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Computed Tomography of the Coronary Arteries: Developmental and Prognostic Investigations

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Background and aim:

Computed tomography (CT) is an increasingly used modality for investigations of patients with suspected coronary artery disease (CAD). Technical advances could improve diagnostic accuracy and lead to clinical workflow improvements. Also, more prognostic information can optimize clinical follow-up strategies and treatments.

The general aim of this thesis was to explore the use of CT for CAD investigations. Three studies aimed to examine new technologies, including the evaluation of an on-site, computed tomography-based fractional flow reserve (CT-FFR) software (study I), the evaluation of an AI-based, calcium scoring computed tomography (CSCT) software (study III), and the evaluation of an photon-counting detector (PCD)-CT (study IV). One study aimed to evaluate the long-term prognostic value of coronary computed tomography angiography (CCTA) in symptomatic patients with no history of CAD (study II).

Material and methods

The software evaluation studies (study I and III) and the prognostic study (study II) utilized CT data from clinical patients, while the PCD-CT evaluation study (study IV) used CT data from cadaveric specimens. The performances of both software programs were compared with standard references, being represented by fractional flow reserve (FFR) measurements (study I), and coronary artery calcification (CAC) scores from a semi-automatic software (study III), respectively. The PCD-CT performance on CAC quantification was compared with corresponding results from an energy integrating detector (EID)-CT, using micro-CT as the standard reference (study IV). The prognostic study merged registries to identify major adverse cardiac events (MACE), having a follow-up time of up to 7.5 years (study II).

Results:

The CT-FFR and CSCT software correlation and agreement to corresponding standard references were good and excellent, respectively. Also, both software programs had time-saving potential (study I and III). The CAC quantification was more accurate using PCD-CT than EID-CT (study IV). The prognosis was excellent in patients with normal coronary arteries, and progressively impaired in non-obstructive and obstructive CAD (study II).

Conclusions:

The results in this thesis convey developmental, technical CT technology advances for CAD investigations. In addition, prognostic follow-up data is communicated. The results may benefit patients by an increased accuracy in the CT evaluation of CAD and can contribute to improve clinical follow-up strategies. Furthermore, the results suggest possibilities to improve the workflow in clinical radiology, which potentially could impact health care costs.