

Supplementary material for Mattonen SA, et al. Distinguishing radiation fibrosis from tumour recurrence after stereotactic ablative radiotherapy (SABR) for lung cancer: A quantitative analysis of CT density changes, Acta Oncologica, 2013;52:910–918.

Supplementary Appendix 1

Scan parameters

Planning scans used for treatment planning were acquired using four-dimensional (4D) CT (Lightspeed 16; GE Medical Systems, Waukesha, USA) at 140 kVp, 100–110 mAs, and a 2.5 mm slice thickness. 4D CT was completed using free breathing with binning by respiratory phase. Pre-treatment 4D CTs used for image analysis were maximum inspiration of each patient.

For the purposes of this analysis, diagnostic CT scans taken post-treatment were used. All diagnostic CT scans done at the treating centre were performed on one of three scanners [Siemens Volume Zoom 4-slice, Siemens Sensations 64-slice (Siemens Nederland N.V., Den Haag, Netherlands) or Philips Brilliance iCT 256-slice (Royal Philips Electronics, Inc., Amsterdam, Netherlands)]. Standard machine settings for post-treatment scans were 120 kVp, 100 mAs, spiral acquisition, 0.5 second rotation time, and 2.5–5 mm slice thickness. Scans were acquired at inspiratory breath hold and 70 cm³ of intravenous contrast [Ultravist-300; Bayer Pharma AG, Berlin, Germany] was administered with a delay of 25 seconds.

Importing and contouring

All images were received in an anonymised form and imported into ClearCanvas Workstation 2.0 (ClearCanvas Inc., Toronto, Canada). Contouring was completed in ITK-SNAP (Version 2.2.0) [15] using a lung window setting (window width of 1500 HU and window level of –600 HU), and a mediastinal window setting (window width of 350 HU and window level of 40 HU) for tumours or fibrosis abutting the mediastinum. Contours were manually segmented slice-by-slice using a polygon tool and/or paintbrush tool.

Calculation of measures

Response Evaluation Criteria In Solid Tumours (RECIST) measures were taken using the ClearCanvas Workstation ruler, for the consolidative areas on the pre- and post-treatment images, according to RECIST 1.1. MATLAB 7.13 (The MathWorks Inc., Natick, MA, USA) was used in the calculation of 3D volume and CT density measures for both the consolidative and ground glass opacity contours. 3D volume was calculated by determining the voxel volume encompassed by the contours, based on the voxel dimensions. The number of voxels contained within each contoured region was determined and then multiplied by the voxel volume to determine 3D volume of each contoured region. CT density was determined based on the mean intensity values (HU) of all voxels in each contoured region of interest.

Analysis of measures

The measures were analysed cumulatively from the treatment end date until a specific follow-up time point. The follow-up time points used in this study included 3, 6, 9, 12, 15, 18, 21, 24, 36, and 42 months post-treatment. For a given time point, all images up to that time point were used in the analysis. For a given lesion, the following cumulative measures were calculated: 1) RECIST – Mean of all RECIST measures per scan; 2) CT density – Mean of all voxels' intensities (HU); 3) Standard deviation of CT density – Standard deviation of all voxel intensities (HU); and 3D volume – Mean of all 3D volume measures per scan.

Differences between groups were assessed using an independent samples t-test with unequal variances in MATLAB 7.13 (The MathWorks Inc., Natick, MA, USA). All statistical tests were two-sided with $p \leq 0.05$ indicative of statistical significance.