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CASE REPORT
Coronary intervention

Threading the needle: a case report of double-wiring technique and double intracoronary imaging guidance for a multifenestrated iatrogenic coronary artery dissection

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Background Iatrogenic coronary artery dissection (ICAD) may represent a serious complication of percutaneous coronary intervention. Stenting the dissected segment is recommended in large dissections with compromised distal blood flow, although wiring the true lumen is often difficult.

Case summary A 64-year-old woman with effort angina was submitted to invasive coronary angiography that revealed a severe stenosis in the distal right coronary artery. A large spiral ICAD occurred after pre-dilatation and guidewire position is lost. We report the treatment of this multifenestrated dissection using combined intracoronary imaging guidance with angiographic co-registered optical coherence tomography and real-time intravascular ultrasound, which were crucial to achieve a successful outcome.

Discussion A double-wiring technique with double intracoronary imaging guidance enables a comprehensive depiction of the compromised artery and should be considered in selected cases to guide true lumen wiring and stent implantation.

Keywords Percutaneous coronary intervention • Intravascular ultrasound • Optical coherence tomography • Coronary artery dissection • Case report

ESC Curriculum 3.2 Acute coronary syndrome • 3.1 Coronary artery disease • 2.1 Imaging modalities

Learning points

- In iatrogenic coronary artery dissections with loss of guidewire position, wiring the true lumen is often challenging. A double-wiring technique with double intracoronary imaging guidance enables a comprehensive depiction of the compromised artery.
- Combined angiographic co-registered optical coherence tomography and real-time intravascular ultrasound may be crucial to guide true lumen wiring and to achieve a successful outcome.

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Introduction

Iatrogenic coronary artery dissection (ICAD) may be a serious complication of percutaneous coronary intervention (PCI), and stent implantation is usually indicated in cases of large spiral dissections, although wiring the true lumen is sometimes challenging. Intracoronary imaging should be employed, and combining more than one imaging technique may be useful in selected cases. We describe a long spiral ICAD where optical coherence tomography (OCT) with angiographic co-registration and real-time intravascular ultrasound (IVUS) were used to guide a double-wiring technique.

Timeline

Day 0	Invasive coronary angiography reveals a severe stenosis in the distal right coronary artery (RCA)
	Large spiral dissection occurred after pre-dilatation
	Guidewire position is lost
	OCT imaging was necessary to identify the guidewire position
	Real-time IVUS guided true lumen wiring
	Further angiographic co-registered OCT runs allowed accurate stent placement
Day 5	The patient was discharged after an uncomplicated post-procedural recovery

Case report

A 64-year-old woman with past medical history of hypertension and dyslipidaemia was referred to invasive coronary angiography due to effort angina and a positive treadmill exercise testing (Duke treadmill score: +2). The physical examination, resting electrocardiogram, and transthoracic echocardiogram were unremarkable. The coronary computed tomography angiography revealed a severe stenosis in distal RCA [Coronary Artery Disease-Reporting and Data System (CAD-RADS) classification: 4A]. The invasive coronary angiography revealed a severe (90%) calcified stenosis in the distal RCA and non-obstructive disease in the proximal and mid segments.

During pre-dilatation using a non-compliant balloon, the patient experienced severe chest pain and ST-segment elevation in the inferior leads. Cineangiography revealed a large spiral type D dissection, according to National Heart, Lung, and Blood Institute (NHLBI) classification system, with compromise of flow to the distal vessel. The patient became agitated, and the position of the guidewire was lost (*Figure 1*; Supplementary material online, *Video S1*).

The initial strategy consisted of attempts to wire the true lumen with a 0.014-inch Runthrough™ NS guidewire (Terumo Corporation, Japan) with the support of a FineCross™ microcatheter (Terumo Corporation), while minimizing contrast injections that may lead to dissection extension. Despite marked difficulty, we managed to cross the lesion and progress the wire until distal posterior descending artery (PDA).

Since it was not possible to ascertain whether the guidewire was in the true or false lumen based on angiography alone, intracoronary imaging was used. Intravascular ultrasound imaging (Eagle Eye, Volcano Corporation, Rancho Cordova, CA, USA) was firstly used, nonetheless, it was not possible to clearly identify the guidewire position along the entire vessel due to low spatial resolution. Albeit requiring an antegrade injection of contrast medium, OCT imaging with angiographic co-registration and using the Ultreon™ Software (St. Jude Medical, St. Paul, MN, USA) was performed. Special care was made to minimize further contrast injections and avoid repetition of the OCT pullbacks. The OCT run demonstrated the wire entering the false lumen (FL) in distal RCA, and co-registration enabled to identify and localize the dissection entry point (*Figure 2*; Supplementary material online, *Video S2*).

Figure 1 Angiographic image revealing an iatrogenic spiral dissection with compromised flow distally.

