Drug-eluting stents (DES) inhibit neointimal proliferation and reduce the rates of subsequent target lesion revascularization as compared with bare-metal stents in randomized clinical trials.\(^1\),\(^2\) However, too much inhibition of neointimal hyperplasia might cause delayed vascular healing with incomplete endothelialization, which has been associated with an increase risk of stent thrombosis.\(^3\),\(^4\) Therefore, accurate assessment of the neointimal coverage in DES may be critical in prognosticating their safety. Optical coherence tomography (OCT) uses near-infrared light and generate cross-sectional images by measuring the echo time delay and intensity of light that is reflected or back-scattered from the tissue. The bandwidths of infrared light used for OCT are significantly higher than ultrasound, resulting in greatly increased image resolution. Therefore, OCT provides intravascular images with 15-µm axial resolution. Because of this advantage, OCT has emerged as a promising intracoronary imaging technique for the evaluation of thin neointimal coverage of stent struts after DES implantation. It has been reported that some struts of the first-generation DES were uncovered even 6 months after stent implantation.\(^5\) Furthermore, a previous OCT study demonstrated that stent struts of the first-generation DES remained uncovered 2 years after deployment.\(^6\)

In this issue of the Journal, Konishi et al\(^7\) report on serial OCT examinations they conducted at 6 and 12 months post-implantation to investigate the natural history of the vascular response to biolimus-eluting stents (BES). From their findings, the percentage of uncovered stent struts decreased between 6 and 12 months after BES deployment, and there was a small increase in neointimal thickness between 6 and 12 months. The presence of uncovered strut decreased from 4.0% to 1.5%, and stents with complete coverage increased from 10% at 6 months to 28% at 12 months. They also evaluated morphological changes of the neointima at 6 and 12 months, and showed that the incidences of peri-strut low intensity area and peri-strut late lumen loss decreased between 6 and 12 months. Therefore, accurate assessment of the neointimal coverage in DES may be critical in prognosticating their safety. Optical coherence tomography (OCT) uses near-infrared light and generate cross-sectional images by measuring the echo time delay and intensity of light that is reflected or back-scattered from the tissue. The bandwidths of infrared light used for OCT are significantly higher than ultrasound, resulting in greatly increased image resolution. Therefore, OCT provides intravascular images with 15-µm axial resolution. Because of this advantage, OCT has emerged as a promising intracoronary imaging technique for the evaluation of thin neointimal coverage of stent struts after DES implantation. It has been reported that some struts of the first-generation DES were uncovered even 6 months after stent implantation.\(^5\) Furthermore, a previous OCT study demonstrated that stent struts of the first-generation DES remained uncovered 2 years after deployment.\(^6\)

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thrombi appearance decreased from the 6- to the 12-month follow-up (57% to 32% and 7% to 0%, respectively). To date, there are no data demonstrating the relationship between peri-strut low intensity area and thrombi appearance and late stent thrombosis. However, a previous animal study revealed that the prevalence of peri-strut low intensity area at 6 months after BES represents delayed healing characterized by persistent fibrin deposition that may be associated with incomplete endothelialization and increased risk of stent thrombosis. The decrease in the prevalence of peri-strut low intensity area from 6 to 12 months, which is a key finding of this study, might represent delayed, but complete healing 12 months after BES implantation.

However, the question remains as to whether complete neointimal coverage of stent struts after DES as assessed by OCT can be used as a surrogate for vessel healing after stent implantation. Although many factors such as patient, lesion, and procedural factors, as well as the number of uncovered struts, are likely contributory, histopathological studies have implicated that poor reendothelialization may also play a major role in the pathogenesis of stent thrombosis. Although OCT offers a higher resolution than any other available imaging modality, it does not have sufficient resolution to visualize re-endothelialization in the form of a 5-μm thick cellular monolayer. Thus, even if OCT shows exposed uncovered stent struts, some struts could be re-endothelialized. In our ex vivo histopathological experience, re-endothelialization of the surface of stent struts was confirmed by histopathological analysis, even though OCT images showed exposed uncovered struts after DES implantation (Figure). Another potential limitation of stent strut coverage assessment by OCT is the lack of functional assessment of the endothelium. There is a discrepancy in terms of vessel healing between OCT studies and physiological studies. Previous physiological studies showed abnormal coronary vasoconstrictive responses to acetylcholine after implantation of first-generation DES. Therefore, it is unclear whether neointimal coverage of stent struts assessed by OCT reflects the early restoration of endothelial function after DES.

Despite these limitations, the present report provides potentially important information that needs to be validated prospectively in larger cohorts of patients. Some questions remain: Which parameter is the more important surrogate for better vessel healing after DES implantation: malapposed strut, uncovered strut, peri-strut low intensity area, or thrombus? How is the duration of dual-antiplatelet therapy determined by OCT findings? Both points remain uncertain and warrant further investigation.

Disclosures

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References