A novel treatment using a guide extension catheter and distal protection device for refractory coronary embolism: case report

Hirofumi Kusumoto, Katsuyuki Hasegawa, Kasumi Ishibuchi*, and Satoru Otsuji

Department of Cardiology, Higashi Takarazuka Satoh Hospital, Takarazuka, Hyogo 6650873, Japan

Received 7 May 2020; first decision 15 July 2020; accepted 20 November 2020

Background
A large thrombus burden in patients with acute myocardial infarction is associated with worse outcomes. Although various methods of thrombus aspiration have been described, there is a potential limitation in the mechanism of eliminating a thrombus with only the use of an aspiration device. In this report, we present a novel method of retrieving massive thrombus using a guide extension catheter and a filter device.

Case summary
An 80-year-old man was diagnosed with anterior ST-elevation myocardial infarction (STEMI). Emergency coronary angiography revealed that the left anterior descending artery (LAD) showed an acute thrombotic occlusion in the mid-section. The percutaneous coronary intervention was performed to recanalize an occluded LAD. Although thrombectomy using an aspiration catheter and a guide catheter extension system was performed repeatedly, only a small amount of the thrombus was retrieved, and the LAD was still occluded. Therefore, we planned to remove the large thrombus burden by capturing the entire thrombus between the tip of the guide extension catheter and distal protection device, followed by pulling them out of the guide catheter together. A large amount of red thrombus, which adhered to the axis of the filter device, was successfully retrieved. The occluded LAD was successfully recanalized without balloon dilatation or stent implantation.

Discussion
Although a variety of aspiration devices are available, removal of large coronary artery thrombi with the use of an aspiration catheter alone can at times prove difficult. To solve this problem, we developed a novel technique for retrieving large thrombi. This method is effective in removing refractory thrombi for the treatment of STEMI patients.

Keywords
Case report • Acute myocardial infarction • Percutaneous coronary intervention • Thrombectomy • Guide extension catheter • Distal protection

Learning points
• Removal of large coronary artery thrombi with the use of an aspiration catheter can at times prove difficult.
• Successful retrieval of a massive thrombus by capturing it between the tip of GuideLiner® and the filter body of a Filtrap®.
• This method is effective in removing refractory thrombi for the treatment of ST-elevation myocardial infarction patients.
Introduction

Primary percutaneous coronary intervention (PCI) is the preferred and effective reperfusion strategy for acute myocardial infarction (AMI). Large thrombus burdens, distal embolization and a slow flow/no flow are sometimes encountered during the PCI which is associated with worse outcomes. Thrombus aspiration using dedicated catheters and 'Mother-in-child' thrombectomy technique may be used in patients presenting with AMI and large thrombus burdens in PCI. In some cases, thrombus aspiration results in successful retrieval of the thrombotic material leaving the culprit lesion without any residual stenosis, especially in patients with atrial fibrillation. Here, we present a case of successful massive thrombus retrieval by capturing it between the tip of the GuideLiner Catheter (Vascular Solutions Inc., Minneapolis, MN, USA) and the filter body of the Filtrap (Nipro Corporation., Nagoya, Japan).

Timeline

| Time line |
|-----------------|
| Day of admission: A 80-year-old male was admitted with an anterior ST-elevation myocardial infarction (STEMI). |
| 35 min after admission: Coronary angiography revealed the left anterior descending artery (LAD) showed an acute thrombotic occlusion in the mid-section. |
| 65 min after admission: Filter device was advanced through the occlusion to the distal part of the lesion. |
| 70 min after admission: Thrombectomy using an aspiration catheter was performed repeatedly. Small portion of the thrombus was retrieved. |
| 94 min after admission: Thrombus aspiration using a guide catheter extension system. |
| 98 min after admission: Massive thrombus was retrieved by capturing it between the tip of GuideLiner and the filter body of Filtrap. |
| 100 min after admission: The occluded LAD was successfully recanalized. |
| 13 days after admission: Patient discharged without complication. |

