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Coronary stent concertina in proximal left anterior descending artery: An unusual case

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Abstract: Since the emergence of stents, there has been persistent improvement in flexibility and deliverability of stents with modifications in its design and number of connectors. This has unfortunately created negative effect on longitudinal strength of stent resulting into a recently recognized and unaccustomed complication, longitudinal stent deformation (LSD). It is an abrupt shortening of the stent along its longitudinal axis, usually after deployment, due to various reasons. We present a case of LSD in Promus Element stent implanted at proximal left anterior descending artery. The stent shortening was about 25%–30% of its actual length. As this led to exposure of a part of lesion, it was successfully managed by overlapping another stent.

Keywords: angiography, complication, drug-eluting stents, longitudinal deformation, percutaneous coronary intervention

Introduction

Since the advent of percutaneous coronary intervention (PCI) in 1977, there has been tremendous advancement in technology, that is, from balloon angioplasty to bare-metal stents, drug-eluting stents, and bioabsorbable scaffolds. There have been improvements in acute and long-term clinical performance of stents along with refinement in several attributes, such as strut thickness, design, stent flexibility, deliverability, trackability, scaffolding, radiopacity, etc. As every advantage has its disadvantage, such innovations had led to maintenance of radial strength but with a compromise of longitudinal strength resulting in incidences of longitudinal stent deformation (LSD) [1, 2]. The LSD is the distortion or shortening of a stent along its longitudinal axis subsequent to stent deployment, which induces the stent rings to nest or concertinate [3]. Thus, this phenomenon can be described as stent concertina. Literature suggests that stent geometry is majorly allied with longitudinal strength rather than strut thickness and metal alloy. Longitudinal strength is contributed by the number of connectors between the rings and their exact geometrical arrangement [4].

There have been several reasons for the development of LSD. Of them, the chief mechanisms are: compression due to balloon during postdilatation, entrapment of intravascular ultrasound catheter, pulling back the jailed guidewire, withdrawal of the stent delivery system after stent deployment, crossing of new stent through the deployed stent for the treatment of a distal lesion, and wire entanglement [1, 5–7]. More often, lesion and vessel characteristics also contribute toward LSD, such that, ostial, bifurcation, long lesions, tortuous, and calcified vessels are more vulnerable to LSD. The LSDs have commonly been observed in the left main artery and ostium of right coronary artery (RCA) mainly due to unintentional intubation of guide catheter against the proximal edge of stent [8]. Here, we report a case of stent concertina in proximal left anterior descending artery (LAD), which was successfully managed by overlapping another stent with good result.

Case Report

A 45-year-old diabetic and hypertensive male presented to us with angina 1 week after acute anterior wall myocardial infarction and was admitted for elective PCI. Access was obtained through right femoral artery using 6F Judkins left catheter. Coronary angiogram showed 90% critical stenosis in proximal LAD *(Fig. 1)*. Then, a BMW Universal II wire (Abbott Vascular, Santa Clara, CA, USA) was used to cross the lesion. The lesion was predilated with 2.5 × 10 mm sprinter plain balloon at 12 atm. A 2.75 × 16 mm Promus Element stent (Boston Scientific, Natick, MA, USA) was deployed at 14 atm *(Fig. 2)*. Postdilatation was planned using the 3 × 10 mm sprinter non-compliant balloon due to uneven expansion of stent. While crossing the postdilatation balloon across the stent, there was longitudinal shortening of implanted stent by almost 25%–30% *(Fig. 3)*. This amount of shortening exposed the covered diseased segment. Therefore, a 3 × 16 mm Taxus Liberte stent (Boston Scientific) was overlapped on Promus Element stent to cover the deficiency and deployed at 10 atm *(Fig. 4A)*. The overlapped portion was postdilated with 3 × 10 mm non-compliant balloon at 16 atm and thrombolysis in myocardial infarction (TIMI) III flow was achieved *(Fig. 4B)*. Patient withstood the procedure well and is on regular follow-up and asymptomatic for 2 years.

