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CASE REPORT
Adult congenital heart disease

Stenting of aortic coarctation before coronary artery bypass surgery in an adult with acute myocardial infarction: a case report

Marco Tomasino [1]*, Filipa Valente [1,2], Pau Rello Sabatè [1], Gerard Martì Aguasca[1,3], and Berta Miranda Barrio [2,3,4]

[1]Department of Cardiology, Vall d'Hebron University Hospital, Paseo Vall d'Hebron 119, Barcelona 08035, Spain; [2]Centro de Investigación Biomédica en Red de Enfermedades Cardiovasculares (CIBERCV), Instituto de Salud Carlos III (ISCIII), Madrid, Spain; [3]Integrated Adult Congenital Heart Disease Unit, Department of Cardiology, Vall d'Hebron Hospital Universitari, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain; and [4]European Reference Network for Rare, Low-prevalence, or Complex Diseases of the Heart (ERN GUARDHeart), Amsterdam, the Netherlands

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Background Aortic coarctation is a major risk factor for high blood pressure and atherosclerotic disease development. Evidence is lacking regarding the treatment of acute coronary syndrome in patients with untreated aortic coarctation.

Case summary A 50-year-old male with a history of hypertension, diabetes, and haemodynamically significant untreated aortic coarctation presented to the emergency department with non-ST-elevation acute myocardial infarction. Coronary catheterization showed severe three-vessel disease. The aortic coarctation was addressed percutaneously using a covered CP stent. A quadruple coronary artery bypass surgery was conducted the following day. He was discharged home 10 days after surgery.

Discussion We describe a successful sequential approach involving the percutaneous repair of a native aortic coarctation followed by a surgical myocardial revascularization in the context of acute coronary syndrome. Discussion within a multidisciplinary Heart Team is key in patients with such complexity.

Keywords Aortic coarctation • Acute myocardial infarction • Multivessel disease • Coronary artery bypass graft • Congenital heart disease • Case report

ESC curriculum 3.2 Acute coronary syndrome • 7.5 Cardiac surgery • 9.1 Aortic disease • 9.7 Adult congenital heart disease • 7.4 Percutaneous cardiovascular post-procedure

Learning points

- Untreated coarctation of the aorta leading to longstanding hypertension is a significant cardiovascular risk factor.
- In the context of an acute coronary event, it is safe to proceed with CABG surgery following percutaneous treatment of aortic coarctation.

Introduction

Coarctation of the aorta (CoA) is characterized by an abnormal narrowing of the aorta, typically due to a ridge situated in the posterolateral wall of the aorta, opposite the ductus arteriosus. Coarctation of the aorta is a risk factor for the long-term development of high blood pressure, coronary artery disease, and stroke, among others. When technically feasible, percutaneous stenting is the current standard for the treatment of adults with CoA.[1,2] In patients with CoA and chronic coronary artery disease, the performance of coronary artery bypass (CABG) surgery has been reported in the literature.[3,4] However, evidence regarding the treatment of acute coronary syndrome in patients with untreated aortic coarctation is lacking.

