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EDITORIAL



Emerging perspectives in cardiovascular medicine

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ABSTRACT

Cardiovascular medicine continues to evolve rapidly through advances in molecular biology, biomarkers, digital technologies, and interventional strategies. Recent contributions highlight progress in arrhythmia management, artificial intelligence-assisted diagnostics, metabolic and inflammatory risk stratification, and the understanding of rare cardiomyopathies. These developments illustrate the transition towards more precise and individualised cardiovascular care while raising new clinical and ethical challenges. Integrating technological innovation with clinical expertise remains essential to ensure that advances translate into improved patient outcomes.

KEYWORDS

Risk stratification; artificial intelligence; interventional cardiology; biomarkers

Cardiovascular research continues to transform clinical practice by integrating novel diagnostic tools, molecular insights, and innovative therapeutic strategies. Over recent years, *Acta Cardiologica* has highlighted how advances in imaging, biomarkers, and digital technologies are reshaping cardiovascular medicine and enabling more precise patient management [1–4]. These developments reflect the broader transition towards precision cardiology, in which clinical decision-making increasingly integrates biological, technological, and patient-specific data.

Atrial fibrillation remains one of the most prevalent arrhythmias worldwide and continues to represent a major source of morbidity and mortality [5,6]. Rhythm-control strategies remain central to patient management, and electrical cardioversion is widely used to restore sinus rhythm in patients with persistent atrial fibrillation. However, the success of cardioversion is influenced by several clinical and structural determinants, including atrial remodelling and disease chronicity. Recent data indicate that prolonged atrial fibrillation duration, heart failure, and increased left atrial size are associated with a higher likelihood of cardioversion failure, highlighting the progressive nature of atrial structural changes [7,8].

The search for biomarkers capable of improving arrhythmia risk stratification has also gained attention. Circulating soluble suppression of tumorigenicity 2 (sST2), a biomarker reflecting myocardial stress and fibrosis, has been associated with both the

development of atrial fibrillation and the risk of recurrence following catheter ablation. These findings suggest that biomarkers reflecting atrial remodelling may complement imaging and clinical parameters in identifying patients at higher risk of arrhythmia progression [9].

Technological innovation continues to transform interventional electrophysiology. Pulsed-field ablation has recently emerged as a promising non-thermal technique for pulmonary vein isolation [10]. Early studies suggest that this approach offers comparable efficacy to conventional radiofrequency and cryoballoon ablation while maintaining a favourable safety profile, particularly with respect to collateral tissue injury [11]. These developments illustrate how advances in ablation technologies may further refine rhythm-control strategies in atrial fibrillation. Beyond ablation therapies, pacing strategies are also evolving towards more physiological approaches. Conduction system pacing has emerged as an alternative to conventional right ventricular pacing. A nationwide survey conducted in Italian pacing centres shows that adoption is rapidly increasing, although operator experience remains heterogeneous and the technique is still being implemented progressively in clinical practice [12].

Digital technologies are also reshaping cardiovascular diagnostics. Artificial intelligence (AI) has increasingly been integrated into clinical workflows, particularly for electrocardiogram interpretation and decision support [13]. Institutional experiences with

