# Diagnosis of Reversible Myocardial Ischemia using Dynamic CT Perfusion: Confirmation by $^{15}$O-labelled Water PET/CT

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## History

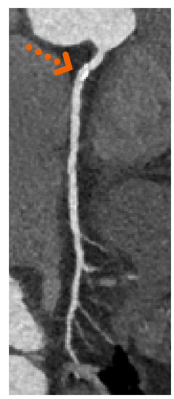
A 72-year-old male patient, suffering from diabetes mellitus and elevated triglyceride levels, was admitted for surgical resection of an adrenal tumor. Echocardiography was performed for preoperative cardiovascular assessment. This revealed a regional hypokinesis in the posterior wall of the left ventricle. A cardiac CT and a $^{15}$O-labelled water PET/CT were requested for further evaluation.

## Diagnosis

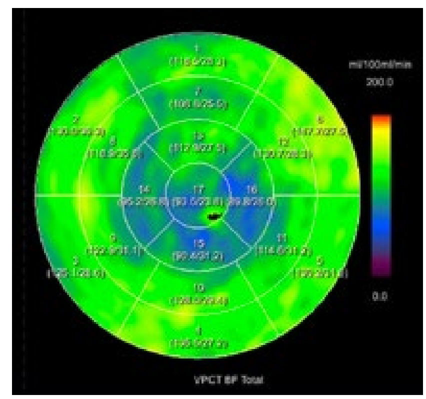
Coronary CT angiography images depicted a high grade stenosis caused by non-calcified plaques in the proximal left anterior descending artery (LAD, Fig. 1a), and a mild stenosis caused by calcified plaques in the proximal right coronary artery (RCA, Fig. 1b). The circumflex artery (Cx) was hypoplastic, and no plaques were seen in the left-main coronary artery (LM).

1a

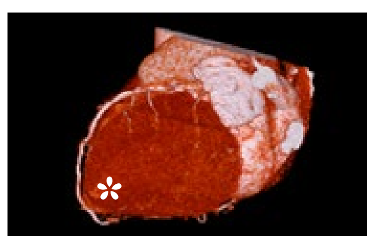
1b



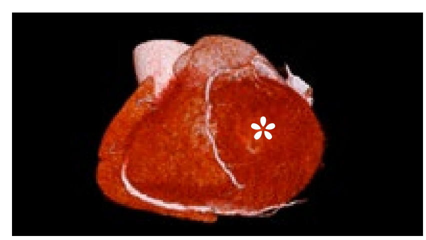
2a



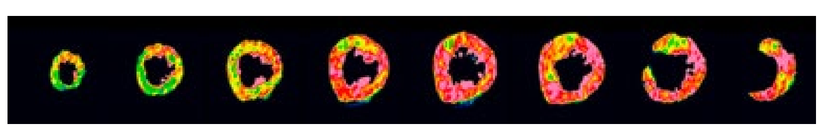

2b



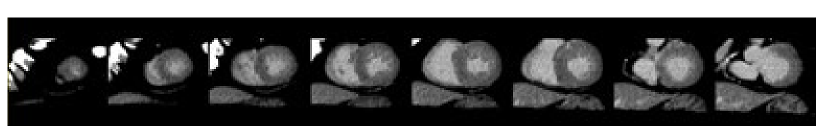
2c



3a



3b



1 Curved MPR images of the LAD (Fig. 1a) and the RCA (Fig. 1b) show a high-grade stenosis in the proximal LAD (Fig. 1a, arrow) and a mild stenosis in the proximal RCA (Fig. 1b, dashed arrow).

2 A polar map of myocardial blood flow derived from dynamic CT perfusion shows reduced perfusion in the anterior and apical segments (Fig. 2a). Volume rendering images (Figs. 2b and 2c) show LAD wrapping around the apex (asteriks).

