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LETTER TO THE EDITOR
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Optical coherence tomography-guided excimer laser coronary angioplasty in overlapping stents with severe under-expansion and underlying calcification

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Excimer laser coronary angioplasty (ELCA) modifies atherosclerotic plaques through its photochemical, photothermal and photodynamic characteristics, while making up for the limitations of intimal disassembly and restenosis of balloon angioplasty without causing significant damage. The American Food and Drug Administration approved of the first clinical application of ELCA in 1992. Since then, ELCA has been used as an adjunct therapy in the treatment of various subsets of coronary artery lesions. ELCA considered to be a relatively safe and effective technique for coronary lesions when routine angioplasty is technically insufficient.[1,2] With the development of research on ELCA treating stent under-expansion in recent years, more and more evidences has shown that ELCA is effective in this situation.[3] Meanwhile, there is a high risk of restenosis and thrombosis due to stent under-expansion, which may be associated with serious clinical complications. Therefore, the management of stent under-expansion remains a clinically significant problem.

In this case, ELCA was utilized to treat overlapping stents with severe under-expansion and underlying calcification. ELCA with contrast was used to modify the calcified plaque under the struts to facilitate optimal stent expansion. To the best of our knowledge, this appears to be the first reported case using ELCA in this clinical setting.

A 55-year-old male patient with the history of diabetes mellitus, hypertension and hyperlipidemia presented with acute myocardial infarction (AMI) in August 2020. Four stents were implanted in the right coronary artery and three stents were implanted in the left anterior descending artery (LAD). Angiography showed poor stent expansion in the middle segment of LAD (Figure 1). This patient suffered recurrent chest pain in a few days after percutaneous coronary intervention (PCI) and the symptoms persisted without relief, accompanied by perspiration. He was admitted to Beijing Anzhen Hospital, Capital Medical University later in September 2020 and underwent coronary angiography and PCI with optical coherence tomography (OCT) and ELCA (0.9 mm, Spectranetics CVX300). After contrast injection (fluence of 80 mJ/mm^2, and frequency of 80 Hz), a series of balloon was fully inflated. OCT showed that stents were well expanded (Figures 2 & 3).

Coronary artery calcification remains an important reason of insufficient stent expansion. Dealing with under-expanded stents remains a technical challenge, as cutting and high-pressure balloons are ineffective and harmful in many cases.[4] In 2014, the Ellement Registry study demonstrated the effectiveness and reproducibility of ELCA combining with contrast injection in modifying plaques and improving stent expansion in under-expanded lesions.[5] At

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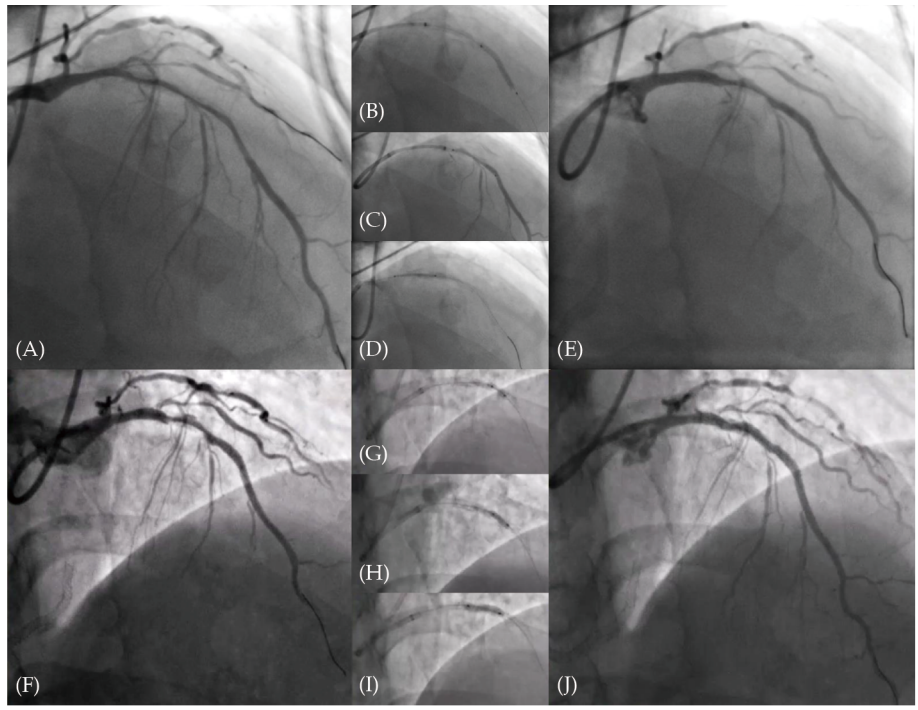

