Procedural step. A drug eluting stent (DES) (3.0 x 36 mm) was successfully implanted from LAD ostium to mid LAD (Figure 4). There was no residual stenosis and coronary blood flow was excellent. After stenting, fractional flow reserve (FFR) was measured at distal LAD during maximal vasodilation with intravenous infusion of adenosine, and its value was 0.73, even though there was no angiographically significant residual stenosis (Figure 4). To exclude the possibilities of unexpectedly very low FFR after stent implantation, pullback pressure tracing under sustained hyperemia and IVUS were performed. The pullback pressure tracing revealed that the pressure (Pd) gradually increased without major step-up from distal LAD to left main and pressure drift was not observed. The IVUS revealed that the stent apposition was good and there was no complication as mentioned above (Figure 5A). However, diffuse plaque was noted at mid to distal LAD, which did not seem to be significant in angiography (Figure 5B). However, it was not clear that those angiographically hidden plaques could cause very low FFR.

In order to find an answer to the discordance between angiography and FFR, treadmill test and 14-N ammonia positron emission tomography (PET) was conducted. The result of treadmill test was suggestive of positive. In PET study, there was a perfusion decrease in LAD territory (Figure 6). The maximal flow was 1.83 ml/min/g and coronary flow reserve (CFR) was 2.15.

Case Summary. Post-stenting FFR, which was 0.73, indicated that myocardial ischemia still exist in LAD territory without visible stenosis. The cardiac PET can be a good judge in the arguments between angiography and FFR. The PET CFR was 2.15 which meant that borderline ischemia may present in LAD territory, although it was more than 2.0. In this case, the influence of diffuse downstream stenosis, which was shown by IVUS study, was the answer to “visual-functional mismatch”. The delicate understanding of anatomy, physiology of coronary blood flow and pressure, which are derived by each modalities, is required to make a correct diagnosis and treatment of coronary artery disease.

TCTAP C-213
Treatment Planning Using Virtual Coronary Stenting and Computed Tomography-derived Computed Fractional Flow Reserve
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[CLINICAL INFORMATION]
Patient initials or identifier number. PMS

Relevant clinical history and physical exam. A 67-year old male patient was admitted for invasive coronary angiography (ICA) for evaluation of possible significant coronary artery disease. He complained exertional chest pain which was developed 2 months ago. The past medical history was unremarkable except hypertension which has been treated since 3 years ago.

Relevant test results prior to catheterization. The treadmill test showed significant ST segment depression in inferior leads at stage 3, which was recovered at 5 minutes after exercise. The coronary CT angiography showed significant stenosis which was consisted with 50-70% stenosis at proximal LAD, 60% stenosis at LCX ostium, accompanied with tandem focal 90% stenosis at distal LCX segment.
Relevant catheterization findings. The ICA showed focal 60% stenosis at proximal LAD and LCX ostium, and tandem 90% stenosis at distal LCX segment, as with the findings of CCTA. The FFR under maximum hyperemia induced by 140ug/min of intravenous adenosine showed 0.72 at distal LAD and 0.52 at distal LCX. The pullback tracing of pressure wire from distal LCX to mid LCX portion showed major step-up of FFR, however, there was no step-up across the LCX ostial lesion, which suggested functionally insignificant LCX ostial lesion.

INTERVENTIONAL MANAGEMENT

Procedural step. Since there was serial stenosis in LCX territory, the functional significance of LCX ostial stenosis was the key to determine the treatment planning regarding bypass surgery or PCI. If LCX ostial stenosis was significant, bypass surgery or complex elective 2-stenting should be considered, however, if LCX ostial stenosis was not functionally significant, simple stenting for the proximal LAD lesion and distal LCX lesion might be considered. If we can predict FFR of LAD and LCX ostium and serial stenosis in distal LCX before the invasive procedure, this complex procedure might be more simplified or even be avoided. The FFRCT derived with computational fluid dynamics using 3-dimensional models from CCTA data showed 0.64 in LAD and 0.61 at distal LCX segments. Virtual coronary stenting was performed by modifying the computational model in the region of the distal LCX stenosis to enlarge the lumen of the stenosis to the proximal and distal reference areas. FFRCT of the LCX ostial lesion was 0.83 after virtual stenting of distal LCX lesion. The patient was treated with PCI to the distal LCX and proximal LAD lesion. The follow-up SPECT showed no reversible perfusion decrease and the patients was free from angina.
Case Summary. If the virtual PCI with treatment planning was possible before the ICA, the infusion of intravenous adenosine, interrogation of the pressure into LAD or LCX lesion, pullback of the pressure wire, and re-wiring into the distal LCX lesion might be omitted. If the LCX ostial lesion was functionally significant after virtual stenting to the distal LCX lesion, the patient might be even avoided the ICA and directly referred to the bypass surgery. To summarize, treatment planning using noninvasive FFRCT and virtual stenting is feasible and may be helpful in determining optimal re-vascularization strategies before invasive procedure.

TCTAP C-214
Coronary Intervention to Grafted Left Anterior Descending Artery Lesions Using Fractional Flow Reserve
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Relevant clinical history and physical exam. An 82 year-old man, who was underwent coronary artery bypass grafting (the left internal mammary artery [LIMA] to the left anterior descending coronary artery [LAD]) 4 years before, was admitted to our hospital for congestive heart failure. His coronary risk factors were hypertension and diabetes mellitus.
Relevant test results prior to catheterization. His electrocardiogram and echocardiogram were normal.
Relevant catheterization findings. The left coronary artery angiogram demonstrated a severe stenotic lesion in the distal left main involving the proximal LAD and the ostium of the ramus intermedius branch, while the distal portion of the LAD was not fully opacified (movie1). The right coronary artery angiogram showed no significant stenosis (movie2). The graft angiogram showed a severe stenosis of the LIMA in the anastomosis site (movie3). Fractional flow reserve (FFR) of the LAD was 0.50.