Short Editorial

AI-Enhanced ECGs for the Diagnosis of HFpEF: A Promising Frontier, But Not Yet a Standalone Solution

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Short Editorial referring to the article: Diagnostic performance of artificial intelligence-driven electrocardiogram algorithms in detecting heart failure with preserved ejection fraction: a systematic review and meta-analysis

Heart Failure with preserved Ejection Fraction (HFpEF) is among the most challenging syndromes in contemporary cardiology. Despite accounting for nearly half of all heart failure cases, HFpEF remains chronically underdiagnosed and is associated with significant morbidity and mortality.[1,2] The diagnosis of HFpEF is challenging and relies on clinical history, natriuretic peptide measurements, and echocardiography. Diagnostic scores have been developed that integrate these three key elements.[3,4] Echocardiography is indispensable for identifying structural and functional criteria, but its availability and cost make population-level screening impractical in many healthcare systems. In addition, in many places, a comprehensive echocardiogram is not performed. Likewise, natriuretic peptides are not always available. Therefore, new solutions to facilitate diagnosis are welcome.

In this context, the systematic review and meta-analysis presented in this issue of International Journal of Cardiovascular Sciences, provide important insights into an increasingly discussed alternative: Artificial Intelligence-enhanced Electrocardiography (AI-ECG).[5] Drawing from more than 170,000 patients across three observational studies, the authors report a pooled sensitivity of 0.89, specificity of 0.80, and an AUC of 0.89 for AI-ECG in detecting HFpEF. These findings suggest that deep learning models can extract subtle electrical signatures associated with diastolic dysfunction – signals that may be visually imperceptible on standard ECGs. The appeal is clear: the ECG is universal, inexpensive, rapid, and deeply embedded in clinical workflows. If Artificial Intelligence could reliably identify patients requiring echocardiographic confirmation, screening strategies might be revolutionized.

This meta-analysis adds meaningfully to a growing body of literature exploring AI-ECG applications across the spectrum of cardiac disease. Prior work has shown that AI-ECGs can detect left ventricular systolic dysfunction with good accuracy,[6,7] hypertrophic cardiomyopathy,[8,9] myocardial ischemia,[10] and assist in risk stratification for arrhythmia.[11] Extending this concept into HFpEF represents a clinically relevant progression. Recently, more data from the field have emerged, based on studies of more than 13,000 patients in the Republic of Korea. Hong *et al*, using the HFA-PEFF score > 5 as the gold-standard for the diagnosis, demonstrated that AI-ECG can predict HFpEF with good accuracy (AUC 0.81).[12] Importantly, cardiac death or heart failure hospitalization was higher in patients with positive AI-ECG as compared with negative findings (3.7% vs 0.7%).[12]

These studies also highlight a potential shift toward scalable triage pathways. In primary care, emergency departments, and especially in low-resource settings, echocardiography may be unavailable or delayed. AI-ECG could help identify individuals in whom HFpEF should be suspected earlier, enabling more timely access to confirmatory imaging.

Nevertheless, the results warrant cautious interpretation. Only three studies met the rigorous inclusion criteria, and the heterogeneity among them was substantial ($I^2 > 99\%$). Variations in population characteristics, AI architectures, ECG acquisition, and reference standards limit generalizability. Moreover, HFpEF itself is a heterogeneous syndrome influenced by comorbidities, age, and loading conditions, and it is not clear whether current AI models perform consistently across these diverse subgroups. Studies in patients with atrial fibrillation, for example, are lacking.

Importantly, AI-ECG cannot – and should not – replace clinical examination nor echocardiography. Rather, its role is most compelling as a screening or triage tool. This is particularly relevant given recent findings showing that integrating AI-ECG outputs with clinical variables and image tests can outperform traditional risk algorithms for the diagnosis of acute myocardial infarction.[13] Similar multimodal strategies may emerge for HFpEF, further enhancing diagnostic confidence as shown in Figure 1.

A major gap highlighted by the authors is the absence of cost-effectiveness or clinical outcome data. Before widespread implementation, health systems will need evidence that AI-ECG screening leads to earlier treatment, fewer hospitalizations, or improved survival. Prospective trials, pragmatic studies, and real-world implementation assessments across diverse populations are critical next steps.

