ACUTE MYOCARDIAL INFARCTION WITH CORONARY OCCLUSION WITHOUT ST-SEGMENT ELEVATION: A SYSTEMATIC LITERATURE REVIEW

INFARTO AGUDO DO MIOCÁRDIO COM OCLUSÃO CORONARIANA SEM SUPRADESNIVELAMENTO DE SEGMENTO ST: UMA REVISÃO DE LITERATURA SISTEMÁTICA

INFARTO AGUDO DE MIOCARDIO CON OCLUSIÓN CORONARIA SIN ELEVACIÓN DEL SEGMENTO ST: UNA REVISIÓN SISTEMÁTICA DE LA LITERATURA

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ABSTRACT

The current paradigm for Acute Myocardial Infarction (AMI), based on the STEMI/NSTEMI dichotomy, fails to identify approximately 30% of acute coronary occlusions (ACO) that do not present with millimeter ST-segment elevation. Objective: To analyze the literature on Myocardial Occlusion (ACO) without ST-segment elevation, comparing its morbidity and mortality and diagnostic criteria with the traditional model. Methodology: Systematic literature review following the PRISMA protocol in the PubMed and SciELO databases (2015-2026), using the terms "Occlusion Myocardial Infarction", "NSTEMI" and "STEMI equivalents". Results: Studies were included that demonstrate that STEMI criteria have a sensitivity of only 43% to 62% for detecting acute occlusion. Patients with non-ST-segment elevation myocardial infarction (NSTEMI-negative) suffer significant delays in catheterization (median > 400 min vs. 41 min in STEMI) and have a 30-day mortality rate of 7.29%, statistically higher than patients without occlusion. New electrocardiographic patterns (Aslanger, De Winter, Precordial Whirlpool) and artificial intelligence show superior accuracy. Conclusion: The transition to the NSTEMI/NOSTEMI paradigm is urgent to mitigate the undertreatment of critically ill patients erroneously classified as low risk.

Keywords: Myocardial Infarction. Coronary Occlusion. Non-ST-Segment Elevation Myocardial Infarction. Electrocardiography.

RESUMO

O paradigma atual de Infarto Agudo do Miocárdio (IAM), baseado na dicotomia STEMI/NSTEMI, falha em identificar cerca de 30% das oclusões coronarianas agudas (OCA) que não apresentam supradesnivelamento milimétrico do segmento ST. Objetivo: Analisar a literatura sobre o Infarto com Oclusão Miocárdica (OCA) sem

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supradesnivelamento do segmento ST, comparando sua morbimortalidade e critérios diagnósticos com o modelo tradicional. Metodologia: Revisão sistemática da literatura seguindo protocolo PRISMA nas bases PubMed e SciELO (2015-2026), utilizando os termos "Occlusion Myocardial Infarction", "NSTEMI" e "STEMI equivalents". Resultados: Foram incluídos estudos que demonstram que critérios de STEMI têm sensibilidade de apenas 43% a 62% para detectar oclusão aguda. Pacientes com OCA sem supra (OMI STEMI-negativo) sofrem atrasos significativos no cateterismo (mediana > 400 min vs. 41 min no STEMI) e apresentam mortalidade em 30 dias de 7,29%, estatisticamente superior aos pacientes sem oclusão. Novos padrões eletrocardiográficos (Aslanger, De Winter, Redemoinho Precordial) e inteligência artificial apresentam acurácia superior. Conclusão: A transição para o paradigma OCA/NOCA é urgente para mitigar o subtratamento de pacientes graves erroneamente classificados como baixo risco.

Palavras-chave: Infarto do Miocárdio. Oclusão Coronariana. Infarto do Miocárdio Sem Supradesnível do Segmento ST. Eletrocardiografia.

