Clinical Outcomes After Treatment with ELCA for In-Stent Restenosis of DES

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Recently, access to the coronary arteries has become possible with excimer laser coronary angioplasty (ELCA) because of a new technique that utilizes a pulsed laser source and multifiber guided catheters. The potential advantages of excimer laser revascularization include concomitant plaque debulking, thrombus removal, and facilitation of adjunct stenting by softening of the plaque. Improved catheter designs, improved techniques, and firmer indications have led to the expansion of applications for ELCA. These include long lesions, ostial disease, saphenous veins, chronic total occlusions, moderately calcified lesions, thrombus rich lesions, failed balloon angioplasty, and in-stent restenosis (ISR).1)

ELCA is thought to be advantageous for ISR treatment by debulking and softening of the neointima, but the detailed mechanism of its advantages and optimal treatment strategies using it remains unknown. Furthermore, there is little information available concerning the clinical outcomes after treatment for ISR of drug-eluting stents (DES). To approach this question, in the current issue of International Heart Journal, Ichimoto, et al evaluated the long-term clinical outcomes after percutaneous coronary intervention (PCI) with ELCA for ISR of DES.2)

Ichimoto, et al retrospectively analyzed 81 consecutive patients with 87 lesions who underwent PCI for ISR of DES. Patients were classified into a PCI with ELCA group (23 patients with 24 lesions) or a PCI without ELCA group (58 patients with 63 lesions). The incidences of diffuse restenosis and AHA/ACC type B2 or C lesions in the PCI with ELCA group were higher than in the PCI without ELCA group. Quantitative coronary angiography showed the acute luminal gain in the PCI with ELCA group was greater than in the PCI without ELCA group (1.64 ± 0.48 mm versus 1.26 ± 0.42 mm, P < 0.001). The mean duration of clinical follow-up was 29.8 ± 11.6 months. There were no significant differences in death, myocardial infarction, target lesion revascularization (TLR), or stent thrombosis between the 2 groups. Kaplan-Meier curves showed that there was no statistical difference in event-free survival between PCI with and without ELCA. Multivariate analysis using a Cox proportional-hazards model showed that multivessel disease was an independent predictor of major adverse cardiac events (MACE) (hazard ratio 3.05, 95% confidence interval 1.22 to 7.61, P = 0.02). They concluded that ELCA was as effective as an atherectomy device for lumen enlargement and optimal lesion preparation and the long-term clinical outcomes were favorable and similar, even though ELCA was used for ISR of DES in the significantly more complex lesions.2)

The novel finding in their study is that the greater acute luminal gain after PCI with ELCA for ISR of DES was achieved in the significantly more complex lesions with favorable long-term clinical outcomes.2) A previous study demonstrated that the mechanisms of ISR after DES implantation were significant intimal hyperplasia and stent underexpansion, and stent underexpansion remained an important preventable mechanism of ISR.3) They considered 3 possible mechanisms regarding this favorable outcome: 1) additional stent implantation for ISR lesions of DES, 2) the higher maximum balloon inflation pressure, and 3) tissue ablation during ELCA.

First, regarding additional stent implantation for ISR of DES, DES implantation was markedly more effective with a lower incidence of target lesion revascularization (TLR) in the treatment of ISR.4) The additional stent implantation for ISR lesions of DES performed in the present study was similar between the with and without ELCA groups (41.7% versus 46.0%, P = 0.71).

Second, regarding the higher maximum balloon inflation pressure, balloon dilatation with higher pressure might be necessary to treat stent underexpansion. A previous study showed ELCA facilitated the fracturing of diffuse calcium behind an underexpanded stent.5) The lesion characteristics in the PCI with ELCA group were significantly more complex and severe than in the PCI without ELCA group, and these might be strongly associated with stent underexpansion.

Third, regarding tissue ablation during ELCA, a pre
previous study showed that tissue ablation during ELCA contributed 29%, tissue extrusion during adjunctive balloon dilatation contributed 31%, and additional stent expansion contributed 40% to the overall lumen gain with treatment of ISR by volumetric intravascular ultrasound analysis.\(^6\) In contrast, Hirose, et al. demonstrated that only 2.6% of the neointimal plaque area was reduced after ELCA by frequency domain optical coherence tomography analysis.\(^7\) They stated that their result indicates that plaque reduction was not the reason for the favorable effect of ELCA in ISR treatment. There seems to be a discrepancy between the two papers, however, the amount of ablated tissue by laser irradiation is thought to depend on the size of the catheter, energy density, pulse repetition rates, and finally treatment strategy. Moreover, the various components of plaques may have different ablation thresholds that respond unevenly to laser irradiation, thus leaving the tissues which have the higher ablation thresholds as remnants.

Their findings suggest that ELCA is safe and effective at facilitating balloon or stent expansion by ablating in-stent intimal hyperplasia and improving optimal lesion preparation, especially in undilatable and underexpanded stents, although their study has several potential limitations, such as the absence of randomization to the treatment strategy, the small number of intravascular imagings used, and the retrospective nature of the study.\(^5\) We look forward to further studies in a larger number of patients and randomized trials.

Disclosures

Conflicts of interest: None.

References