Visualization of the left anterior descending coronary artery on computed tomographic images used for the planning of breast radiation treatments

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Introduction

RT has demonstrated a strong clinical benefit in patients with breast conservative surgery or patients with radical mastectomy who are at high risk for relapse.

Unfortunately, this benefit was counterbalanced by an increased risk of death from cardiac events, most trials did not consider cardiac toxicity in its entirety.

Favourable and unfavourable effects on long-term survival of radiotherapy for early breast cancer: an overview of the randomised trials.

Purpose

The voxel aspect of this study was to assess the visualization of the left anterior descending coronary artery (LAD) on CT images that were used for RT planning of a homogenous population of patients.

These patients had two CT scans in the treatment position before and after surgery. The first CT was performed with contrast media and the second CT without contrast.

we analyzed the doses received by the heart and by the LAD.

Methods

CT-Scanning

The imaging protocol consisted of a pre-op CT scan in the treatment position using IV to see the tumour bed, a post-op CT scanner without IV, also in the treatment position, was used for treatment planning.

The contouring of the LAD coronary artery was performed using the Eclipse® TPS. Contouring was attempted on each CT (50 image series) using the heart atlas proposed by Feng et al.

The delineation of the LAD artery was achieved by one radiologist and one radiation oncologist independently on the 2 sets of images for the 25 patients.

A Student paired t-test (p value of < 0.05) was used to compare the number of CT slices where the LAD was visible (LAD) for each patient on the 2 series, for each observer.

only the left-sided breast cancer (11 patients) were considered, 3D reconstructions of the whole LAD were performed using a linear interpolation that was available in the TPS when the artery was not contiguous due to a lack of visibility on some slices.

Doses to 2% of the interpolated LAD volume (D2%) as well as the volumes of heart receiving more than 5 Qy (V5Qy) and more than 25 Qy (V25Qy) respectively were reported.

Results

The 3D reconstruction of the artery showed artifacts on its cranial extremity leading to a structure with a thickness superior to its actual thickness. In addition, the reconstructed structure presented some missing segments especially in the caudal part of the artery.

For the radiologist, the median KLA0 was 12 (range 4-24) on the contrast enhanced CT and 11 (range 5-20) on the CT without IV.

The paired Student t-test concluded to a non significant difference between the results with and without IV (p = 0.34 for the radiologist; p = 0.90 for the radiation oncologist).

Discussion

The creation of a PRV for the coronary artery would imply the measurement of these movements:

- a study using cardiac gating could lead to the evaluation of the margins needed to construct a PRV of the artery

- Using structure interplay tools to approximate its location as well as the lack of PRV margins may have lead to imprecise dose reporting and inaccurate dose-volume histograms.

There is also need to improve the imaging protocols commonly used in the radiation therapy field in order to better localize heart arteries and improve the quality of dose reporting.

Potential benefits of using cardiac gated images to reduce the dose to the left anterior descending coronary during radiotherapy of left breast and internal mammary nodes.

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