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ATHEROSCLEROTIC PLAQUE REGRESSION: CAUSE OF BYPASS GRAFT OCLUSSION

Cojocaru Lucia[1,2], Avram Anamaria[3], Chioncel Valentin[3], Rusali Andrei[1], Parepa Irinel [1,2]

[1] Faculty of Medicine, University ”Ovidius” of Constanța
[2] Emergency Clinical COunty Hospital of Constanța, Cardiology Clinic
[3] Emergency Clinical Hospital ”Bagdasar-Arseni”, Bucharest

Lucia Cojocaru

Emergency Clinical Hospital of Constanta, Cardiology Clinic
Tomis Boulevard No 145, Constanta, Romania
email: bostanlucia@yahoo.com
phone: +40 722370635

ABSTRACT

We present a case of a patient who had coronary artery bypass grafting during surgery for severe aortic stenosis. Seven months after surgery the arterial graft was occluded following native coronary artery disease regression. The heart team must consider this possibility when assessing the requirement for bypass grafts in a borderline lesion.

Keywords: bypass graft, atherosclerotic plaque regression, atherosclerosis

Introduction

Atherosclerosis is a systemic disease characterized by narrowing of blood vessels due to the formation of atheromatous plaque or atheroma(1). Atheroma is the deposition of fatty material and cholesterol within the inner wall of arteries that makes arterial lumen stenotic (1).

Generally, atherosclerosis was viewed as a progressive, nonremitting disease. Although the concept of plaque regression was earlier refuted, recent case reports (2-4) and studies (5-10) have showed atherosclerosis regression to be a realistic goal in some patients (1). Plaque regression, as viewed today, delves over the prospect of treating vulnerable plaques beyond just stabilization (1). It emphasizes on aggressive and/or long-term therapy (especially lipid modifying therapies - statins) for the reduction in plaque volume and the reversal of the arterial endothelium to its normal functional state (1). Not only lifestyle changes and aggressive lipid-lowering therapy can retard the progression of atherosclerotic lesions and promote the disease regression. Changes in the anatomy and hemodinamics after coronary artery bypass grafting (CABG) can significantly affect the evolution of coronary atherosclerosis (11).

We present a case of coronary artery bypass occlusion following native coronary artery disease regression in a patient who had CABG

during surgery for severe aortic stenosis.

Clinical Case

A 77-years old woman, with hypertension, dyslipidemia, diabetes mellitus, rheumatoid arthritis and hypothyroidism, with bioprosthetic aortic valve (Medtronic 21) replacement in November 2015 for symptomatic severe aortic stenosis and CABG with the left internal mammary artery (LIMA) to the left anterior descending artery (LAD) for 70% stenosis of LADII during the time of aortic surgery presents for moderate effort angina. A computerized tomography coronary angiography performed in June 2016 revealed total occlusion of the bypass graft from its origin from left subclavicular artery till its attachment in the middle third of the LAD.

The clinical exam revealed an overweight patient with a blood pressure of 130/80mmHg, heart rate of 55 bpm, without signs of pulmonary or systemic stasis.

Electrocardiogram (ECG) on admission: sinus rhythm, 60bpm, QRS axis = 0 degree, negative T waves in V1-V3 (similar to the previous ECGs) and isolated premature atrial beat (Figure 1).

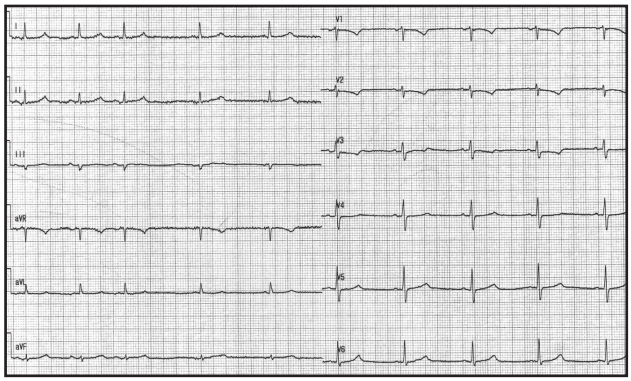

Figure 1: Electrocardiogram on admission (description in text)

Laboratory tests revealed a mild normochromic, normocytic anemia, transitory azotate retention, hyperglycemia, normal myocardial necrosis markers and a lipid profile with normal total cholesterol (152mg/dl), LDL-cholesterol (68.2mg/dl) and HDL-cholesterol (50mg/dl) with mild hypertriglyceridemia (169mg/dl).