RESUMEN

El paradigma actual para el Infarto Agudo de Miocardio (IAM), basado en la dicotomía STEMI/NSTEMI, no logra identificar aproximadamente el 30% de las oclusiones coronarias agudas (OCA) que no presentan elevación del segmento ST de milímetros. Objetivo: Analizar la literatura sobre Oclusión Miocárdica (OCA) sin elevación del segmento ST, comparando su morbilidad y mortalidad y criterios diagnósticos con el modelo tradicional. Metodología: Revisión sistemática de la literatura siguiendo el protocolo PRISMA en las bases de datos PubMed y SciELO (2015-2026), utilizando los términos "Oclusión Miocárdica Infarto", "NSTEMI" y "equivalentes de STEMI". Resultados: Se incluyeron estudios que demuestran que los criterios STEMI tienen una sensibilidad de solo 43% a 62% para detectar oclusión aguda. Los pacientes con infarto de miocardio sin elevación del segmento ST (NSTEMI negativo) sufren retrasos significativos en la cateterización (mediana > 400 min frente a 41 min en STEMI) y presentan una tasa de mortalidad a 30 días del 7,29 %, estadísticamente superior a la de los pacientes sin oclusión. Los nuevos patrones electrocardiográficos (Aslanger, De Winter, Remolino Precordial) y la inteligencia artificial demuestran una mayor precisión. Conclusión: La transición al paradigma NSTEMI/NOSTEMI es urgente para mitigar el infratratamiento de pacientes críticos clasificados erróneamente como de bajo riesgo.

Palabras clave: Infarto de Miocardio. Oclusión Coronaria. Infarto de Miocardio Sin Elevación del Segmento ST. Electrocardiografía.

1 INTRODUCTION

Cardiovascular diseases (CVD) have consolidated themselves as the main cause of global mortality in the twenty-first century, representing a significant epidemiological transition. While at the beginning of the twentieth century deaths from infectious diseases and malnutrition predominated, today chronic non-communicable diseases, particularly CVD, account for the largest share of deaths. According to the 2021 Global Burden of Disease (GBD), CVD was responsible for 19.4 million deaths, with ischemic heart disease as the main cause in individuals over 50 years of age. This scenario is especially critical in low-income countries, where limited access to appropriate treatments and the high prevalence of uncontrolled risk factors, such as hypertension and diabetes, result in high mortality rates (IHME, 2021; Bonow et al., 2012).

In Brazil, CVD is a serious public health problem, accounting for approximately 28% of deaths in people over 30 years of age (Bonow et al., 2012). Within this context, acute coronary syndrome (ACS) stands out as one of the most serious manifestations, with more than 100 thousand deaths annually related to ischemic heart disease, equivalent to 43% of CVD deaths in the country (Nascimento et al., 2025).

However, Alencar et al. (2024) describe an additional critical condition: acute coronary occlusion (OCA), characterized by total or near-total blockage of a coronary artery, which can lead to significant myocardial ischemia and infarction, even in the absence of ST-segment elevation on the ECG. It is estimated that 30% to 50% of OCA cases do not present ST elevation, and are often underdiagnosed. Patients with non-ST OCA have mortality and infarction extent comparable to those of STEMI, highlighting the need to identify alternative electrocardiographic signs early, such as hyperacute T waves, "De Winter" pattern, and ST-specific depressions (Alencar et al., 2024).

By defining the disease exclusively by an imprecise aspect (the elevation of the ST segment on the ECG), it ends up neglecting the true pathophysiology of OCA. This creates the so-called "no false negative" paradox: when a patient has OCA but does not have ST elevation, they are not classified as STEMI and therefore are not considered a false negative for STEMI. This gap in the literature ends up hindering clinical decision-making, as physicians are forced to use criteria that may not be the most appropriate to address Acute Coronary Syndrome (Alencar et al., 2024).

However, this study aims to review the scientific literature on AMI with non-ST-segment elevation coronary occlusion, with emphasis on its clinical characteristics, diagnostic methods, therapeutic strategies, and prognostic implications.

