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Wei-Chieh Lee, Chung-Jen Wu, Hsiu-Yu Fang

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An 87-year-old Asian male experienced progressive shortness of breath for two days. He presented symptoms and signs of decompensated heart failure and was diagnosed as non ST-segment elevation myocardial infarction, Killip III. Coronary intervention was performed for chronic total occlusion of left anterior descending artery. Unfortunately, coronary perforation happened during balloon anchoring after rotational atherectomy. Rotational atherectomy may be not related to perforation, but causes vessel wall more fragile after disruption of the arc of calcification. Even if balloon anchoring was performed at low pressure, we need keep in mind that it still could result in a terrible coronary perforation after debulking techniques. Covered stents for emergency implantation in case of coronary perforation must be an obligatory inventory of catheterization laboratories. It is an effective alternative that can be used to seal a major coronary perforation.

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CASE REPORT

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Keywords: Cardiac tamponade, Chronic total occlusion, Coronary perforation, Rotational atherectomy

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INTRODUCTION

Coronary perforation is a rare but life-threatening complication of percutaneous coronary interventions (PCIs) and approximately ranges from 0.19–0.59% of these procedures [1], depending on the patient's risk factors. Based on the type of perforation, various methods as emergent surgery, covered stent implantation, coil insertion, prolong balloon inflation, and conservative approaches can be used. Covered stents enabled efficient endovascular repair of coronary artery perforations. Coronary perforation occurs more frequently with debulking techniques (directional/rotational atherectomy) with an incidence of approximately 1% [2]. Approximately 50% of the coronary perforations are guidewire (GW) related [2]. We present a case of coronary artery perforation, Ellis type 3, with cardiac tamponade that occurred during the balloon anchoring after rotational atherectomy of a chronic total occlusion (CTO) of coronary vessel. This perforation was successfully managed by performing emergent pericardiocentesis and implanting two covered stents. Even if balloon anchoring was performed at low pressure, we need keep in mind

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that it still could result in a terrible coronary perforation after debulking techniques.

CASE REPORT

An 87-year-old Asian male experienced progressive shortness of breath for two days. He also presented with orthopnea and paroxysmal nocturnal dyspnea, but denied chest tightness. He had a medical history of hypertension, type 2 diabetes mellitus, and chronic kidney disease, stage 3.

Electrocardiography showed sinus tachycardia and poor R-wave progression in lead V1–V3. Chest radiography showed pulmonary edema. Initially, serum creatinine was 1.68 mg/dL, serum troponin-I raised from 2.584–14.461 ng/mL and serum B-type natriuretic peptide was 410 pg/mL. The tentative diagnosis was non ST-segment elevation myocardial infarction, killip 3, and TIMI risk score, 5 points. Coronary angiography was performed. The right coronary artery was non-dominant with chronic total occlusion (CTO) arising from the mid-segment (Figure 1A). The left coronary artery was heavily calcified, the mid segment of the left anterior descending (LAD) artery was totally occluded, and the proximal segment of left circumflex (LCX) artery also exhibited significant stenosis (Figure 1B–C). An intracoronary bridge collateral to the distal LAD and a septal branch supplying the distal RCA territory were noted (Figure 1B–C). After diagnostic coronary angiography, the symptoms of heart failure progressed and the patient could not lie for advance intervention. The syntax score of coronary tree was 39.5 points. The J-CTO score of the LAD was 3 points as no stump, occlusion length over 20 mm, and severe calcification. The transthoracic echocardiography presented impaired left ventricular performance and anteroapical hypokinesia. Based on the above observations, we discussed the coronary artery bypass graft surgery and PCI with the patient and his family. Unfortunately, acute respiratory failure occurred before the decision could be made. We inserted intra-aortic balloon pumping (IABP) and performed intubation for ongoing heart failure and difficult intervention. After IABP implantation and vasoactive agent use, hemodynamic condition stabilized for PCI.

An antegrade approach method was chosen for the CTO lesion of LAD. Seven Fr. extra back-up catheter 4.0 (EBU4) (Medtronic, Minneapolis) were used with the sheathless technique and transradial approach via the left radial artery. A Fielder FC (Asahi Intecc. Co.) guidewire with a microcatheter was failed to pass through target lesion and was switched to a Fielder XT-A (Asahi Intecc. Co.) guidewire, which passed through the heavily calcified lesion of mid-LAD. Several small sized balloons were inflated, but the balloons could not be fully dilated. Therefore, rotational atherectomy was performed for this heavily calcified lesion. A 1.25 mm and 1.5 mm rotational atherectomy were performed smoothly. Next, pre-dilatation was performed with several sized

balloons at proximal- to mid-LAD. An intravascular ultrasound (IVUS) study revealed the target lesion site was not surrounded by calcification, and had some linear disruption of calcification, and the minimal luminal diameter (MLD) was approximately 2.5 to 2.75 mm at the mid-LAD (Figure 1D). The MLD of the proximal-LAD was approximately 3.0 mm and the MLD of the left main was approximately 3.5 to 4.0 mm. Three everolimus-eluting stents (Xience V, Abbott, USA) 2.25x28 mm, 2.75x38 mm, and 3.0x38 mm; respectively) were deployed from the distal-LAD to proximal-LAD. Post-dilatation with a high pressure balloon (HPB) was performed at the proximal to mid-LAD at 20–24 atm.