The Runthrough™ NS wire was left in place, and the IVUS catheter was positioned with the transducer immediately after the entry point to the FL, visualizing simultaneously the true lumen (TL) and FL. A second guidewire was then advanced in parallel using the FineCross™ microcatheter (the tip of which was placed before the fenestration), aiming to rewire the compressed TL. Therefore, the position of the second guidewire (TL or FL) could be assessed immediately after the fenestration in real-time using IVUS imaging. Multiple attempts were unsuccessful despite employing different wires, including a Runthrough™ NS, a Hi-Torque Balance Middleweight (BMW) Universal II (Abbott Vascular, Santa Clara, CA, USA), a Sion® blue (Asahi Intec, Japan) and a Hi-Torque Pilot™ 50 (Abbott Vascular). Still assisted by real-time IVUS images, we ultimately achieved to enter the TL using a Fielder XT® wire (Asahi Intec) (*Figure 3*), which was further advanced along the artery architecture. Notwithstanding, we could not perceive the wire position in distal vessel with IVUS. The IVUS catheter and the wire in the FL were then removed.

With the wire tip in distal PDA, a second co-registered OCT run was acquired. It demonstrated the position of the wire in the TL until the level of the crux, where it reentered the FL (see Supplementary material online, *Video S3*). Subsequently, we decided to stent the RCA before the crux (true lumen) with two overlapping stents, covering the proximal margin of the dissection.

Afterwards, a new Runthrough™ NS guidewire was inserted in the PDA with the support of the FineCross™ microcatheter, with both wires being apparently positioned in different lumens, considering their distance in fluoroscopy. A third OCT run confirmed the TL position of the second guidewire and the FL position of the first guidewire in the PDA (*Figure 4*; Supplementary material online, *Video S4*).

The guidewire in the FL was removed, and using a GuideLiner® catheter (Vascular Solutions Inc., Minneapolis, MN, USA), two additional stents were deployed in the PDA, which yielded a satisfactory angiographic result (*Figure 5*; Supplementary material online, *Video S5*). The dissection in the posterolateral branch was treated conservatively.

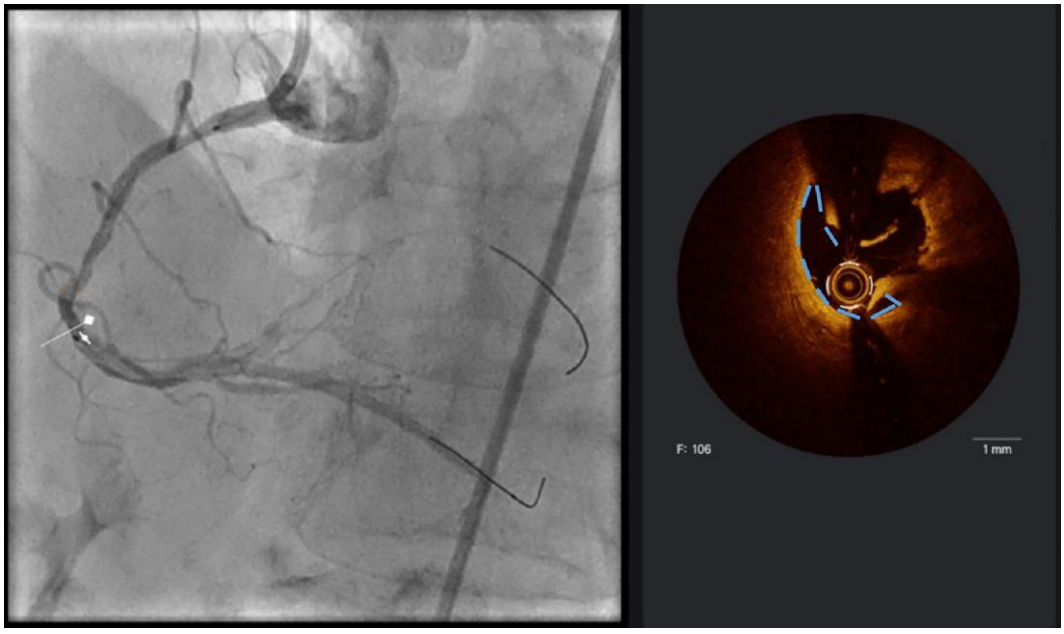

Figure 2 Optical coherence tomography (OCT) with angiographic co-registration showing the guidewire entering the false lumen (FL) in the distal right coronary artery. Intraluminal image reveals endothelial–intimal disruption with the crescent-shaped FL (broken line) compressing the true lumen.