2 THEORETICAL FRAMEWORK

According to Rao et al. (2025), acute coronary syndromes occur due to the rupture or erosion of an unstable atherosclerotic plaque, leading to the formation of thrombi and microemboli that reduce blood flow to the myocardium, resulting in ischemia. These syndromes encompass three clinical conditions of progressive severity: unstable angina (UA), non-ST-elevation acute myocardial infarction (NSTEMI), and ST-elevation acute myocardial infarction (STEMI). The diagnosis and classification of these conditions are based on the patient's clinical history, symptoms, ECG analysis, and measurement of cardiac biomarkers, such as cardiac troponins I and T.

While unstable angina is characterized by transient episodes of myocardial ischemia without significant necrosis, acute myocardial infarction involves prolonged and intense ischemia, with elevated biomarkers. In NSTEMI, arterial obstruction is partial, causing subendocardial ischemia, while in STEMI there is complete coronary occlusion, resulting in extensive transmural ischemia (Rao et al., 2025).

The approach proposed by the OCA-NOCA paradigm emphasizes the urgency of reperfusion (catheterization or thrombolysis) in all cases of OCA, regardless of ECG, aiming to reduce irreversible myocardial damage and improve clinical outcomes. This perspective challenges current guidelines and reinforces the importance of integrating anatomical and physiological criteria in the diagnosis of AMI (Alencar et al., 2024).

Despite the widespread use of ECG as an initial diagnostic tool in ACS, its sensitivity to identify non-ST-elevation OCA remains limited. Research has shown that about 30% to 50% of patients with angiographically confirmed OCA do not meet the classic criteria for STEMI, being erroneously classified as NSTEMI. Meta-analyses reveal that the sensitivity of ST-segment elevation for detecting OCA is only 43.6%, whereas other electrocardiographic markers, such as hyperacute T waves, are more accurate. Such findings reinforce the need for a more comprehensive diagnostic approach, incorporating not only ECG but also ultrasensitive biomarkers and imaging methods, in order to reduce underdiagnosis and improve the prognosis of these patients (Alencar et al., 2024).

The electrophysiological rationale for the failure of the STEMI (ST-Segment Elevation Myocardial Infarction) paradigm lies in the vector physics and spatial limitation of the conventional 12-lead electrocardiogram. As discussed in the manifesto, ST-segment elevation is a result of the direction of the injury current in relation to the electrodes; If the occlusion vector points to regions of the myocardium not directly covered by the standard leads, the phenomenon may not be registered as a classic "supra". This concept explains why acute occlusions, which pathophysiologically represent the same risk, are often

neglected when they do not produce vector changes that reach the arbitrary millimetric thresholds of the guidelines (Meyers; Weingart; Smith, 2018).

A critical example of this limitation occurs in circumflex artery occlusions, which are responsible for supplying the low and posterior lateral wall of the left ventricle. The article emphasizes that such events are commonly "muted" on standard ECG, as the resulting injury vectors target areas where there are no corresponding leads on the anterior thoracic surface. By misclassifying these cases as NSTEMI (Non-ST-Segment Elevation Myocardial Infarction), the current model ignores the anatomical reality of a total arterial obstruction, delaying emergency reperfusion therapy for patients who have subtle or isolated electrocardiographic evidence of coronary occlusion (Meyers; Weingart; Smith, 2018).

According to Meyers, Weingart and Smith (2018), the traditional classification of infarctions, based on the distinction between STEMI and NSTEMI, is pointed out as an insufficient and conceptually flawed nomenclature, as it prioritizes millimetric electrocardiographic criteria to the detriment of the pathophysiology of acute coronary occlusion. According to the manifesto that proposes the new paradigm, the term "STEMI" constitutes an error that limits clinical progress, since it fails to identify about 25% to 30% of patients with total arterial obstruction who do not have classic elevation. Instead, the authors advocate the transition to the OCA/NOCA model (Occlusion Infarction vs. Infarction without Occlusion), whose objective is to redirect the focus of the diagnosis to the presence of mechanical occlusion that requires immediate reperfusion, regardless of whether the electrocardiogram tracing complies with the current formal definitions.

