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Cardiac arrhythmias in adults with type 2 diabetes: implications for cardiometabolic and CKM-integrated care

Abstract

Cardiac arrhythmias are prevalent across the cardio kidney metabolic (CKM) spectrum in adults with type 2 diabetes and frequently occur both before and after diabetes onset. Analysis of a national cohort demonstrates onset of major arrhythmias even in patients with CKM Stage 1–2 and later events aligning with progressive metabolic and structural disease. The close temporal proximity between arrhythmia onset and diabetes during the CKM trajectory supports the notion that major arrhythmias are active markers of CKM deterioration. Earlier monitoring, baseline rhythm assessment at diabetes diagnosis, and incorporation of arrhythmic markers into risk stratification may improve detection of vulnerable patients and guide preventive management. Understanding the bidirectional links among metabolic disease, structural remodeling, and arrhythmogenesis is essential for closing gaps in cardiovascular prevention and reshaping care pathways for adults with type 2 diabetes within the CKM continuum.

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Introduction

Type 2 diabetes substantially alters the contemporary cardiovascular risk profile, and cardiac arrhythmias represent an increasingly recognized component of this burden.[1] Metabolic dysregulation contributes to structural remodeling, electro physiologic alterations, and autonomic imbalance, all of which promote arrhythmogenesis.[2] Despite these mechanistic links, arrhythmias are not consistently incorporated into standard frameworks for diabetes-related cardiovascular risk assessment.

This real-world analysis provides quantitative evidence regarding the incidence and timing of arrhythmias in a large U.S. cohort of adults with type 2 diabetes, characterizing their temporal relationship to diabetes onset and subsequent major adverse cardiovascular events. These findings align with and reinforce the emerging cardiometabolic-kidney (CKM) model, including work presented at the American Heart Association Scientific Sessions in New Orleans in 2025,[7] which underscored the importance of integrating rhythm surveillance into CKM stage specific evaluation.

The present paper situates arrhythmias within a broader cardiometabolic construct, highlighting their relevance to early risk identification, longitudinal monitoring, and preventive cardiovascular care.

Overview of the evidence

The study analyzed more than 8.8 million adults with type 2 diabetes in a national dataset of over 300 million U.S. lives.[6] Among them, 1.14 million (13 percent) had documented arrhythmia. Nearly half occurred after diabetes diagnosis, with a median onset of 496 days, while 43 percent occurred before diabetes diagnosis. These findings indicate that arrhythmias develop early in metabolic disease and continue to accumulate as cardiometabolic burden increases. Indeed, a bidirectional risk cycle has been reported in which ischemia, metabolic dysfunction, and arrhythmias reinforce each other.[4]

Arrhythmias in the CKM continuum

The CKM framework presented at the 2025 American Heart Association Scientific Sessions proposes a unified model of risk progression that integrates metabolic, cardiovascular, and renal pathways.[7] The findings from the present analysis are consistent with this conceptual structure and illustrate how arrhythmias may serve as indicators of advancing CKM dysfunction.

Arrhythmias identified before the clinical diagnosis of type 2 diabetes likely represent early CKM Stage 1 or Stage 2 pathophysiology, characterized by insulin resistance, adipose-driven inflammation, autonomic imbalance, and subclinical structural remodeling.[2] In contrast, arrhythmias occurring after diabetes onset appear to track with progression into later CKM stages involving overt metabolic derangement, renal impairment, and structural cardiac disease.[6] In the study cohort, 38 percent of individuals with post-diabetes arrhythmias had at least one major metabolic comorbidity, and more than 20 percent had two or more, reinforcing the close association between arrhythmogenic risk and escalating multisystem metabolic burden.

The temporal patterns observed between arrhythmias and major adverse cardiovascular events further support the CKM model's cyclical and bidirectional risk paradigm^.[8] Atrial fibrillation elevates the risk of ischemic stroke and heart failure, while myocardial ischemia and structural remodeling increase susceptibility to atrial and ventricular arrhythmias.

Clinical implications

Several clinical considerations emerge directly from these findings. First, earlier rhythm surveillance is warranted. Because a proportion of arrhythmias preceded diabetes diagnosis, individuals with metabolic syndrome, obesity, chronic kidney disease, or other CKM risk features should undergo ECG-based or ambulatory rhythm monitoring even in the absence of established hyperglycemia.[1] Detection of early electrical abnormalities should prompt evaluation for latent metabolic dysfunction.[4]

Second, patients newly diagnosed with type 2 diabetes should receive a baseline assessment of cardiac rhythm.[6] The high incidence of arrhythmias within the initial years following diabetes diagnosis suggests a period of heightened susceptibility during which earlier detection may facilitate targeted prevention.

Third, arrhythmia burden should be incorporated into CKM staging algorithms^.[7] Existing cardiovascular risk assessment tools generally exclude arrhythmic parameters, yet accumulating evidence supports the prognostic significance of arrhythmia timing, burden, and phenotype across the cardiometabolic spectrum.[3]

Fourth, long-term rhythm monitoring solutions, including wearable or patch-based ECG technologies, may enable identification of subclinical atrial fibrillation and other rhythm disturbances that confer elevated risks of stroke and MACE.[5] Broader adoption of continuous or intermittent rhythm monitoring may therefore enhance early intervention strategies.

Future directions

Future investigations should seek to clarify the mechanistic pathways by which early metabolic dysfunction predisposes individuals to arrhythmias prior to diabetes onset.[2] The narrow temporal intervals between arrhythmia detection and subsequent MACE events warrant dedicated mechanistic studies examining acute and chronic triggers for electrophysiologic instability. Additionally, predictive models that incorporate arrhythmic biomarkers, such as atrial ectopy burden, heart rate variability, or left atrial functional indices, may refine CKM staging and enable more precise stratification of cardiometabolic risk.[7–9]

Prospective clinical trials are needed to determine whether interventions targeting early arrhythmia detection, rhythm control strategies, anticoagulation, or intensified cardiometabolic management can interrupt the arrhythmia–MACE cycle demonstrated in real-world data.

Conclusion

Cardiac arrhythmias are highly prevalent across the cardiometabolic continuum and occur both before and after the diagnosis of type 2 diabetes.[6] Their strong temporal association with major adverse cardiovascular events highlights the need for earlier identification, more comprehensive risk assessment, and incorporation of rhythm evaluation into CKM-integrated care pathways. Arrhythmias should be considered a central component of cardiometabolic risk rather than a downstream complication.

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None.

Conflicts of interest

The author declares that there are no conflicts of interest.

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