* Corresponding author. Tel: +34 934893000, Email: marcotomasino21@gmail.com
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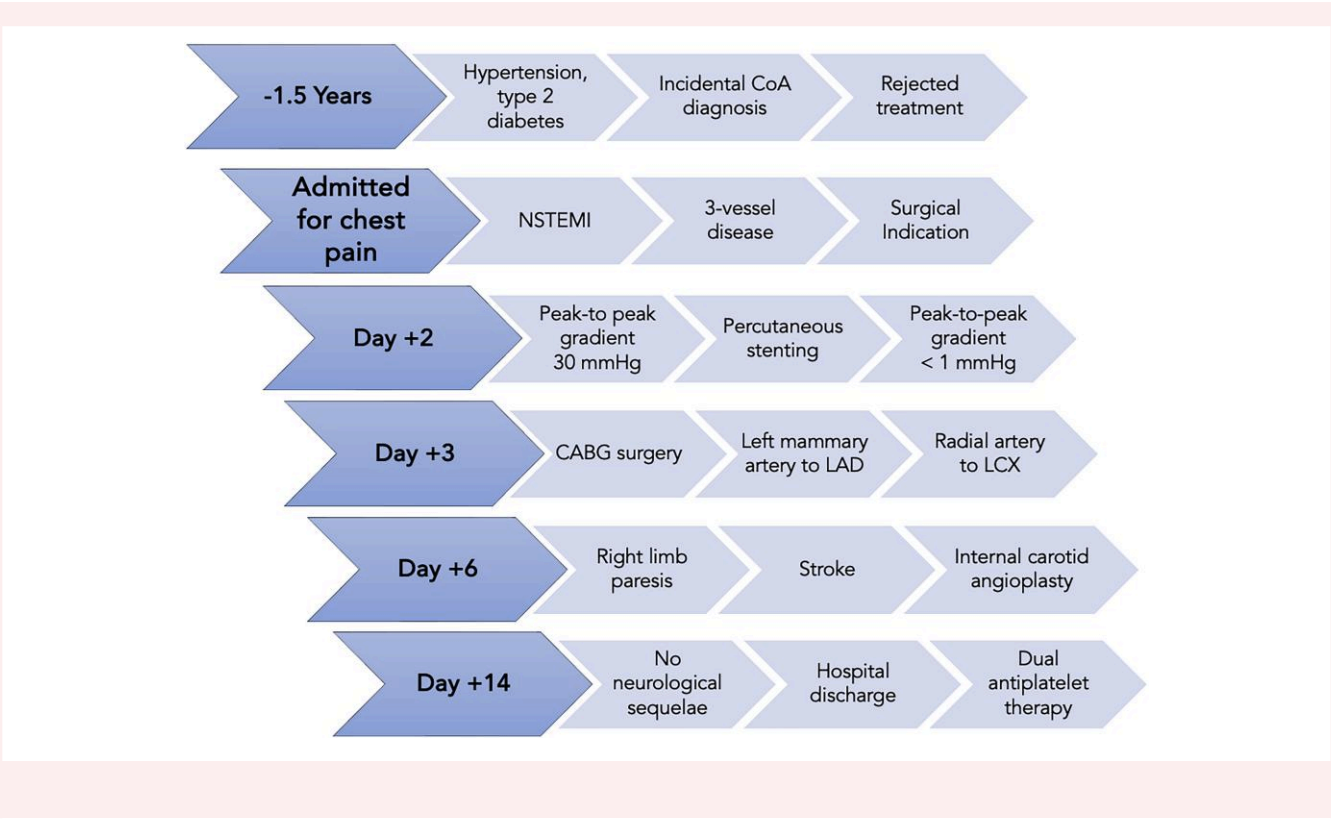
Summary figure



Case presentation

A 50-year-old man presented to the emergency department (ED) with intermittent chest pain and progressive shortness of breath over the previous week. The patient had a medical history of high blood pressure and type 2 diabetes mellitus; a CoA had been discovered six months earlier on an urgent computed tomography (CT) scan performed due to abdominal pain (*Figure 1A*). He presented a systolic blood pressure gradient between the upper and lower extremities > 60 mmHg, and an echocardiogram showed moderate left ventricular hypertrophy with normal left ventricular systolic function and a bicuspid aortic valve with normal function. Catheter treatment of the CoA had been offered but was rejected by the patient. He had not previously suffered angina pectoris or dyspnoea. His home medication included labetalol, insulin, empagliflozin, and metformin.

In the ED, his blood pressure was 131/76 mmHg in the right arm and 92/77 mmHg in the lower limbs; his heart rate was 93 beats per minute; and his oxygen saturation was 96% on room air. On auscultation, there was a harsh continuous murmur along the left sternal border and in the back, and bibasilar wet crackles were audible. Femoral and popliteal pulses were weak, and both pedal pulses were absent.

The electrocardiogram (ECG) demonstrated sinus rhythm at 90 b.p.m., PR 150 ms, QRS 90 ms with left axis deviation, and a QS complex in V1–2 (*Figure 1B*) that was not present in the previous outpatient ECG.

The chest X-ray showed signs of mild pulmonary congestion and bilateral inferior notching of the third, fourth, and fifth ribs (*Figure 1C*).

The transthoracic echocardiogram (TTE) revealed mild left ventricular dysfunction with a biplanar ejection fraction of 44%, hypokinesia of the basal inferolateral, mid- and basal inferoseptal, and inferior segments, mild functional mitral regurgitation, and mild aortic regurgitation.

Additional investigations supported the diagnosis of non-ST-elevation acute myocardial infarction (NSTEMI) with acute heart failure. Laboratory tests demonstrated basic haematological and biochemical values within the normal range, d-dimer 195 ng/mL (normal range ≤ 280 ng/L), N-terminal prohormone of brain natriuretic peptide 1870 ng/L (normal range ≤ 125 ng/L), and high-sensitivity troponin-I 23 590 ng/L (normal range < 45 ng/L) and 18 530 ng/L 2 h later.