Reinforcing this need for transition, a retrospective study by Meyers et al. (2021) demonstrated that patients with acute coronary occlusion who do not meet the criteria for STEMI (hollow STEMI) have areas of infarction and mortality rates equivalent to those with evident ST elevation. However, the study showed that this group suffers significant diagnostic delays, with a median time for catheterization more than twice that recorded in STEMI patients(+). These findings suggest that the use of more accurate electrocardiographic findings for OCA would allow the rapid and noninvasive identification of these patients, enabling emergency reperfusion and mitigating myocardial damage that is currently neglected by the conventional protocol.

De Winter et al. (2008) described a distinct electrocardiographic pattern, observed in about 2% of cases of previous infarction, characterized by a ST-segment depression of 1 to 3 mm at point J with an upward slope in the precordial leads (V1 to V6). This morphology progresses to high, symmetrical, positive T waves, often accompanied by a slight elevation of the ST segment in the aVR lead. Unlike transient hyperacute T waves, this signal

manifests statically and is associated with total vessel occlusion, implying a risk of significant myocardial loss and the need for immediate reperfusion therapy.

Hyperacute T waves are often the first electrocardiographic sign of an acute coronary occlusion (OCA), appearing even before ST-segment elevation. According to Ricci et al. (2025), these waves are not defined only by their amplitude, but mainly by being wide, broad-based, "bulky" and symmetrical in relation to the preceding QRS complex. Their identification is critical, as they represent a very early phase of infarction, and are now formally recognized as an equivalent of STEMI that requires immediate reperfusion, since the relationship between T wave amplitude and QRS is a more sensitive marker than the isolated height of the wave.

The diagnosis of left ventricular posterior wall infarction is often overlooked in the standard 12-lead electrocardiogram due to the absence of leads on the dorsal chest wall. As explained by Ayyad et al. (2025), the occlusion affecting this region is manifested through a mirror image in the anterior precordial leads (V1 to V4), characterized by horizontal depression of the ST segment, prominent and positive T waves, and wide R waves. Ricci et al. (2025) corroborate that any ST-segment depression, even if less than 1 mm, when maximum in leads V1 to V4, has a specificity of 97% for the diagnosis of OCA, and should be treated with the same urgency as a classic elevation.

The Aslanger pattern describes a specific presentation of lower myocardial occlusion in patients with multivessel coronary artery disease. According to Ricci et al. (2025), this pattern is identified by an isolated ST-segment elevation in lead DIII (lead III), associated with a diffuse depression in leads V4 to V6, but with the ST-segment in V1 greater than in V2. Although it does not meet the traditional criteria for STEMI, which require elevation in two contiguous leads, this finding indicates an acute occlusion of the right circumflex or coronary artery with concomitant subendocardial ischemia, representing a high-risk condition.

The presence of Left Bundle Branch Block (LBB) or pacemaker rhythm traditionally makes it difficult to diagnose acute infarction due to changes in ventricular repolarization. However, Ricci et al. (2025) highlight that the Sgarbossa Criteria Modified by Smith overcome this limitation by introducing the concept of proportionality. The modification replaces the absolute criterion of 5 mm of discordance with a ratio between ST-segment elevation and S-wave (ST/S ratio) less than or equal to -0.25 (or 25%). This change significantly increased the sensitivity for detecting acute coronary occlusion in patients with LBB, allowing for early interventions that the original criteria failed to indicate.

Distinguishing between benign early repolarization and a subtle anterior descending artery (ADA) occlusion is a common challenge in the emergency room. According to Ricci et al. (2025), the presence of "QRS Terminal Distortion", defined by the absence of both the S wave and the notch at the J point in leads V2 or V3, is a highly specific marker of ADA occlusion. The presence of this sign indicates that the elevation, even if subtle and does not meet the traditional millimetric criteria, is of malignant ischemic origin and not a benign variant.

