



Case Report

Rare complications of Guideplus guide-extension catheter during complex percutaneous coronary intervention



Mitsuhiro Shoda (MD)^a, Hiroyuki Yamamoto (MD, PhD)^{a,b,*}, Yoshiro Tsukiyama (MD, PhD)^{a,b}, Hiroya Kawai (MD, PhD, FJCC)^{a,b,c}, Tomofumi Takaya (MD, PhD)^{a,b,c}

^a Division of Cardiovascular Medicine, Hyogo Brain and Heart Center, Himeji, Japan

^b Division of Cardiovascular Medicine, Hyogo Prefectural Harima-Himeji General Medical Center, Himeji, Japan

^c Department of Exploratory and Advanced Research in Cardiology, Kobe University Graduate School of Medicine, Kobe, Japan

ARTICLE INFO

Article history:

Received 24 May 2022

Received in revised form 29 July 2022

Accepted 3 August 2022

Keywords:

Guide-extension catheter

Guideplus

Percutaneous coronary intervention

Radiopaque marker

Stent dislodgment

ABSTRACT

Guide-extension catheters (GECs) are effective in providing reinforced backup support and coaxial alignment, leading to successful complex percutaneous coronary intervention (PCI). However, several GEC-associated complications have been reported, including coronary injuries, thrombotic events, and GEC fractures. The Guideplus GEC (Guideplus II ST; Nipro, Osaka, Japan) has a higher crossability due to its unique hydrophilic-coated soft cylinder, which is frequently used in complex PCI for diffuse, tortuous, and heavily calcified lesions. We describe two cases of Guideplus GEC-associated complications during complex PCI: Case 1 with a radiopaque marker dislodgement and Case 2 with a stent dislodgment. In both cases, the Guideplus GEC was used within 7-Fr guiding catheters, employing the mother-and-child technique. A large inner-catheter gap between these catheters caused by a positioning bias due to arterial bends (the aortic arch in Case 1 and brachiocephalic arterial bends in Case 2) may have caused these complications due to its interference with coronary devices (the trapping balloon in Case 1, and the scoring balloon in Case 2). Early cognition and management of these potential Guideplus GEC-associated complications are important to prevent further deterioration.

Learning objectives: The Guideplus guide-extension catheter (GEC) with a hydrophilic-coated soft cylinder can deliver coronary devices to complex lesions owing to its high crossability. However, delivering coronary devices with the Guideplus GEC should be carefully performed because a large inner-catheter gap between Guideplus GEC and a guiding catheter may occur if a proximal port of the Guideplus GEC is located at an arterial bend. In such settings, Guideplus GEC-associated complications must be carefully observed, including radiopaque marker dislodgement and stent dislodgement.

© 2022 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Complex percutaneous coronary intervention (PCI) for anatomically challenging diffuse, tortuous, and calcified lesions is increasingly being performed due to advancements in PCI techniques and devices. Guide-extension catheters (GEC) are effective in providing reinforced backup support and coaxial alignment, facilitating successful PCI [1,2]. The Guideplus GEC (Guideplus II ST; Nipro, Osaka, Japan) comprises a hydrophilic-coated soft cylinder, 250 mm in length and with a 1.33-mm (0.052-inch) inner diameter, and a unique port with a radiopaque marker located at the transition of the port and cylinder, which has

high crossability to heavily calcified lesions and compatibility with a ≥ 6 -Fr guiding catheter [3]. We present two cautionary cases of Guideplus GEC-associated complications, namely a radiopaque marker dislodgment and a stent dislodgment, during complex PCI. Informed consent to publish the cases and any accompanying images was obtained from the patients.