Figure 1 Coronary angiogram in August and September 2020. In August 2020, angiography indicated 90%–99% stenosis with calcification in LAD (A), and three stents were implanted (B–D). Postoperative angiography showed poor stent expansion (E). In September 2020, the images before ELCA treatment shows the three stents implanted in LAD with 90% to 99% stenosis (F), severe under-expansion and calcification. After application of ELCA and balloon compression in diameter from 2.5 mm to 3 mm (G–I). No obvious stent stenosis was observed with level III of thrombolysis in myocardial infraction blood flow (J). ELCA: excimer laser coronary angioplasty; LAD: left anterior descending artery.

present, ELCA is still the only anti-atherosclerosis technique that can be used without damaging the structure of the stent. It modifies the plaque beneath stent struts, weakening the overall resistance, and thus allowing the subsequent full stent expansion.[6]

ELCA with or without contrast has previously been applied to treat stent under-expansion. Veerasamy, *et al.*[7] found that ELCA with or without contrast provides a safe and effective method for the treatment of under-expanded stents, and may avoid the long-term complications. In a case reported by Egred, *et al.*,[8] ELCA was successfully used to treat poor stent dilation. Andreou, *et al.*[9] also reported a case of ELCA combined with contrast to improve the safety and effectiveness of insufficient stent dilation in calcified lesions. In the study of ELCA in treating AMI caused by poor stent expansion, the use of ELCA with contrast injection to modify the plaque promotes optimal stent expansion and restores normal coronary artery flow.[2]

In clinical case-control studies, Lee, *et al.*[10] studied eighty-one patients who received OCT before and after PCI. Compared with simple high pressure balloon dilation, the final lumen size of ELCA therapy was larger and the effect of stent dilation was better, which confirmed that ELCA was effective in the treatment of in-stent restenosis (ISR) with insufficient stent dilation.[10] Moreover, in a study of twenty-six consecutive patients who received ELCA-assisted PCI, stent dilation improved in all cases, suggesting that ELCA may be a reasonable option for the treatment of insufficient stent dilation.[11]

Tcheng, *et al.*[12] demonstrated that normal saline did not produce pressure waveforms, whereas exposure to blood produced increased pulse pressure, which was amplified by exposure to contrast. Therefore, "flush and bathe" techniques were used to reduce the risk of ELCA.[12] Interestingly, in a case of frequent ISR due to double-stent and insufficient stent expansion, Nakabayashi, *et al.*[13] demonstrated the efficacy of ELCA therapy by using a non-flushing technique. Based on Yin, *et al.*[14] performed ELCA in a case of stent under-expansion with severe underlying calcification of the proximal LAD and

