SUPPLEMENT

Supplementary Materials

Dynamic CT-MPI + CCTA Protocol

The scan range of dynamic CT-MPI was determined based on the calcium score images to cover the entire left ventricle and all coronary arteries. A fixed volume of contrast media (50 mL, Ultravist, 370 mg iodine/mL, Bayer) was administered in a bolus injection at a rate of 6 mL/s in all participants, followed by a 40 mL saline flush using a dual-barrel power injector (Tyco, Cincinnati). Dynamic CT-MPI acquisition was initiated 4 seconds after the beginning of contrast injection. The end-systolic phase (triggered at 250 ms after the R wave in all participants) was set for dynamic acquisition by using a shuttle mode technique with a coverage of 10.5 cm for complete imaging of the whole left ventricle. Scans were launched every second or third heart cycle according to the participant's heart rate, resulting in a series of 10 to 15 phases acquired over a fixed period of 32 seconds. The acquisition parameters of dynamic CT-MPI were as follows: collimation = 96 x 0.6 mm, CARE kV with reference tube voltage = 80 kVp, rotation time = 250 ms, CARE dose 4D with effective current = 300 mAs, reconstructed slice thickness = 3 mm, and reconstructed slice interval = 2 mm.

Coronary CT angiography (CCTA) was performed using a bolus-tracking technique, with regions of interest placed in the ascending aorta. A bolus of contrast media was injected into the antecubital vein at a rate of 4–5 mL/s, followed by a 40 mL saline flush using a dual-barrel power injector. The amount of contrast media was determined according to the patient's body weight (patients with body mass index < 18 kg/m^2 were injected with 40 mL contrast media at 4 mL/s, patients with body mass index of 18–24 kg/m^2 were injected with 50 mL contrast media at 4.5 mL/s, and patients with body mass index > 24 kg/m^2 were injected with 60 mL contrast media at 5 mL/s). Prospective electrocardiogram-triggered sequential acquisition was performed in all participants for CCTA, with the acquisition window covering from 35% to 75% of the R-R interval, with collimation = 96 x 0.6 mm, reconstructed slice thickness = 0.75 mm, reconstructed slice interval = 0.5 mm, rotation time = 250 ms and application of automated tube voltage and current modulation (CAREKv, CAREDose 4D, Siemens Healthineers). The reference tube current was set to 320 mAs and the reference tube voltage was set to 100 kVp.

CT-FFR Simulation

This study used an machine learning (ML)-based CT-fractional flow reserve (FFR) calculation algorithm (cFFR, version 3.0, Siemens Healthineers) as an alternative to the physics-based approach for the on-site calculation of CT-FFR values. The algorithm is trained using a synthetically generated database of 12000 different anatomies of coronary arteries with randomly placed stenosis among different branches and bifurcations. Computational fluid dynamics was applied by solving reduced-ordered Navier–Stokes equations to calculate the pressure and flow distribution for each coronary tree. The quantitative features of the anatomy and computed CT-FFR values were extracted for each location along the coronary tree. Then, a deep ML model was trained using a deep neural network with four hidden layers to learn the relationship between the FFR value and quantitative anatomic features.

For on-site processing, after the CCTA data were successfully loaded, the centerline and luminal contours for the whole coronary tree were automatically generated. The centerline and luminal contour were fundamental and critical information for computing the CT-FFR value. They were manually adjusted as required. The users then manually identified all stenotic lesions to extract the geometrical features required for the cFFR algorithm. Finally, these data were input into the pre-learned model and cFFR was computed automatically at all locations in the coronary arterial tree. The resulting values were visualized using color-coded three-dimensional coronary maps.