Case 1

A 64-year-old woman undergoing hemodialysis was admitted with persistent chest pain and diagnosed with inferior ST-segment elevation acute myocardial infarction. Her hemodynamic condition was stable; her blood pressure and heart rate were 114/68 mmHg and 58 beats/min, respectively. Urgent coronary angiography (CAG) showed occlusion of the proximal right coronary artery (RCA) as the culprit lesion

* Corresponding author at: Division of Cardiovascular Medicine, Hyogo Prefectural Harima-Himeji General Medical Center, 3-264 Kamiya-cho, Himeji, Japan.
E-mail address: y0493589m@hotmail.co.jp (H. Yamamoto).

and a heavily calcified stenosis in the proximal left anterior descending artery (LAD) as a non-culprit lesion. Primary PCI for the proximal RCA was successfully performed, with optimal results of coronary flow of Thrombolysis in Myocardial Infarction grade 3. After an uneventful clinical course, a scheduled PCI for the proximal LAD was performed using a 7-Fr EBU3.5 guiding catheter (Launcher; Medtronic Inc., Minneapolis, MN, USA) via the right femoral artery (Fig. 1A). Although successful wiring of the main LAD and the second diagonal branch was achieved, PCI devices, such as small-sized balloons and intravascular ultrasound (IVUS) (Altaview™; Terumo, Tokyo, Japan), could not reach the target lesion, even with Guideplus GEC support. Thereafter, rotational atherectomy was successfully performed on a Rotawire Floppy (Rota Wire™, Boston Scientific, Natick, MA, USA) with a 1.5-mm burr without Guideplus GEC support. IVUS was repeated under Guideplus GEC support to confirm intravascular condition. Then, a Rotawire Floppy was exchanged with a 0.014-inch guidewire

(Runthrough® NS; Terumo) using a microcatheter (ASAHI Caravel MC; ASAHI Intecc, Aichi, Japan). We tried to retrieve the microcatheter using a TRAPPER™ trapping balloon (Boston Scientific); however, a slight resistance was perceived during the procedure, and fluoroscopy revealed that the trapping balloon did not completely advance into the 7-Fr guiding catheter, potentially due to an inner-catheter gap between the 6-Fr Guideplus GEC and the 7-Fr guiding catheter (Fig. 1B-C). Consequently, we inflated the trapping balloon advanced to hold the Runthrough® NS wire; then, the microcatheter was removed. Subsequently, a 2.5/15-mm cutting balloon (WOLVERINE™; Boston Scientific) was delivered to the lesion under the Guideplus GEC support; however, an unknown foreign body became attached to the cutting balloon and migrated into the mid-LAD (Fig. 2A). After withdrawing both devices, we attempted to deliver a small balloon to entrap the foreign body; however, it advanced in a distal direction (Fig. 2A). Thereafter, we performed balloon angioplasty for the culprit lesion