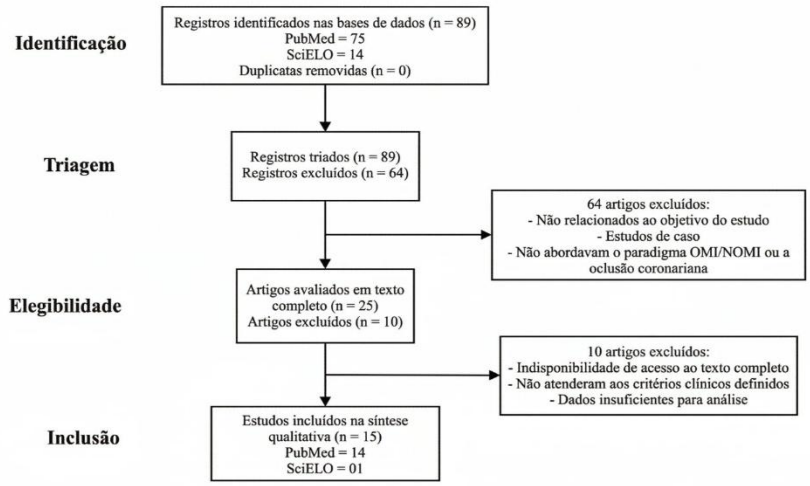
There are specific patterns that point to occlusions of important arterial branches that do not generate the classic pattern of STEMI. Ayyad et al. (2025) describe the "South African Flag Sign" as an indicator of occlusion of the first diagonal branch of the anterior descending artery, manifesting by elevation in leads D1, aVL, and V2, combined with depression in D3. Additionally, Batubara et al. (2025) and Ricci et al. (2025) cite the "Precordial Swirl Sign" (Precordial Swirl), characterized by elevation or hyperacute T waves in leads V1 and V2 with reciprocal depression in V5 and V6, indicating a proximal occlusion of the anterior descending artery that requires immediate catheterization.

3 METHODOLOGY

For this study, a systematic review of the literature was carried out based on the PRISMA protocol (Figure 1) (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*), aiming to analyze the transition from the traditional paradigm to the Myocardial Occlusion Infarction (OCA) model in patients initially classified as NSTEMI.

Figure 1

Prism flowchart



Source: Authors, 2026.

3.1 DEFINITION OF THE SURVEY QUESTION (PEAK)

The guiding question was structured through the PICO strategy: Patients with non-ST-segment ACS; Identification of signs of acute occlusion (STEMI equivalents); Comparison with the traditional millimetric criterion; Occlusion confirmed by coronary angiography.

3.2 SEARCH STRATEGY AND DATABASES

The search was conducted in the PubMed and SciELO databases, using controlled descriptors (MeSH and DeCS) and Boolean operators to maximize the sensitivity of the search:

("Acute Myocardial Infarction" OR "Acute Coronary Syndrome") AND ("NSTEMI" OR "Non-ST Elevation Myocardial Infarction" OR "OMI" OR "Occlusion Myocardial Infarction") AND ("Coronary Occlusion" OR "Total Occlusion" OR "ECG" OR "Electrocardiography" OR "Troponin" OR "Sgarbossa" OR "De Winter") ("Myocardial Infarction" OR "Acute Coronary Syndrome") AND ("Non-ST Elevation" OR "NSTEMI" OR "Coronary Occlusion").

3.3 INCLUSION AND EXCLUSION CRITERIA

Articles published between 2015 and 2026, in English, Portuguese, or Spanish, that address clinical characteristics, diagnostic methods, therapeutic strategies, and prognostic implications of NSTEMI, were selected. Articles that do not present clear information on the topic or that are limited to case studies will be excluded.

