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It's a Trap: A Case of Strangulated Coronary Guidewire and Longitudinal Stent Deformation in the Right Coronary Artery

Authors' Contribution:

Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

BFG 1 **Adeel Ur Rehman**ABEF 1 **Jahanzeb Malik**AEG 1 **Imran Iftikhar**BCFG 1 **Asim Javed**BDG 2 **Anjum Jalal**AF 1 **Khawar Satti**

1 Department of Interventional Cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan

2 Department of Cardiac Surgery, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan

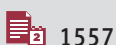
Corresponding Author: Jahanzeb Malik, e-mail: Heartdoc86@gmail.com**Conflict of interest:** None declared

Patient: Male, 62-year-old
Final Diagnosis: Coronary artery disease • entrapped coronary guidewire • stent deformation
Symptoms: Angina pectoris
Medication: —
Clinical Procedure: Angioplasty • coronary artery bypass grafting (CABG)
Specialty: Cardiac Surgery • Cardiology

Objective: Management of emergency care
Background: Strangulation of the coronary guidewire is an infrequent complication of percutaneous coronary intervention (PCI), and it can lead to disastrous outcomes of stent thrombosis, vessel occlusion, and vessel damage.

Case Report: Early-generation stents were made from stainless steel and had a bulky design as compared to cobalt-chromium or platinum chromium alloys, which have superior trackability at the cost of a thin core and low-strength struts, resulting in increased incidence of longitudinal stent deformation. We present a case of a 62-year-old active smoker with effort angina of Canadian Cardiovascular Society (CCS) class III. His coronary angiogram revealed a totally occluded right coronary artery (RCA). After placing 2 coronary guidewires (Run-through and Balanced middle-weight), Xience Xpedition (3.25×48 mm) and Promus Element (2.75×32 mm) were deployed through the whole length of the RCA. While placing the distal stent, the guidewire securing the posterior left ventricular (PLV) was trapped between 2 stents and all attempted maneuvers were unsuccessful in retrieving the wire. The stents sustained longitudinal deformation by the guide catheter, and subsequent arteriotomy for stent and wire retrieval and coronary artery bypass graft surgery were (CABG) performed.

Conclusions: Despite the remarkable safety profiles of the percutaneous equipment, complications still occur even with experienced operators. Calcified and tortuous vessels are primarily at risk for wire strangulation between stents or side-branches, and better deliverability of newer drug-eluting stents (DES) comes at the cost of reduced longitudinal strength.

Keywords: Cardiology • Coronary Angiography • Coronary Artery BypassFull-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/931058>

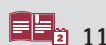
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Background

Percutaneous coronary intervention (PCI) of the right coronary artery (RCA), especially if it is tortuous and diffusely atherosclerotic, can turn into one of the most technically challenging procedures for interventional cardiologists. In complex PCIs with multiple stents, some equipment can be jailed between the struts, trapping the guidewire in between. Entrapped wire is a rare complication, with an incidence ranging from 0.2% to 0.8% during multiple stents deployment, and as more percutaneous interventions are being performed, the incidence of this complication is increasing [1]. In general, provisional stenting to the RCA requires a certain amount of experience and troubleshooting for the delivery of equipment to the diseased segment. Even with remarkable progress in coronary stent design, coursing a stent through the curve of the RCA can be difficult, which leads to an undue fluoroscopy time and contrast use. In addition, if the internal diameter of the arterial lumen is large, the guide catheters can track the length of the RCA and damage the arterial wall or the equipment [2].

One such complication observed in these cases is longitudinal stent deformation, defined as the shortening of the stent in the longitudinal axis after stent deployment [3]. Early-generation stents were made from stainless steel and had a bulky design as compared to cobalt-chromium or platinum chromium alloys, which have superior trackability at the cost of a thin core and low-strength struts [4]. With reduced thickness of the struts, cutting-edge technology has enabled a more stable maintenance of the radial strength and stent curvature; however, longitudinal strength is compromised, resulting in stent deformation. Longitudinal stent deformation can cause protrusion of stent struts through vessel lumen, and malapposition can disrupt blood flow and cause a higher degree of in-stent thrombosis or restenosis [5].

We present a case of a 62-year-old man with a trapped guidewire between 2 overlapping stents in a routine PCI of the RCA and longitudinal stent deformation in an attempt to pull out the trapped guidewire.