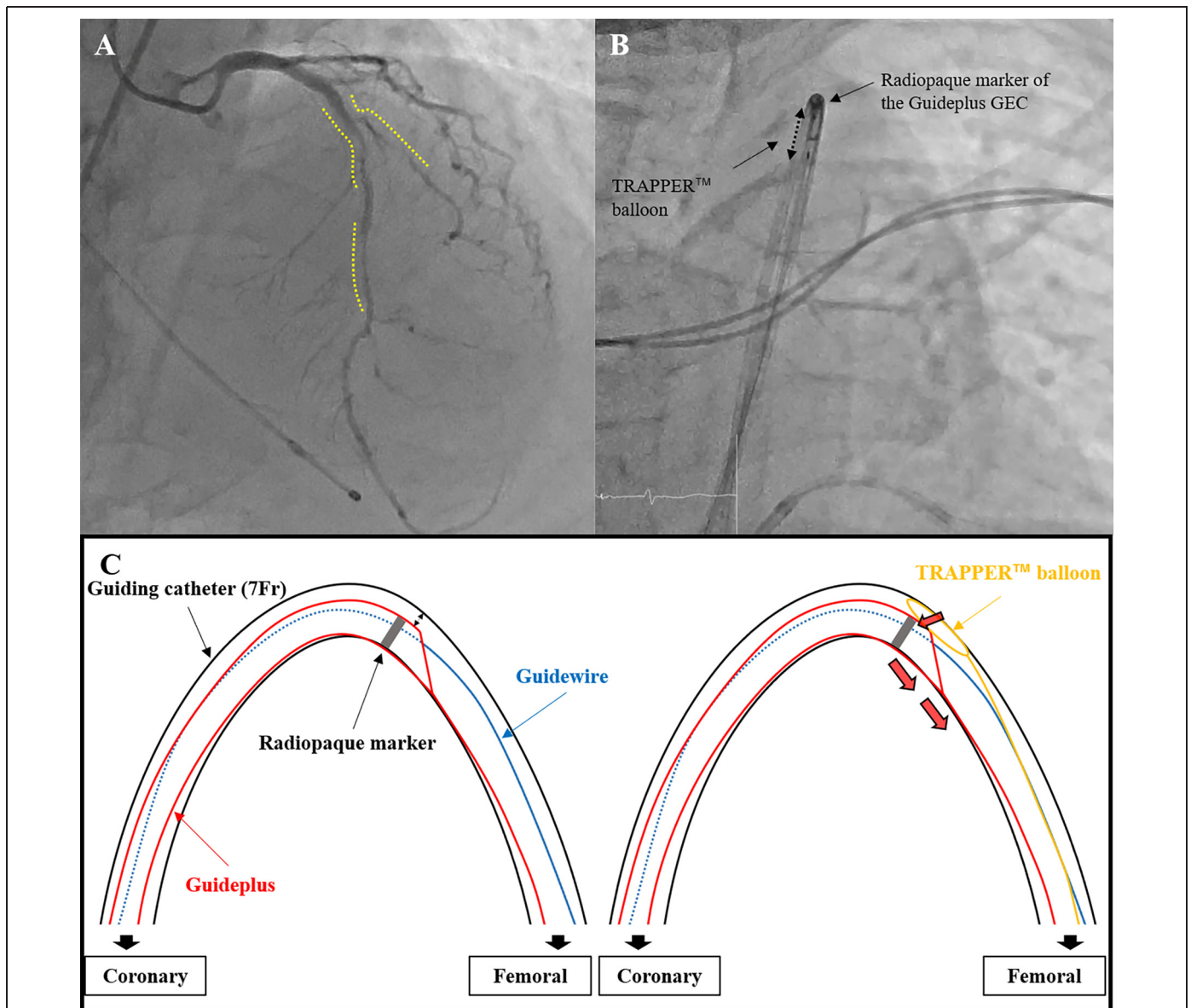