Suspecting NSTEMI, an oral loading dose of aspirin was administered, and anticoagulation with unfractionated heparin was started according to 2023 ESC guidelines for the management of acute coronary syndromes.[5] Also, intravenous furosemide was initiated. Urgent coronary catheterization showed three-vessel disease (*Figure 2*), with severe proximal lesions in the left anterior descending artery (LAD) and in the circumflex artery (LCX), with an acceptable distal coronary bed, as well as a chronic total occlusion of the right coronary artery (RCA). The calculated SYNTAX score was 44 points.

An ECG-synchronized CT scan showed a coarctation of the aorta with a minimum diameter of 3 mm and abundant collateral circulation through ectatic and tortuous internal mammary arteries (IMA) and intercostal arteries (*Figure 3*). The maximum diameter of the left and right IMA was 6 and 7 mm, respectively.

A single photon emission computed tomography demonstrated global myocardial viability, with a pattern suggestive of non-transmural necrosis of the inferobasal segments. Pre-operative ultrasound screening of vertebral and carotid arteries showed a 70–79% stenosis of the left carotid bulb. The European System for Cardiac Operative Risk Evaluation (EuroSCORE) II predicted a 2.9% risk of perioperative mortality for CABG surgery alone, and a 9.0% risk for a double procedure including intervention on the aorta.

It was decided to perform percutaneous repair of the coarctation, followed by CABG surgery the next day. Cardiac catheterization showed a peak-to-peak systolic pressure gradient across the coarctation of 30 mmHg. The CoA was percutaneously addressed under

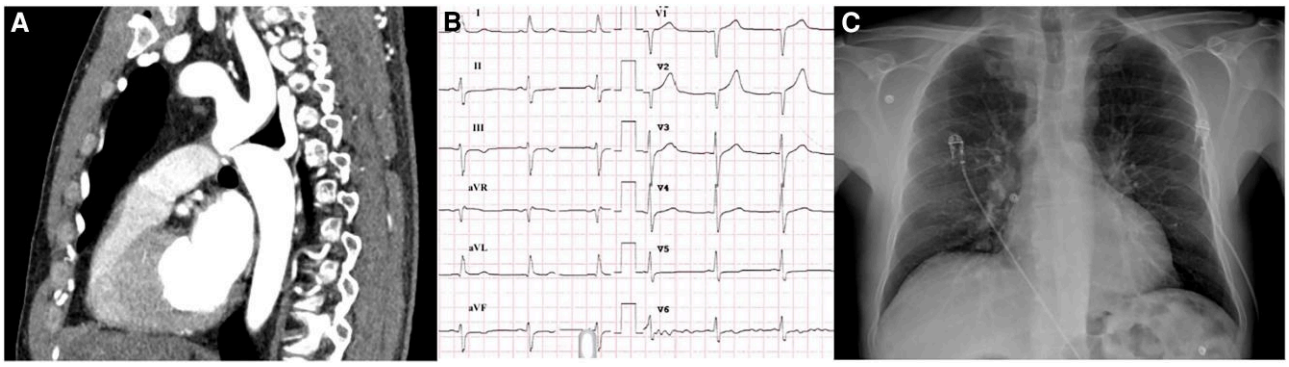


Figure 1 Outpatient computed tomography scan showing aortic coarctation (*A*); 12-lead electrocardiogram (*B*); and chest radiography at admission at the emergency department (*C*).

