

## CASE REPORT

## Management of immediate partial bioresorbable vascular scaffold stent thrombosis

### Kısmen eriyebilen vasküler çatı stenti trombozunun acil tedavisi

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**Summary**– Bioresorbable vascular scaffold (BVS) stents have been proposed recently as an elegant technique for treatment of coronary artery disease. However, perspective that these “dissolvable” stents will replace conventional metallic stents in broad spectrum of clinical conditions and patient categories in the near future has been moderated by non-negligible incidence of stent thrombosis (ST). Mechanical factors, such as strut thickness and malapposition have been implicated in increased risk of BVS ST. Presently described is case of immediate partial BVS ST in a young male related to technical procedural problem, rather than mechanical problem. Glycoprotein IIb/IIIa inhibitors associated with anticoagulation resulted in complete resolution of thrombus and facilitated successful patient outcome.

New imaging modalities, such as optical coherence tomography (OCT) and intravascular ultrasound (IVUS), have been widely used in interventional coronary procedures with goal of gaining better understanding of mechanism, extent, and severity of disease, as well as better stent implantation. Optimal strut apposition is a primary objective during stent implantation in order to avoid thrombosis and to decrease rate of reintervention. Due to high spatial resolution, OCT has gained momentum over IVUS as tool to verify strut apposition of BVS stents to degree that its use has now been paired with BVS stent implantation.

#### CASE REPORT

A 56-year-old male with history of hypertension, diabetes mellitus, and previous percutaneous coronary

**Özet**– Eriyebilen vasküler çatı (BVS) stentleri son zamanlarda koroner arter hastalığının tedavisinde mükemmel bir teknoloji olarak önerilmektedir. Ancak bu “eriyebilir” stentlerin yakın bir gelecekte geniş bir klinik durum spektrumunda ve hasta kategorisinde geleneksel metal stentlerin yerini alacağı şeklinde görüşe sahip uzmanların sayısı, ihmal edilemez sıklıktaki stent trombozu (ST) nedeniyle azalmıştır. Strut kalınlığı ve tam olmayan stent açılması (malapozisyon) gibi mekanik faktörler BVS’de ST riskinin artışından sorumludur. Burada mekanik bir sorundan ziyade işlemle ilgili teknik bir sorundan kaynaklanan kısmi BVS’de acil ST saptanan bir genç erkek olgu sunuldu. Antikoagülasyonla birlikte glikoprotein IIb/IIIa inhibitörlerinin kullanılması trombusun tamamen çözülmesiyle ve hasta prognozunun iyileşmesiyle sonuçlandı.

intervention (PCI) in the ostial right coronary artery (RCA) 10 years earlier, presented at our institution with recurrent chest pain. Electrocardiography (ECG), cardiac enzymes, and cardiac ultrasound were normal. Coronary angiogram through right radial artery revealed severe long stenosis of the proximal and mid left anterior descending (LAD) artery (Figure 1a) and critical in-stent resten-

#### Abbreviations:

AC	Anticoagulation
ACS	Acute coronary syndrome
ACT	Activated coagulation time
BVS	Bioresorbable vascular scaffold
ECG	Electrocardiography
IV	Intravenous
IVUS	Intravascular ultrasound
LAD	Left anterior descending artery
OCT	Optical coherence tomography
PCI	Percutaneous coronary intervention
RCA	Right coronary artery
ST	Stent thrombosis
TIMI	Thrombolysis in Myocardial Infarction risk score
UFH	Unfractionated heparin

