

Chest Tomosynthesis for Detection and Surveillance of Pulmonary Pathology

Studies on Cystic Fibrosis and Solid Pulmonary Nodules

Akademisk avhandling

som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet
kommer att offentlig försvaras i hörsal Arvid Carlsson, Academicum, Medicinaregatan 3, Göteborg,
den 5 September 2019, klockan 09:00

av

Carin Meltzer

Fakultetsopponent:

Docent Sophia Zackrisson

Diagnostisk radiologi, Malmö, Lunds Universitet

Avhandlingen baseras på följande delarbeten:

- I. Meltzer C, Båth M, Kheddache S, Ásgeirsdóttir H, Gilljam M, Johnsson Å A.
Visibility of structures of relevance for patients with cystic fibrosis in chest tomosynthesis: influence of anatomical location and observer experience.
Radiation Protection Dosimetry 2016;169(1-4):177-187.
- II. Meltzer C, Gilljam M, Vikgren J, Norrlund RR, Vult von Steyern K, Båth M, Johnsson Å A.
Surveillance of pulmonary pathology in cystic fibrosis – comparison between digital chest tomosynthesis and computed tomography.
Submitted
- III. Meltzer C, Vikgren J, Bergman B, Molnar D, Norrlund R R, Hassoun A, Gottfridsson B, Båth M and Johnsson Å A.
Detection and characterization of solid pulmonary nodules at digital chest tomosynthesis: data from a cohort of the pilot Swedish CArdioPulmonary bioImage Study.
Radiology 2018;287(3):1018-1027.
- IV. Meltzer C, Fagman E, Vikgren J, Molnar D, Borna E, Beni M M, Brandberg J, Bergman B, Båth M, Johnsson Å A.
Surveillance of small, solid pulmonary nodules at digital chest tomosynthesis: data from a cohort of the pilot Swedish CArdioPulmonary bioImage Study
Submitted

SAHLGRENKA AKADEMIN
INSTITUTIONEN FÖR KLINISKA VETENSKAPER



Chest Tomosynthesis for Detection and Surveillance of Pulmonary Pathology

Studies on Cystic Fibrosis and Solid Pulmonary Nodules

Carin Meltzer

Department of Radiology, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

Abstract

Introduction: Digital tomosynthesis (DTS) is a relatively new imaging modality in thoracic imaging. The technique is based on the equipment of conventional radiography, upgraded with a moving tube that enables separation of structures that are superimposed on chest x-ray (CXR). DTS has proven to be superior to CXR in detection of pathology, as well as a problem-solver for inconclusive findings in CXR, and has also been suggested as a low-dose / low-cost alternative to computed tomography (CT). However, the number of studies comparing DTS with CT are limited. Consequently, the overall aim of this thesis was to compare pulmonary imaging in DTS with CT, and to investigate the potential for DTS to serve as an alternative to CT. The performance of DTS was evaluated in terms of visualization, characterization, detection and follow-up of structural changes for two groups that often undergo multiple CT examinations; patients with cystic fibrosis (CF), and individuals with incidental solid pulmonary nodules.

Methods: Visibility of anatomical structures in CF was studied by a head-to-head comparison of concurrently performed CT and DTS (*Paper I*). Estimation of extent of disease was quantified by modality-specific scoring methods on CT, DTS and CXR, in two sets of examinations for each participant, separated by three years (*Paper II*).

The studies on pulmonary nodules were based on individuals recruited from the pilot study of the population-based Swedish CARdioPulmonary bioImage Study (SCAPIS), with incidental solid nodules requiring follow-up detected on chest CT. Participants were examined by DTS in addition to routine CT for surveillance of nodule growth. Detection rates and recommendation for follow-up were independently assessed on DTS and compared to CT (*Paper III*). Nodule size and change of size between two examinations were estimated by diametrical measurements on DTS and semi-automated derived diameters and volume on CT (*Paper IV*).

Results: The studies on CF showed equal or superior visibility of anatomical structures in DTS in 48% of the cases. Structures in the anterior, posterior and lower parts of the lungs were less well depicted than those located in the central and lateral parts. Perceived visibility varied significantly among the observers (*Paper I*). Inter-modality correlation between DTS and CT for assessment of extent of disease was very strong regarding total severity score as well as sub-scores of bronchiectasis and bronchial wall thickening, which are key findings in CF (*Paper II*).

Nodule detection rates in DTS were between 48 and 62% for nodules measuring 5-10 mm in diameter, with a reduced number of nodules recommended for follow-up compared to CT (*Paper III*). An acceptable inter-modality agreement of average diameter, but lower agreement compared to volumetric estimates on CT was found (*Paper IV*).

In conclusion, the results indicate that DTS could be an alternative to CT in surveillance of patients with CF, and for follow-up of well-depicted solid nodules. Further studies including cases with progressive disease are warranted.

Keywords: Digital Tomosynthesis, Cystic Fibrosis, Solid Lung Nodules