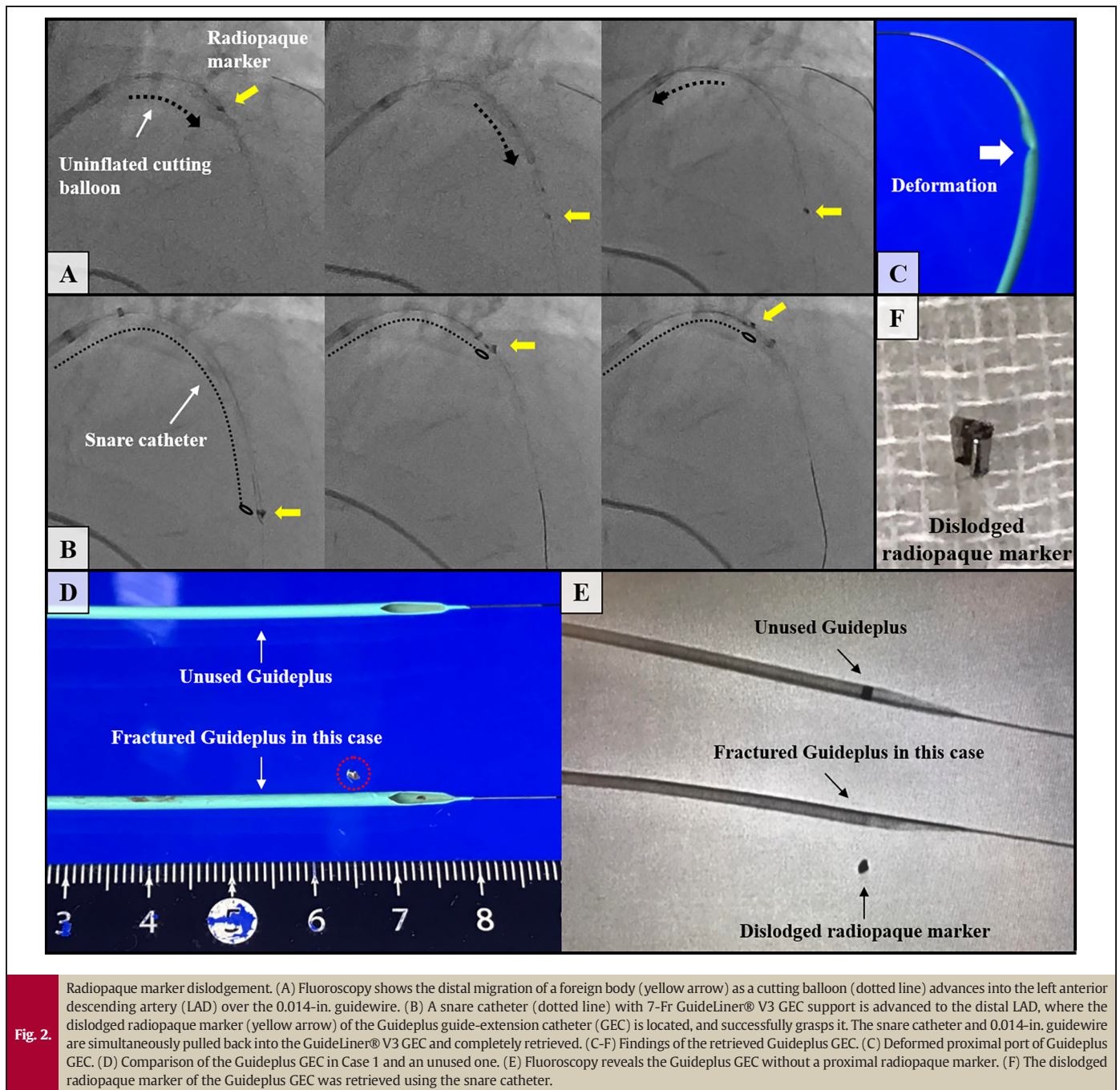