Case report

An 80-year-old man with a history of myocardial infarction, paroxysmal atrial fibrillation, and dyslipidemia was admitted to our hospital complaining of persistent chest pain. The electrocardiogram revealed an ST-segment elevation in the V2-6 leads (Figure 1) and echocardiography showed anteroseptal hypokinesis, indicating an anterior ST-elevation myocardial infarction (STEMI). Blood tests showed the troponin level to be as low as 50–100 ng/L. The patient remained haemodynamically stable (Killip 1) with normal blood pressure (110/70 mmHg) and heart rate, without the need for drug support. Emergency coronary angiography revealed no significant stenosis in the right coronary artery, while the left anterior descending artery (LAD) showed an acute thrombotic occlusion in the mid-section (Figure 2A). The PCI was performed to recanalize the occluded LAD. Right femoral artery access was gained using an 8 Fr sheath, and an 8 Fr extra back-up 3.75 guide catheter was used to intubate the LAD. A 0.014" guidewire (SION, Asahi Intecc, Japan) was successfully passed through the occluded lesion with the support of the microcatheter (Caravel MC, Asahi Intecc, Japan). The simultaneous injection of the guide catheter and the tip injection from the Caravel MC microcatheter revealed a translucent image corresponding to the thromboembolism. First, the Filtrap was advanced through to the distal part of the occluded lesion in order to avoid distal embolism during the procedure (Figure 2B). Although thrombectomy using an aspiration catheter was performed repeatedly, only a small portion of the thrombus was retrieved (Figure 2C), and the LAD was still occluded with a heavy thrombus burden (Figure 2D). Aspiration was performed with a suction pressure generated by a 30 cc syringe attached to the proximal tip of the 7 Fr guide extension catheter (GuideLiner Catheter) via a Y-connector. However, a large thrombus still remained. Therefore, we planned to remove the heavy thrombus burden by capturing the entire thrombus between the tip of the GuideLiner catheter and the filter body of the Filtrap, followed by pulling them out of the guide catheter together (Figures 2E, 3A, 4). A large quantity of red thrombus, which adhered to the axis of the filter device, was successfully retrieved (Figures 2F, 3B, 5). After the successful thrombus retrieval, intravascular ultrasonography (IVUS) catheter was inserted to examine the lesion morphology, and no ruptured atherosclerotic plaque was observed. The IVUS findings suggested that this STEMI event was caused by cardioembolism. The occluded LAD was successfully recanalized without balloon dilatation.
or stent implantation. Although follow-up echocardiography showed no evidence of cardiac thrombus formation, sufficient anticoagulant therapy was continued to avoid recurrent thromboembolism due to paroxysmal atrial fibrillation. We have been prescribing Rivaroxaban 15 mg as an anticoagulant therapy for 4 years. The anticoagulant drug was changed from Rivaroxaban 15 mg to warfarin 2 mg after PCI. The patient was discharged from the hospital 13 days after the procedure without any complications. At the 1-year follow-up visit, there has been no recurrence of thrombotic events.

**Discussion**

In PCI procedures including the treatment of STEMI patients, stent implantation is common for high-grade vessel stenosis. However, completing PCI procedures with thrombus aspiration alone may provide significant theoretical advantages such as a lower risk of stent thrombosis, shorter durations, and less dependence on dual antiplatelet therapy, as long as acceptable recanalization of the occluded vessels can be obtained. Some reports suggest that additional
balloon inflation or stent implantation may be unnecessary in selected patients when there is no significant residual stenosis after thrombus aspiration.\textsuperscript{1,4,5}

The TASTE and TOTAL trials did not demonstrate any benefit of thrombus aspiration in clinical outcomes.\textsuperscript{6,7} Furthermore, TOTAL trial showed an increased risk of cerebral stroke.\textsuperscript{6,7} In the 2017 ESC guidelines for the management of STEMI patients, routine thrombus aspiration has been downgraded to a Class III recommendation.\textsuperscript{8} On the other hand, the TAPAS trial showed favourable findings in terms of cardiac death at one year in the thrombus aspiration group.\textsuperscript{9}

The actual report provides a few thrombectomy techniques, such as the mother-in-child thrombectomy\textsuperscript{2,3} and the thrombus aspiration catheter-assisted twisting wire technique\textsuperscript{10} in patients with AMI and a large thrombus burden undergoing PCI. However, sometimes large thrombi that cannot be retrieved by these techniques are encountered as there is a potential limitation in the mechanism of eliminating the thrombus with the aspiration device alone. To solve this problem, we developed a novel technique combining a guide extension catheter and a filter device.

As demonstrated in the movie file (\textit{Figure 4, Video 1}), this technique consists of the following three steps: (i) Inserting a filter device (Filtrap\textsuperscript{\textregistered}) and unfolding it beyond the occlusion. (ii) Advancing a guide extension catheter (GuideLiner\textsuperscript{\textregistered}) and capturing the large thrombus between the tip of the GuideLiner\textsuperscript{\textregistered} Catheter and the filter body of the Filtrap\textsuperscript{\textregistered}, and pulling them out of the guide catheter together. (iii) Pulling them back together out of the guide catheter.

The advantages of this method compared with conventional thrombus aspiration are as follows:

**Figure 2** Coronary angiography results. (A) Initial angiography. Total occlusion of the middle left anterior descending artery (TIMI Grade 0); (B) Distal protection device was advanced through, to the distal part of the occluded lesion; (C) Thrombus aspiration using the thrombectomy using an aspiration catheter; (D) Persisting high-grade thrombus after unsuccessful aspiration; (E) Capturing the entire thrombus between the tip of the GuideLiner\textsuperscript{\textregistered} Catheter and the filter body of the Filtrap\textsuperscript{\textregistered}, and pulling them out of the guide catheter together; (F) Final results: coronary flow restoration after successful thrombus aspiration (TIMI Grade 3).