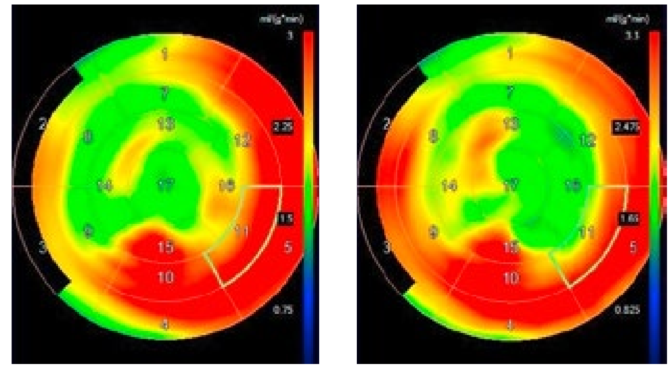
3 Short axis images of myocardial blood flow map (Fig. 3a) and delayed enhancement CT (Fig. 3b) show no evidence of infarction in the area with reduced perfusion.

Myocardial blood flow maps, derived from dynamic CT perfusion, revealed a significant reduction of blood flow in the area subtended to the LAD (Figs. 2a and 3a).

Delayed enhancement CT showed no abnormal enhancement and no evidence of infarction in the area with reduced perfusion (Fig. 3b).

Quantitative polar maps of myocardial perfusion obtained from $^{15}O$-labelled water PET/CT also demonstrated reduced myocardial blood flow under stress and myocardial perfusion reserve in the LAD territory (Fig. 4).

4a 4b



4 Polar maps of myocardial blood flow (Fig. 4a) and myocardial perfusion reserve (Fig. 4b) obtained from $^{15}O$-labelled water PET/CT demonstrate reduced perfusion in the anterior and apical segments showing good agreement with the CT-derived polar map (Fig. 2a).

## Comments

Cardiac CT has evolved from the morphological assessment of coronary arteries to the assessment of myocardial perfusion and viability. As exemplified above, a comprehensive cardiac CT examination can provide almost all needed information to guide patient management and develop therapeutic strategies. Dynamic CT perfusion, which had been limited by relatively high radiation and insufficient z-axis coverage, has broadened its clinical applicability since the introduction of SOMATOM Force. This new system allows higher tube current at lower tube voltage and has a 96-row detector covering 10.5 cm in the cardiac shuttle mode.

$^{15}O$-labelled water PET/CT imaging is considered the gold standard for the quantitative assessment of myocardial perfusion because $^{15}O$-labelled water is a freely diffusible agent and the extraction fraction is not affected by flow rates or the metabolic state of the myocardium. However, despite promising results in the research context, its availability is extremely limited. As shown here, dynamic CT perfusion can provide quantitative parametric maps that agree well with $^{15}O$-labelled water PET/CT. ●

## Examination Protocol

| Scanner | SOMATOM Force | | |
|---|---|---|---|
| Scan area | Left ventricle | Heart | Left ventricle |
| Scan mode | Stress myocardial perfusion | cCTA (Seq.) | Delayed enhancement CT |
| Scan length | 105 mm | 120 mm | 105 mm |
| Scan direction | shuttle | Cranio-caudal | shuttle |
| Scan time | 32 s | 5 s | 8 s |
| Tube voltage | 70 kV | 80 kV | 80 kV |
| Tube current | 182 mAs/rot. | 247 mAs/rot. | 278 mAs/rot. |
| Dose modulation | CARE Dose4D™ | CARE Dose4D™ | CARE Dose4D™ |
| $CTDI_{vol}$ | 24.2 mGy | 10.4 mGy | 15.8 mGy |
| DLP | 255.8 mGy cm | 128.1 mGy cm | 167.2 mGy cm |
| Effective dose | 3.6 mSv | 1.8 mSv | 2.3 mSv |
| Contrast | | | |
| Volume | 40 mL | 60 mL | – |
| Flow rate | 5 mL/s | 4.7 mL/s | – |
| Start delay | 4 s | Bolus tracking | – |
| Scan timing | Adenosine infusion<br>start<br>↓ 3 min<br>scan | Adenosine infusion<br>release<br>↓<br>Nitro<br>↓ 5 min<br>scan | cCTA<br>↓ 3 min<br>scan |