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Editorial

How can we improve our outcomes in myocardial infarction? Use of IVUS in high-risk patients

¿Cómo podemos mejorar nuestros resultados en infarto? Uso de la IVUS para pacientes en alto riesgo

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The ESC/EACTS guidelines on myocardial revascularization recommend the use of intracoronary imaging to optimize outcomes after percutaneous coronary intervention (PCI) of the left main coronary artery and in other selected patients.[1] In cardiology practice, a very high proportion of PCI procedures are performed in patients with acute myocardial infarction (AMI), around half of whom have multivessel disease. Nevertheless, the use of intravascular imaging in this setting is relatively rare, probably due to factors related to urgency and patient stability.

The firmest evidence for the benefit of intravascular ultrasound (IVUS) in coronary revascularization comes from the ULTIMATE and IVUS-XPL randomized clinical trials.[2,3] Both these trials examined mixed populations, including patients with acute coronary syndrome and others with stable disease, and reported a near 50% reduction in events at 3 and 5 years, respectively. Of note, the primary outcome measure in these studies was a composite of death, target-vessel myocardial infarction, or target-vessel repeat revascularization, and most of the benefit was due to a reduction in repeat revascularizations rather than deaths or infarctions. Nevertheless, in a recent meta-analysis[4] that included both these studies and focused on patients with long lesions ($\geq$ 28 mm), IVUS guidance was associated with a statistically significant 57% reduction in cardiac deaths. This meta-analysis also detected large reductions in infarctions and in-stent thrombosis, although these effects were not statistically significant.

Recently reported data from the Korea Acute Myocardial Infarction-National Institutes of Health registry show that IVUS guidance in AMI patients reduced the risk of 3-year target-lesion failure by 40%.[5] In a recent article in *Revista Española de Cardiología*, Roh et al.[6] published a subanalysis of this study, focusing on the impact of IVUS guidance in AMI patients at high ischemic risk. Of more than 13 000 patients in the registry, the authors classified approximately 4000 as being at high ischemic risk according to the number of stents and treated vessels, total stent length, left main PCI, or clinical factors such as diabetes mellitus and chronic kidney disease. IVUS was used to guide revascularization in a fifth of these patients and resulted in a reduction by almost a half (6.7% vs 12%; hazard ratio [HR], 0.54) in a composite measure of target-lesion failure at 3 years. The authors also recorded highly significant reductions in all-cause death, target-vessel myocardial infarction, and ischemia-driven target-lesion revascularization.

Evidence supporting the use of IVUS in AMI patients remains scarce because, while the ULTIMATE and IVUS-XPL trials included some patients in this category, no major trials have specifically examined the benefits of IVUS guidance in this population. A recent meta-analysis of 9 studies and more than 800 000 patients showed a significant reduction in deaths and major cardiovascular events.[7] Nevertheless, only 1 of the studies was a randomized clinical trial, and it included just 80 patients. There is thus a clear need for better quality data to address this question.

Follow-up intravascular imaging has revealed that primary PCI revascularization is frequently less successful in AMI patients than in patients with stable or unstable angina.[8] Suboptimal stent implantation in AMI patients has many possible causes, but by far the most predominant is that the presence of a thrombus hinders angiographic assessment of plaque morphological features (such as possible calcification and the length of the target lesion) and prevents many operators from predilating the artery with a size-matched balloon to reduce the risk of distal embolism. The study by Roh et al.[6] is a retrospective analysis and therefore does not report the additional interventions motivating the use of IVUS to prevent subsequent events. Nor does the study report the degree of «acute» incomplete stent apposition or strut endothelialization in patients undergoing PCI revascularization with IVUS guidance. However, the analysis does reveal that on average these patients received a larger number of stents and that they had a larger diameter and total length than those implanted with angiography guidance. This indicates that IVUS provides a better estimate of lesion size and vessel diameter, factors crucial to the long-term success of PCI. This is evident from the ULTIMATE and IVUS-XPL trials, which showed a notable difference in events between patients who met the prespecified criteria for a good result with IVUS and those who did not.

Another interesting finding of the study by Roh et al.[6] is that IVUS did not significantly reduce the rate of target-lesion failure in

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patients who met none of the criteria for high ischemic risk. Target-lesion failure is rare after PCI revascularization with second-generation drug-eluting stents, and the benefits of IVUS guidance are thus concentrated in patients whose more complex anatomy increases the risk of a suboptimal outcome due to technical difficulties. It is therefore noteworthy that half of the patients in the registry met at least 1 of the criteria for high ischemic risk. Moreover, most of these criteria are thoroughly anatomical, and the 2 clinical criteria (diabetes and chronic kidney disease) have a well established association with complex coronary anatomy. These results thus support the use of angiography guidance in AMI patients with a simpler anatomy, while justifying a high alert level when the angiographic and clinical data indicate high ischemic risk.

Roh et al.[6] also report interesting data on the impact of center experience with IVUS. To assess the risk of target-lesion failure in relation to the number of IVUS examinations carried out, the authors grouped centers into quartiles according to the proportion of AMI patients who underwent PCI revascularization with IVUS guidance. This analysis revealed that patients treated by the team with most IVUS experience had an event rate less than half that of those treated by the least experienced team. These data underline the need to provide training in intravascular imaging techniques to operators performing emergency procedures in AMI patients. The SEC Association of Interventional Cardiology has a working group on intracoronary diagnostic techniques that promotes training courses to meet this need, some of which can be freely accessed online.

The study by Roh et al.[6] provides empirical evidence for some key measures that can improve the long-term outcomes of PCI for AMI: training all operators in intracoronary imaging; activating a high alert level in response to clinical and anatomical indicators of high ischemic risk; and optimizing stent size, length, expansion, and apposition.

It is also important to recognize that the observational nature of the largest studies in the field hinders the adoption of this methodology and its reclassification to a firmer recommendation in clinical practice guidelines. Evidence is needed from clinical trials demonstrating an unequivocal benefit of IVUS guidance in AMI patients. The SPECTRUM[9] and iSTEMI (NCT04775914) trials will address this question in the coming years.

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CONFLICTS OF INTEREST

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