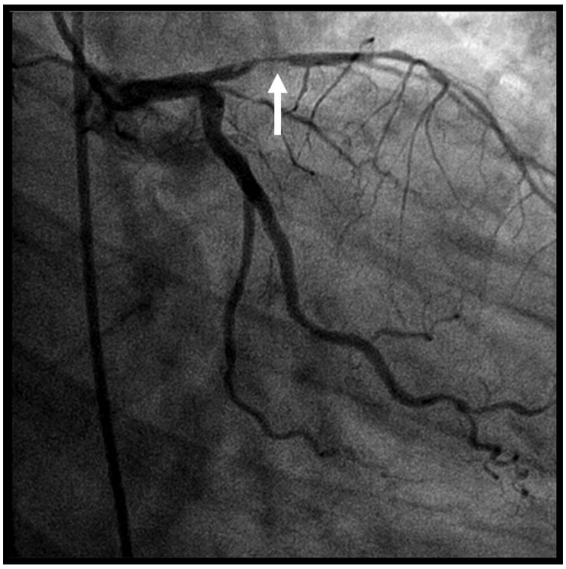

Fig. 1. Coronary angiogram showing 90% stenosis in proximal LAD

Discussion

The literature states that Promus Element stent has commonly been associated with LSD [9]. An earlier study reports that incidence of LSD with Promus Element stents was 0.86%, whereas in other stent platforms, it was only 0.1%–0.2% [1]. As previously mentioned that the number of connectors between the rings and their exact geometrical arrangement has been considered as the major contributing factors of longitudinal strength; by the same token, Promus Element stent has offset peak-to-peak two-connector design, which appeared the most susceptible to deformations as observed in two different bench tests. Ormiston et al. [6] had applied 0.5 N compressing forces on all the studied stents, and most stent shortening was found in Omega/Element stent (Boston Scientific) (5 mm), followed by Driver stent (4 mm). Prabhu et al. [10] had applied load of 50 gf on all the 14 stents included in the study. Of them,

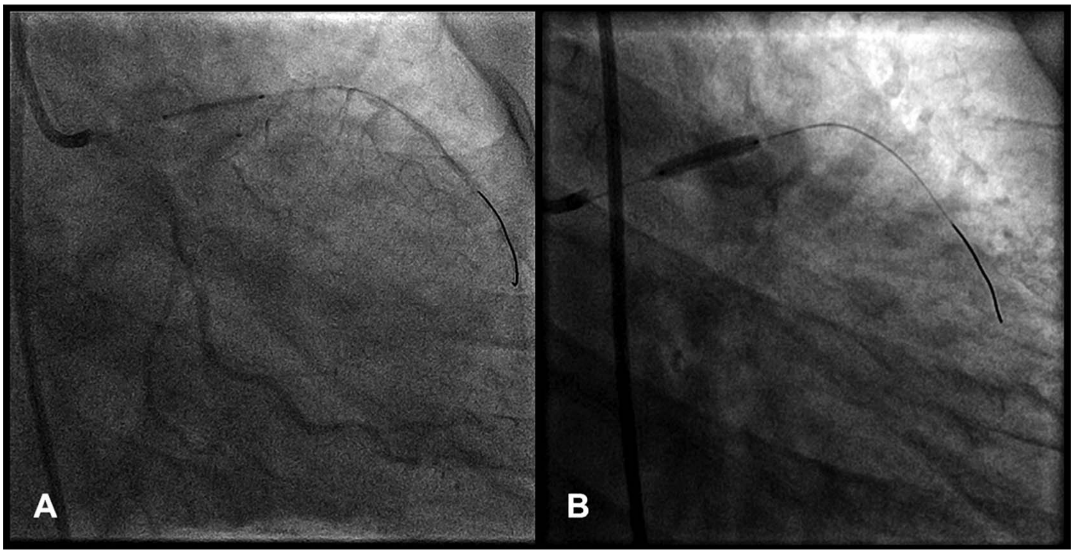

Fig. 2. (A) Negotiation and (B) deployment of 2.75 × 16 mm Promus Element stent

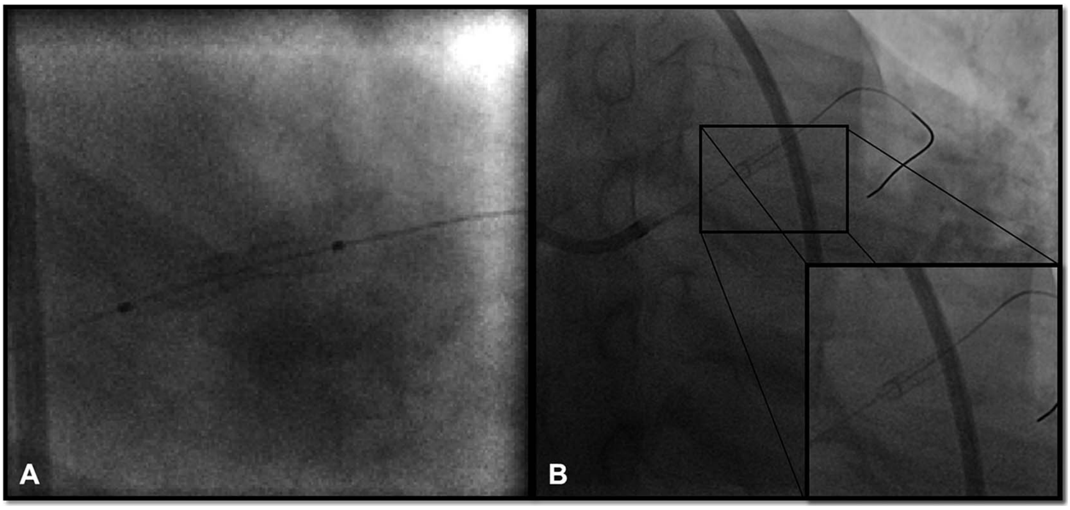

Fig. 3. (A) Initially deployed stent before postdilatation and (B) shortening of stent while crossing the postdilatation balloon

