CASE REPORT

Rescue Percutaneous Coronary Intervention for a Lethal “Jailed” Septal Perforator Branch to Resolve Delayed Complete Atrioventricular Block

Yuhei Nojima, MD, Madoka Ihara, MD, Hidenori Adachi, MD, Tetsuya Kurimoto, MD and Shinsuke Nanto, MD

Summary

Delayed complete atrioventricular (AV) block associated with an occluded septal perforator branch (SPB) is an uncommon complication after performing percutaneous coronary intervention (PCI) for the left anterior descending coronary artery (LAD). Here we report the case of a 74-year-old man who underwent elective PCI for proximal LAD complicated with occlusion of the first major SPB and developed a complete AV block 78 hours after PCI was performed. The patient received a temporary transvenous pacemaker via the jugular vein and successfully underwent balloon angioplasty of the lethal “jailed” SPB, resulting in recovery from the complete AV block. Permanent pacemaker implantation was avoided. Our findings indicate the importance of post-procedural monitoring and consideration of rescue PCI for an occluded SPB in cases of complicated AV conduction disturbances.

Key words: Angioplasty, Transluminal, Atrioventricular conduction block

An occlusive side branch requiring ballooning or stenting is a common complication associated with an increase in the number of percutaneous coronary interventions (PCIs). Atheromatous plaque shift or the snow-plow effect in the side branch has been reported to be responsible for this complication. Conversely, delayed complete atrioventricular (AV) block due to a “jailed”/occluded septal perforator branch (SPB) following PCI for the left anterior descending coronary artery (LAD) is considered an uncommon complication with few reported cases in the literature. We describe the case of an elderly man who developed syncope because of complete AV block 3 days after PCI for LAD complicated with the occlusion of the first major SPB.

Case Report

A 74-year-old man with atypical left sternal pain during exertion and rest was referred to our hospital. His baseline electrocardiography (ECG) indicated complete right bundle branch block (CRBBB) change (Figure 1A). Coronary risk factors included hypertension, dyslipidemia, and current smoking. Under prescription, his blood pressure was 140/80 mmHg and his low-density lipoprotein level was 135 mg/dL [reference value (RV): 65-139 mg/dL]. Because of his osteoarthritis, he could not undergo any exercise test. Therefore, he was screened for coronary artery disease using computed tomography (CT). Coronary CT angiography demonstrated severe calcification in the coronary vessels. Thus, we performed coronary angiography (CAG) and found severe stenotic lesions in both LAD and the left circumflex artery (LCX) (Figure 2A).

To confirm the presence of ischemia, we performed a fractional flow reserve (FFR) test in each coronary artery. The FFR values for LAD and LCX were 0.64 and 0.80, respectively; therefore, we decided to perform revascularization for LAD.

A 0.014-inch conventional wire (Runthrough NS Extra Floppy, Terumo, Tokyo, Japan) was advanced distally to the stenosis in LAD. Subsequently, on performing intravascular ultrasound (IVUS), the IVUS could not get through the stenotic lesion. Therefore, we used a 2.0-mm noncompliant balloon to dilate the lesion. Finally, with balloon inflation at 30 atm, the distal stenotic lesion could be assessed on IVUS. Considering the IVUS findings, we deployed a 3.0 × 33-mm cobalt-chromium everolimus-eluting stent (XIENCE Xpedition, Abbot Vascular, Santa Clara, CA). Despite the rising inflation pressure of up to 30 atm with the previous balloon, we could not deliver the stent to the desired site. While repeatedly trying to place the stent at the desired site, we unintentionally left the stent in the left main coronary artery and decided to deploy the stent at an undesired site without retrieving the dislodged stent from the coronary artery. Subsequently, using a special child catheter (GUIDEPLUS, NIPRO, Osaka, Japan), we deployed another stent (XIENCE Xpedition).
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Figure 1. ECG history. A: Baseline ECG. Only CRBBB with normal axis deviation is confirmed. B: ECG after occlusion of the first major SPB. CRBBB with new-onset LAFB (i.e., obvious left axis deviation) is noted. The QRS interval in this ECG is wider than that in the baseline ECG. C: ECG after rescue PCI for the lethal “jailed” SPB. CRBBB with normal axis deviation, which is similar to the finding on baseline ECG. ECG indicates electrocardiogram; CRBBB, complete right bundle branch block; SPB, septal perforator branch; LAFB, left anterior fascicular block; and PCI, percutaneous coronary intervention.

Discussion

Our patient developed complete AV block 3 days after PCI for LAD. During PCI for LAD, the first major SPB was “jailed” and completely occluded. On the next day, ECG showed CRBBB with LAFB, which indicated bifascicular block.