Case Report

A 62-year-old man with effort angina of Canadian Cardiovascular Society (CCS) class III was scheduled for an ad-hoc coronary angiography at our institute. His pre-morbid conditions included 20-pack year smoking. A physical exam and laboratory parameters, including cardiac troponin T, were unremarkable. The electrocardiogram and transthoracic echocardiogram were normal. The selective coronary angiogram via the right radial artery showed a critical bifurcation disease in the proximal left circumflex (LCX) involving the ostium of the first major obtuse marginal (OM) branch and multiple moderate lesions through the course of the left anterior descending artery (LAD). A large dominant RCA was totally occluded from mid-course (**Figure 1A-1C**).

Cardiac catheterization was then planned using a 6 Fr Judkins right (JR, Medtronic, USA) catheter to cannulate the RCA. A Runthrough (Terumo, Europe) guidewire was used to cross the lesion and was predilated with a 2×15 mm semi-compliant Emerge balloon (Boston Scientific, USA). This revealed a critical RCA with diffuse disease throughout the proximal to mid-course and an intermediate lesion distally, extending to the posterior left ventricular (PLV) and posterior descending artery (PDA). A Xience Xpedition stent (3.25×48 mm, Abbott, USA) was deployed from the proximal course to a healthy segment in mid-course. After post-dilation with a non-compliant balloon (Sapphire NC, 3.25×18 mm, OrbusNeich, Hoevelaken, Netherlands), the disease at the distal edge of the stent became prominent, so a second stent (Promus Element, 2.75×32 mm, Boston Scientific, USA) was overlapped at the distal RCA after securing the PLV

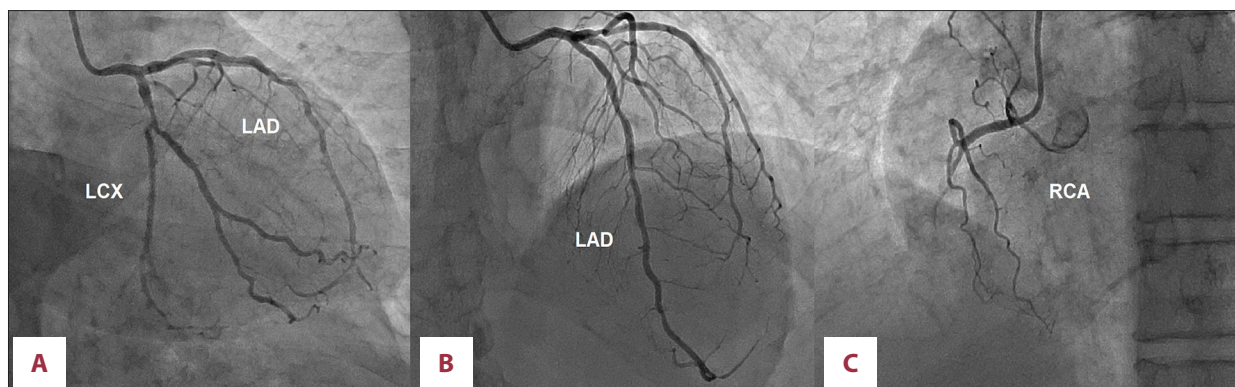


Figure 1. The selective coronary angiogram via the right radial artery showed a critical bifurcation disease in proximal left circumflex (LCX) involving the ostium of the first major obtuse marginal (OM) branch (**A**) and multiple moderate lesions through the course of the left anterior descending artery (LAD) (**B**). A large dominant RCA was totally occluded from mid-course (**C**).

