

EDITORIAL COMMENT

Impact of Stent Length on Outcomes in Women



Newer Generation Stents Are Better, But Far From Perfect*

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Outcomes of percutaneous coronary intervention (PCI) have dramatically improved in the past 2 decades, thanks, for the most part, to the evolution of drug-eluting stent (DES) technology, leading to significant reductions in neointimal hyperplasia and need for target lesion revascularization (TLR). It is important to recognize, however, that certain subsets of lesions and/or patients remain more susceptible to suboptimal outcomes. Increasing lesion length or a multiplicity of lesions inevitably results in longer and/or more stents needed to achieve procedural success, which have consistently been associated with increased risk for major adverse cardiac events (MACE) following PCI (1-3). Although first-generation DES significantly reduced neointimal hyperplasia, increasing stent length persisted as a harbinger for restenosis, TLR, and stent thrombosis (4-6). The advent of newer generation DES (and newer, more potent, antiplatelet therapies) has favorably modified the relationship between increasing stent length and MACE; the TLR penalty paid with longer stents is not as significant as previously seen. Importantly, the higher rates of definite and probable stent thrombosis are no longer detected (7,8).

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In this issue of *JACC: Cardiovascular Interventions*, Chandrasekhar et al. (9) examine the impact of stent length on clinical outcomes in a pooled analysis of 5,410 women receiving newer generation DES. The data are analyzed on the basis of total stent length

(the sum of lengths of all stents used) per patient, as well as stent length per lesion. For both analyses, quartiles of stent lengths were used, and 3-year MACE were reported. In the per-patient analysis, increasing total stent length was associated with an increased risk for MACE, cardiac death, myocardial infarction (MI), and TLR. In the per-lesion analysis, increasing stent length was associated with increased MACE and MI. Stent thrombosis was not increased with longer stents in either analysis.

The study brings up a number of questions and interesting observations. The focus on women is well warranted. Women are often underrepresented in all-comers PCI trials (typically 25% to 35% of the overall sample). Typically, women have worse baseline risk profiles and higher risk of complications (10,11). On a patient level, women undergoing PCI are older, are more likely to have diabetes, have more comorbidities, and have worse left ventricular function than men (12). From a procedural standpoint, target vessels are typically smaller, necessitating the use of smaller diameter stents and increasing risk for complications. Adding these unfavorable characteristics to increasing stent length, a known predictor of adverse events, can only accentuate the magnitude of this effect (13,14). Similar to men, outcomes with newer generation DES are better in women than they were with first-generation devices (15,16). It appears, however, that the TLR penalty associated with longer stents, which was reduced or eliminated in some studies (7,8), remains a concern in this population. This emphasizes an important concern about women in PCI trials: with their aforementioned unique characteristics, it is unwise to extrapolate the overall conclusions drawn from predominantly male samples.

The per-patient and per-lesion analyses provide more insights. It is reassuring that increasing stent length was not associated with stent thrombosis,

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confirming prior reports on safety of newer generation DES in higher risk patients with higher risk lesions. Almost all included studies relied on traditional dual-antiplatelet therapy regimens; more contemporary therapy may result in further reduction in ischemic complications. However, both analyses clearly confirm an increasing risk for TLR with increasing stent length in the female population. On the basis of the Kaplan-Meier analyses, cardiac death and MI, which may or may not be stent related, were more frequent in the third and fourth quartiles of stent length in the per-patient analysis but only the fourth quartile in the per-lesion analysis. This is probably a function of the difference in quartile boundaries between both analyses but also demonstrates the impact of underlying higher baseline risk (higher prevalence of diabetes, multivessel disease, complex lesions, and lower ejection fraction in the higher quartiles). Hence, over the 3 years of follow-up, and in the absence of increased stent thrombosis, increased death and MI may have been related to higher plaque burden and non-stent-related disease progression.

How can these findings be integrated into our daily practice? Understanding the increased risk for subsequent events in women requiring longer or multiple stents should warrant a heart team approach and

careful consideration of PCI versus coronary bypass surgery, especially in those with diabetes, multivessel disease, and/or impaired ventricular function. If PCI is considered the better option, every effort should be made to optimize the procedural result to reduce the risk for TLR. Superior outcomes can be achieved with the use of intravascular imaging for guidance of PCI of long lesions (17), mainly by achieving larger acute lumen gain and eventual lower TLR rates. Additionally, although the event rates tapered beyond the first year, one must consider that the DAPT (Dual-Antiplatelet Therapy) trial demonstrated a reduction in MI with extended therapy (18). In the absence of higher bleeding risk, women receiving long or multiple stents should be considered for such extended therapy. Last, but not least, newer generation DES examined in this analysis represent clear progress in reducing adverse events, but optimal medical therapy and secondary prevention remain the cornerstone for reducing subsequent non-stent-related ischemic events.

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