AI in ECG Interpretation: Reflections on Challenges and Insights

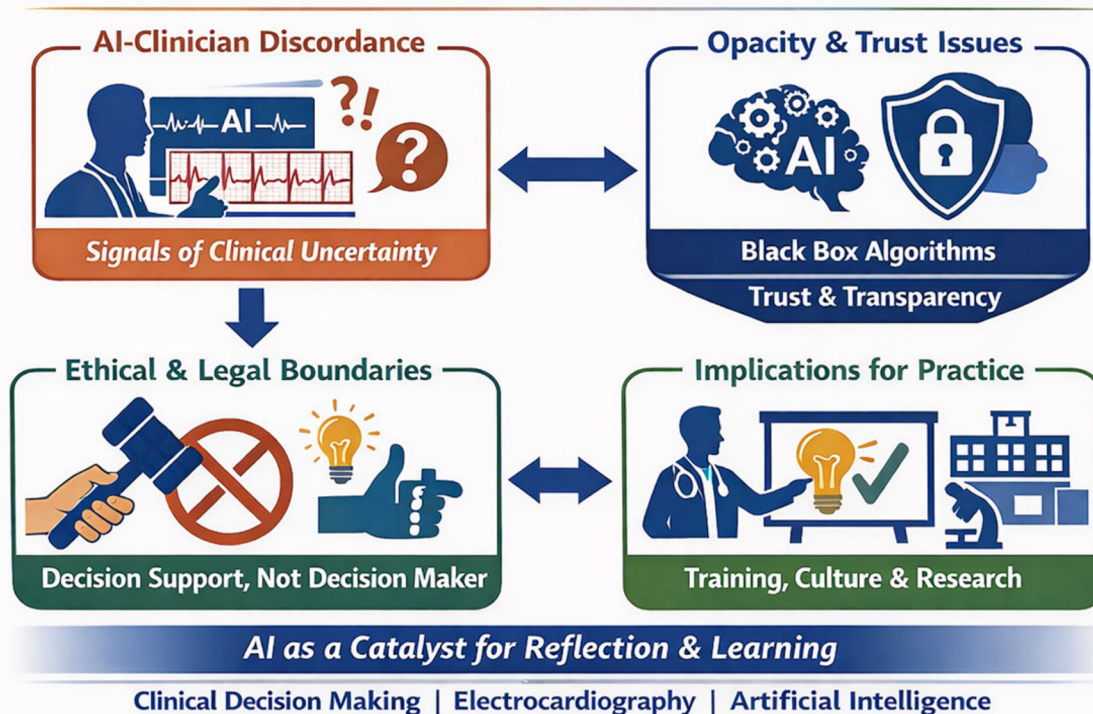


Figure 1. Conceptual framework illustrating key challenges and implications of artificial intelligence (AI) in ECG interpretation. AI–clinician discordance may signal clinical uncertainty, while algorithm opacity raises issues of trust and transparency. These challenges highlight ethical and legal boundaries and emphasise that AI should function as a clinical decision-support tool, guiding training, practice, and research rather than replacing physician judgement (from Ref. [14]).

AI-assisted ECG analysis demonstrate that such tools may improve diagnostic efficiency and expand access to expert-level interpretation. However, real-world implementation has revealed that disagreements between AI outputs and clinician judgement are relatively frequent, raising important questions regarding clinical trust, responsibility, and the limits of algorithmic decision-making (Figure 1) [14,15]. These observations reinforce the concept that AI should be viewed primarily as a clinical support tool rather than a replacement for physician expertise. Technological advances in cardiovascular medicine also raise important ethical and clinical considerations. The management of implantable cardioverter-defibrillators at the end of life remains a challenging issue. A recent scoping review highlights significant knowledge gaps among patients, relatives and healthcare professionals regarding device deactivation, emphasising the need for improved communication and earlier discussions in clinical practice [16].

Beyond arrhythmia management, significant progress has been made in identifying biomarkers capable

of refining cardiovascular risk prediction. Metabolic and inflammatory markers have emerged as important indicators of cardiovascular risk [17,18]. The triglyceride–glucose index, a marker of insulin resistance, has been associated with adverse cardiovascular outcomes after percutaneous coronary intervention when combined with inflammatory markers such as high-sensitivity C-reactive protein [19,20]. Similarly, metabolic dysregulation reflected by an elevated triglyceride–glucose index has also been associated with increased lesion complexity in patients with chronic total coronary occlusion [21].

Molecular research has also identified novel biomarkers that may provide additional insights into cardiovascular disease mechanisms. Circular RNAs have recently emerged as promising regulators and potential diagnostic indicators in acute coronary syndromes. Dysregulation of specific RNA molecules has been associated with disease severity and adverse cardiovascular outcomes, suggesting that RNA-based biomarkers may contribute to future diagnostic and prognostic strategies [22].

