Recent Advances in Coronary Artery Disease Detection, Risk Assessment: Integrating with Artificial Intelligence: Review Article

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Abstract: There is a growing global occurrence of diabetes mellitus with dyslipidemia along with hypertension, and other cardiometabolic disorders, coronary artery disease (CAD) ruins the major cause of disease and death in current society despite inventions in imaging technology, pharmacological medicine, and interventional cardiology. Recently, advancements in Artificial Intelligence (AI) technology, such as Machine Learning (ML) and Deep Learning (DL) algorithms, have noticeably enhanced CAD diagnostic accuracy, risk assessment, and preventive decisions. The present article aims to comprehensively summaries an AI-driven system that influences two corresponding sources of information: Electrocardiography (ECG) images and patient biometric data, including age, gender, Blood Pressure (BP), and heart rate. Combining these methods provides a more complete and accurate prediction model for CAD detection. The study focuses on AI-powered ECG analysis algorithms as well as machine learning algorithms for CAD predictive models. Methods used in AI, including algorithmic paradigms implemented with algorithms and validation techniques, will be discussed in details in this paper. This article explains the AI advances in diagnosing CAD

Keywords: Coronary Artery Disease (CAD), Artificial Intelligence (AI), Cardiovascular Imaging, Machine Learning, Deep Learning

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Introduction

Coronary artery disease is a long-term and progressive disease that happens when atherosclerotic plaque builds up in the arteries. The plaque can cause ischemia. This can lead to major adverse cardiovascular events. Doctors use clinical scoring systems, stress testing, angiography and imaging methods to diagnose and assess artery disease. Doctors also use these methods to sort patients into risk groups. It is observed that the above methods help patients with artery disease do better. These testing methods have improved outcomes. However, it is observed that these measures have limitations due to observer variability. Hence, inter-observer variability enables ways to identify problems at an early stage. Inter-observer variability also prevents the measures from including clinical data.

It is noticed that AI in cardiology has become more common because it helps remove limits by using pattern spotting, prediction tools and the combination of data types. It is also seen that AI techniques help doctors find CAD in early patients by risk check, along with how weak the plaque is, and plan prevention steps. I wrote this review to look at cardiology, medical imaging and computer intelligence studies. I also show progress in both AI approaches for treating CAD

Related work

Over the last two decades, there has been an intense investigation for improvements in CAD detection, risk stratification, and prevention from both medical and computational standpoints. More recent articles, on the other hand, emphasized the analytical interest of non-invasive imaging modalities, mainly Customer Acquisition Cost (CAC) scoring and Cardiac Computed Tomography Angiography (CCTA), and demonstrated how these tools could deliver better estimations of atherosclerotic burden and plaque features [1,3,5]. Reviews and consensus statements indicated that traditional population-based risk scores often underestimate true risk, and serve as an impetus to incorporate.

Table 1. Systematic Literature Review Table

Sr. No	Study Type	Population / Dataset	Modality / Data Source	Methodology	Outcomes / Findings	Limitations
[1]	Narrative review	General CAD population	CT coronary calcium imaging	Clinical synthesis	Reinforced CAC as robust predictor for ASCVD risk stratification	Lack of pooled quantitative analysis
[2]	Narrative review	Patients at ASCVD risk	Clinical & lipid profiles	Guideline-based review	Advocated earlier and more ntensive preventive strategies	No primary data analysis
[3]	Randomized clinical trial	Familial CAD patients	CAC score, plaque imaging	CAC-guided intervention	Reduced plaque progression with CAC-informed therapy	Limited to Familial CAD cohort
[4]	Multicenter RCT	Patients with vulnerable plaques	Angiography, IVUS	Preventive PCI vs OMT	Preventive PCI lowered future adverse events	Invasive approach; selected population
[5]	Systematic review & meta-analysis	Atherosclerotic CAD patients	CCTA plaque imaging	Quantitative synthesis	Identified plaque features predictive of MACE	Imaging heterogeneity across studies
[6]	Clinical review	Cancer survivors	CT, angiography	Descriptive analysis	Highlighted diagnostic complexity of radiation-induced CAD	Limited longitudinal evidence

Result and Discussion

This As per the available dataset, the charts compare the age distribution of people with CVD and without CVD, Systolic Blood Pressure vs cardiovascular disease, and Cholesterol Levels vs cardiovascular disease.

All these charts put together show that older age, higher blood pressure, and elevated cholesterol are all associated with cardiovascular disease.

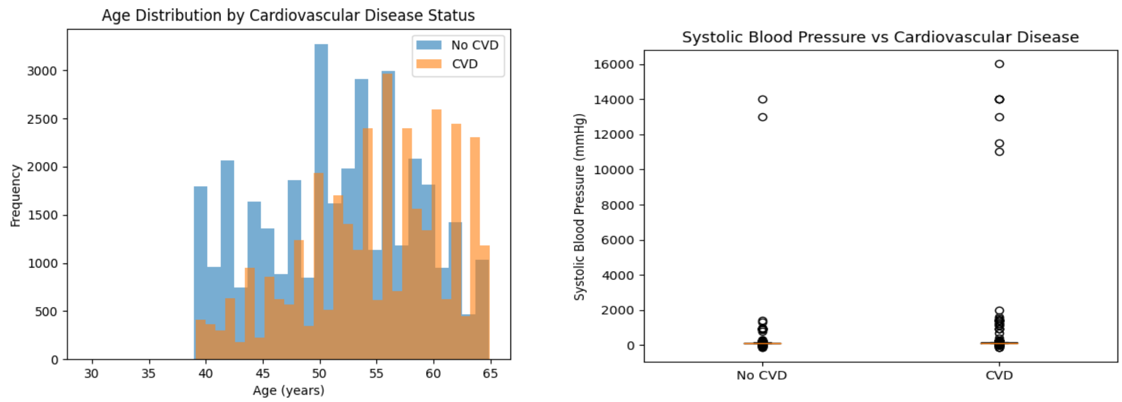

Figure 1. the age distribution of people with CVD and without CVD, Systolic Blood Pressure vs CVD

Despite promising results, there are multiple factors that prevent extensive clinical translation of AI algorithms in CAD management. These factors include data heterogeneity, limited external validation, algorithmic bias, unclear interpretability of results, and regulatory and ethical issues due to aspects of data privacy. Integration into clinical workflow and clinician education remains a crucial obstacle. The proposed research addresses the abovementioned problem by proposing an advanced, AI-driven system that leverages two complementary sources of information: ECG images and patient biometric data comprising gender, BP, age and heart rate. Merging these modalities provides a more comprehensive and accurate prediction model for CAD detection.

Conclusions

Recent advances in CAD detection, along with risk assessment and prevention, highlight the synergistic potential of integrating clinical approaches with artificial intelligence. AI-enhanced diagnostics and predictive models offer improved accuracy, efficiency, and personalization across the CAD care continuum. While challenges remain, ongoing research and technological innovation position AI as a key enabler of patient-center, precision cardiovascular medicine.

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