On echocardiography there was mild left ventricular hypertrophy, preserved left ventricular ejection fraction (55%), type I diastolic dysfunction, mitral regurgitation second degree and normal aortic prosthetic valve function (Figure 2).

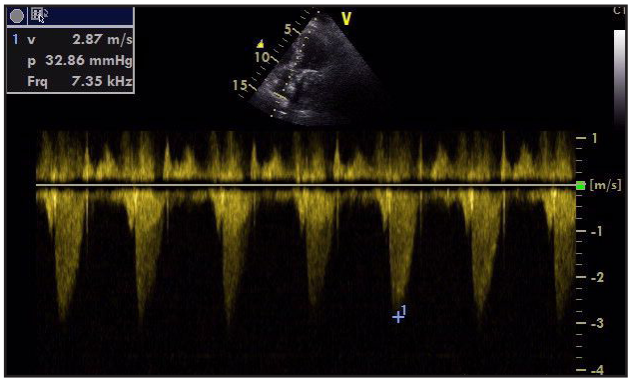

Figure 2: Echocardiography – Continuous wave Doppler showing normal peak gradient across the aortic prosthetic valve

The coronarography confirmed the occlusion of the arterial bypass graft (Figure 3) and revealed a 50% stenosis of LAD at the emergence of 2nd diagonal branch (Figure 4) (as opposed to the 70% stenosis at the same level on the pre-surgery evaluation) (Figure 5) and a 50-60% stenosis of the intermediary branch.

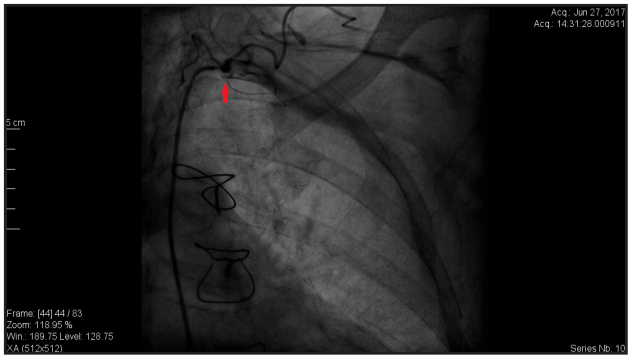

Figure 3: Coronarography from June 2017 showing occlusion of the arterial bypass graft from its origin (red arrow)

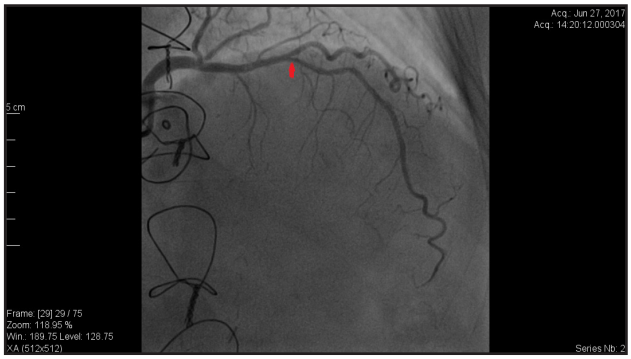

Figure 4: Coronarography from June 2017 showing image from 2015 showing 50% stenosis of LAD at the emergence of 2nd diagonal branch (red arrow)

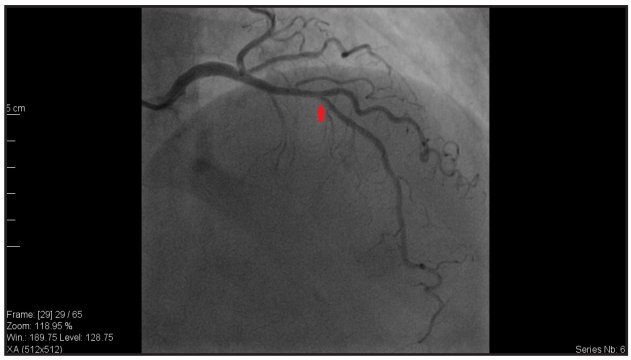

Figure 5: Coronarography from June 2015 showing 70% stenosis of LAD at the emergence of 2nd diagonal branch (red arrow)

Given the stable character of the angina and the insignificant coronary stenosis the heart team decided in favor of the conservative approach with optimized medical treatment (antiplatelet therapy, beta-blocker, ivabradine, long lasting nitrate, sartan and statin).

