

A GRAFT WITHIN A GRAFT: A CASE OF COMPLEX CORONARY FRACTIONAL FLOW RESERVE

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Introduction:

The 1-year patency rate of bypass grafts has been prospectively correlated with the functional severity of the native coronary stenosis. However, left internal mammary artery (LIMA) patency has shown to be over 96% to the Left Anterior Descending Artery (LAD) at 10 years. As a result, LIMA has been extensively used and LIMA-LAD has been a staple in Coronary artery bypass graft (CABG) over the past 3 decades. Assessment of atherosclerotic coronary bypass graft lesions remains a challenge, especially when surrounding vascular disease concomitantly exist. We present a very challenging case of a patient who had CABG and left subclavian stenosis leading to coronary steal phenomena from the LIMA to LAD assessed by Fractional Flow Reserve (FFR).

Case Presentation:

A 61-year-old male with history of coronary artery disease (CAD) status post 3 vessel CABG (LIMA-LAD, SVG-OM1, SVG-RPDA) 1-year prior, history of left subclavian stenosis status post left carotid-subclavian bypass graft, history of cerebrovascular accident, and tobacco abuse presented with typical chest pain. His vital signs were stable. Physical examination revealed normal heart sounds, and intact equal bilateral upper extremities pulse.

EKG showed normal sinus rhythm with ST-depressions in the lateral leads. Laboratory tests showed negative cardiac enzymes. Transthoracic echocardiogram showed reduced LV systolic function, ejection fraction 35-40%, without regional wall motion abnormalities. Nuclear stress test showed medium size ischemia involving the mid to distal anterior wall and apex. A decision was made to perform diagnostic coronary angiography via right radial access which showed severe native coronary artery disease, occluded SVG-OM1 and occluded SVG-RPDA.

Procedural Technique:

Selective angiography using 6 Fr JR4.0 catheter showed patent LIMA to mid LAD without anastomotic lesion. Keeping in mind the extent of anterior wall ischemia on the nuclear stress test, a steal phenomenon was suspected, and a decision was made to proceed with FFR of the LIMA. Theoretically, equalization in the aorta reflects pressure changes as a result of both subclavian stenosis and any possible steal syndrome. One of the challenges we encountered was passing the FFR wire from the left subclavian artery to the aorta. The FFR wire was advanced from the JR4.0 guide catheter through the subclavian graft. Due to difficulties advancing the pressure wire, we used a versaturn wire to provide support up to the left common carotid artery down to the aorta. The FFR wire was advanced over the versaturn wire to ascending aorta, then the versaturn wire was removed followed by equalization. The pressure wire was subsequently retracted to the left subclavian artery, and advanced down the LIMA to distal LAD. A baseline FFR value recorded at 0.82, and 0.71 at maximal hyperemia which deemed physiologically significant. Live pullback of the FFR wire into the ostium of LIMA graft revealed FFR of 0.94 which is lower than FFR of 1.0 in the ascending aorta.

Evaluation of the left carotid to subclavian bypass revealed normal flow without pressure change. Normal flow was noted in retrograde fashion into the proximal left subclavian and mammary origin. We theorized that the decrease in flow between left subclavian artery and distal LAD may be related to possible steal phenomenon from a large cervical branch of the mammary artery with very proximal take off near the left subclavian artery. This has led to anterior wall ischemia which is demonstrated by nuclear stress test and confirmed by FFR.



Image 1: Left subclavian angiography demonstrating the cervical branch just proximal to the LIMA origin leading to steal syndrome.

Discussion:

Fractional flow reserve (FFR) is a well-validated tool for assessment of native coronary artery stenosis. This is a particularly interesting topic of study, as the 5-year follow-up of the FAME-II trial revealed significantly lower rate of death, myocardial infarction, or urgent revascularization with FFR-guided PCI strategy of native coronary artery disease.

Left subclavian steal is a phenomenon where an alteration of circulation patterns leads to a reduction in the blood flow directed to the coronary circulation. It is associated with certain medication such as dipyridamole, or new patterns of blood vessel growth. Our patient had severe left subclavian stenosis status post bypass graft to left common carotid with a cervical branch causing steal phenomena from the LIMA. FFR was used to detect the effect of this phenomena on coronary blood flow from the LIMA graft attached to the LAD artery. Equalization must be done at the ascending aorta, in addition to evaluating any pressure difference across the left carotid-subclavian bypass graft in order to obtain a reliable FFR value in the setting of tandem stenotic vascular beds.