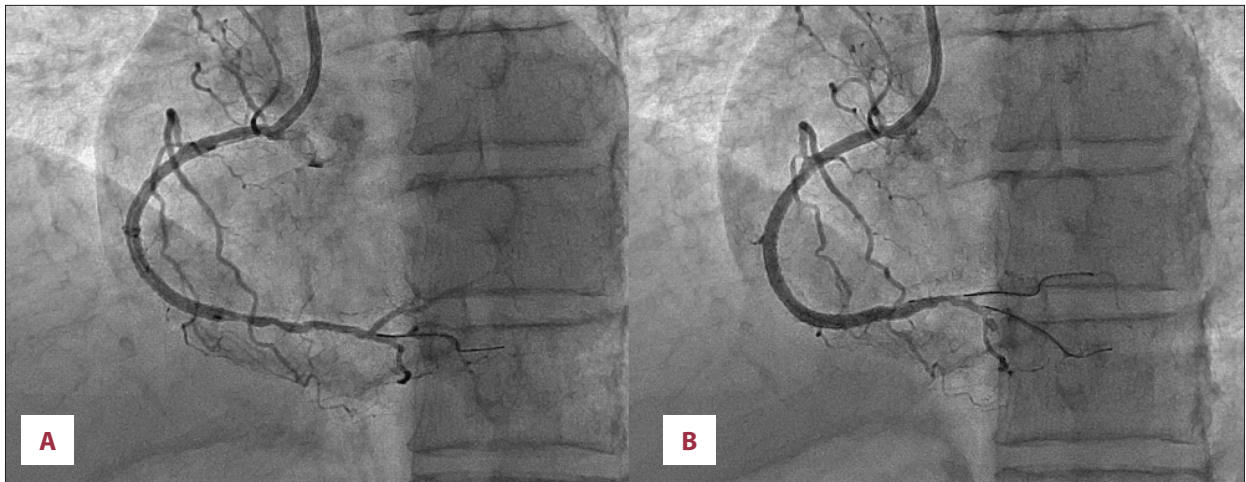


Figure 2. A Xience Xpedition stent (3.25×48 mm, Abbott, USA) deployed from proximal to mid-course revealing a diseased segment distally (A). Distal segment was covered by Promus Element, 2.75×32 mm (Boston Scientific, USA.) after parking the Runthrough guidewire in posterior left ventricular artery (PLV) and balanced middle-weight guidewire in posterior descending artery (PDA) (B).

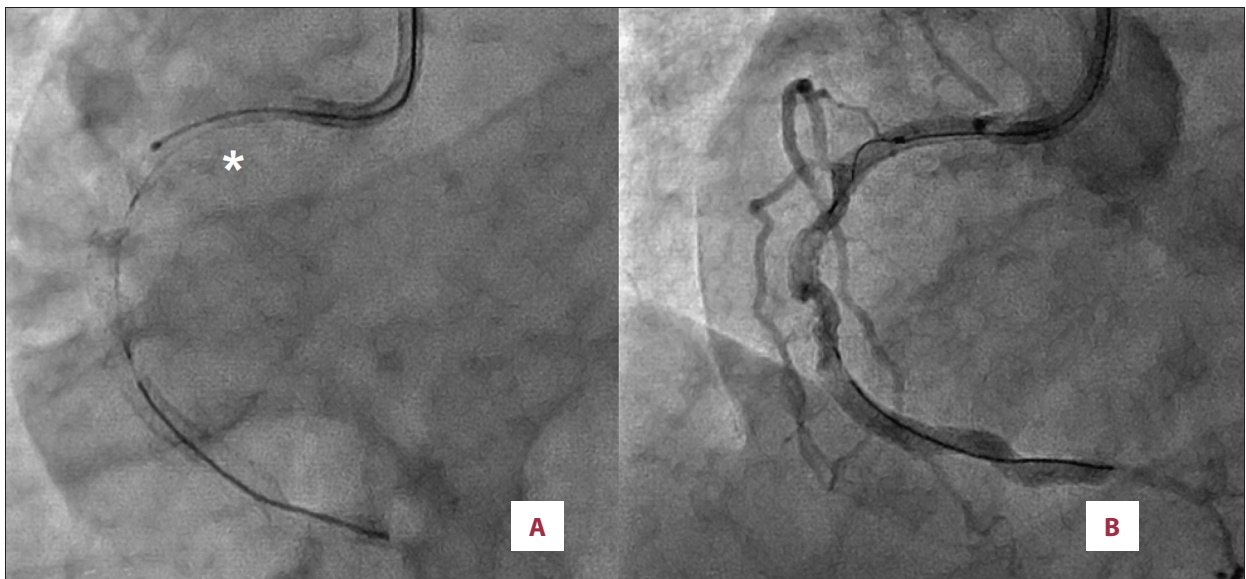


Figure 3. Runthrough guidewire trapped between the overlapping stents after post-dilation by Sapphire NC, 3.25×18 mm non-compliant balloon (OrbusNeich, Hoevelaken, Netherlands.) (A). While maneuvering to pull the wire, the guide catheter deformed the proximal stent after deep cannulation of the right coronary artery (RCA) (B). * Microcatheter.

with a Runthrough guidewire and PDA with a new guidewire (Balanced middle-weight, Abbott, USA) (Figure 2A, 2B). After the procedure, the operator was unable to remove the Balanced middle-weight (BMW) guidewire, which was jailed between the proximal and distal stents. All attempted maneuvers with angioplasty balloons or microcatheter were unsuccessful in retrieving the wire. A snare was not used during retrieval this time, but a micro-snare was passed down the guidewire into the coronary artery to the location where the wire was trapped and this greatly enhanced the traction force applied on the wire at the point of jailing. Another advantage of this approach is that if

the wire does fracture, it will be distal to the point of snaring, entirely within the coronary artery, and can be stented against the wall, avoiding the need for bypass surgery. While pulling the wire, the JR catheter tip hit the stent proximally and disrupted its profile, producing a longitudinal deformation (Figure 3A, 3B). The operator tried to yank the wire, but it pulled the heart along with itself. Serial small balloon inflations were performed to correct the longitudinal stent deformation, but it failed to align the struts with the vessel lumen. Although the patient was pain-free and hemodynamically stable, the heart team decided to move the patient for an emergent coronary artery bypass operation.