Discussion

Aortic valve stenosis is the most common valvular heart disease in the elderly population and frequently occurs in conjunction with coronary artery disease (CAD) (12-14). More than 50% of patients with aortic stenosis over 70 years of age also have CAD (15)[15]. This strong association is thought to be due to common physiopathology and shares similar risk factors (age, smoking, hypertension and hyperlipidemia) (16, 17).

Although there has never been a randomized controlled trial of surgical aortic valve replacement (SAVR) with or without CABG of concomitant CAD at the time of the surgery [16], the combined approach is the one recommended by the current practice guidelines. The American College of Cardiology, the American Heart Association, the European Society of Cardiology and the European Association for Cardio-Thoracic Surgery guidelines on valvular heart disease advocate (Class I recommendation) that patients undergoing aortic valve replacement who have significant CAD (≥70% reduction in luminal diameter in major coronary arteries) should be treated by bypass grafting (18, 19). This recommendation is based more on opinion than evidence. In patients undergoing aortic valve replacement that also have significant CAD, the combination of CABG and SAVR reduces the rates of perioperative myocardial infarction, perioperative mortality, late mortality, and morbidity when compared with patients not undergoing simultaneous CABG, even though the combined operation carries a small but real increased risk of mortality (18). The survival benefit was seen mostly in those that received a LIMA to the LAD (16, 20) as was the case with our patient.

Patency rates for arterial grafts are very good (at 10 years are as high as 95 percent) (21). The cases in which the arterial graft develops a stenosis or becomes occluded early after the surgery are related to operative issues (ie, technical harvest problems, distal anastomotic technique, perioperative management, including the variable use and timing of antiplatelet therapy, vasospasm, and statin therapy) and patient-related anatomical issues (proximal stenosis, presence of competitive flow in the bypassed vessel, size of distal vessel, as well as plaquing and diffuse disease in the bypassed vessel) (22).

In our patient the most probable cause for graft failure was the competitive flow in the native bypassed vessel due to the regression of the atherosclerotic stenosis. The question that arises is what was responsible for this regression? It is known that aggressive cholesterol lowering with statins slows progression of atherosclerosis, reduces new lesions' formation or even causes atheroma regression and the beneficial effects of increased HDL-cholesterol are also recognized (3, 23-25). A LDL-cholesterol/HDL-cholesterol ratio under 1.5 was associated with the regression of plague (24, 26) which was the case with our patient where this ratio was 1.3. The bypass grafting can also have an influence on native coronary artery disease regression. Data derived from the RAPCO trial (Radial Artery Patency and Clinical Outcomes) showed that 45% of the patients who had CABG surgery demonstrated regression in 1 or more native coronary vessels (11). These data shown that native coronary lesions were more likely to exhibit regression in females and diabetic patients, if the revascularized coronary vessels where in the left circulation and in those with pre-existing severe stenosis (more than 70%) (11). Arterial grafts appear to protect

the native circulation against disease progression and might also induce regression due to them being metabolically active (their endothelium is able to release vasoactive substances and endothelial progenitor cells) (11, 27). The regression of the disease in the native vessel will, in turn, affect arterial graft patency by increasing the coronary flow competition to the graft and will double the risk of graft failure (11).

Taking into account these data particular attention must be paid to the evaluation of the degree and significance of a coronary stenosis prior to CABG, which in patients with severe aortic stenosis is very challenging. Angina is present in a patient with severe aortic stenosis even in the absence of significant CAD so it can't be used to determine the significance of a stenosis, and an ECG stress test is contraindicated in these patients. Given inter- and intraobserver variability with visual assessment of the coronarographyc stenosis, we need a more objective method. Quantitative Coronary Analysis can be used but it can be inaccurate in extremely tortuous and calcified vessels which are common in patients with severe aortic stenosis, and in this circumstance intracoronary imaging might more useful (16, 28). The fractional flow reserve is not validated in severe aortic stenosis (16) and the instantaneous wave-free ratio is under investigation (29).

Conclusions

Regression of native coronary artery disease can be observed in close to one half of patients after CABG and can be a cause for graft failure. The heart team must take this into account when assessing the indication of CABG, especially in a borderline lesion, when they will have to use an objective method to determine the degree and significance of the stenosis.

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