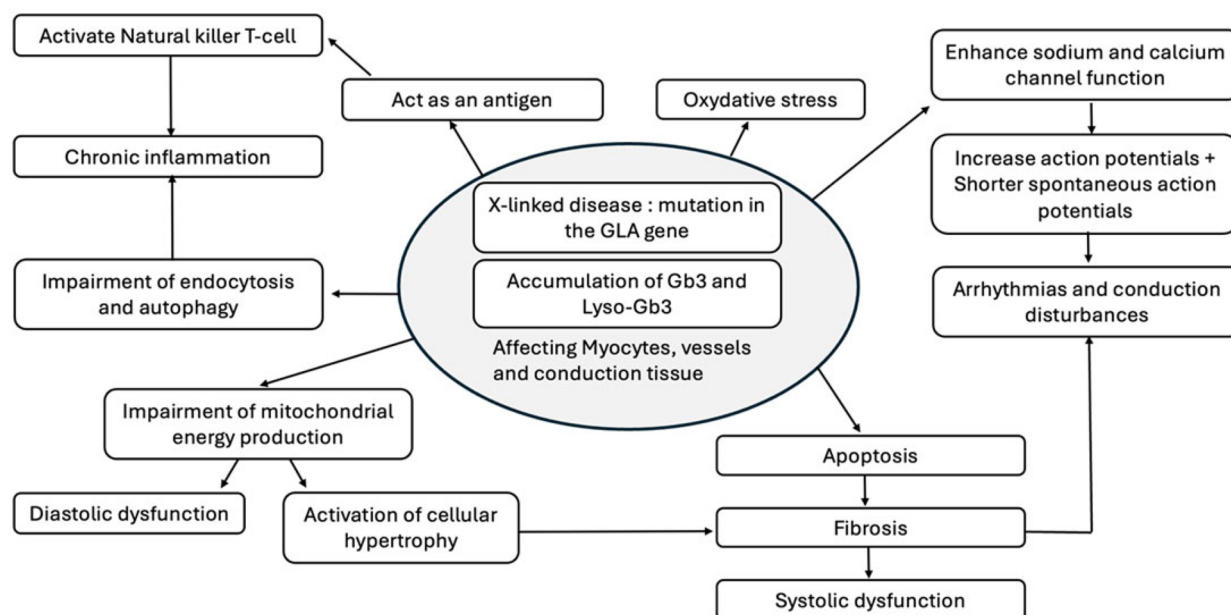


Figure 2. Pathophysiology of cardiac manifestations in Fabry disease (from Ref. [25]).

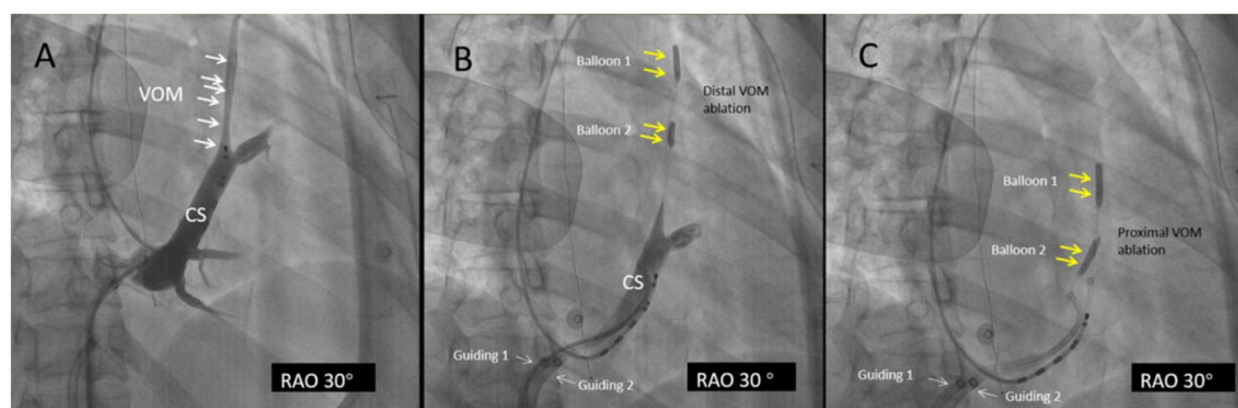


Figure 3. Fluoroscopic views illustrating the double-balloon technique for ethanol infusion into the vein of Marshall (VOM). (A) Venography showing the vein of Marshall originating from the coronary sinus (CS). (B) Positioning of two balloons to isolate the distal VOM segment for targeted ablation. (C) Sequential ethanol infusion with proximal and distal balloon occlusion to achieve effective VOM ablation (RAO 30° view) (from Ref. [32]).

Imaging and genetic approaches continue to improve the understanding of inherited cardiovascular diseases. In heterozygous familial hypercholesterolaemia, coronary artery calcium scoring has proven useful in detecting subclinical atherosclerosis and refining cardiovascular risk stratification. Elevated calcium scores have been associated with cumulative exposure to high LDL cholesterol levels and delayed initiation of lipid-lowering therapy, emphasising the importance of early diagnosis and aggressive treatment in this high-risk population [23,24].

Rare cardiomyopathies also represent an area of growing interest. Fabry disease, an X-linked lysosomal storage disorder, can lead to progressive cardiomyopathy characterised by left ventricular hypertrophy,

conduction disturbances, and arrhythmias (Figure 2). Although the disease was historically considered to affect primarily men, increasing evidence demonstrates that women may also develop clinically significant cardiac involvement, often with heterogeneous and delayed presentations. This diagnostic complexity highlights the importance of genetic testing and advanced imaging in patients presenting with unexplained left ventricular hypertrophy [25,26].

Therapeutic strategies for infiltrative cardiomyopathies are also evolving. In transthyretin amyloid cardiomyopathy, disease-modifying therapies have improved outcomes, yet many patients continue to experience progressive heart failure. Recent analyses suggest that sodium-glucose cotransporter-2 inhibitors may offer

additional benefits in this population, including improved survival and renal outcomes, although randomised trials are required to confirm these observations [27,28].

Lifestyle factors remain an essential component of cardiovascular risk assessment [29,30]. Emerging data suggest that sleep patterns may influence cardiovascular health. In particular, compensatory weekend sleep recovery has been associated with lower risks of coronary artery disease and myocardial infarction in certain populations, particularly among individuals with insufficient weekday sleep [31]. These observations reinforce the growing recognition of sleep health as an important determinant of cardiometabolic risk.

In this issue of *Acta Cardiologica*, some focus images highlighting interesting cases have also been reported (Figure 3) [32–38].

Disclosure statement

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

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