3.4 DATA ANALYSIS AND SYNTHESIS

The identified studies underwent a two-stage screening (title/abstract and full text). The methodological quality of the selected studies was evaluated according to the guidelines of Evidence-Based Medicine. The extracted data were synthesized in comparative tables, highlighting the sensitivity of the new diagnostic criteria in relation to the old paradigm.

4 RESULTS

The search resulted in 89 studies identified, 75 in the PubMed database and 14 in SciELO. No duplicates were found. After screening by title and abstract, 64 studies were excluded because they did not meet the inclusion criteria. Thus, 25 articles were selected for full reading, of which 10 were excluded due to unavailability of access to the full text or for not meeting the established clinical criteria. In the end, 15 studies were included in the review.

Table 1

Autoria e Ano	Revista / Base de Dados / DOI	Título do Artigo	Objetivo Central	Métodos
Kos et al. (2026)	World J Cardiol / PubMed / 10.4330/wjc.v18.i1.111736	Impact of total occlusion of the infarct-related coronary artery on mortality of 2483 patients...	Avaliar o impacto da oclusão total da artéria coronária na mortalidade de pacientes com IAM, independentemente do supra de ST.	Estudo de coorte prospectivo com 2.483 pacientes com IAM, comparando desfechos entre artérias ocluídas e não ocluídas.
Meyers et al. (2025)	Eur Heart J Acute Cardiovasc Care / PubMed / [DOI no texto]	Failure of standard contemporary STEMI ECG criteria to reliably identify acute occlusion of the LAD...	Avaliar a sensibilidade dos critérios padrões de STEMI para detectar oclusão aguda da artéria descendente anterior (ADA).	Estudo de caso-controle retrospectivo comparando critérios de STEMI versus achados de OMI em pacientes com oclusão da ADA confirmada.
Ricci et al. (2025)	Ann Emerg Med / PubMed / 10.1016/j.annemergmed.2024	ECG Patterns of Occlusion Myocardial Infarction: A Narrative Review	Descrever e revisar os padrões eletrocardiográficos sutis que indicam Oclusão Coronariana Aguda (OMI) sem critérios de STEMI.	Revisão narrativa da literatura focada em padrões de ECG (De Winter, Aslanger, Ondas T hiperagudas, etc.).
Ayyad et al. (2025)	Curr Cardiol Rep / PubMed / [DOI no texto]	Reevaluating STEMI: The Utility of the Occlusive Myocardial Infarction Classification...	Discutir a utilidade e a necessidade da transição da classificação STEMI/NSTEMI para o paradigma OMI/NOMI.	Revisão da literatura abordando limitações do modelo atual e benefícios da nova classificação baseada na oclusão.
Batubara et al. (2025)	Egypt Heart J / PubMed / 10.1186/s43044-025-00688-2	A case series of OMI: time for revisiting STEMI/NSTEMI ECG criteria	Demonstrar através de casos clínicos a falha dos critérios STEMI e a eficácia dos sinais de OMI.	Série de casos clínicos ilustrando padrões de ECG de OMI (Aslanger, Sgarbossa, etc.) e revisão da literatura.
Frick et al. (2025)	Adv Interv Cardiol / PubMed / [DOI no texto]	Occlusion myocardial infarction: a revolution in acute coronary syndrome	Analisar a mudança de paradigma em curso na classificação das síndromes coronarianas agudas.	Editorial / Artigo de opinião baseado em evidências recentes sobre o conceito de OMI.

