IN THE SPOTLIGHT: 4D DYNAMIC CONTRAST-ENHANCED DEDICATED BREAST CT

A PHANTOM STUDY FOR THE VALIDATION OF A NOVEL IMAGING TECHNIQUE

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1. Introduction

Four-dimensional dynamic contrast-enhanced dedicated breast CT (4D DCE-bCT) is a novel imaging technique aimed at characterizing breast tumours by monitoring the wash-in and wash-out of an iodinated contrast agent.[1] This information could enhance tumour characterization and treatment. However, optimal imaging protocols must be established before clinical implementation.

2. Objectives

We aim to develop breast and tumour perfusion phantoms that simulate clinically relevant time-intensity curves (TICs) with known ground truth for validating time-dependent iodine concentration estimates in 4D DCE-bCT.

3. Methods

The phantoms include a 3D-printed breast, filled with olive oil to simulate fatty tissue, a fibroglandular tissue insert to mimic background parenchymal enhancement, and gyroid-structured tumour phantoms to simulate tumoral microvasculature.[2] Programmable syringe pumps control contrast and water flow. Additionally, an in-line optical spectroscopy system monitors iodine concentrations at the phantom's entrance and exit.[3] The phantom was used for 4D DCE-bCT imaging, with a programmed wash-in time of 100 s, to 4.5 mg I/mL, and wash-out over 200 s. The time-dependent iodine concentration estimates from the bCT were compared to those from the optical system.

4. Results

Optical TICs captured wash-in to 4.2 mg I/mL in 100 s and wash-out over 200 s, while 4D DCE-bCT acquisitions of the phantom showed wash-in up to 3.9 mg I/mL with similar wash-out timing. The discrepancy highlights potential areas for improving the bCT reconstruction.

5. Conclusion

Overall, our breast phantom provides a valuable platform for quantitatively validating the imaging process, marking a significant step toward clinical implementation of 4D DCE-bCT.

6. References

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