Complete AV block is wildly known to be reversible in some cases of inferior acute myocardial infarction (AMI) because blood is supplied to the AV node via the

dition\(^\circ\), 3.0 × 28 mm) overlapping the previous stent at the distal site. The first major SPB, which was across the site at which these two stents were overlapping, showed complete occlusion after the procedure (Figure 2B). The patient complained of chest oppression after the procedure; therefore, we attempted to salvage PCI for the first major SPB. However, no improvement of coronary flow in the first major SPB was observed, and the procedure failed. As a result, he was admitted to the coronary care unit for overnight observation.

Although his condition improved 18 hours after the procedure, he developed acute septal myocardial infarction. His peak creatinine phosphokinase (CPK) level was 721 IU/L (RV: 14-170 IU/L), and his myocardium isozyme of CPK level was 74.0 ng/mL (RV: 0-5.0 ng/mL). ECG demonstrated the original CRBBB with new-onset left anterior fascicular block (LAFB) without ST-elevation (Figure 1B). His symptoms resolved, and he was discharged 2 days after PCI.

However, 3 days after PCI, he experienced several presyncopal episodes at home. He was admitted to the emergency room (ER) in our hospital and was diagnosed with complete AV block with a ventricular rate of 44 beats/minute (Figure 3A). His consciousness was clear, and his blood pressure was 100/74 mmHg. Laboratory findings demonstrated a high serum troponin T level [1.293 ng/mL (RV: 0-0.1 ng/mL)] but no CPK elevation or electrolyte abnormalities. Suddenly, he became unresponsive in the ER. On 12-lead ECG, complete AV block without escape rhythm was noted (Figure 3B). With an immediate atropine shot and cough resuscitation, spontaneous circulation resumed. After placing a 5-Fr temporary transvenous pacemaker (TPM) via the right jugular vein, he underwent emergency CAG, which showed partial patency of the first major SPB and the thrombolysis in myocardial infarction (TIMI) grade was 1 (Figure 2C). No occlusive lesion was found in the right coronary artery (RCA) (Figure 2D). The partial patency of SPB was successfully penetrated with a 0.010-inch polymer jacket wire (XT-R\(^\circ\), Asahi Intec, Aichi, Japan) over a microcatheter (Corsair\(^\circ\), Asahi Intec, Aichi, Japan), which was advanced through the two previously placed overlapping stents. Balloon angioplasty was performed using a 1.5 × 10-mm balloon (Tazuna\(^\circ\), Terumo, Tokyo, Japan) (Figure 2E). The TIMI grade improved from 1 to 3 (Figure 2F). One day after angioplasty of the first major SPB was performed, the patient’s condition returned to normal. ECG demonstrated the original CRBBB without LAFB (Figure 1C). His conduction disturbance completely resolved after 2 days. Therefore, we removed the TPM and placed him under continuous close observation. Seven days after TPM removal, we performed an electrophysiology study, which confirmed a normal conduction system. Consequently, he was discharged without permanent pacemaker implantation.
Figure 2. Coronary images. A: A severe stenosis lesion is found from the proximal to middle LAD. B: The white triangle indicates complete occlusion of the first major SPB of the LAD “jailed” by two stents. The first major SPB in thrombolysis in myocardial ischemia (TIMI) grade reveals zero (0) (white triangle). C: Partial patency of the first major SPB is recognized with a TIMI grade of 1 (white triangles). D: The right coronary artery is patent. E: Balloon angioplasty is performed using a 1.5 × 10-mm balloon to recanalize the lethal “jailed” SPB. F: The TIMI grade in SPB improves from 1 to 3 immediately (white triangles). LAD indicates left anterior descending artery; SPB, septal perforator branch; and TIMI, thrombolysis in myocardial infarction.

Figure 3. ECG in the emergency room. A: ECG on the monitor shows complete AV block with a heart rate of 44 beats/minute. B: ECG after an episode of unresponsiveness. ECG shows loss of escape rhythm. At this point, he immediately received a shot of atropine and cough resuscitation, which resulted in the return of circulation. ECG indicates electrocardiogram; and AV, atrioventricular.
AV nodal branch, which is most commonly derived from RCA. Spencer, et al. reported that complete AV block developed in 3.3% of patients with anterior AMI and 6.3% of patients with inferior AMI. The bundle of His is also supplied by RCA with a minor contribution by SPB from LAD. Therefore, delayed complete AV block after PCI for LAD is an uncommon complication. We reviewed the English literature and found only eight published case reports on delayed complete AV block following “jailed”/occluded SPB of LAD (Table). The occlusion of SPB can lead to angina, myocardial infarction, and conduction abnormalities. Various mechanisms have been proposed, including plaque shift, the snow-plow effect, and stent jailing of the side branch. An acute occlusive side branch during PCI has been shown to have a good prognosis. The patency of the side branch is often well maintained at long-term follow-up. Although infrequently performed, PCI for SPB has been shown to be feasible in selected patients. In our case, angioplasty for the lethal “jailed” SPB helped to successfully resolve the acute conduction disturbances.