Alencar et al. (2024)	Arq Bras Cardiol / SciELO / 10.36660/abc.20230733	Além do Paradigma IAMCSST-IAMSSST: Proposta do Instituto Dante Pazzanese para o Diagnóstico de OCA	Propor a adoção do modelo "Oclusão Coronariana Aguda (OCA)" em substituição à dicotomia baseada apenas no supra de ST.	Artigo de Revisão e Posicionamento Institucional analisando evidências e propondo novo fluxograma de atendimento.
Kola et al. (2024)	J Clin Med / PubMed / 10.3390/jcm13175201	OMI/NOMI: Time for a New Classification of Acute Myocardial Infarction	Avaliar a necessidade de reclassificação do IAM baseada na oclusão e não apenas na elevação do segmento ST.	Revisão abrangente da literatura discutindo a fisiopatologia e as falhas dos critérios atuais.
Bae et al. (2023)	JACC Cardiovasc Interv / PubMed / 10.1016/j.jcin.2022.09.027	Early Invasive Strategy Based on the Time of Symptom Onset of Non-ST-Segment Elevation MI	Investigar o impacto da estratégia invasiva precoce baseada no tempo do início dos sintomas em NSTEMI.	Estudo de coorte prospectivo multicêntrico (KAMIR-NIH) analisando mortalidade e tempo de intervenção.
Tsai et al. (2022)	Dis Markers / PubMed / [DOI no texto]	Troponin I Cutoff for Non-ST-Segment Elevation	Determinar o ponto de corte ideal de Troponina I para diagnóstico e risco em NSTEMI.	Análise retrospectiva de dados laboratoriais e desfechos clínicos.
Meyers et al. (2021)	J Emerg Med / PubMed / 10.1016/j.jemermed.2020.10.026	Comparison of the STEMI vs. NSTEMI and Occlusion MI (OMI) vs. NOMI paradigms of acute MI	Comparar a precisão diagnóstica e tempos de tratamento entre os paradigmas STEMI/NSTEMI e OMI/NOMI.	Estudo retrospectivo comparativo analisando tempos de cateterismo e desfechos em coorte de IAM.
Meyers et al. (2021)	IJC Heart & Vasc / PubMed / 10.1016/j.ijcha.2021.100767	Accuracy of OMI ECG findings versus STEMI criteria for diagnosis of acute coronary occlusion MI	Testar a acurácia dos achados de ECG de OMI versus critérios milimétricos de STEMI para diagnosticar oclusão.	Estudo caso-controle retrospectivo (DOMI ARIGATO) comparando interpretação de ECG por especialistas e critérios padrões.

Baro et al. (2019)	Clin Cardiol / PubMed / 10.1002/clc.23130	High-sensitivity cardiac troponin T as a predictor of acute Total occlusion in patients with NSTE-ACS	Avaliar a Troponina T de alta sensibilidade como preditor de oclusão total em pacientes com NSTEMI.	Estudo observacional transversal analisando níveis de troponina e achados angiográficos.
Khan et al. (2017)	Eur Heart J / PubMed / 10.1093/eurheartj/ehx418	Impact of total occlusion of culprit artery in acute non-ST elevation myocardial infarction	Determinar o impacto prognóstico da oclusão total da artéria culpada em pacientes diagnosticados como NSTEMI.	Revisão sistemática e meta-análise de estudos observacionais comparando NSTEMI com e sem oclusão total.
de Winter et al. (2008)	N Engl J Med / PubMed / [DOI no texto]	A New ECG Sign of Proximal LAD Occlusion	Descrever um novo padrão de ECG associado à oclusão da artéria descendente anterior proximal sem supra de ST.	Estudo observacional retrospectivo de ECGs e angiografias identificando o padrão "De Winter".

Source: Authors, 2026.

Analysis of the selected studies revealed consistent data that challenge the effectiveness of the current binary model. According to research conducted by Meyers et al. (2025), focused on anterior descending artery occlusions, traditional STEMI criteria failed to identify 38% of angiographically confirmed TIMI 0 (total occlusion) flow cases. In terms of global accuracy, previous reviews, such as the one by Meyers et al. (2021), have already pointed out that the sensitivity of ST-segment elevation criteria for the detection of acute occlusion is around 41%, contrasting with the interpretation based on the OCA concept, which can double this sensitivity while maintaining high specificity.