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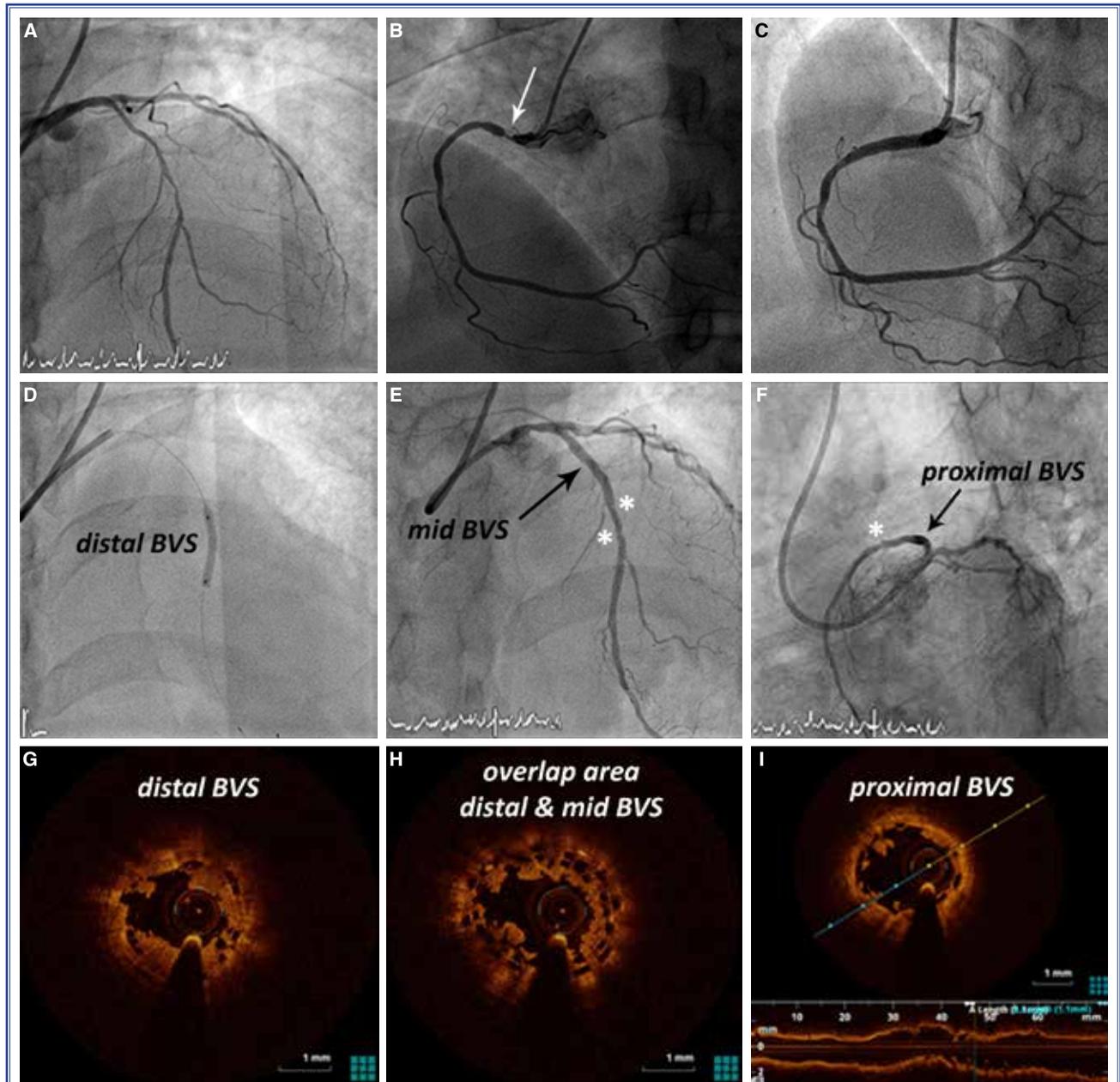
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nosis of the ostial RCA (Figure 1b). After administration of 6000 UI of unfractionated heparin (UFH) intravenous (IV), PCI in the RCA was performed using 3x18 mm Resolute Integrity metallic drug-eluting stent (Medtronic, Inc., Minneapolis, MN, USA) with