Fig. 1. Mechanism of the Guideplus guide-extension catheter damage. (A) Coronary angiography shows heavily calcified stenoses in the mid-left anterior descending artery and the second diagonal branch (yellow dotted lines). (B) The TRAPPER™ trapping balloon could not advance into the 7-Fr guiding catheter from the proximal port of the Guideplus guide-extension catheter (GEC). (C) The softness of the Guideplus GEC results in a large inner-catheter gap between the two catheters when a proximal port of the Guideplus GEC is located at the aortic arch bend. During withdrawal of the microcatheter, unexpected force (red arrows) could potentially place external stress on the radiopaque marker of the Guideplus GEC, resulting in its dislodgement.



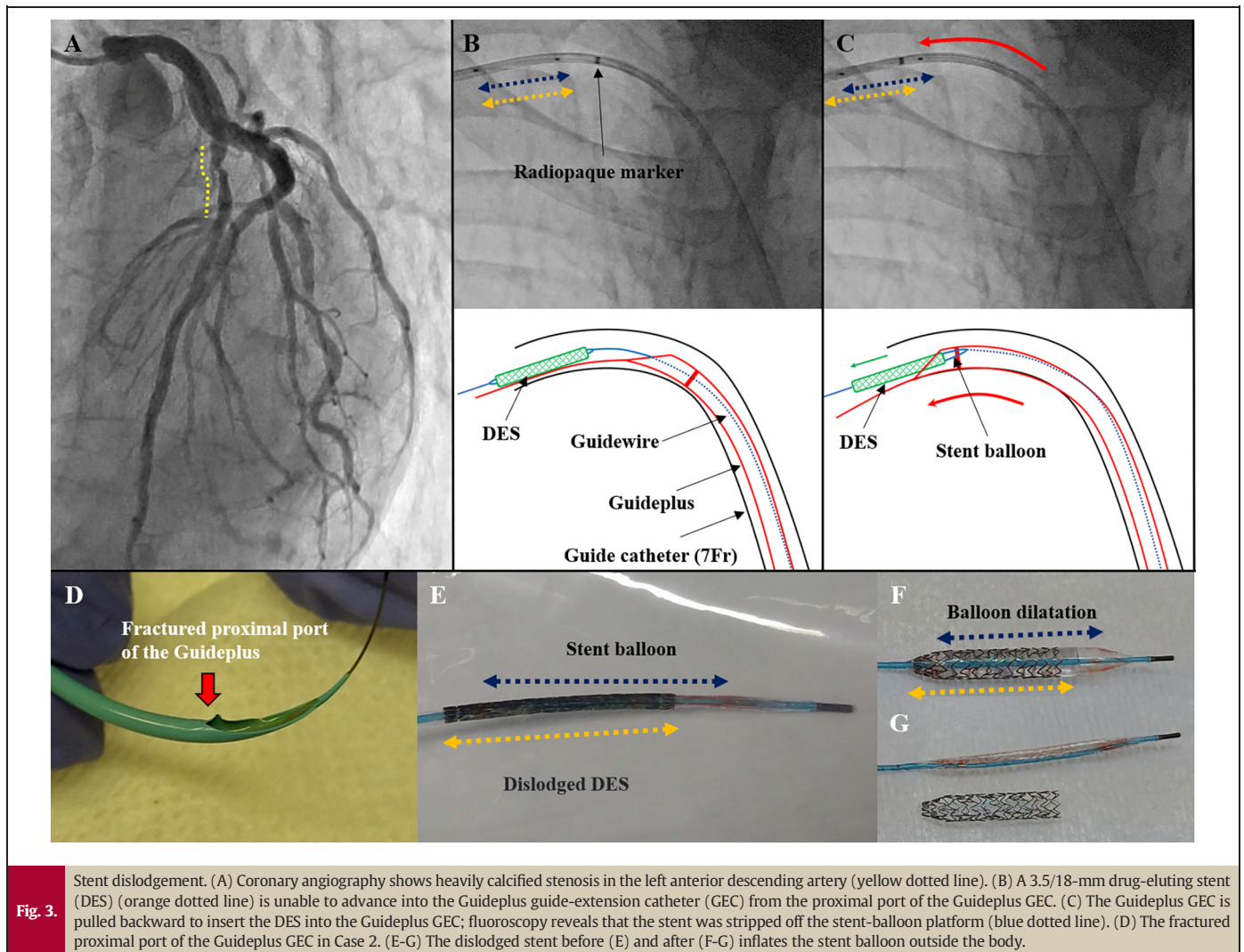
and successfully retrieved the foreign body using a 5-mm snare (Amplatz Goose Neck™ snare kit, Medtronic) in a 7-Fr GuideLiner® V3 GEC (Teleflex, Wayne, PA, USA) (Fig. 2B). Finally, additional balloon angioplasty with a cutting balloon and subsequent implantation of a drug-eluting stent (DES) was successful without further complications.

