clinic. All analysis was done in MatLab version 2007b. Results: Results are listed in table 1. The overall interobserver uncertainties were 0.14 mm (SDtrans) and 0.26 mm (SDCC), and the uncertainties were significantly larger for the radiologists compared to the oncologists in both directions (Wilcoxon signed rank test, two-tailed significance level, p <0.05). Conclusion: The inter-observer uncertainties in this study are small compared to earlier, similar studies. This is probably caused by the very homogeneous patient population, the uniform use of PET information and that all observers except one were recruited from the same institution. Nevertheless, delineation error contributes to the highly weighted systematic part of the probabilistic margin computation, and remains a major source of uncertainty in modern radiotherapy, where set-up uncertainties have been significantly reduced.

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