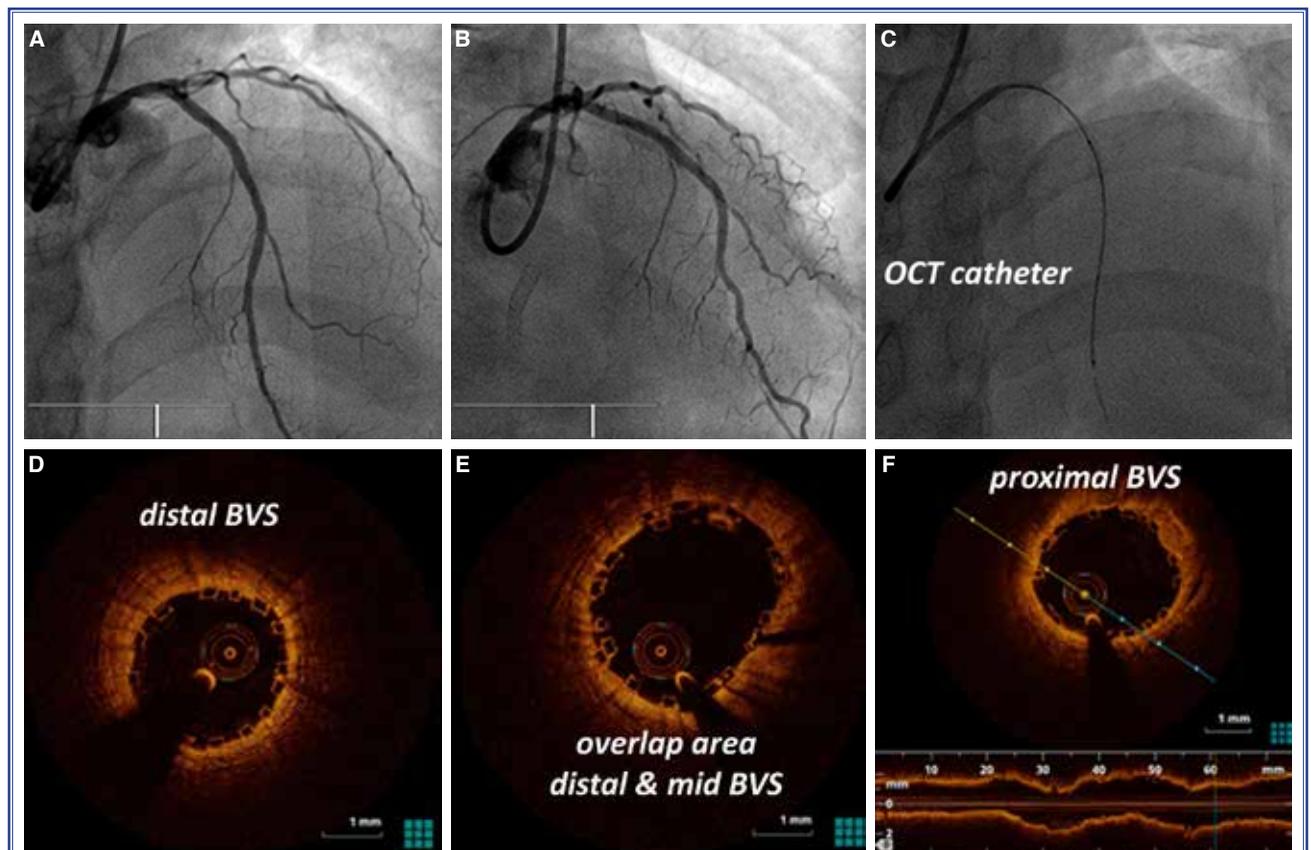
good angiographic result (Figure 1c). Staged PCI was scheduled for intervention in the LAD artery. The patient was discharged with dual antiplatelet therapy of aspirin 81 mg daily and clopidogrel 75 mg daily, along with statin and antihypertensive medication.



**Figure 1.** (A) Coronary angiogram revealing severe, long stenosis of the proximal and mid left anterior descending artery; (B) Coronary angiogram showing severe in-stent restenosis (arrow) of the ostial right coronary artery; (C) Coronary angiogram indicating good angiographic result in the ostial right coronary artery after percutaneous coronary intervention using conventional metallic stent; (D) Implantation of the distal ABSORB bioresorbable vascular scaffold (BVS) stent (Abbott Vascular, Inc., Santa Clara, CA, USA). Angiographic cranial (E) and caudal (F) views after implantation of 3 overlapping BVS stents showing haziness (\*) in zone of overlap between distal and middle BVS stents. (G-I and Video 1) Optical coherence tomography indicating thrombus formation at level of distal BVS stent (G), at level of overlap area between distal and middle BVS stents (H), and at level of proximal BVS stent (I).

One month later, after administration of 6000 UI of UFH IV, predilatation of LAD artery stenosis using 2.5x20 mm non-compliant Trek NC balloon (Abbott Vascular, Inc., Santa Clara, CA, USA) at 16 atm was performed using right transradial access, followed by distal to proximal implantation of 3 (2.5x18 mm, 3x28 mm, and 3x12 mm) overlapping everolimus-eluting ABSORB BVS stents (Abbott Vascular, Inc., Santa Clara, CA, USA) at 15 atm (Figure 1d–f). Postdilatation was performed using 3x20 mm non-compliant Trek NC balloon at 18 atm from distal to proximal part along entire length of the 3 newly implanted BVS stents. Thereafter, angiographic imaging showed haziness centralized mainly at level of overlapping zone between distal and middle BVS stents (Figure 1e, f) with grade 3 Thrombolysis in Myocardial Infarction (TIMI) risk score flow. ECG showed no ischemic changes and the patient denied experiencing any chest pain. OCT was performed immediately and showed hyperintense masses with irregular borders protrud-

