CASE REPORT

A late complication of coronary artery perforation during primary percutaneous coronary intervention: Coronary arteriovenous fistula

Primer perkütan koroner girişimi esnasında gelişen koroner arter delinmesinin geç dönem komplikasyonu: Koroner arteriyovenöz fistül

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Summary– Coronary artery perforation (CAP) is a rare, but potentially mortal possible complication of percutaneous coronary intervention. There are several treatment options for this complication, including prolonged balloon dilatation, use of a coronary stent graft, and bypass surgery. In this case report, a 65-year-old female patient who was admitted to the catheter laboratory with a diagnosis of acute coronary syndrome, was presented. Coronary angiography revealed total occlusion in the mid segment of the right coronary artery and a drug-eluting stent was implanted under 12 atm of pressure following pre-dilatation with a perfusion balloon. In order to perform defragmentation of the thrombus shifted into the proximal stent segment, post-dilatation was performed with a stent balloon (4–6 atm). After post-dilatation, an Ellis Class II perforation developed. In order to control the bleeding, a coronary stent graft was implanted at the perforation area. The rupture was sealed. Control coronary angiography 40 days later indicated that the stent graft was patent, but an arteriovenous fistula (AVF) draining to the right ventricle was detected. To the best of our knowledge, this is the first case of AVF seen as a late complication of CAP treated with a stent graft.

Özet– Koroner arter delinmesi (KAD), perkütan koroner girişimlerin nadir fakat ölümcül bir komplikasyondur. Bu komplikasyon uzatılmış balon dilatasyonu, koroner stent-greft ve baypas cerrahisi gibi bazı tedavi seçeneklerine sahiptir. Bu olguda, altmış beş yaşında kadın hasta akut koroner sendrom tanısıyla kateter laboratuvarına alındı. Koroner anjiyografide sağ koroner arterin orta bölümünde tam bir tıkanıklık vardı ve buraya bir ilaç kaplı stent, perfüzyon balonu ile ön-dilatasyonun ardından 12 atmosfer (atm) basınç altında yerleştirildi. Proksimal stent bölgesine kayan trombüsün parçalanmasını sağlamak için stent balonu ile post-dilatasyon yapıldı (4–6 atm). Post-dilatasyon sonrası Ellis Sınıf II delinme gelişti. Kanama kontrolünü sağlamak amacıyla koroner stent-greft delinme bölgesine yerleştirildi. Yırtık kapatıldı. Kırk gün sonraki kontrol koroner anjiyografisinde stent-greft açıktı, fakat sağ ventriküle boşalan bir arteriyo-venöz fistül (AVF) görüldü. Bildiğimiz kadarıyla, bu olgu stent-greft ile tedavi edilmiş KAD'nin geç dönem komplikasyonu olarak AVF'nin görüldüğü ilk olgudur.

Coronary artery perforation (CAP) is a rare, but possibly life-threatening complication that occurs with an incidence of 0.2% to 0.5% during percutaneous coronary intervention (PCI).[1] Serious additional possible complications associated include the formation of pericardial tamponade, myocardial infarction, and death. The most common situations in which coronary perforation is encountered include directional and rotational atherectomy, laser angioplasty, use of intravascular ultrasound, operations on chronic total occlusions, and the use of balloon catheters that are larger than the reference vessel. In addition to these important reasons, there is also a relationship with basic stent operations, as well.[2–5] Coronary perforations are classified into 3 groups (Ellis Classification) according to their angiographic appearance.[6] Class I is characterized by extraluminal crater formation without extravasation, Class II is defined by the presence of a pericardial or myocardial blush, and Class III is frank streaming of contrast into the cardiac cavities through a tear greater than 1 mm in width (IIICS). Class III perforations are the most clinically

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catastrophic; such situations often result in pericardial tamponade, myocardial infarct, and at times, death.[6]

This report presents a case of a Class II CAP following the deployment of a drug-eluting stent (DES), which was subsequently treated with a polytetrafluoroethylene (PTFE)-coated stent.