Most of the eight published cases demonstrated the following various conduction abnormalities at baseline: first-degree AV block, left bundle branch block, CRBBB, and LAFB. To treat hypertrophic obstructive cardiomyopathy, a procedure known as “percutaneous transluminal septal myocardial ablation (PTSMA),” which results in SPB occlusion, can be used. Chang, et al. concluded that left bundle branch block (odds ratio: 39; P = 0.002) and first-degree AV block (odds ratio: 14; P = 0.001) on base-line ECG are independent predictors of complete AV block after PTSMA. In our case, baseline ECG showed only CRBBB; however, after the first major SPB was “jailed” and occluded following PCI for LAD, ECG showed CRBBB with LAFB. This might be a typical sign that develops into a delayed complete AV block. Notably, five of the eight published cases required permanent pacemaker implantation.

Several studies have shown that the development of right axis deviation during AMI is associated with a poor prognosis. In contrast, some studies have mentioned that the development of left axis deviation in AMI is associated with a good prognosis, and this supports our result. Kim, et al. also demonstrated that postprocedural TIMI flow in non-ST-elevation myocardial infarction patients did not affect the clinical outcomes. However, here, the patient had a potential possibility to implant a permanent pacemaker. Fortunately, the rescue PCI for the compromised SPB not only avoided permanent pacemaker implantation but also recovered his AV conduction. According to the previous reports, delayed complete AV block occurred within 1-2 days after PCI was performed. Our findings indicate the importance of postprocedural monitoring for at least 3 days and the consideration of rescue PCI for a compromised SPB in cases of complicated AV conduction disturbances.

### Conclusions

We present an interesting case of delayed complete AV block associated with “jailed”/occluded first major SPB following PCI for proximal LAD. In certain subgroups of patients, SPB occlusion might lead to signifi-

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Table. Review of Eight Published Case Reports and Our Report of Delayed Complete AV Block Associated with a “Jailed”/Occluded Septal Branch of the LAD

| Case reports | Age (years) /Sex | Pre-PCI for the LAD conduction abnormalities | Septal branch flow at the end of PCI for the LAD | Post-PCI for the LAD conduction abnormalities | Complete AV block onset after PCI for the LAD | Septal branch flow after the onset of complete AV block | Permanent pacemaker implantation |
|-------------|-----------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------|---------------------------------|
| Furgerson, et al. | 74/Female | Complete left bundle branch block | TIMI 0 | Complete left bundle branch block | 2 days | TIMI 2 | No |
| Pillai, et al. | 67/Female | None | TIMI 0 | None | 2 days | TIMI 1-2 | No |
| Nee, et al. | 76/Female | Left anterior fascicular block | TIMI 2 | Left anterior fascicular block | 1 day | TIMI 2 | Yes |
| Kireyev, et al. | 59/Male | First-degree AV block | TIMI 3 | Complete right bundle branch block + first-degree AV block | 2 days | TIMI 0 → 3 (POBA) | No |
| Sadiq, et al. | 75/Female | None | TIMI 0 | Complete right bundle branch block + left anterior fascicular block | 2 days | TIMI 3 | Yes |
| Hamatani, et al. | 76/Male | Complete right bundle branch block + first-degree AV block | TIMI 0 → 3 (POBA) | Complete right bundle branch block + left anterior fascicular block + first-degree AV block | 2 days | TIMI 3 | Yes |
| Guragai, et al. | 63/Male | None | TIMI 3 | None | 2 days | TIMI 3 | Yes |
| Shah, et al. | 70/Female | None | TIMI 0 | None | 5 hours | TIMI 0 | Yes |
| Our case | 74/Male | Complete right bundle branch block | TIMI 0 | Complete right bundle branch block + left anterior fascicular block | 3 days | TIMI 1 → 3 (POBA) | No |

AV indicates atrioventricular; LAD, left anterior descending artery; PCI, percutaneous coronary intervention; TIMI, thrombolysis in myocardial infarction; and POBA, plain old balloon angioplasty.
cant clinical consequences, especially in those with preexisting conduction abnormalities, including first-degree AV block or bundle branch block. If such ECG changes are noted, an extension of hospital stay for prolonged cardiac monitoring after PCI and/or prophylactic TPM should be considered. We believe that an intervention in SPB is feasible in selected patients despite the lack of evidence to support such an intervention. Further studies are warranted to validate our findings and to investigate the focus on long-term outcomes.

Disclosures
Conflicts of interest: The authors declare that there is no conflict of interest.

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