After the PCI, a fluoroscopic evaluation confirmed that the unknown foreign object was the migrated radiopaque marker of the Guideplus GEC; thus, radiopaque marker dislodgement was confirmed (Fig. 2C-F). The patient was discharged 2 days after the PCI, and an uneventful clinical course was observed for one year.

Case 2

A 74-year-old man with a history of hypertension, type 2 diabetes mellitus, and chronic kidney disease presented with exertional angina pectoris. CAG showed calcified stenosis in the proximal LAD (Fig. 3A).

A scheduled PCI for the calcified lesion was performed using a 7-Fr EBU3.5 guiding catheter via the right radial artery. Rotational atherectomy with a 1.5-mm and subsequent 2.0-mm burr was successfully performed, and a 3.0/13-mm scoring balloon catheter (Aperta NSE; Nipro) was delivered under 6-Fr Guideplus GEC support. The Aperta NSE balloon advanced into the Guideplus GEC with a little resistance. After balloon angioplasty with adequate expansion, delivery of a 3.5/18-mm DES (Orsiro; Biotronik AG, Bülach, Switzerland) to the culprit lesion was attempted; however, the DES could not pass into the Guideplus GEC, even using a careful approach under fluoroscopic guidance. The Guideplus GEC was pulled backward while holding stent balloon to insert the DES into the Guideplus GEC; however, fluoroscopy showed that this resulted in the stent being stripped off the stent-balloon platform (Fig. 3B-C). We cautiously withdrew the devices and visually observed that the Guideplus port was fractured, and the stent was dislodged from the stent balloon (Fig. 3D-G). A new DES (Orsiro) was



subsequently inserted into a new 6-Fr Guideplus GEC outside the patient's body, and this combination reached the culprit lesion. The DES was successfully implanted without any complications. After the PCI, the patient was free from angina symptoms for 8 months.

Discussion

The Guideplus GEC, which has excellent crossability and compatibility with a ≥ 6 -Fr guiding catheter due to its soft cylinder, hydrophilic coating, and unique-shaped entrance port, is reportedly effective for complex PCIs [3]. Currently, complex PCI for calcified lesions is often performed using the ≥ 7 -Fr system because of the compatibility for atherectomy devices, and Guideplus GEC is usually used with the mother-and-child technique (6-Fr Guideplus GEC in ≥ 7 -Fr guiding catheter). Various GEC-associated complications have been reported, including coronary artery injury, GEC fractures, thrombotic events, and stent damage; meanwhile, Guideplus GEC-associated complications are rarely reported [4–6]. In the present cases, Guideplus GEC-associated complications involving radiopaque markers and stent dislodgement occurred. These cases had one common feature: the 6-Fr Guideplus GEC, with an outer diameter of 0.061 and 0.069 in., respectively at distal and proximal parts, was used within a 7-Fr guiding catheter (inner diameter, 0.081 in.), which can theoretically lead to a maximal inner-catheter gap of 0.020 in. distally and 0.012 in. proximally, between these devices.

In Case 1, a TRAPPER™ trapping balloon might have been inflated within the gap between the Guideplus GEC and the guiding catheter,

which could have caused deformation of the proximal port of the Guideplus GEC, leading to proximal radiopaque marker dislodgement. Very few cases of GEC-associated radiopaque marker dislodgement during PCI have been reported. A technique using a small balloon has been reported for retrieving migrated objects [7]; however, in our case, the use of a small-sized balloon unfortunately advanced the dislodged radiopaque marker more distally. Conversely, retrieval with a snare catheter was successful. Additionally, a rare case of ring marker dislodgement of a GuideLiner® V3 GEC, where a coronary stent was implanted to trap the dislodged ring marker between the stent and vessel wall, has been reported [8]. However, considering the size of the present migrated Guideplus radiopaque marker, this technique should be avoided because of the potential risk of coronary perforation.