CASE REPORT

A 65-year-old woman was admitted to the emergency department with the complaint of chest pain, which was tight in character and had been present for 6 hours. Her medical history included a 2.75x20-mm bare metal stent implantation due to 90% stenosis at the mid portion of the left anterior descending (LAD) artery in our hospital 8 months earlier. There had been no significant stenosis in the left circumflex (LCx) or the right coronary artery (RCA) (Fig. 1a). The patient discontinued the prescribed treatment after 1 month.

On her first examination, she was mentally well. Vital signs showed blood pressure of 120/80 mmHg, a respiratory rate of 18 breaths/minute and a body temperature of 36.4°C. The electrocardiography (ECG) showed sinus bradycardia (50 beats/minute), 1-mm ST-elevation in the D2-3-avF, V1-3 QS, and D1-avL, with the presence of T(-) in V5-6. The patient was taken to the catheter laboratory with a diagnosis of acute inferior myocardial infarction. According to the coronary angiography, the mid-RCA was 100% occluded (Fig. 1b), there was a plaque in the LCx, and the LAD artery had 70% in-stent restenosis. Primary PCI for the RCA occlusion was planned. A PT2 guide wire (Boston Scientific Corp., Marlborough, MA, USA) was passed across the lesion without a protecting second guide wire in the right ventricle (RV) branch. The lesion was pre-dilated with a 2.0x20-mm perfusion balloon. This was followed by the deployment of a 2.5x23-mm DES at a pressure of 12 atm (Fig. 1c, d). In the proximal stent segment, a thrombus shift was seen. The thrombus was defragmented with the aid of a stent balloon at 4 to 6 atm. Control fluoroscopic images revealed an Ellis Class II perforation at the level of the RV branch (Fig. 2a, Video 1*). The patient became agitated, and simultaneously, a 2:1 AV block and hypotension were observed. It was decided to close the perforation immediately using a PTFE-coated stent for the patient's safety. A 2.8x19-mm coronary stent graft (Jostent Graftmaster, Abbott Vascular, Inc., Santa Clara, CA, USA) was deployed to the perforation site successfully under 16 atm of pressure (Fig. 2b). Control injections did not show any extravasation of the contrast agent (Fig. 2c, Video 2*). Due to the placement of the stent graft, RV branch flow was completely blocked.

Abbreviations:

AV	*Atrioventricular*
AVF	*Arteriovenous fistula*
CAP	*Coronary artery perforation*
DES	*Drug-eluting stent*
ECG	*Electrocardiography*
LAD	*Left anterior descending*
LCx	*Left circumflex*
PCI	*Percutaneous coronary intervention*
PTFE	*Polytetrafluoroethylene*
RCA	*Right coronary artery*
RV	*Right ventricle*

Fluid replacement was initiated. After 20 minutes, it was observed that localized opacity had disappeared in control images and control injections revealed no extravasation (Fig. 2d, Video 3*). A follow-up echocardiography did not show the presence of pericardial fluid. Dual anti-thrombotic therapy was continued. On the first day of intensive care follow-up, sinus rhythm had been recovered and vital parameters had stabilized. After approximately 7 days of ward follow-up, and with the recommendation of PCI for the LAD artery stent, she was discharged with treatment of 100 mg once daily aspirin, 75 mg once daily clopidogrel, 80 mg once daily valsartan, and 40 mg once daily atorvastatin.

