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EDITORIAL

Recent advances and emerging research in cardiovascular science

KEYWORDS Heart failure; digital innovation; acute coronary syndrome; precision medicine

Cardiovascular medicine continues to evolve through an increasingly integrated approach that links molecular mechanisms, clinical innovation, and preventive strategies [1,2]. The November 2025 issue of *Acta Cardiologica* reflects this evolution, spanning discoveries in molecular cardiology, advances in heart failure (HF) management, acute coronary syndromes (ACS), population health, and digital innovation. Across these contributions, precision, interdisciplinarity, and patient-centered care emerge as defining principles [3–8]. Together, these studies demonstrate how scientific progress, from biological mechanisms to pragmatic interventions, translates into improved outcomes and quality of life for cardiovascular patients.

The complex interaction between the gut microbiota and cardiovascular health continues to reveal important mechanistic insights. Alterations in microbial composition can disrupt host–microbe balance, activating inflammatory and metabolic pathways that promote atherosclerosis, hypertension, and HF, ultimately contributing to the development and progression of multiple cardiovascular risk factors (Figure 1) [9]. Understanding these processes offers new opportunities for microbiome-based therapies and preventive strategies, while encouraging multidisciplinary integration across cardiology, microbiology, and nanomedicine.

At the molecular level, advances in bioinformatics and artificial intelligence are helping to refine diagnostic precision [10,11]. In an integrated analysis combining gene-expression data and machine learning, several dysregulated microRNAs were identified as potential biomarkers for hypertrophic cardiomyopathy (HCM), particularly those involved in inflammation and extracellular matrix remodelling [12]. Predictive models demonstrated high diagnostic accuracy, suggesting that miRNA profiling may provide a valuable tool for early detection and personalised management of HCM.

Hemodynamic assessment also continues to inform risk stratification [13]. By analysing the pulmonary artery pulsatility index (PAPi) in patients with atrial fibrillation (AF) and HF, it was shown that AF is independently associated with reduced right-ventricular performance and worse outcomes [14]. Low PAPi values predicted higher rates of death and HF hospitalisation, underscoring the importance of right-sided hemodynamics as an adjunct to conventional assessment in this population.

Therapeutic advances in HF are equally noteworthy [15–19]. The addition of dapagliflozin, a sodium-glucose cotransporter-2 (SGLT2) inhibitor, to standard therapy including sacubitril/valsartan led to significant short-term improvements in exercise capacity, cardiopulmonary efficiency, left-ventricular function, and quality of life, highlighting its multifaceted benefits beyond glycemic control [20]. Complementary evidence from a Belgian HF clinic registry demonstrated high implementation of guideline-directed medical therapy (GDMT) and notably low dependence on loop diuretics, illustrating how structured, patient-centered management optimises pharmacologic outcomes [21]. Expanding beyond pharmacology, a home-based physical-activity program for patients with HF and preserved ejection fraction (HFpEF) proved safe and effective, improving exercise duration, left-atrial function, and well-being, and reinforcing the role of lifestyle-centered care within HF management [22].

In ACS, the potential vascular effects of SGLT2 inhibition have attracted increasing interest [23]. In patients with type 2 diabetes mellitus and acute myocardial infarction (AMI) undergoing percutaneous coronary intervention (PCI), long-term dapagliflozin use was associated with a markedly lower incidence of the no-reflow phenomenon, suggesting a possible microvascular protective effect that warrants confirmation in randomised trials (Figure 2) [24]. Beyond pharmacotherapy, functional and behavioural determinants of post-ACS outcomes are increasingly recognised. Reduced six-minute walk distance, lower expiratory pressure, and higher perceived barriers to cardiac rehabilitation were independent predictors of early

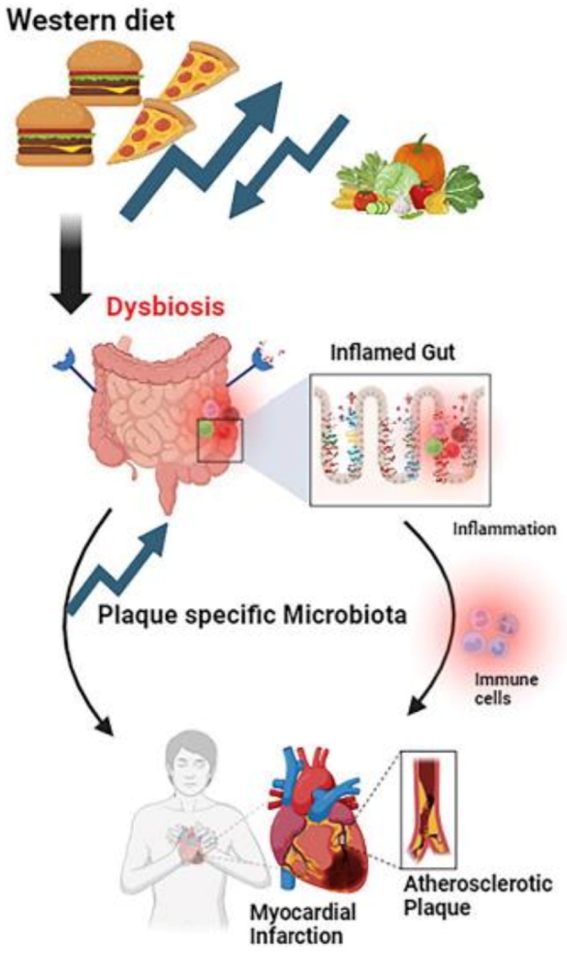

Figure 1. Mechanism of atherosclerosis due to gut dysbiosis (From reference [9]).