**Figure 3** Capturing the entire thrombus. (A) Capturing the thrombus between the tip of the GuideLiner\textsuperscript{\textregistered} Catheter and the filter body of the Filtrap\textsuperscript{\textregistered}; (B) Large thrombus was extracted.
The underlying mechanism of this technique involves capturing the thrombus but not thrombus aspiration. Removing a large thrombus can be achieved even in cases where the aspiration device does not work.

(2) The thrombus strongly adhered to the axis of the filter device between the tip of the extension catheter and the filter body, and thrombus migration or systemic embolism is less likely to occur.

(3) Blood loss during aspiration can be avoided.

(4) The entire procedure is not very complicated.

(5) After successful retrieval of a large thrombus, additional balloon dilation or stent implantation is not often required.

The limitations of this method are as follows:

(1) It is essential to keep the guiding catheter engaged deeply in the coronary ostium to prevent systemic thromboembolism.

(2) This method requires a large guiding catheter system, which may increase the risk of vascular complications. In this case, complications related to the access site were fortunately avoided due to the use of a haemostatic device.

In this case, a large red thrombus that adhered to the axis of the filter device was retrieved, and the occluded LAD was successfully recanalized without balloon dilation or stent implantation. Nonetheless, we did not observe serious intraprocedural complications. This method could be an effective method to remove the thrombus from the coronary artery when conventional treatments fail to remove the refractory thrombus.

**Lead author biography**

Dr Hirofumi Kusumoto studied Medicine at Kindai University (Japan). Since 2016, he is Cardiology resident at Oaka Medical College Hospital. Since 2018, he works as cardiologist in the Higashi Takarazuka Satoh Hospital. He has been undertaking percutaneous coronary intervention and electrophysiology ablations for last 4 years.

**Supplementary material**

Supplementary material is available at European Heart Journal - Case Reports online.
Acknowledgements

We would like to thank Editage (www.editage.com) for English language editing.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidelines.

Conflict of interest: None declared.

Funding: None declared.

References

1. Kramer MC, Verouden NC, Li X, Koch KT, van der Wal AC, Tijssen JG et al. Thrombus aspiration alone during primary percutaneous coronary intervention as definitive treatment in acute ST-elevation myocardial infarction. Cathet Cardiovasc Intervent 2012;79:860–867.
2. Dauvergne C, Araya M, Uriarte P, Novoa O, Novoa L, Maluenda G. ‘Mother-in-child’ thrombectomy technique: a novel and effective approach to decrease intracoronary thrombus burden in acute myocardial infarction. Cardiovasc Revasc Med 2013;14:14–17.
3. Bozitosun B, Aitaro RI. Treating thrombus in the coronary arteries. Heart 2015;101:60–65.
4. Sakai K, Iinoue K, Nobuyoshi M. Aspiration thrombectomy of a massive thrombotic embolus in acute myocardial infarction caused by coronary embolism. Int Heart J 2007;48:387–392.
5. Avramidis D, Raisakis K, Matsakis E. Acute inferior ST-segment elevation myocardial infarction treated with primary angioplasty using only a Pronto aspiration catheter. J Invasive Cardiol 2008;20:177–179.
6. Jolly SS, Cairns JA, Yusuf S, Meeks B, Pogue J, Rokoss MJ et al. Randomized trial of primary PCI with or without routine manual thrombectomy. N Engl J Med 2015;372:1389–1398.
7. Jolly SS, James S, Dzavik V, Cairns JA, Mahmoud KD, Zijlstra F et al. Thrombus aspiration in ST-segment-elevation myocardial infarction: an individual patient meta-analysis: thrombectomy trialists collaboration. Circulation 2017;135:143–152.
8. Ibanez B, James S, Agewall S, Antunes MJ, Buccionelli-Ducci C, Bueno H et al. ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Rev Esp Cardiol (Engl Ed) 2017;70:1082.
9. Vlaar PJ, Sviitas T, van der Horst IC, Diercks GF, Fokkema ML, de Smet BJ et al. Cardiac death and reinfection after 1 year in the thrombus aspiration during percutaneous coronary intervention in acute myocardial infarction study (TAPAS): a 1-year follow-up study. Lancet 2008;371:1915–1920.
10. Yi-Lun Z, Jian-Qiang L, Yong-Tai G, Dang-Hui S, Yue L. A novel treatment of refractory coronary embolism: thrombus aspiration catheter-assisted twisting wire technique. J Geriatric Cardiol 2020;17:110–115.