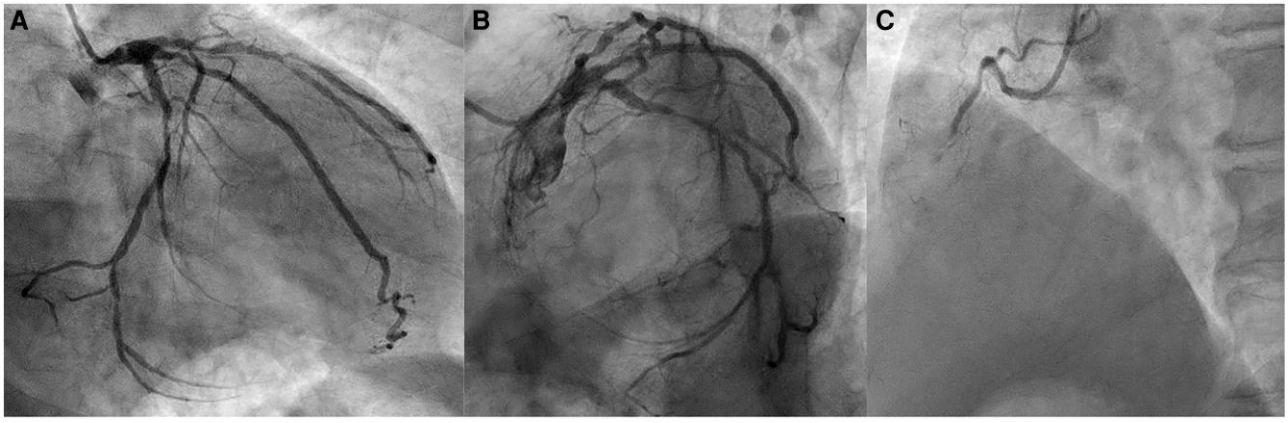


Figure 2 Coronary angiography showing three-vessel disease, with severe proximal lesions in the left anterior descending artery and in the circumflex artery (*A* and *B*), with an acceptable distal coronary bed, as well as a chronic total occlusion of the right coronary artery (*C*).

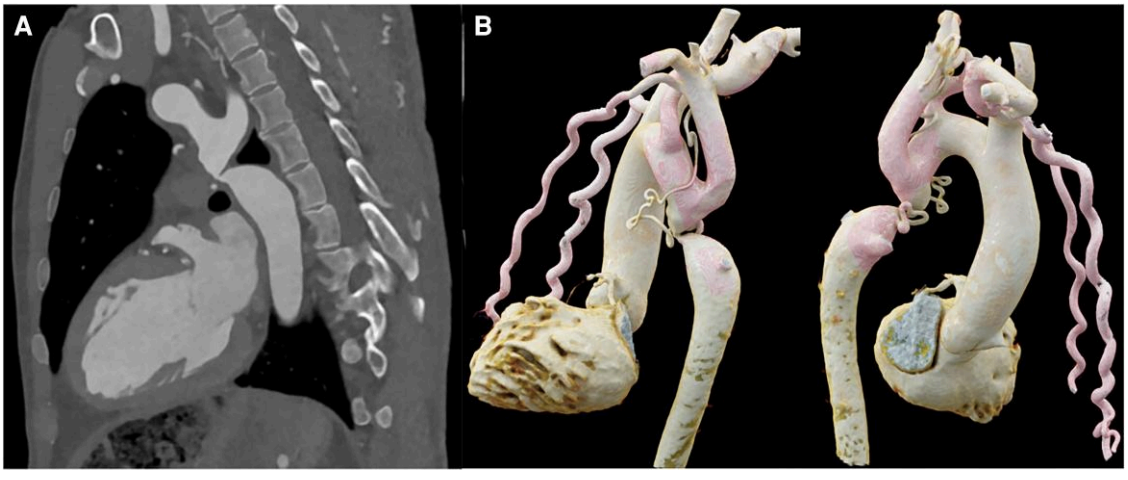


Figure 3 Electrocardiogram-synchronized computed tomography scan showing aortic coarctation with a minimum diameter of 3 mm and abundant collateral circulation through intercostal arteries and ectatic and tortuous internal mammary arteries of a maximum diameter of 7 mm. (*A*) Sagital plane and (*B*) 3D reconstruction.