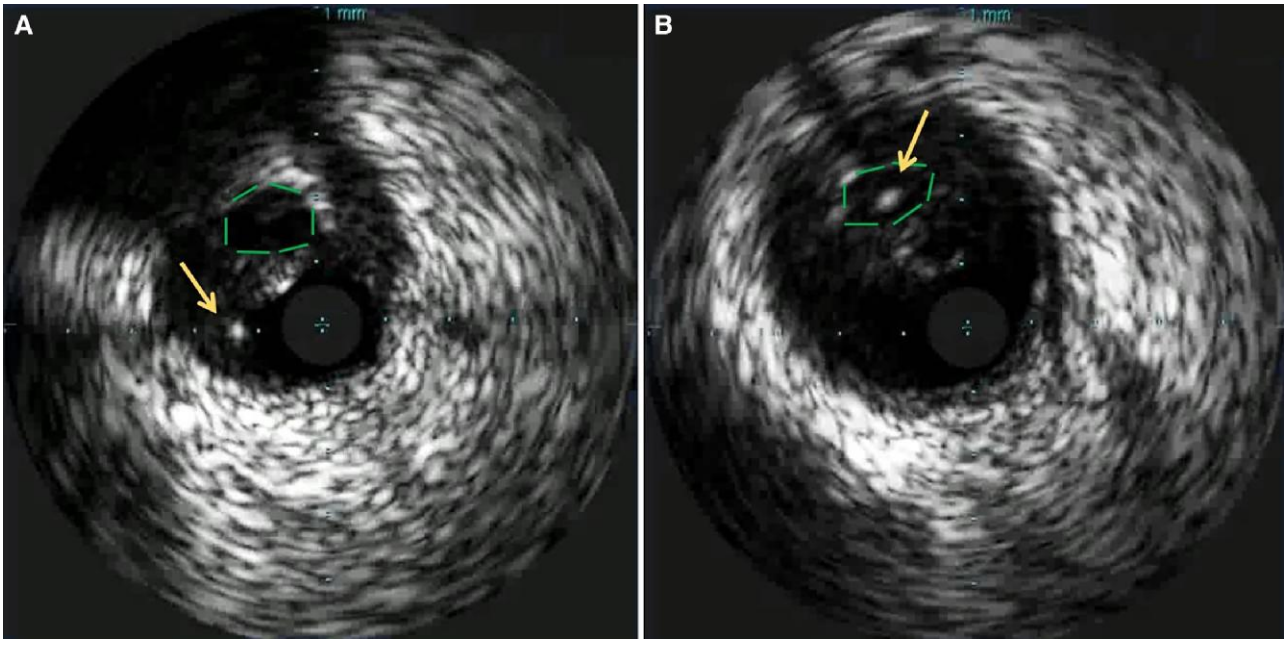

Figure 3 Intravascular ultrasound (IVUS) imaging displaying the IVUS catheter in the false lumen (FL) and the true lumen (TL) (broken line) compressed to one side. (*A*) Guidewire position in the FL (arrow). (*B*) After multiple attempts, we reached to introduce the wire in the TL (arrow).

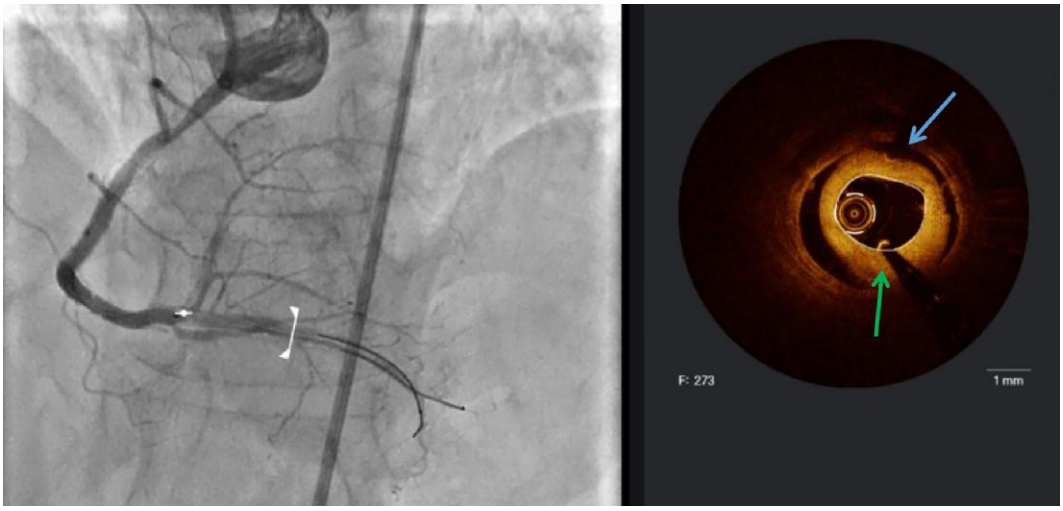

Figure 4 Co-registered optical coherence tomography (OCT) showing the wires in different lumens in the posterior descending artery. Blue arrow indicates the first wire in the false lumen, and the green arrow indicates the second wire in the true lumen.

