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EDITORIAL

Precision over prevalence: moving beyond binary risk stratification after PCI

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The management of chronic coronary syndromes (CCS) continues to evolve with advances in interventional techniques and pharmacotherapies, yet recurrent ischaemic events remain a significant concern after percutaneous coronary intervention (PCI). Despite improvements in drug-eluting stents (DES) and antiplatelet regimens, long-term outcomes remain suboptimal for many, driven by persistent risks of myocardial infarction, stroke, and death. The 2024 European Society of Cardiology (ESC) guidelines for CCS management define high ischaemic risk (HIR) as coronary atherosclerosis plus at least one risk enhancer or procedural factor from a detailed list[1]. They recommend personalised antithrombotic strategies, such as extending dual antiplatelet therapy (DAPT) or switching to long-term $P2Y_{12}$ inhibitor monotherapy for HIR patients after PCI to reduce the risk of recurrent events.

In this issue of EuroIntervention, Raona et al provide an in-depth analysis from Mount Sinai Fuster Heart Hospital in New York, USA, that questions the practical applicability of these HIR criteria in a real-world, diverse patient population[2]. They retrospectively assessed the prevalence and prognostic impact of HIR criteria, as defined by the 2024 ESC guidelines, in a large all-comer cohort of 15,336 CCS patients who underwent PCI with DES between 2012 and 2022. The findings showed that 71.4% of patients met at least one HIR criterion[2]. Diabetes was the most common HIR feature, affecting nearly half of patients (48.5%), followed by chronic kidney disease (CKD; 27.2%), bifurcation lesions (9.8%), stent length >60 mm (9.2%), chronic total occlusion (CTO; 7.3%), and left main disease (6.7%).

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The study demonstrated a clear association between HIR status and an increased risk of 1-year major adverse cardiac and cerebrovascular events (MACCE), including death, myocardial infarction, or stroke. Patients with multiple HIR criteria showed a stepwise rise in MACCE risk, from 1.9% in those with no criteria to 8.4% in those with three or more. Among individual HIR factors, CKD was the strongest predictor of MACCE (hazard ratio [HR] 2.69), followed by left main PCI (HR 2.00), diabetes (HR 1.69), and stent length >60 mm (HR 1.45). Notably, bifurcation lesions and CTO interventions were not significantly associated with MACCE in multivariate analysis, likely reflecting advances in contemporary PCI techniques and technologies.

The study highlighted the challenge of balancing ischaemic and bleeding risks, as the presence of HIR criteria was associated with increased bleeding complications, particularly in the periprocedural period. Furthermore, although underutilised, intracoronary imaging was independently associated with a significant reduction in 1-year MACCE (HR 0.59), suggesting its potential to improve outcomes in HIR patients.

The HIR criteria in the 2024 ESC guidelines were derived from eligibility requirements for clinical trials assessing antithrombotic strategies to improve long-term outcomes in patients with CCS, in which a single HIR feature was sufficient

for inclusion. In the present study, the observed hazard ratios and the stepwise increase in MACCE risk among patients with multiple HIR characteristics provide strong support for the prognostic validity of these criteria.

Nevertheless, the high prevalence of HIR features raises important concerns about the clinical applicability of the current binary risk stratification. Ischaemic and haemorrhagic risk factors often share common biological determinants – most notably advanced age, diabetes, and renal dysfunction. As a result, a classification system that counts risk factors and labels nearly three-quarters of patients as "high risk" may inadvertently encourage a broadly intensified antithrombotic approach.

Such broad escalation carries the risk of overtreatment, in which the incremental reduction in ischaemic events among patients with lower-tier HIR profiles may be offset by a disproportionate rise in major bleeding. The substantial overlap in risk factors highlights the limitations of risk stratification based on counting binary risk factors and underscores the need for more refined, individualised risk assessment strategies that better balance competing ischaemic and haemorrhagic hazards.

The current HIR stratification, based on binary risk factors and identifying nearly three-quarters of patients as high risk, as shown in this study, calls for greater precision. Not all HIR criteria carry the same weight, as evidenced by the different hazard ratios observed in the present study. Further iterations of the HIR classification should employ a weight-based scoring system derived from hazard ratios obtained in large-scale population-wide registries.

The most striking finding in the Mount Sinai cohort is the protective effect of intracoronary imaging. Despite being underutilised, intravascular ultrasound (IVUS) guidance was associated with a 41% reduction in 1-year MACCE risk, consistent with evidence from recent randomised trials[3-6]. Based on this evidence, the guidelines now recommend intracoronary imaging guidance with IVUS or optical coherence tomography (OCT) during PCI for anatomically complex lesions, particularly left main stem lesions, true bifurcations, and long lesions, with a Class I, Level of Evidence A recommendation[1]. The marked reduction in MACCE observed with IVUS guidance suggests that HIR can be partially "neutralised" by superior technical execution. HIR should therefore be determined not solely by the patient's comorbidities but also by the final physiological and imaging results. A diabetic patient with an IVUS/OCT-optimised, well-expanded stent may be a better candidate for DAPT de-escalation than a lower-risk patient with a suboptimal result.

The dominant prognostic impact of CKD (HR 2.69 – exceeding even that of left main disease) demands targeted intervention beyond antiplatelet optimisation: aggressive risk factor modification, renal protective therapies (sodium-glucose cotransporter-2 inhibitors, finerenone), meticulous contrast stewardship, and recognition of altered antiplatelet pharmacodynamics in this population.

The analysis of the Mount Sinai cohort is a clarion call to improve post-PCI care. While the 2024 ESC HIR criteria provide a necessary foundation for identifying vulnerable patients, their widespread prevalence in contemporary PCI patients necessitates a move towards more granular, precision-based stratification. By weighing individual risk factors, using intravascular imaging for complex anatomy, and tailoring pharmacotherapy to each patient's unique physiological response, we can move from the broad application of guidelines to the precise delivery of care. In the burgeoning field of personalised cardiology, our goal must be to ensure that treatment decisions are guided by nuanced, individualised assessment rather than broad categorisation.

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Conflict of interest statement

C.J.M. Vrints has no conflicts of interest to declare.

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