

Case report

Anomalous coronary origin and severe calcification: a challenge for percutaneous coronary intervention. Case report

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Received: March 27, 2026
Accepted: July 15, 2026
Online: August 11, 2026

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Funding

Self-funded.

Conflicts of interest

None.

Cite as

Quevedo-Candela F, Nolte-Rickards C, Cieza T. Anomalous coronary origin and severe calcification: a challenge for percutaneous coronary intervention. Case report. Arch Peru Cardiol Cir Cardiovasc. 2026;7(3):232-236. doi: 10.47487/apcyccv.v7i3.629.



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ABSTRACT

We present the case of a 68-year-old man with stable angina and complex multivessel coronary artery disease. Computed tomography revealed a critically calcified stenosis of the left anterior descending artery and an anomalous origin of the right coronary artery from the left coronary sinus, with an interarterial course and severe calcification. Following initial revascularisation of the left anterior descending artery using rotational atherectomy, the right coronary artery was treated in a staged procedure. Because the severe stenosis and challenging ostial anatomy precluded advancement of an intracoronary imaging catheter, angiography-guided intravascular lithotripsy was performed. This approach enabled effective plaque modification and the successful implantation of two drug-eluting stents, with an optimal angiographic result. This case highlights the safety and effectiveness of intravascular lithotripsy as an alternative treatment for anomalous coronary anatomy and severely calcified lesions when intracoronary imaging guidance is not feasible

Keywords: Coronary Vessel Anomalies; Lithotripsy; Percutaneous Coronary Intervention; Computed Tomography Angiography; Vascular Calcification (Source: MeSH-NLM).

RESUMEN

Origen coronario atípico y calcificación severa: un reto en la intervención coronaria percutánea. Reporte de caso

Se presenta el caso de un varón de 68 años con angina estable y enfermedad coronaria multivazo compleja. La tomografía computarizada reveló estenosis crítica calcificada en la arteria descendente anterior y un origen anómalo de la arteria coronaria derecha (ACD) desde el seno coronario izquierdo con trayecto interarterial y calcificación severa. Tras una revascularización inicial de la ADA mediante aterectomía rotacional, se abordó la ACD en un segundo tiempo. Ante la imposibilidad técnica de avanzar un catéter de imagen intracoronaria por la severidad de la estenosis y la anatomía ostial, se realizó litotricia intravascular guiada por angiografía. La técnica permitió la modificación efectiva de la placa y el implante exitoso de dos *stents* farmacoactivos con resultado angiográfico óptimo. Este caso destaca la seguridad y eficacia de la litotricia intravascular como alternativa en anatomías coronarias anómalas y lesiones severamente calcificadas donde la guía por imagen no es factible.

Palabras clave: Anomalías de los Vasos Coronarios; Litotricia; Intervención Coronaria Percutánea; Angiografía por Tomografía Computarizada; Calcificación Vascular (Fuente: DeCS-BIREME).

Introduction

An anomalous coronary artery origin (ACAO) accompanied by severe coronary calcification presents a highly complex setting for percutaneous coronary intervention (PCI). Anomalous aortic origins of the coronary arteries have a low but appreciable prevalence in imaging and autopsy series ⁽¹⁾. Variants such as a right coronary artery arising from the left coronary sinus with an interarterial course pose specific technical challenges ⁽²⁾, including an atypical take-off, acute angulation, and a slit-like ostium. These features hinder coaxial engagement and reduce guide catheter support, often necessitating additional support manoeuvres, such as the use of a guide extension catheter, to facilitate device delivery ^(2,3).

Severe coronary calcification increases the risk of stent underexpansion and malapposition, with adverse clinical consequences, including thrombosis and restenosis. By limiting vascular compliance, it also increases the likelihood of periprocedural complications, such as dissection and perforation ⁽⁴⁻⁶⁾. Conventional angiography tends to underestimate calcium extent and arc; intravascular imaging is therefore useful for quantifying calcium burden, guiding the selection of lesion preparation techniques, and optimising stent implantation ^(5,6). However, when intracoronary imaging is not feasible because of anatomical or access constraints, angiography-guided intravascular lithotripsy (IVL) has proved feasible and effective in contemporary registries ⁽⁷⁻¹⁰⁾.

IVL, an important component of plaque modification strategies ⁽⁴⁻⁷⁾, has emerged as a complementary option. Acoustic pressure waves emitted by a balloon at low inflation pressure induce controlled fractures in intimal and medial calcium, increasing vascular distensibility and facilitating optimal stent expansion ⁽⁵⁻¹¹⁾.