ing into the lumen, demonstrating fresh thrombus formation (Figure 1g–i, and Video 1<sup>\*</sup>). However, there was no evidence of BVS stent strut malapposition, stent underexpansion (minimal scaffold area was 5.27 mm<sup>2</sup>), or edge dissection. Activated coagulation time (ACT) monitoring at that time was 176 seconds. Additional 2000 UI of UFH IV and intracoronary bolus of eptifibatid (Integrilin; Takeda Pharmaceutical Company, Ltd., Osaka, Japan) were administered, and further sequences of postdilatation using 3.5x20 mm non-compliant Trek NC balloon at 18 atm were performed to expand scaffold size to maximum allowed limit. Since clinical condition of the patient remained stable, decision was made to pursue continuous infusion of glycoprotein (GP) IIb/IIIa inhibitors for 12 hours in addition to subcutaneous enoxaparin (0.6 mg) twice daily for 3 days. Clopidogrel was replaced with ticagrelor (90 mg) twice daily. The patient continued to be asymptomatic and coronary angiogram performed 4 days later revealed complete resolution



**Figure 2.** (A, B) Coronary angiogram (4 days after procedure) revealing complete resolution of haziness in the left anterior descending (LAD) artery; (C) Optical coherence tomography (OCT) catheter in the LAD; (D–F and Video 2) OCT indicating complete resolution of thrombus at level of distal bioresorbable vascular scaffold (BVS) stent (D), at level of overlap area between distal and middle BVS stents (E), and at level of proximal BVS stent (F).

of haziness with TIMI grade 3 flow through the LAD artery (Figure 2a, b). OCT confirmed disappearance of thrombus formation (Figure 2c–f, and Video 2\*). The patient was discharged on dual-antiplatelet therapy, aspirin and ticagrelor, and remained asymptomatic 12 months later.

## DISCUSSION

BVS stents have emerged as an alternative to conventional metallic stents with favorable clinical outcomes.<sup>[1–4]</sup> However, concerns regarding stent thrombosis (ST) were raised, particularly due to significant strut thickness (approximately 150  $\mu\text{m}^3$ ), which could generate more microenvironmental blood flow disturbances compared with narrower metallic stent struts, which are usually embedded in the vessel wall.<sup>[5]</sup> Moreover, BVS stent struts typically protrude into vessel lumen.<sup>[6]</sup> Several mechanisms have been proposed to explain early BVS ST, including edge dissection, strut fracture, malapposition, and undersized BVS stent.<sup>[7,8]</sup> OCT is light-based modality of intravascular imaging with high spatial resolution enabling more accurate detection of intraluminal structures and subtle abnormalities. OCT has been highly recommended to illuminate underlying cause of BVS ST.

Resistance to antiplatelet therapy can also be major cause of ST. Both aspirin and clopidogrel are efficient antiplatelet drugs for secondary prevention of cardiovascular events, but clinical efficacy may vary among individuals. Platelet function tests can be useful to assess individual platelet response to aspirin or clopidogrel treatment, and individually tailored antiplatelet therapy may improve clinical outcomes. Furthermore, it has been demonstrated that early administration of GP IIb/IIIa inhibitors can be helpful to prevent ST in setting of acute coronary syndrome (ACS) with metallic stents.<sup>[9]</sup>

In the present case, OCT performed during BVS stent implantation was fundamental in ruling out possible mechanical mechanisms for ST, since no edge dissection or strut fracture was present. In addition, it showed that BVS stent size was accurate for vessel lumen and no strut malapposition was detected. This early partial BVS ST could be attributed to periprocedural subtherapeutic level of anticoagulation (AC), since ACT was <200 seconds. Note that, curiously, although it was not measured, same subtherapeutic level of AC is assumed to have been reached during

first PCI procedure for in-stent restenosis of the ostial RCA, since same dosage of UFH was used; however, there was no ST with metallic drug-eluting stent. GP IIb/IIIa inhibitors and therapeutic AC level, along with exchange of antiplatelet drug to more potent agent, were vital in achieving complete resolution of BVS ST and facilitating successful patient outcome.

## Conclusion

As demonstrated in present case, OCT is useful tool to identify mechanical problem as cause of BVS ST, and GP IIb/IIIa inhibitor administration may be useful in case of BVS ST, even outside context of ACS. Yet, an ounce of prevention is worth a pound of cure. Therefore, it is recommended to be vigilant and aggressive with periprocedural AC level during BVS stent implantation in order to avoid ST and to improve patient outcome.

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**\*Supplementary video file associated with this article can be found in the online version of the journal.**

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**Anahtar sözcükler:** Eriyebilen vasküler çatı stentleri; Gp IIb/IIIa inhibitörleri; stent içi tromboz; perkütan koroner girişim.