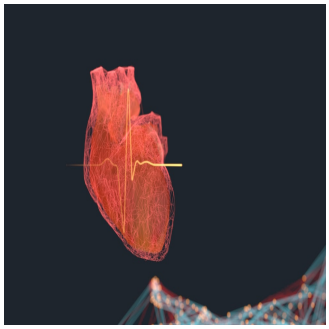
HealthManagement
Promoting Management and Leadership

AI-Driven Detection of Cardiomyopathies in Cardiac POCUS



Cardiomyopathies, such as hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy, are frequently underdiagnosed due to their subtle clinical presentation and the need for advanced imaging for definitive diagnosis. Early detection is crucial, as both conditions are associated with increased morbidity and mortality, yet current diagnostic pathways often fail to identify them in their early stages. Point-of-care ultrasonography (POCUS) is increasingly used in various clinical settings, including emergency departments and primary care, offering a rapid and accessible method for cardiac assessment. However, traditional POCUS studies suffer from significant limitations, including variability in image quality, operator experience and limited acquisition protocols.

Recent advancements in artificial intelligence have enabled automated interpretation of POCUS videos, improving the detection of under-recognised cardiomyopathies. AI-guided POCUS screening has the potential to enhance diagnostic accuracy, reduce disparities in healthcare access and provide early prognostic insights.

AI Integration in POCUS Screening

POCUS is a valuable tool for cardiac imaging, particularly in emergency and resource-limited settings. However, it has traditionally been used to address acute clinical questions rather than for comprehensive diagnostic evaluations. The quality of POCUS imaging varies depending on environmental factors, patient characteristics and operator expertise, making it less reliable for detecting subtle pathologies such as hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy. AI-driven models have been developed to overcome these challenges by applying deep learning algorithms to video-based POCUS studies. These models use convolutional neural networks (CNNs) trained on large datasets, including over 290,000 transthoracic echocardiographic videos, to enhance their ability to recognise abnormal cardiac structures and function. Unlike conventional AI algorithms designed for expert-acquired echocardiograms, these POCUS-specific models are adapted for real-world conditions by incorporating data augmentation techniques that simulate low-quality acquisitions and non-standard imaging views.

By applying AI to POCUS, these models can accurately identify cases of hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy from single-view ultrasound scans. In clinical testing across two large health systems, AI-POCUS demonstrated strong diagnostic performance, with an area under the receiver operating characteristic (AUROC) curve reaching 0.90 for hypertrophic cardiomyopathy and 0.97 for transthyretin amyloid cardiomyopathy. These results suggest that AI-POCUS screening is not only feasible but also highly effective in detecting under-recognised cardiomyopathies in routine clinical practice. Importantly, AI-POCUS does not require highly trained operators, making it a scalable solution for opportunistic screening in diverse healthcare settings.

Early Diagnosis and Prognostic Implications

A major advantage of AI-enhanced POCUS is its ability to detect cardiomyopathies before they are clinically recognised. In a retrospective analysis, AI screening identified cases of hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy at a median of 2.1 and 1.9 years, respectively, before their formal diagnosis via advanced imaging techniques such as cardiac magnetic resonance or nuclear amyloid scans. This early identification window provides an opportunity for timely intervention and closer monitoring, potentially improving patient outcomes by initiating treatment before the disease progresses.

In addition to enabling earlier diagnosis, AI-POCUS also provides valuable prognostic insights. Among individuals without a known diagnosis of cardiomyopathy, those in the highest quintile of AI-derived probabilities for hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy were found to have significantly higher mortality risks—17% and 32% greater, respectively, compared to those in the lowest quintile. These findings suggest that AI-POCUS screening may be detecting subclinical cases of cardiomyopathy that would otherwise remain unrecognised, with important implications for patient management and long-term health outcomes.

Impact on Healthcare Accessibility and Efficiency

AI-driven POCUS screening represents a cost-effective and scalable solution for detecting cardiomyopathies in diverse healthcare environments. Traditional echocardiographic studies require highly trained sonographers and cardiologists, limiting their availability, particularly in resource-constrained settings. In contrast, AI-POCUS can be performed using compact, handheld ultrasound devices, reducing reliance on advanced imaging modalities. This approach has the potential to bridge diagnostic gaps, particularly in underserved populations.

POCUS is already widely used in emergency departments, primary care clinics and community health settings, where it serves as a rapid bedside imaging tool. AI-enhanced POCUS can further improve efficiency by automating image interpretation, reducing diagnostic variability and prioritising high-risk cases for follow-up evaluation. By enabling early detection without the need for specialised imaging expertise, AI-POCUS can help streamline clinical workflows, allowing healthcare providers to focus resources on patients most likely to benefit from further investigation and treatment. Moreover, by identifying cardiomyopathy cases earlier, AI-POCUS screening could reduce healthcare costs associated with delayed diagnoses and complications arising from undetected disease progression.

AI-powered POCUS screening represents a significant advancement in cardiology, offering a practical and scalable approach to detecting hypertrophic cardiomyopathy and transthyretin amyloid cardiomyopathy. By integrating AI-driven interpretation with handheld ultrasound devices, this technology enhances diagnostic precision, facilitates early disease recognition and provides important prognostic insights. Furthermore, AI-POCUS improves healthcare accessibility, particularly in settings where advanced echocardiography is not readily available. Further research should focus on optimising real-time AI integration in clinical practice, ensuring that this innovative approach is seamlessly adopted to improve patient care and outcomes.

Source: **The Lancet**

Image Credit: **iStock**

Published on : Tue, 18 Feb 2025