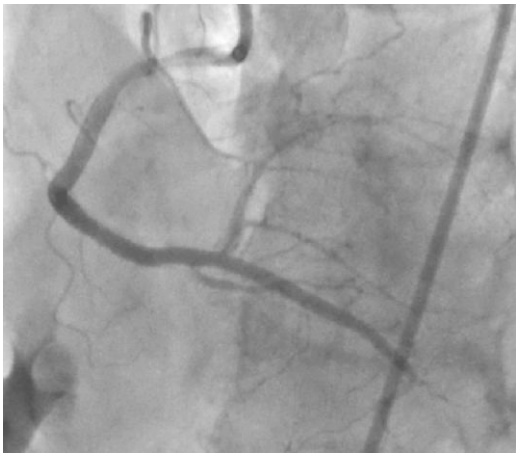

Figure 5 Final angiographic image showing satisfactory angiographic result with restoration of normal calibre of the vessel.

The patient had an uncomplicated post-procedural recovery. Peak high-sensitivity troponin I was 27 184 pg/mL (upper reference limit: 16 pg/mL). The patient was discharged 5 days later, with the echocardiogram showing mild hypokinesis of the inferior and inferoseptal walls and left ventricular ejection fraction of 59%.

Discussion

ICAD is a mechanical intimal disruption followed by extravasation of blood into subendothelial tissue planes. Large visible dissections have been described in up to 29% of all angioplasty procedures.[1] Iatrogenic injury can result from either catheter manipulation, forceful injection of contrast medium, guidewire advancement, or balloon inflation.[1] Distinct from spontaneous coronary artery dissection, ICAD is a potentially catastrophic complication of PCI. The most significant factors determining prognosis include the integrity of antegrade flow and size of the compromised artery.[2]

Once the diagnosis of ICAD is confirmed, repeated contrast injections should be minimized to avoid extending the dissection.[3] Treatment depends on the location and severity of the dissection and the clinical and haemodynamic status of the patient. Stenting the dissected segment remains the standard of treatment.[4] Obtaining wire access to the true lumen is mandatory, however, re-crossing the dissected segment is often challenging.[5] Repeated entry into the false lumen is very common since this is often the path of least resistance. In this scenario, wiring the true lumen can be facilitated by choosing a non-hydrophilic workhorse guidewire with a low tip load.[6]

Intracoronary imaging should be used in order to visualize the dissection entry point, determine whether the guidewire is in the true or false lumen, and provide useful information regarding dissection length and vessel diameter that can guide stent selection.[5] Optical coherence tomography should generally be avoided as this modality requires a forceful contrast flush that may lead to propagation of the subintimal dissection. Nonetheless, its higher spatial resolution may be valuable in selected cases to clarify the position of the guidewires.[7,8] The use of a co-registered OCT system, by integrating the OCT information on an angiographic roadmap, is particularly useful in complex or diffuse disease where spatial orientation might be difficult. In our case, it allowed to identify exactly the location of the two entry points into the FL. In addition, co-registration guided stent placement before the second entry point into the FL, which simplified the procedure. Intravascular ultrasound is usually the technique of choice in coronary artery dissections since no contrast injections are necessary, although spatial resolution is lower compared with OCT. If the guidewire is in the FL, IVUS can be left in place, and double-wiring technique performed. The position of the second guidewire can be assessed in real-time by placing the transducer immediately after the entry point into the FL.[3] High-definition IVUS, which uses transducers with higher frequencies, is the latest advance in the development of this imaging technique. It allows a substantially higher spatial resolution and may represent an alternative solution to OCT.

If antegrade wiring cannot be accomplished, alternative bailout techniques to gain access to the TL should be considered, including

retrograde approach[9] or subintimal tracking and reentry.[10] Emergent surgical intervention may be required in selected cases.[11]

Conclusion

A long spiral ICAD with loss of guidewire position represents a challenging scenario. In such cases, double-wiring technique with double intracoronary imaging guidance, particularly OCT with co-registration and IVUS, represents a potentially useful strategy. Operator experience and knowledge of the different treatment strategies are key to a successful outcome.

Lead author biography

José Miguel Viegas graduated from NOVA Medical School and received the MD degree in 2014. After completing the general residency year and one year as an Internal Medicine resident, he is currently a Cardiology resident at Santa Marta Hospital, Lisbon, Portugal. He has special interest in interventional cardiology, cardiomyopathies, and sports cardiology.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports*.

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Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission of the case report including images and associated text has been obtained from the patient in line with COPE guidance.

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Ethics approval: Our institution does not require ethical approval for reporting individual cases or case series.

Data availability

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

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