Feasibility of a New C-arm angiography (DYNA-CT) based three-dimensional algorithm in combination with myocardial perfusion assessment

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Introduction

“conflict of interest”

G. Lauritsch is employe of Siemens Health Care Sector. H. Rittger received speakers honoraria from Siemens.
Introduction

advantages

- fast
- reliable

“eye-balling”
Introduction

disadvantages

- overestimation of stenosis degree
- high intra- and interindividual variability
- foreshortening effects

“eye-balling”
Introduction

Quantitative Coronary Angiography

**Advantages**

- Objective
- Reproducible
- And valid tool for quantification of coronary artery stenoses
- Newer systems with high reliability even in complex stenoses
Introduction

3D- coronary reconstruction

Optimal Next Projection: RAO 18 CRAN 16

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A three dimensional reconstruction of the coronary tree is nowadays usually performed using multidetector computed tomographic angiography whereas myocardial perfusion deficits are assessed by SPECT, cardiac MRI or MSCT using dedicated scanning protocols.

A precise reconstruction of the coronary arteries in combination with an information about the perfusion situation in the supplied myocardium might also be desired to facilitate complex coronary interventions.
Introduction

- An algorithm has been developed to obtain the image data acquired by a conventional C-arm during rotational angiography and to perform a 3-dimensional reconstruction.

- This approach has been successfully established for the assessment of non moving structures like the cerebral arteries.

- Imaging of fast moving objects like the heart and the coronaries remains challenging in this setting.
Introduction

3D-reconstruction of the LAA and RA
C-arm computed tomography (CACT) is a technology, that utilizes an x-ray tube/detector system to create a 3D image of a portion of the body.

This is accomplished by rotating the C-arm laterally around the patient while collecting an array of equally spaced 2D x-ray projection images and then using algorithms to reconstruct a 3D image.

Introduction
DYNA-CT

- the way it works -

Figure 1: [left and right panel] C-arm rotation with 60°/sec during a 5 second acquisition run; [mid] the result is a 3D dataset in 512-matrix

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The aim of our study was to prove the feasibility of a new C-arm based three-dimensional reconstruction algorithm of the coronary arteries in combination with myocardial perfusion assessment.
During the 7s run 133 projections were acquired along a 198° arc (99° RAO to 99° LAO view). ECG-tracing was performed to enable a retrospective gating. A 3D-reconstruction technique was applied, and an initial reference 3D image at the desired cardiac phase was reconstructed from 20 projection images selected by ECG gating showing the coarse structure of the coronary tree.
Further, all projection data were separated in 10 groups according to their associated cardiac phase, and used for reconstruction of intermediate 3D images. The intermediate 3D images were registered to the reference 3D image and accumulated yielding a tomographic 3D image.
Methods I

1. Template for registration. 2. Achieved by ECG-gating from just a few projection images.


Figure 2: Creation of motion corrected tomographic reconstruction
The perfusion assessment was performed during the myocardial phase of the contrast transit. The resulting dataset was reconstructed and analyzed using short axis and long axis maximum intensity projections (MIP) with 5mm slice thickness.

Methods II

myocardial perfusion assessment
Approx. 7-10 cc contrast dye was manually injected over 7 seconds in the ostium of the left or right coronary artery via conventional Judkins coronary catheters. The CACT was done during the myocardial phase of the contrast transit.

myocardial perfusion assessment
The resulting dataset was reconstructed and analyzed using short axis and long axis maximum intensity projections (MIP) with 5mm slice thickness by two observers blinded to the results of the other studies. The presence or absence of perfusion defects was noted using a standardized assessment scheme with MRI serving as the standard of reference.
Results

• In 20 Patients, referred for PCI and participating in the myocardial perfusion study, a rotational coronary angiography using a monoplane C-arm system (Artis zee; Siemens, Erlangen, Germany) was performed.

• Perfusion deficits were detected as mentioned
Results

- 20 pts.; mean age 71±9 ys; 15 male, 5 female.

- After this a fusion of the 3D-reconstructed coronary tree with the perfusion image was executed. In all 20 cases the LCA was contrasted.

- This fusion was feasible in all patients with a good imaging of the whole coronary tree and the perfusion situation of the myocardium
Methods
Results

Comparison DYNA-CT and MRI:
212 segments were analyzable by CACT and MRI. Perfusion defects were visible 71/212 (33%) by CACT and 72/212 (34%) by MRI. Sensitivity, specificity and NPV were 67%, 84% and 83%.
These data suggest, that simultaneous motion corrected C-arm-CT reconstruction of coronary arteries and perfusion imaging is feasible. This method can support the physician during interventional procedures esp. in decision making during complex recanalisation procedures.
Feasibility of a New C-arm angiography with a three-dimensional algorithm in combination with myocardial perfusion assessment.

Thank you very much for your attention!

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