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LETTERS TO THE EDITOR

Stent Underexpansion in Early Drug-Eluting Stent Thrombosis

We read with interest the article by Liu et al. (1) comparing intravascular ultrasound findings from definite drug-eluting stent thrombosis patients with in-stent restenosis (ISR) patients with no evidence of stent thrombosis and "no-event" patients with neither thrombosis nor ISR. The authors demonstrated that minimum stent area and stent expansion were significantly smaller in the stent thrombosis group versus ISR and in both groups versus the "no-event" group.

Because underexpansion is associated with both technique/operator-related factors (undersized balloon size, low balloon pressure, and short duration of inflation) and lesion-related factors (vessel size; plaque volume; and plaque composition, especially calcification), it is sometimes difficult to achieve optimal stent expansion even with large balloon size, high balloon pressure, and long duration of inflation (2,3). To clarify this point, it would be valuable to know intravascular ultrasound (IVUS) data after repeat procedure. If stent expansion was little improved even with the use of higher balloon pressures and/or larger balloons, underexpansion seemed to be associated with lesion-related factors. In such patients, additional (pharmacological) intervention may be needed.

Interestingly, IVUS examination at baseline was performed in 6 of 20 patients with stent thrombosis and in 15 of 50 patients with ISR, a similar rate with 16 of 50 "no-event" patients. A recent study demonstrated that IVUS-directed bare-metal stent placement does not significantly reduce the 12-month target lesion revascularization rate (4). To determine interaction between underexpansion and IVUS guidance on outcome, it would be of great help if the authors would provide data to compare stent expansion in patients with baseline IVUS examination and that in patients without.

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Stent Expansion at the Segment With Thrombus

With great interest I read the article by Otake et al. (1) assessing the determinants of subclinical thrombus after sirolimus-eluting stent implantation using optical coherence tomography. The authors demonstrated that *average* stent eccentricity index (minimum/maximum stent diameter) and stent length were associated with the presence of thrombus. The authors speculate that "asymmetric stent expansion affects thrombus formation in part due to uneven stent coverage and healing." To examine local determinants on the presence of thrombus, an additional within-patient analysis may be helpful. Was stent expansion more asymmetric at (or near) the segment with thrombus than that at the segment without thrombus in a patient?

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Reply

We thank Dr. Kaneda for his interest and comments on our recent publication (1). Dr. Kaneda suggested an additional within-patient analysis comparing stent expansion index (SEI) (minimum/maximum stent diameter) between segments with and without thrombus. This is an important suggestion to examine more local determinants on the presence of thrombus.

In our study, we demonstrated that the average SEI was associated with the presence of subclinical thrombus after sirolimus-eluting stent (SES) implantation (SEI: SES with throm-

bus: 0.89 ± 0.04 vs. SES without thrombus: 0.92 ± 0.03; p = 0.001). Our results simply suggest, as stated by Guagliumi and Costa (2) in their editorial comment on our study, that the lesions with lower average SEI were more likely to have thrombus somewhere in the stented segment. In our study, however, even in SES without thrombus, there were segments showing suboptimal symmetry. Indeed, the average value of minimum SEI was not statistically different between SES with and without thrombus (0.80 ± 0.07 vs. 0.77 ± 0.06, respectively; p = 0.15). According to detailed cross-sectional optical coherence tomography (OCT) analysis from 14 lesions with thrombus, the segments with thrombus showed comparable SEI with segments without thrombus (segments without thrombus: 0.88 ± 0.04 vs. segments with thrombus: 0.87 ± 0.06). From these observations, we speculate that: 1) the average symmetrical property throughout the stented segment is important rather than the mere existence of segment(s) with asymmetric expansion; 2) thrombus seems to form at the segment whose SEI is at least comparably low as compared with other segments in the same stents (the SEI of the segment with thrombus appears smaller than the average SEI of SES without thrombus); and 3) thrombus does not necessarily form at the most asymmetric segment throughout the stented segment.

We feel that, considering the low statistical power with the small number of patients in this study, a study involving a larger population would be necessary to confirm these findings. However, the greater resolution of OCT might have the potential to provide more detailed information after stenting.

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