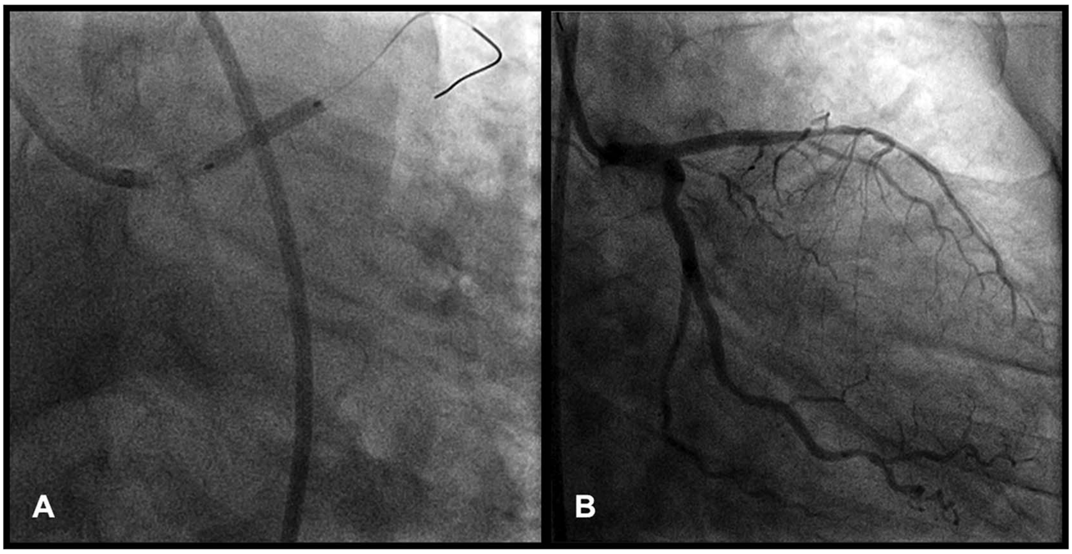

Fig. 4. (A) Overlapping of 3 × 16 mm Taxus Liberte stent on previous stent and (B) final angiogram showing TIMI III flow

Omega (Element stent series) was most compressed (average change in length was 47.07%), whereas Multi-Link 8 stent was least compressed (4.46%). Moreover, various clinical cases have also reported that this stent platform has been more prone to the LSD when compared with other stents [1, 11–13].

The incidence of LSD of various stents is likely to be underreported. This underreporting is because the interventionalists are not much accustomed to this rare complication, thus at times, this remains unrecognized. Similarly, compressions or elongations in radio opaque platforms, such as platinum–chromium (Pt-Cr), are more easily identified than radiolucent platforms [2, 4]. This is probably the reason why Promus stent has been observed to be mostly associated with LSD as it has Pt-Cr platform that can be easily visualized when compared with other platforms, such as cobalt–chromium and stainless steel.

Previously, Janakiraman et al. [2] have reported a case of 67-year-old female to whom PCI was done in mid LAD with 2.75 × 16 mm Promus Element stent, and during poststent balloon dilatation, the stent got distorted. This was managed with non-compliant balloon dilatation. In contrast, in this case, the compressed part of the stent had exposed the diseased lesion in proximal LAD as the amount of shortening was 25%–30%; therefore, the overlapping of another stent was mandated. Kwok [3] had encountered two cases of LSD in Promus Element stent; one in proximal-mid left circumflex artery that was managed by overlapping another Promus

Element stent and the other in left main coronary artery that was managed by balloon dilatation. Hanratty and Walsh [5] had also reported a case of LSD in Promus Element when multiple stents were implanted in the diffusely diseased RCA. They mentioned that the issue was not related to the stent platform itself, but was due to braided guide catheter which is capable of deforming any type of coronary stent.

Although rare, the LSD is not devoid of consequences. If left unmanaged, the compression of stent might lead to malapposition of stent predisposing to stent thrombosis [1, 5, 6, 10]. In rare cases, percutaneous management of stent concertina might become difficult, such that, surgery becomes necessary in such situations. However, prevention is better than cure, so avoidance of LSD will be more optimal than its consequences or management. Various strategies have been proposed to circumvent LSD; these include sufficient predilatation, more optimal stent expansion, evading wire bias, reduced guide catheter–stent contact, and applying adroitness instead of force in case of resistance upon recrossing [14]. The management of LSDs has been based on individual's clinical condition, by only postdilatation balloon or by overlapping the deformed stent with another stent. In this case, a part of lesion was exposed after deformation, so the overlapping of another stent was required.

Conclusion

Although rare, LSD could lead to potential complications. The interventionists must be aware of this complication and must recognize and manage it carefully. Various strategies can be applied to circumvent LSD, which include sufficient predilatation, optimal stent expansion followed by apt passing of postdilatation balloon, eluding contact of guidewire with the edges of stent, avoiding reuse of old postdilatation balloons, and applying adroitness instead of force in case of resistance upon recrossing. In this case, the patient was successfully managed with the overlapped stent and was asymptomatic at 2-year follow-up.

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Conflict of interest: The authors declare no conflict of interest.

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