Despite limitations, this meta-analysis provides timely and compelling evidence supporting the diagnostic promise of AI-ECG for HFpEF. It reinforces a broader paradigm shift: the ECG is no longer a static tracing but a rich physiologic signal whose interpretive potential expands dramatically when paired with deep learning. If validated through prospective research and integrated thoughtfully into clinical pathways, AI-ECG may become a valuable adjunct in mitigating the diagnostic blind spots of HFpEF and expanding access to early cardiovascular evaluation.

For now, the appropriate stance is one of cautious optimism. AI-ECG is not yet ready to stand alone, but its potential to transform screening, triage, and early detection is undeniable. The authors have contributed an important step toward realizing that future.

Keywords

Heart Failure; Insuficiência Cardíaca Diastólica; Electrocardiography; Artificial Intelligence; Diagnosis

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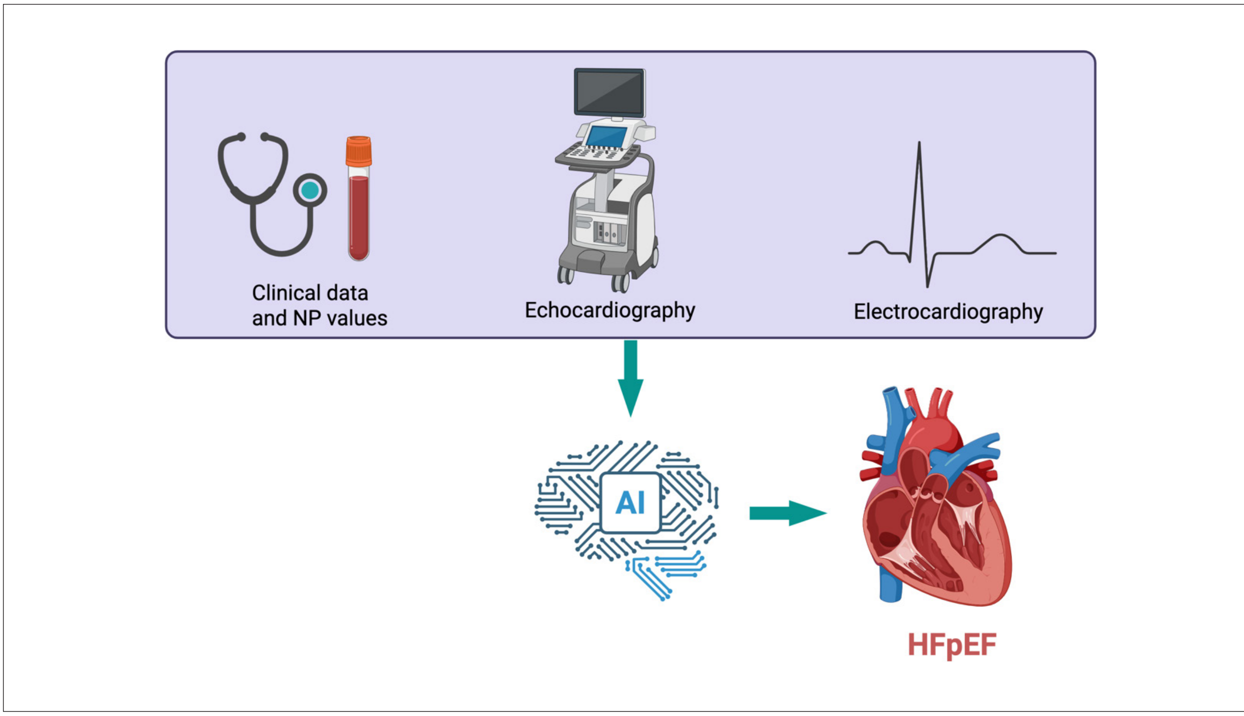

Figure 1 – *Multimodal analysis process, illustrating how an AI model could unify clinical history, image data, and electrocardiography to improve diagnostic accuracy for HFpEF. AI: Artificial Intelligence; HFpEF: Heart Failure with preserved Ejection Fraction; NP: Natriuretic Peptides.*

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