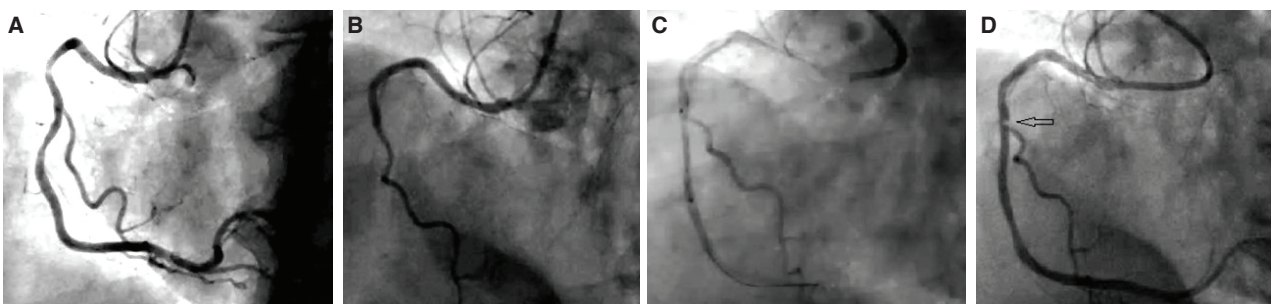

Figure 1. (A) Right coronary artery (RCA) angiography image taken 8 months earlier. **(B)** The level of RCA occlusion during the acute inferior myocardial infarction. **(C)** Drug-eluting stent was placed at the lesion site. **(D)** Thrombus shift in the proximal stent segment following the deployment of the stent (black arrow).

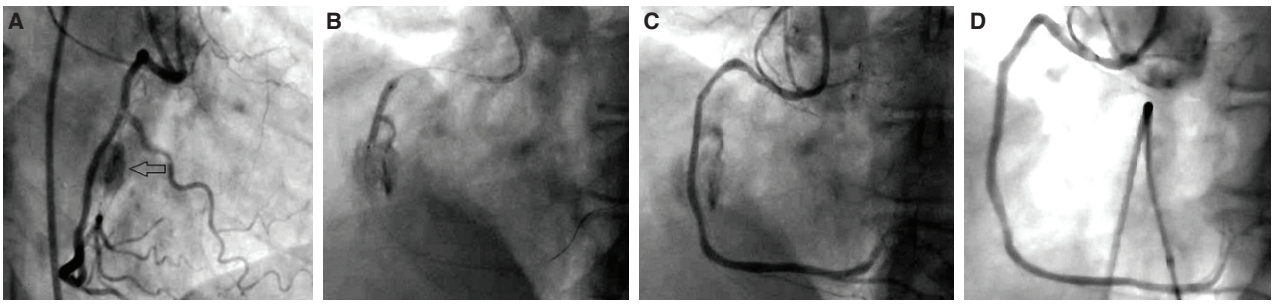

Figure 2. **(A)** Myocardial blush forming as a result of perforation (black arrow). **(B)** Deployment of the coronary stent graft. **(C)** Control image after deployment of the stent graft. **(D)** Control image taken 20 minutes after the deployment of the stent graft.

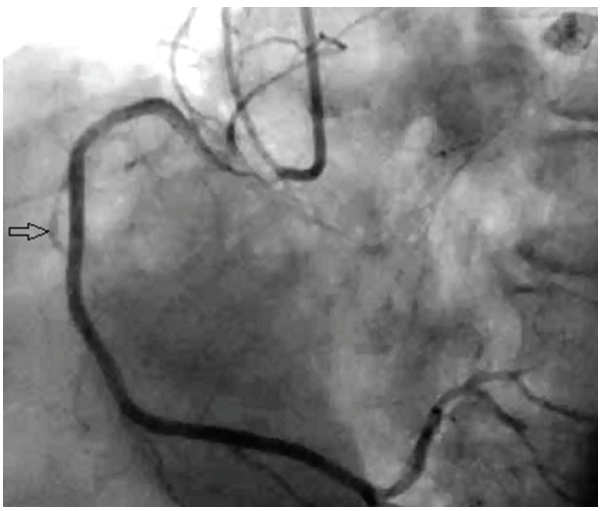

Figure 3. Control angiography performed 40 days later showing the arteriovenous fistula draining to the right ventricle cavity (black arrow).

Forty days after the recent intervention, the patient underwent PCI for 70% stenosis in the LAD artery stent. A 2.75x18-mm DES was deployed at 18 atm of pressure. The stent graft was patent on RCA control fluoroscopic imaging, but an arteriovenous fistula (AVF) connecting to the RV had occurred and there was a shunt from the RCA to the RV (Figure 3, Video 4*). The patient was discharged with medical therapy. We did not perform an ischemia study because there was no active cardiac complaint at the 1-month follow-up visit.