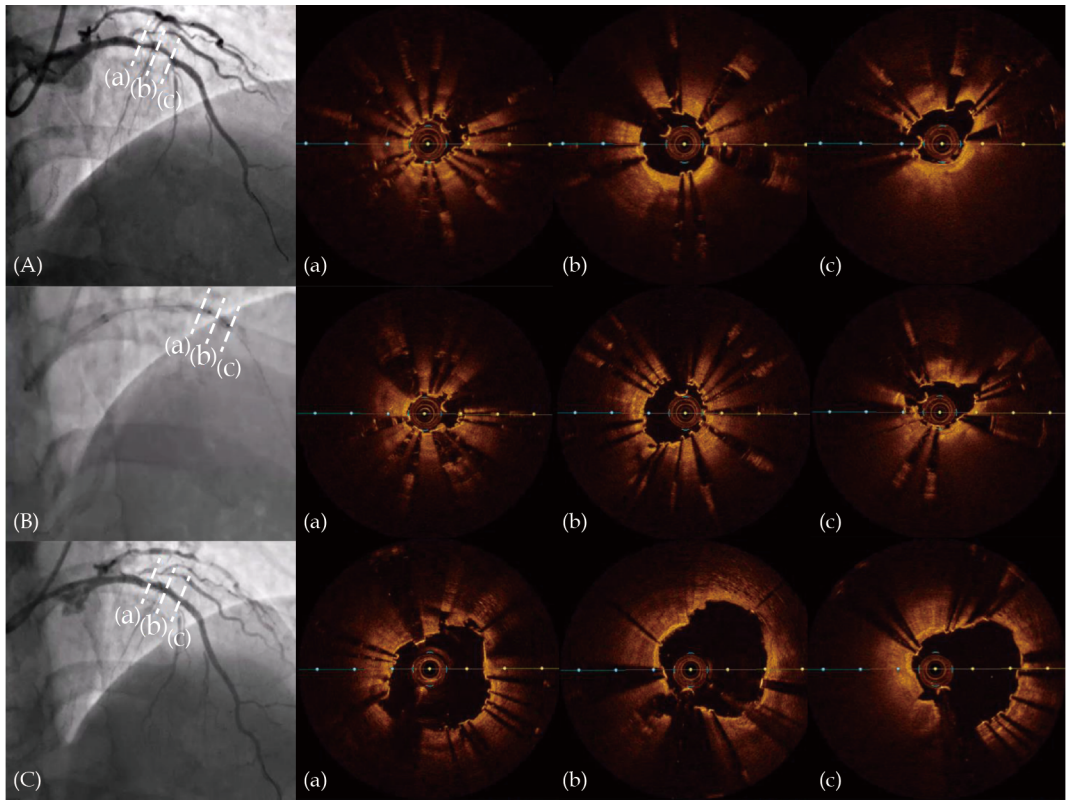

Figure 2 Coronary angiogram and OCT in September 2020. In the lesion of poor stent expansion, OCT was used to record the changes of lumen diameter pre (A), post (B) and after (C) ELCA treatment (a, b, and c respectively represent OCT images at different levels of poor stent expansion). After repeated ELCA treatment for three times, 2.5 mm × 8 mm and 2.5 mm × 15 mm balloons were successively applied for expansion at 18–24 atm, and then 3.0 mm × 8 mm, 3.0 mm × 15 mm and 3.0 mm × 16 mm balloons were applied for repeated expansion. ELCA: excimer laser coronary angioplasty; OCT: optical coherence tomography.

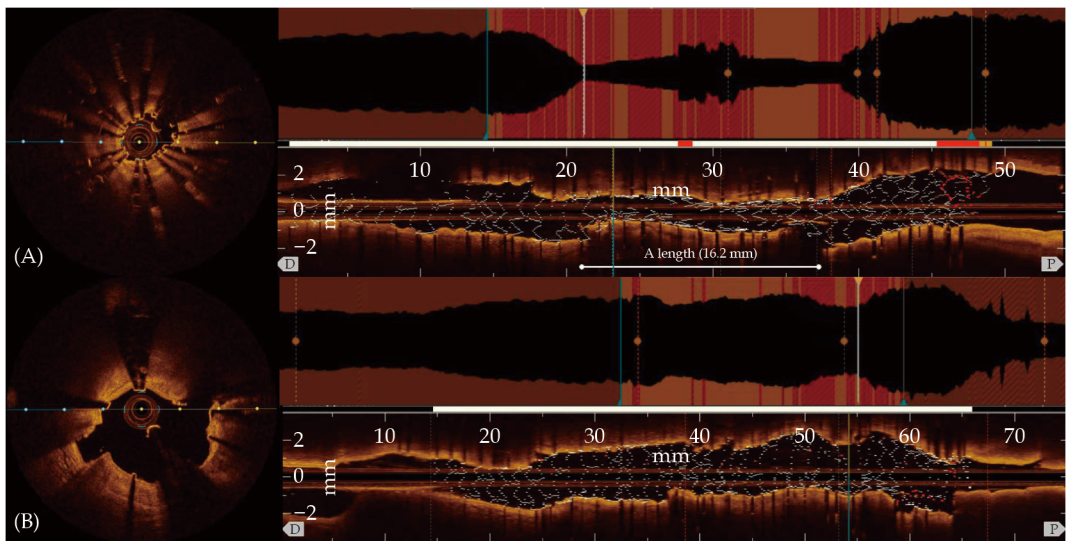

Figure 3 Pre and after ELCA in September 2020. Optical coherence tomography measured the minimum lumen area before (A) and after ELCA (B) treatment as 1.18 mm^2 and 5.5 mm^2, with area stenosis as 84.8% and 28.4%, respectively. ELCA: excimer laser coronary angioplasty.

used OCT to document the mechanism behind this approach. We attempted to use ELCA in complex coronary artery lesions, and recorded through the treatment with OCT.

ELCA is an effective anti-atherosclerosis method with unique advantages. In the case, we have reported for the first time the application of ELCA with contrast in a complex case of three overlapping stents with severe under-expansion and underlying calcification providing evidence for the safety and effectiveness of ELCA in this challenging clinical scenario.

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