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Artificial Intelligence Enhanced Electrocardiography to Detect Occlusion Myocardial Infarction in Acute Coronary Syndrome

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Abstract

Coronary angiogram and subsequent percutaneous coronary intervention are critical in the management of acute coronary occlusions. The emerging paradigm distinguishing occlusion myocardial infarction from non-occlusion myocardial infarction will enhance diagnostic accuracy and prognostic effect in the management of acute coronary syndrome. Artificial intelligence enhanced electrocardiography can recognize subtle, acute coronary occlusions which are often missed by the traditional criteria. This can lead to timely cath lab activation, enhanced myocardial salvage and better prognosis for patients with myocardial infarction.

Key words: Acute coronary syndrome, Occlusion myocardial infarction, Artificial intelligence, Electrocardiography.

Introduction

Acute coronary syndrome (ACS) includes ST elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI) and unstable angina. Coronary angiogram and subsequent percutaneous coronary intervention are very important in the management of acute coronary occlusions. The STEMI criteria are electrocardiographic features which are used to triage patients to catheterization laboratories. Patients who do not fulfill STEMI criteria are triaged as NSTEMIs. The NSTEMIs are managed with delayed coronary reperfusion strategies. But a significant proportion of patients with NSTEMI ACS are found to have acute occlusion of coronary vessels and they need urgent reperfusion [1]. Adherence to STEMI/NSTEMI-based management algorithms will delay reperfusion in these individuals, leading to increased morbidity and mortality.

The limitations in the STEMI/NSTEMI framework underscore the necessity for a revised approach to ACS management. The emerging paradigm distinguishing occlusion myocardial infarction (OMI) from non-occlusion myocardial infarction (NOMI) will enhance diagnostic accuracy and prognostic effect in the management of ACS. This can lead to earlier detection of acute coronary occlusion, timely cath lab activation and enhanced myocardial salvage [2].

The OMI paradigm shift uses clinical features, electrocardiogram (ECG), Point-of-Care Ultrasound findings and judicious use of troponin to find out patients in need of emergent reperfusion. OMI

ECG signs have high specificity and can be learned by artificial intelligence (AI) [3]. The OMI-NOMI paradigm offers greater prognostic precision for patients with chest pain who require emergent angiography, compared to the traditional STEMI-NSTEMI framework [4].

Artificial Intelligence Enhanced Electrocardiography in OMI

The 12-lead electrocardiogram is the common diagnostic test for ischemic heart disease. The interpretation of ECG is limited by human variability. Conventional ECG interpretation often fails to detect subtle ischemic changes. This highlights the necessity for artificial intelligence-driven approaches. Through machine learning and artificial intelligence algorithms, ECG analysis can be made more efficient. AI enhanced ECG algorithms will detect myocardial infarction with high accuracy and door-to-balloon coronary intervention time can be reduced in ischemic heart disease [5]. Integrating AI in prehospital ECG interpretation improves the identification of patients at low risk for having NSTEMI [6].

Artificial intelligence has transformed the management of ACS by shifting the diagnostic focus to the OMI versus NOMI paradigm. AI enhanced electrocardiography can recognize subtle, acute coronary occlusions which are often missed by the STEMI versus NSTEMI traditional criteria. AI enhanced ECG enable earlier detection and precision-guided interventions in occlusion myocardial infarction. Convolutional neural network (CNN) and integrated neural network (INN)-enhanced ECGs demonstrated superior performance in detecting acute coronary syndrome with subtle ischemic ECG changes [7]. While evaluating the performance of AI device in assessing angiographic occlusion myocardial infarction and predicting clinical outcomes, it was found that the AI model demonstrated higher sensitivity compared with traditional STEMI criteria, improving OMI detection [8].

AI models learn from large datasets and can identify complex relationships that may not be obvious to human interpreters. Deep learning techniques have improved the OMI diagnosis by identifying subtle ECG patterns invisible to the human eye. AI-enhanced ECG technology holds high potential for reshaping cardiovascular diagnostics [9]. In high-risk NSTEMI, AI-ECG model help to accurately diagnose OMI, enhancing early identification of patients who require urgent invasive coronary angiography [10]. AI tools which identify OMI earlier than standard ECG interpretation can expedite intervention and shorten reperfusion times.

DIFOCULT-3 Trial (Time for a Diagnostic paradigm shift from ST-elevation/non-ST-elevation to Occlusion/non-occlusion myocardial infarction) [11] design published in JACC: Advances in October 2025 is evaluating this aspect. DIFOCULT-3 is a multicenter, modified cluster-randomized, open-label study designed to compare the OMI/NOMI paradigm with the STEMI/NSTEMI approach in 6,000 participants presenting with suspected myocardial infarction. Study enrollment and follow-up are ongoing. Acute outcomes will be reported after enrolment and late outcomes including mortality and rehospitalization will be published after completion of one year follow-up.

Conclusion

AI-enhanced electrocardiography has enormous potential to improve the management of cardiovascular disorders. Integrating Artificial Intelligence with electrocardiograms represents a transformative shift in the management of ACS. The occlusion myocardial infarction paradigm is based on the presence or absence of acute coronary occlusion in the patient rather than ST elevation on ECG. The OMI paradigm shift harnesses advanced ECG interpretation augmented by artificial intelligence. Artificial intelligence augmentation of ECG assessment has significant role in improving the patient outcomes in acute coronary syndrome. AI has shown promise in detecting subtle ECG changes indicative of OMI, improving diagnostic accuracy. Transitioning to the OMI paradigm and emphasizing the identification of acute coronary occlusion through AI-enhanced

electrocardiography will significantly improve patient outcomes by reducing delays in reperfusion therapy.

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