DISCUSSION

CAP is a rare complication of PCI, but one that can have immediate or delayed effects, and can even result in death. Previous studies have reported an incidence of 0.2% to 0.5%.[1] It is more often seen with the use of hydrophilic-coated wires, thicker balloons (>1.1 mm) or stents compared with the reference vessel, a cutting balloon, high-pressure balloon expansion, catheters, or during the use of rotational atherectomy devices.[2–5] Risk factors contributing to an increased risk of perforation include older age, female gender, lesions of interest that occur in areas of vessel calcification and tortuous anatomy, lesions around the bifurcation, LCx or RCA lesions, chronic total occlusions, complex lesions (type B2 or C), and vessel diameter less than 2.5 mm.[1,7,8] The increased risk factors that we identified in our case were advanced patient age, female gender, presence of RCA lesion, and hydrophilic wire use. The perforation in this case may have been related to the post-dilatation use of the balloon for defragmentation.

Conservative treatment may be exercised without any adverse clinical outcomes (Ellis Class I). Serious clinical complications (Ellis Class II-III), such as pericardial tamponade and myocardial infarct, may result in an increased risk of operative intervention. The clinical severity of complications is proportional to the size of the perforation. There is an incremental increase in risk of developing tamponade, myocardial infarct, the need for emergent surgery, and death as the classification increases from I through III.[5]

In the treatment of CAP, prolonged balloon expansion, reversal of anticoagulation, a stent graft, coil embolization (in cases with distal vessel damage), and surgical methods can applied. The choice of treatment method is dependent on the severity and location of the perforation, and hemodynamic status of the patient. The availability of equipment in the catheter laboratory can limit treatment options, as well.[8] In the treatment of Class I and II CAP, reversal of heparin anticoagulation (1 mg protamine to neutralize

100 IU heparin to achieve an active bleeding target time of 150 seconds), stopping all glycoprotein IIb/IIIa inhibitors, and the application of prolonged balloon expansion (10 to 20 minutes) is the appropriate course of action.[6] If this approach is unsuccessful or not tolerated by the patient, or if Class III perforation is diagnosed, a PTFE-coated stent may be preferable. Stent grafts comprise a layer of PTFE membrane between 2 stents. The currently accepted success rate of stent grafting therapy is 91% to 93%[1,6] with an angiographic restenosis rate of 32%.[9] In the event of unsuccessful stent graft application, use of an expanded balloon in the perforated area may also require the availability of emergency surgical treatment, given the high mortality rate.[6] Despite these measures, and even with surgical intervention, the mortality rate is approximately 20%.[10]

AVF may be congenital, or secondary, as a result of trauma or iatrogenic PCI. Iatrogenic AVF secondary to PCI is an exceedingly rare complication that characteristically drains into the cardiac cavities or the veins.[11,12] Stent graft deployment to remedy this complication has resulted in excellent clinical outcomes.[13,14] Another treatment option is the coil embolization device, which is suitable in iatrogenic AVF caused by distal guide wire-induced perforation. In some patients, iatrogenic AVF that emptied into the venous circulation has been reported to resolve spontaneously.[11,15]

Because of the thrombus load and perforation-dissection line advancing towards the RV branch, our patient developed deep bradycardia, hypotension, and agitation. We decided to treat with a stent graft to prevent pericardial tamponade, as it would take time to reach the echocardiography device and patient compliance was likely to be poor for prolonged balloon dilatation therapy. Studies have reported that coronary AVF most often develops during intervention. An interesting aspect of this case is the development of AVF that drained from the site to the RV occurred after 40 days, despite closure of the perforation site. We did not think coil embolization was suitable in this case due to the RV connection at the mid RCA. Therefore, we considered increasing the diameter of the stent graft by using a non-compliant balloon, or deploying a second stent (basic or stent graft). However, we opted against these approaches in order not to disrupt the in-stent epithelization and to avoid adding to the existing metal load.

In conclusion, the use of a stent graft in the treatment management of coronary perforation is an effective and safe therapeutic option. Although seldom needed, it is recommended that the tools be made available in PCI labs, as they can be life-saving.

This case report was presented as an e-poster at the 22nd National Interventional Cardiology meeting.

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

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Anahtar sözcükler: Arteriyo-venöz fistül; koroner arter perforasyonu; perkütan koroner girişim; stent-greft.