In Case 2, deformation of the proximal port of Guideplus GEC, which might have been damaged by the scoring balloon before DES delivery, was observed. This fractured Guideplus proximal port could have hooked onto the coronary stent during delivery and stripped it off the stent-balloon platform. GEC-associated stent damage has been reported [8]; however, Guideplus GEC-associated stent damage has not yet been described. It is important to note that the GEC entrance located at bent sites could be easily damaged, which may induce stent dislodgement; early recognition of this complication may prevent its further exacerbation.

Comparison of GECs available in Japan is listed in Online Fig. 1. The Guideplus GEC is useful for reaching distal lesions because of its special profile of a tapered cylinder with a distal outer diameter of 1.55 mm and

proximal outer diameter of 1.76 mm. However, considering the soft material of the Guideplus cylinder, a positioning bias of Guideplus GEC could be predisposed to these complications when the proximal port of the Guideplus GEC is located at the arterial bends, for example, at the aortic arch in case of PCI via the femoral artery or at the brachiocephalic artery in case of PCI via the right radial artery. This is not simple due to the patient's physique limitations and other factors affecting the positional relationship. Therefore, we should avoid using trapping balloons and cautiously advance coronary devices, such as scoring balloons, cutting balloons, and coronary stents, into the Guideplus GEC under fluoroscopic guidance to prevent these complications, especially in cases wherein a proximal port of the Guideplus GEC is located at arterial bends. Furthermore, another GEC with a long cylinder or compatible diameter to the guiding catheter could be used to reduce the inter-catheter gap in such cases, if applicable (Online Fig. 1).

While the Guideplus GEC is effective in complex PCI, Guideplus GEC-associated complications should be recognized, particularly in cases where the proximal port of the Guideplus GEC is located at the arterial bends.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jccase.2022.08.006>.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Acknowledgments

None.

Funding statement

None.

Patient consent statement

Informed consent was obtained from the patients for publication of the case and accompanying images.

References

- [1] Fabris E, Kennedy MW, Di Mario C, Sinagra G, Roolvink V, Ottervanger JP, Van't Hof AWJ, Kedhi E. Guide extension, unmissable tool in the armamentarium of modern interventional cardiology. A comprehensive review. *Int J Cardiol* 2016;222:141–7.
- [2] Duong T, Christopoulos G, Luna M, Christakopoulos G, Master RG, Rangan BV, Roesle M, Banerjee S, Brilakis ES. Frequency, indications, and outcomes of guide catheter extension use in percutaneous coronary intervention. *J Invasive Cardiol* 2015;27:E211–5.
- [3] Tsukui T, Sakakura K, Taniguchi Y, Yamamoto K, Wada H, Momomura SI, Fujita H. Comparison of the device performance between the conventional guide extension catheter and the soft guide extension catheter. *Cardiovasc Revasc Med* 2019;20:113–9.
- [4] Chang YC, Fang HY, Chen TH, Wu CJ. Left main coronary artery bidirectional dissection caused by ejection of guidewire catheter from the guiding catheter. *Catheter Cardiovasc Interv* 2013;82:E215–20.
- [5] Waggoner T, Desai H, Sanghvi K. A unique complication of the GuideZilla guide extension support catheter and the risk of stent stripping in interventional & endovascular interventions. *Indian Heart J* 2015;67:381–4.
- [6] Waterbury TM, Sorajja P, Bell MR, Lennon RJ, Mathew V, Singh M, Sandhu GS, Gulati R. Experience and complications associated with use of guide extension catheters in percutaneous coronary intervention. *Catheter Cardiovasc Interv* 2016;88:1057–65.
- [7] Paulus BM, Fischell TA. Retrieval devices and techniques for the extraction of intravascular foreign bodies in the coronary arteries. *J Interv Cardiol* 2010;23:271–6.
- [8] Papayannis AC, Michael TT, Brilakis ES. Challenges associated with use of the GuideLiner catheter in percutaneous coronary interventions. *J Invasive Cardiol* 2012;24:370–1.