Then, PCI was performed for proximal-LCX lesion. A 3.0x15 mm HPB was inflated at the mid-LAD at 12 atm for anchoring because the small balloon could not pass smoothly. Pre-dilation was performed at proximal-LCX. However, the patient became agitation and hemodynamical instability suddenly. Heart rate decreased to 30–40/min, and systolic blood pressure decrease to 50–60 mmHg. Unfortunately, the Ellis type III (cavity spilling) of the mid-LAD (Figure 1E–F) and type B coronary dissection of the proximal-LCX (Figure 1E) were noted. A bedside cardiac echocardiography showed cardiac tamponade with high density pericardial effusion over 100 ml. Emergent pericardiocentesis was performed and 250 ml of bloody effusion was drained. At that time, protamine 50 mg was infused to convert procedure used heparin dosage. Then, hemodynamic condition became stable gradually. Prolonged balloon inflation was performed at perforation site of the mid-LAD, but could not seal the perforation. A 2.8x19 mm Graftmaster covered stent (Abbott Vascular, USA) was placed at the mid- to distal-LAD. However, dye extravasation persisted. A balloon inflation was used to check the perforation site and another 2.8x16 mm Graftmaster covered stent (Abbott Vascular, USA) was placed at the distal-LAD to overlap with the previous covered stent. The LAD presented TIMI 2 flow finally, and no dye extravasation was noted on the final angiography.

Rotational atherectomy may be not related to perforation, but caused vessel wall more fragile. Even if balloon anchoring was performed at low pressure after debulking techniques, it still could result in a terrible coronary perforation. Finally, two covered stents were deployed for coronary perforation because prolonged balloon inflation did not seal the perforation.

DISCUSSION

The coronary perforation classification by Ellis et al. has received world-wide acceptance. The classification of coronary perforations is broken down as type I (extraluminal crater), type II (myocardial or pericardial blushing), and type III (contrast streaming or cavity spilling) [3]. The incidence of coronary perforation ranges from 0.19–0.59% [1]. The incidence of coronary

Figure 1: (A) Right coronary artery (RCA): non-dominant artery and chronically total occlusion (CTO) arising from the mid segment (white arrow); (B, C) left coronary artery: heavily calcified, the mid segment of left anterior descending (LAD) artery was totally occluded (upper white arrows), intracoronary bridge collateral to the distal-LAD and a septal branch supplying the distal-RCA territory (lower white arrows); (D) no surrounding calcification, had linear disruption of calcification and minimal luminal diameter was approximately 2.5 to 2.75 mm at the mid-LAD. (F) Ellis type III coronary perforation at mid-LAD (right white arrows in figure (E), lower white arrows in figure (F)); post-dilatation type B dissection at proximal segment of left circumflex artery (left white arrows in figure (E)); pigtail (black arrows in figure (E, F)).

perforation after PCIs with debulking techniques ranged from 0.5–1.2%. [4]. Coronary perforation occurs when a dissection or intimal tear completely penetrates the arterial wall leading to either vessel puncture with minimal dye staining or vessel rupture with brisk extravasations of blood and dye into the pericardial space. The associated risk factors were divided into three concepts as clinical variables, angiographic factors, and technique-associated factors [5]. With the improvement of intervention technique, the possibility of coronary perforation increased due to more debulking procedure, more complex lesion as chronic total occlusion, calcified lesion.

Therapeutic strategies include prolonged balloon inflation, covered stents, reversal of anticoagulation, embolization of the distal vessel and surgery. The choice depends on the site and severity of the perforation, the patient's hemodynamic status and the equipment available in the catheterization laboratory. It has been reported that the administration of protamine in patients with coronary perforation seems to be safe, without an increase in the risk of vessel/stent thrombosis.

Pericardiocentesis must be performed immediately if cardiac tamponade occurs. Cardiac tamponade means causes much more blood loss from hemodynamically unstable perforated vessels, and may be related to higher mortality. Cardiac tamponade related to guidewire-induced coronary artery perforation increased to an almost three-fold risk of late death [6]. Surgical repair of coronary perforation is prescribed as ligation or suturing of the vessel, or bypass grafting to the distal portion of the vessel, or pericardial patch/teflon felt wrapping repair if multiple stents with coronary perforation and subepicardial hematoma happen [7].

Covered stents for emergency implantation for coronary perforation is a safe and effective alternative, and can seal a major coronary perforation. The utilization of covered stents is faster, and more effective, and is considered to be the gold standard in the management of coronary perforation [8]. The incidence of subacute thrombosis and restenosis in the covered stents is relatively higher than in the conventional coronary stents (10.3% versus 3.4%). This problem may be related to delayed endothelialization and increases susceptibility to thrombus formation [8], and long-term dual antiplatelet therapy is recommended [9]. According to previous studies, in-stent restenosis occurs with a frequency of approximately 30% within the first six months after implantation, and in most cases was related to edge stenosis (29.8%) [10].

Our case had multiple coronary perforation risk factors, such as advanced age, renal dysfunction, non ST-segment elevation myocardial infarction, CTO, coronary artery calcification, long target lesions (>20 mm), atherectomy devices, IVUS guided PCI optimization and high-pressure post-dilatation. Rotational atherectomy may be not related to perforation, but causes vessel wall more fragile after disruption of the arc of calcification.

CONCLUSION

Rotational atherectomy creates fragile vessel wall due to calcification with linear disruption. Even if the balloon anchoring was performed at low pressure, it could result in a terrible coronary perforation. Covered stent is a safe and effective alternative for sealing a major coronary perforation.

Author Contributions

Wei-Chieh Lee – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Chiung-Jen Wu – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Hsiu-Yu Fang – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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