Recent procedural studies and registries ⁽¹²⁻¹⁵⁾ have reported high success rates and a favourable safety profile for IVL in severely calcified lesions. Device-specific data for the Sonico CX balloon ⁽¹⁶⁾ have also shown high procedural success and a low incidence of in-hospital major adverse cardiovascular events (MACE). Calcium fractures were documented in subgroups assessed by optical coherence tomography (OCT), supporting the device's ability to restore vascular compliance.

In patients with ACAO and severe calcification, a stepwise strategy prioritising adequate coaxial guide catheter support, calcium characterisation using intracoronary imaging whenever feasible, and appropriate selection of plaque modification techniques, including IVL when conventional techniques fail or imaging is not feasible, provides a reasoned approach to maximising PCI safety and effectiveness. This report illustrates the practical application of this strategy in a highly complex setting.

Case report

A 68-year-old man with hypertension, type 2 diabetes *mellitus*, and established coronary artery disease previously treated by PCI of the left circumflex artery, with a patent stent, presented with a 4-month history of Canadian Cardiovascular Society class II stable angina. He also had a family history of ischaemic heart disease.

Initial assessment included an exercise stress test, which showed evidence of ischaemia, and transthoracic echocardiography, which demonstrated preserved left ventricular function without regional wall motion abnormalities. Coronary computed tomography (CT) angiography (CCTA) showed critical stenosis and severe calcification of the left anterior descending artery (LAD), a patent left circumflex artery stent, and an anomalous origin of the right coronary artery (RCA; **Figure 1A**). The RCA arose from the left coronary sinus, 16 mm from the sinotubular junction (**Figure 1B**), and followed an interarterial course. Severe calcification with significant stenosis was also identified in the proximal and mid RCA (**Figure 1C**).

During the first procedure, performed via radial access, the LAD was treated with rotational atherectomy using a 1.75-mm burr, followed by implantation of a 3.5 x 28-mm drug-eluting

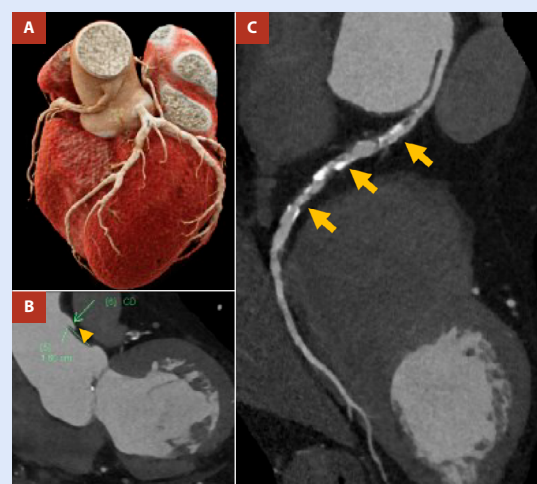


Figure 1. Coronary computed tomography angiography showing **A**) a three-dimensional reconstruction of the anomalous origin of the right coronary artery (RCA); **B**) the RCA arising 16 mm above the left sinus of Valsalva and following a long interarterial course (yellow arrowhead); and **C**) severe calcification throughout the RCA (yellow arrows).

stent, achieving a satisfactory angiographic result. However, selective engagement of the RCA was unsuccessful because of its anomalous origin, and a staged procedure was planned.

Femoral access was selected for the second procedure, which targeted RCA revascularisation. Selective engagement was challenging because of the anomalous anatomy (**Figure 2A**). The RCA ostium was initially engaged with a Judkins Left (JL) 4.0 diagnostic catheter, through which a 0.014-inch, 300-cm hydrophilic guidewire was advanced into the distal RCA. After exchange for a CLS 3.5 guide catheter, adequate stability for instrumentation could not be achieved. Given the insufficient support and inability to achieve selective coaxial engagement, a guide extension catheter was introduced, providing the additional support required for safe delivery of interventional devices.

Predilatation with a 1.25 x 12-mm balloon at high pressures (18-20 atm) produced partial luminal gain, but

subsequent attempts with larger balloons failed to expand the undilatable calcified lesion. An intracoronary imaging catheter could not be advanced, so an angiography-guided strategy was adopted. IVL was performed using a 3.25 x 12-mm Sonico-CX balloon (Spectrumedics), delivering a total of 120 pulses at a protocol-specified inflation pressure of 4 atm, followed by sequential postdilatation up to 6 atm according to the angiographic response in the proximal and mid RCA. This produced effective fracture of calcium within the vessel wall, allowing adequate lesion expansion and implantation of two overlapping drug-eluting stents measuring 3.5 x 28 mm and 3.5 x 30 mm. Final angiography showed adequate stent expansion with no residual stenosis (**Figure 2B**).