Figure 4. Retrieved stent after arteriotomy and subsequent coronary artery bypass graft surgery (CABG).

The patient was transferred to the operating room after preparation for coronary artery bypass graft surgery (CABG). After median sternotomy, cardiopulmonary bypass was initiated and saphenous vein grafts (SVG) were harvested. After exposing the coronaries, the stents along with the guidewire were removed by arteriotomy of the RCA (**Figure 4**). Then, an aorto-RCA and aorto-OM artery to the SVG bypass were performed. No postoperative complications were observed and the patient was discharged after 4 days.

Discussion

Strangulation of the coronary guidewire is rare. Notwithstanding the technical evolution of guidewires and superior flexibility, the incidence of trapped wires is increasing due to the complex procedures being performed in high-volume centers around the world. There are different methods of guidewire retrieval following entrapment. A literature review of 67 patients reported surgical removal in 43.4% and percutaneous interventions in 41.8%, while 14.9% received conservative treatment [6].

Intentionally jailing a wire between 2 stents, especially over a long segment, should be avoided if at all possible. This was the fundamental problem in this case. If it does occur, however, specialized equipment for releasing a trapped wire should be used in several ways. The wire can be manipulated by advancing 2 or more guidewires alongside the strangulated wire, and by applying torque on all of the wires, the entrapped wire or its fragment can then be externalized along with the catheter as a single unit. A microcatheter wedge and balloon inflation technique can sometimes release the entrapped wire if it is intact. Particular rotations to the microcatheter can release the tip of the wire, allowing it to be pulled out along with other equipment [6]. Another option is to use a micro-snare passed down into the coronary artery to the location where the wire is trapped. This enhances a significant traction force on the jailed wire, which often becomes retrievable. If the wire does fracture, it will be distal to the point of snaring, entirely within the coronary artery, and can be stented against the wall, avoiding the need for CABG. If these methods fail, surgical retrieval is warranted. In cases such as ours, prompt

surgical removal via arteriotomy or aortotomy with combined CABG can be performed.

While manipulating equipment, a guide catheter should be sufficiently parked to minimize the rocking movement into the coronary ostia. Excessive manipulation can cause tracking of the catheters into the artery and it can dissect or rupture the vessel lumen and deform stents in their wake. Although longitudinal stent deformation is a rare phenomenon, some studies have demonstrated an increased risk with modern stent designs. The Promus Element was the first stent with reported longitudinal deformation leading to stent thrombosis [7]. The design with thin struts and connectors makes it prone to malformation by slight touch by any equipment. In our case, Xience Xpedition and Promus Element stents were used and both deformed upon impact with the guide catheter. Apart from procedural characteristics, stent deformation is generally seen in tortuous, calcified, and bifurcation lesions. Aggressive guide catheter manipulation and deep cannulation of the coronary artery can cause stent injuries. Moreover, the risk can be increased by the use of multiple balloons, optical coherence tomography (OCT) techniques, and rotational atherectomy equipment [8]. One study reported that side-branch stenting or ballooning, and subsequent use of intravascular ultrasound (IVUS), is independently associated with longitudinal stent deformation [9].

Despite the remarkable safety profile in terms of stent thrombosis and in-stent restenosis, drug-eluting stent (DES) design is constantly changing to provide better performance attributes such as stent trackability, shortening on expansion, flexibility of the core to negotiate calcified lesions, scaffolding, and radiopacity. However, longitudinal strength is not being addressed in research. An evaluation of different stent designs reported stent deformation with a 50 g force results in longitudinal deformation of 4.5% to 19%, compared with the normal expanded stent length [10]. In the DUTCH-PEERS study, longitudinal stent deformation was observed in 0.86% of everolimus-eluting stents [11]. In our case, strangulation of the coronary guidewire and longitudinal stent deformation occurred after a successful PCI, which led to subsequent CABG.

Conclusions

Although the jailed wire technique is effective in protecting side-branch occlusion, there is a risk of wire entrapment with a potential iatrogenic stent deformation. The most widely recommended treatment is surgical removal of the entrapped or deformed equipment from the coronary circulation, but we emphasize that CABG is the measure of last resort only when all percutaneous techniques have been attempted. Newer techniques and equipment should be developed for complex PCIs to reduce the risk of jailed wires and potential damage to the stent structure.

Conflict of Interest

None.

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