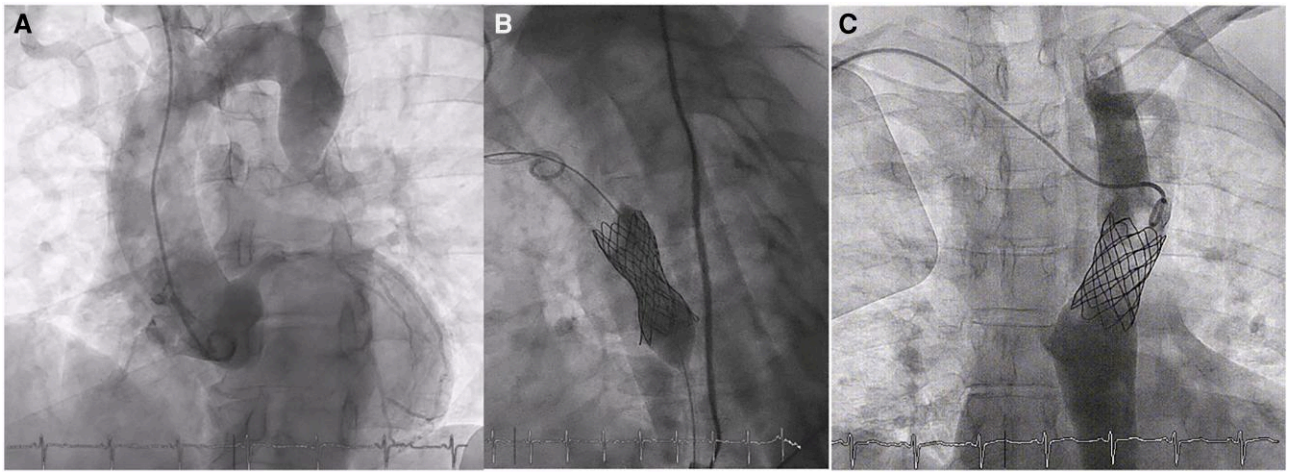


Figure 4 Percutaneous placement of a covered CP stent in the aortic coarctation: basal aortic angiography (*A*), stent expansion (*B*), and final result (*C*).

general anaesthesia, crossing it with an angled catheter and placing a covered Cheatham-Platinum (CP) stent without immediate complications, obtaining a final peak-to-peak gradient < 1 mmHg and improvement in vessel calibre > 90% of the adjacent aortic arch (*Figure 4*). The following day, quadruple coronary artery bypass surgery was performed, using the left IMA to sequentially bypass the LAD and its first diagonal branch and implanting the left radial artery to sequentially bypass from the left IMA to the LCX and its first obtuse marginal branch. Treatment with aspirin was continued, and clopidogrel was added. On the third post-operative day, the patient presented with right limbs paresis; a multimodal CT scan showed severe stenosis of the left internal carotid artery and hypoperfusion of the left cerebral hemisphere. Carotid angioplasty with stent placement was performed, and dual antiplatelet therapy was not discontinued. The patient subsequently experienced a full recovery without any lingering neurological deficits, and he was discharged home 10 days after the surgery. Six months later, he was asymptomatic and in a good functional class without sequelae. Furthermore, the blood pressure gradient between the upper and lower extremities normalized. A follow-up TTE showed partial recovery of left ventricular function and no signs of re-coarctation. Six months after the acute event, clopidogrel was discontinued.

Discussion

To our knowledge, this is the first report in the literature describing a sequential approach of aortic coarctation and surgical myocardial revascularization in the setting of an acute coronary syndrome.

Intravascular stent therapy for the treatment of CoA in adults, first introduced in the 1990s, has become widely accepted in the last decade. Even though evidence comparing it to the classical surgical approach is scarce, long-term follow-up data on the percutaneous procedure support its safety and effectiveness.[6,7]

In this diabetic patient with an untreated CoA who presented with an acute myocardial infarction with multivessel disease and a complex coronary anatomy, surgical myocardial revascularization was considered to be the best therapeutic option due to the low predicted surgical risk and mortality for isolated CABG. The performance of a hybrid procedure involving percutaneous coarctation treatment and CABG in the same operation raised concerns about the potential risk of compromised lower body blood flow after IMA harvesting, particularly in case of suboptimal results from the first procedure. Therefore, the decision was ultimately made to first stent the aortic coarctation. After confirming a good haemodynamic result and the absence of immediate complications from the first procedure, CABG surgery was performed the following day. This approach resulted in a favourable clinical and haemodynamic outcome.

In patients of such complexity, it is crucial to convene a multidisciplinary Heart Team comprising experts in adult congenital heart disease, acute cardiovascular care, interventional cardiology, cardiac surgery, and imaging specialists. This collaborative approach ensures a tailored strategy that addresses the unique needs of the patient's specific condition.

Lead author biography

Marco Tomasino is a medical doctor from Italy (University of Palermo). Since 2020, he has been training as a cardiology resident in Vall d'Hebron Hospital (Barcelona, Spain). He has a special interest in adult congenital heart disease and in acute cardiovascular care.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online. Supplementary video: Three-dimensional computed tomography reconstruction (detail).

Consent: The authors confirm that written informed consent for submission and publication of this case report, including images and associated text, has been obtained from the patient in line with the Committee on Publication Ethics (COPE) guidance.

Conflict of interest: None declared.

Funding: None.

Data availability

The data underlying this article are available in the article and in its online Supplementary material.

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