The patient's recovery was uneventful, with no in-hospital complications. He was discharged on dual antiplatelet therapy with aspirin and a P2Y12 inhibitor, together with optimal medical therapy for his comorbidities. At the 1-month outpatient follow-up, he remained asymptomatic.

Discussion

This case highlights the dual challenges posed by the coexistence of an anomalous coronary origin and severe coronary calcification when planning and performing PCI. In anomalous aortic origins of the coronary arteries, atypical ostial angulation, a high take-off, and particularly interarterial courses hinder coaxial engagement and reduce guide catheter support. These features compromise device delivery and often necessitate additional support strategies, such as guide extension catheters ^(2,3). Securing stable access is therefore a prerequisite for any plaque modification technique or stent implantation.

Severe calcification is itself a determinant of technical failure and adverse events: it limits arterial wall distensibility, promotes stent underexpansion and malapposition, and increases the risk of dissection and perforation. Evidence supports the systematic use of intravascular imaging to characterise calcium burden and morphology, select the lesion preparation strategy, and optimise stent implantation, with better outcomes than angiographic guidance alone in complex lesions ⁽⁴⁻⁶⁾. Features such as large calcium arcs, greater calcium thickness, and longer calcified segments predict the need for advanced plaque modification techniques ⁽⁴⁻⁶⁾. However, contemporary evidence also supports angiography-guided IVL when intracoronary imaging is not feasible. In the BENELUX registry ⁽⁷⁾, angiography-guided IVL accounted for almost half of the treated lesions and achieved procedural success comparable to imaging-guided IVL, with no appreciable differences in clinical outcomes during follow-up. Similarly, real-world analyses ⁽⁸⁻¹⁰⁾ and a meta-analysis ⁽¹¹⁾ indicate that IVL without intravascular imaging remains highly feasible and has a favourable overall safety profile, although imaging guidance



Figure 2. (A) Baseline coronary angiography showing severely calcified stenoses in the proximal and mid segments of the right coronary artery. (B) Final angiographic result after intravascular lithotripsy and drug-eluting stent implantation, showing adequate stent expansion.

might be associated with better final optimisation in complex lesions.

In recent years, IVL has become an established strategy for preparing severely calcified vessels. The DISRUPT CAD trials^(12,13), their pooled analyses^(14,15), and a meta-analysis⁽¹¹⁾ have consistently demonstrated high procedural success rates and a low incidence of major adverse events at 30 days. Specifically, in DISRUPT CAD IV⁽¹³⁾, freedom from MACE at 30 days was 93.8% versus 91.2% ($p = 0.008$). Device-specific data for the Sonico-CX balloon⁽¹⁶⁾ also support its performance, showing very high procedural success and a low rate of in-hospital MACE. Collectively, the evidence suggests that IVL is an effective option for plaque modification in severely calcified coronary lesions, particularly when conventional techniques fail to achieve adequate expansion. Complication rates are low, with flow-limiting coronary dissection occurring in less than 2% of cases and slow flow in less than 0.5%, according to evidence from the DISRUPT CAD trials⁽¹²⁾.

In our case, the combined strategy was crucial: first, securing guide catheter support and selective engagement in the setting of an anomalous coronary origin; then, selecting the plaque modification technique according to technical feasibility. The LAD was treated with rotational atherectomy followed by stent implantation, whereas the anomalously arising, severely calcified RCA was treated with angiography-guided IVL using a Sonico-CX balloon. This enabled adequate expansion and successful implantation of overlapping stents, with an optimal angiographic result and no complications.

The main limitation was the inability to document calcium

morphology and thickness using intravascular imaging. Nevertheless, the angiographic response to predilatation and IVL, together with the satisfactory final result, supported the treatment decision.

In conclusion, in patients with an anomalous coronary artery origin and severe calcification, a stepwise approach that prioritises adequate coaxial guide catheter support, intracoronary calcium characterisation whenever feasible, and appropriate selection of plaque modification techniques, including angiography-guided IVL when intravascular imaging is not feasible, can optimise stent expansion and improve angiographic and clinical outcomes.

Ethical aspects

The institutional ethics committee approved the preparation and presentation of this case report.

Acknowledgements

We thank the multidisciplinary team at Clínica Delgado, particularly the Interventional Cardiology team (cardiac catheterisation laboratory and nursing staff), the Cardiac Imaging team (CT), and the Intensive Care Unit, for their coordinated and crucial contributions to the diagnosis, procedure, and postoperative care of this patient.

Author contributions

FMQC: Conceptualisation, investigation, formal analysis, visualisation, writing-original draft, writing-review and editing.

CNR and TC: Validation, writing-review and editing.

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