

# A step forward: imaging-based approach to in-stent restenosis

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In-stent restenosis (ISR) remains a common problem in contemporary practice despite significant advances in interventional tools and techniques<sup>1</sup>. ISR is not a binary finding, however, and we have evolved from simply stratifying ISR based on focal or diffuse patterns, to specific patterns based on intravascular imaging appearance including neointimal hyperplasia, calcified or non-calcified neoatherosclerosis and underexpansion<sup>2,3</sup>. In fact, recognition of the predominant lesion morphology has important treatment implications guiding optimal therapy.

In the present issue of EuroIntervention, Xhepa and colleagues evaluated, in a multicentre, optical coherence tomography (OCT)-based registry of lesions treated for in-stent restenosis (ISR), the role of drug-eluting stents (DES) and drug-coated balloons (DCB) based on lesion inhomogeneity<sup>4</sup>.

#### Article, see page 388

Notably, irrespective of the mechanism of restenosis, event rates were significant, with target lesion revascularisation (TLR) occurring in one quarter of patients, highlighting the importance of identifying improved treatment approaches for this subset of

lesions. The authors demonstrated that tailored treatment based on OCT findings may have a favourable impact on clinical outcomes.

The rate of adverse events, particularly TLR, was high irrespective of ISR type or treatment applied. This highlights the importance of preventing ISR in the first place. Underexpansion, which was not the primary focus of the present study, was common and present in the majority of the lesions studied. Stent underexpansion is an entity that is best addressed at the time of initial stent implantation; however, it must first be recognised. Even better is predicting its occurrence by recognising significant calcification and addressing it prior to stent implantation<sup>5</sup>. Until intravascular imaging is the standard of care for percutaneous coronary interventions, stent underexpansion will continue to plague interventional cardiology. Applying a lesion-specific treatment approach with maximally sized stents is critical to minimise future ISR<sup>6</sup>. Prevention of ISR must take precedence and should be considered with each and every stent implanted. We now have the imaging catheters, lesion preparation devices and treatment algorithms readily available to allow us to reduce TLR meaningfully.

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According to the 2018 European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS) Guidelines on myocardial revascularisation, there is a Class IIa, level of evidence C recommendation for intravascular imaging to be considered to detect stent-related mechanical problems associated with restenosis<sup>7</sup>. Perhaps the time has come for intravascular imaging to be more than just considered when treating stent failure. ISR has been the Achilles' heel for interventional cardiology since the introduction of coronary stents. Further work is needed specifically assessing the impact of intravascular imaging in clinical practice on the treatment of ISR. Fundamentally, when encountering any problem, a root cause analysis is a critical step in the pathway to systematically evaluating and overcoming the shortcoming. The same is true when addressing ISR. One cannot treat ISR effectively without understanding the primary mechanism of stent failure, and this cannot be achieved without intravascular imaging. The authors acknowledge a major limitation of the present literature, with most data from randomised trials on restenosis being based on angiography-guided treatment and endpoints. Angiography-based outcomes should no longer be the primary imaging endpoint in trials on ISR. Randomised trials analysing treatment options for ISR, guided by intravascular imaging with intravascular imaging endpoints, are needed. The future of treating ISR is lesion-specific treatment guided by intravascular imaging. The next frontier for coronary interventions in interventional cardiology is not further iterations in stent design, but a change to a patient-centred approach with treatment tailored specifically to the lesion subtype. The future is now, and this can be facilitated by routine and systematic utilisation of intravascular imaging.

## Conflict of interest statement

E. Shlofmitz is a consultant for Abbott Vascular, Cardiovascular Systems Inc., Opsons Medical, Philips and Shockwave Medical. He serves on advisory boards for Abbott Vascular and Philips and is on the speaker's bureau for Janssen Pharmaceuticals and Medtronic.

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