Perfusion imaging and coronary anatomy

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Myocardial perfusion imaging is a functional test that does not provide information about coronary artery anatomy. However, the most common indication for perfusion imaging is to detect coronary artery disease (CAD) and more specifically identify significant stenosis in the large epicardial arteries. Therefore, when reporting the perfusion imaging, the results are commonly assigned to vascular territories supplied by the main coronary arteries.

This assignment is mostly based on standard myocardial segments that are assigned to three myocardial regions typically supplied by the left anterior descending coronary artery (LAD), left circumflex coronary artery (LCX), or right coronary artery (RCA). While doing this, it is well known that this assignment is subject to errors since individual coronary anatomy varies a lot.

The most well-known variability is the dominance of either right or left coronary tree. This leads to individual variability in blood supply to lateral and inferior left ventricle walls. Less commonly acknowledged variability deals with the anterolateral wall (LAD vs. LCX) and septum (LAD vs. RCA).

The study by Thomassen et al.2 investigated whether the assignment of perfusion findings with the coronary anatomy using the standard segmental model rather than true individual anatomy will have impact on the accuracy of the imaging test.

The authors analysed PET perfusion images of 44 patients with suspected CAD using both standard segment assignment and individual assignment. The individual assignment was based on the coronary computed tomography (CT) angiography and hybrid images. The reference standard for significant obstructive CAD was invasive quantitative coronary angiography.

They found that individual definition of vascular territory deviated from that of standard model in 23 of 44 (52%) patients. However, only 39 out of 748 (5%) myocardial segments were reassigned to other vascular territory than in the standard model. Most of the re-assigned segments were transferred from the LCX to the LAD territory. Only in one patient the myocardial blood flow in an individualized coronary territory deviated enough to change the test from a false positive to a true negative in this particular vessel territory.

Naturally the reassignment does not have any impact on whether the test is interpreted as abnormal or normal at patient level, but may have impact on which of the main coronary arteries are affected by a haemodynamically significant stenosis. The authors conclude that although roughly half of patients have regional reclassification of segments, this hardly affects the overall diagnostic accuracy.

Interestingly, reclassification occurred most commonly in lateral wall segments potentially supplied by either the LAD or the LCX. Less commonly, the apical and septal segments were realigned when individual coronary anatomy became available. The authors report also having hard time to convincingly reassign septal segments between LAD and RCA, since the small intramural arteries are challenging to follow. However, the realignment occurred between RCA and LCX in none of the patients.

The most commonly recognized variability of coronary anatomy is left or right dominance of the coronary tree. In the right dominance, which is the most common anatomy, the inferior septum and inferior wall are supplied by the RCA and its branches. In the left dominance, the LCX is supplying perfusion towards these regions. It is not uncommon that with left dominance the RCA does not supply the left ventricle at all, but only the right ventricle. The incidence of right coronary artery dominance has been reported to be 82–86%, the left dominance 9–12%, and co-dominance 5–6% in previous reports.3,4

None of the patients in the study of Thomassen et al. had a posterior descending artery supplying the inferior wall originating from the LCX. This is likely due to small patient population and explains why the results are somewhat different than the results of previous reports5 in which image fusion provided more benefits than obtained in the current study.

What is the clinical message of the study? The simplest answer is to not recommend assigning perfusion findings into specific coronary arteries at all if individual coronary anatomy is not known. When reporting only the location and severity of perfusion findings, no mistakes can be done. However, if the assignment is reported, it must be done cautiously. This study demonstrates that, in addition to well-known errors in assignment of inferior wall, there may also be challenges in assigning anterolateral wall and septum.

Whatever is the assignment to coronary anatomy, the segmental division has its inherent limitations. Perfusion defects very seldom follow the predefined segmentation and mechanical reporting of mean perfusion values within the whole predefined vascular...
Optical coherence tomography can visualize the pulmonary artery in Williams–Beuren syndrome

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Williams–Beuren syndrome (WBS) is caused by a microdeletion at the 7q11.23, including the ELN gene. In the absence of elastin, pervasive subendothelial migration and proliferation of smooth muscle cells cause occlusion of the vascular lumen. We assessed peripheral pathological findings of the pulmonary artery (PA) in a 3-year-old girl and a 9-year-old boy with WBS by optical coherence tomography (OCT). We measured PA wall thickness in 2 patients and 20 normal children. Representative cross-sectional OCT images of PA in a control subject (Panel A) and two children with WBS (Panel B and C) are shown. The images show that the PA wall comprised a single layer with homogeneous signal-rich bands. The PA wall thickness in control group was 0.14 ± 0.30 mm. The wall thickness was increased in WBS (0.29 and 0.33 mm, respectively). Furthermore, the vasa vasorum (arrowheads) was abundant in the dense adventitial layer. The pulmonary alveoli were indicated by ‘a’ in Panels. The arterial wall thickening in WBS is characterized by expansion of the media caused by an increased number of lamellar units. Furthermore, recent studies indicate that adventitial fibroblasts in the pulmonary circulation comprise a critical regulator of vascular wall function. Vascular diseases are frequently accompanied by prominent development of the vasa vasorum, which contributes to vascular remodelling. This is the first report to describe that OCT can reveal pathological abnormalities of the PA in patients with WBS.

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