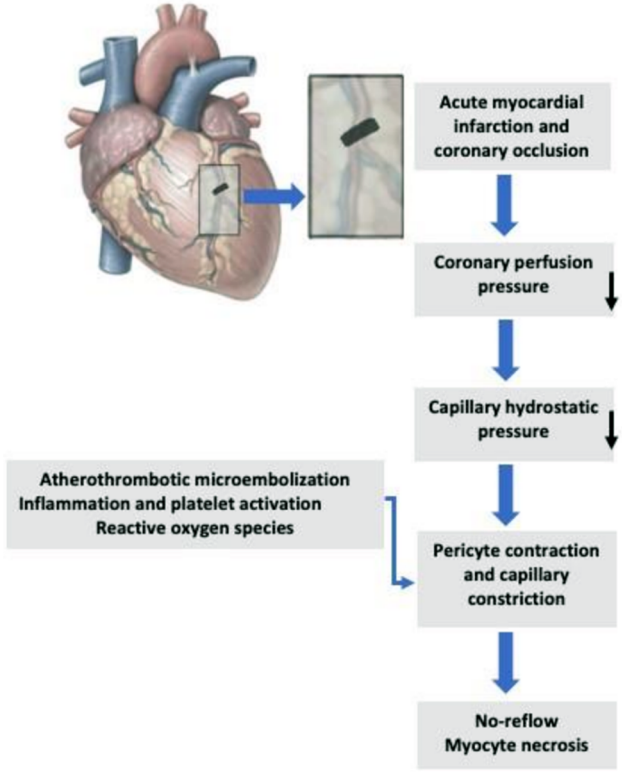

Figure 2. Mechanism of no-reflow during acute myocardial infarction (From reference [24]).

readmission, indicating the need for targeted strategies to support vulnerable patients after discharge [25]. Reinforcing this message, participation in structured cardiac rehabilitation programs significantly improved adherence to secondary prevention measures, including medication, diet, and physical activity, and reduced rehospitalization rates across STEMI, NSTEMI, and unstable-angina populations [26].

At a population level, epidemiological analyses continue to illuminate global disparities in cardiovascular risk. Between 1990 and 2021, the burden of AF and atrial flutter rose steadily, driven primarily by metabolic risk factors such as increasing body-mass index, while regional gaps persisted, with low-income regions experiencing disproportionate growth [27]. Similarly, data from over 1.6 million hospitalisations revealed that nearly one in six patients admitted with cardiac arrest (CA) had been hospitalised within the previous month, most commonly for cardiovascular, infectious, or respiratory conditions, underscoring a critical window for early prevention (Figure 3) [28]. In maternal health, peripartum cardiomyopathy (PPCM) was associated with substantially higher rates of hypertensive disorders, haemorrhage, and maternal death, as well as adverse neonatal outcomes, emphasising the need for multidisciplinary coordination and early recognition [29].

Finally, the growing integration of artificial intelligence into patient education and clinical communication represents an exciting frontier. Assessment of ChatGPT-4 as an educational tool for cardiac rehabilitation in HF showed highly accurate and consistent responses, although readability remained moderate [30]. Such developments illustrate how language-based AI systems could complement traditional communication strategies and enhance the accessibility of cardiovascular information for patients.

The issue also includes several focus images illustrating particularly interesting interventional or clinical cases [31–35]. Together, these contributions highlight the expanding boundaries of cardiovascular science—from molecular biology and precision analytics to patient-centered management, prevention, and digital innovation—and reaffirm the journal's mission to promote rigorous, multidisciplinary research that advances both understanding and care in cardiovascular medicine.

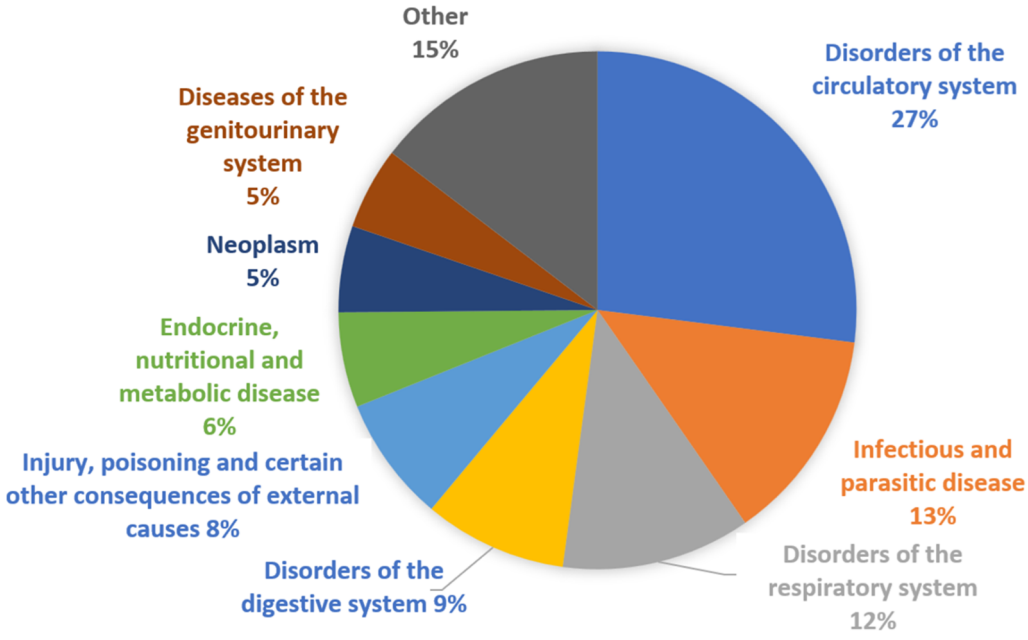

Figure 3. Categories for causes of hospitalisations 30-days before admissions with cardiac arrest (From reference [28]).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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