Regarding prognosis and mortality, data compiled by Kos et al. (2026) in a cohort of 2,483 patients demonstrated that the presence of total occlusion of the culprit artery is an independent predictor of 30-day mortality, with a rate of 7.29% in the group with occlusion (OCA) versus 3.52% in the group without occlusion (NOCA), regardless of the initial electrocardiographic presentation. These findings are corroborated by the meta-analysis by Khan et al. (2017), which indicated that approximately 25% of patients initially diagnosed as NSTEMI had a fully occluded artery, resulting in a significantly elevated mortality risk when compared to non-occluded patients.

Regarding the treatment time, the literature analyzed indicates a critical disparity. Patients classified as non-ST-elevation OCA face substantial delays to catheterization, with median times often exceeding 90 minutes or, in more severe cases, exceeding 400 minutes to intervention, while patients with classic STEMI criteria are seen, on average, within 41 to 60 minutes. In addition, recent studies on the use of artificial intelligence, such as the models

validated by Meyers et al. (2025) and cited by Batubara et al. (2025), have shown that algorithms trained on the OCA concept achieved 100% sensitivity in detecting proximal occlusions of the anterior descending artery on the first electrocardiogram, surpassing the standard human capacity and the criteria of the current guidelines.

5 DISCUSSIONS

A critical analysis of the contemporary literature shows that the current paradigm for the classification of acute myocardial infarction, based on the dichotomy between ST-segment elevation infarction (STEMI) and non-elevation infarction (NSTEMI), presents severe structural flaws when using the surface electrocardiogram (ECG) as the sole arbiter for the decision of emergency reperfusion. As Frick et al. (2025) argue, this classification creates a "paradox of no false negative", where the absence of millimetric criteria for elevation in a patient with total occlusion is not recognized as a failure of the diagnostic test, but rather categorized as a distinct clinical entity (NSTEMI), masking the urgency of the underlying pathology.

The ineffectiveness of the traditional criteria is quantitatively alarming. Meyers et al. (2021) demonstrated that the sensitivity of STEMI criteria for detecting acute coronary occlusion (OCA) is only 41%. More recent data reinforce this limitation: in a study focused specifically on total occlusions of the anterior descending artery (ADA) — the lesion with the highest lethality potential — Meyers et al. (2025) identified that 38% of patients with TIMI 0 flow (total occlusion) did not meet the criteria for STEMI at any time during electrocardiographic monitoring. These findings are corroborated by Kola et al. (2024), who in their cohort observed that 40% of angiographically confirmed patients with OCA did not meet the classic criteria for hemodynamic activation.

The direct consequence of this diagnostic gap is the systematic therapeutic delay for the group called "STEMI(-) OCA" (Unsupra Occlusion). Ayyad et al. (2025) and Batubara et al. (2025) highlight that these patients suffer significant delays in door-to-balloon time, with medians often exceeding 90 minutes, in contrast to the 40 to 60 minutes observed in the classic STEMI group. The prognostic impact of this delay is devastating: the meta-analysis by Khan et al. (2017) revealed that the 25.5% of patients diagnosed as NSTEMI who have a fully occluded artery have a mortality risk 1.67 times higher than NSTEMI without occlusion. In addition, Bae et al. (2023) demonstrated that 3-year mortality almost doubles (13.4% vs 7.3%) when the time between symptom onset and catheterization ("symptom-to-catheter time") exceeds 48 hours, reinforcing that the conservative or delayed strategy for false-NSTEMI is deleterious.

To mitigate these flaws, the transition to the OCA paradigm proposes the valorization of subtle but specific electrocardiographic patterns that precede or replace the classic elevation. Ricci et al. (2025) extensively reviewed these patterns, emphasizing the importance of hyperacute (wide and symmetrical) T waves, which are often the first sign of occlusion, and terminal QRS distortion, which differentiates benign repolarization from ADA occlusion. Additionally, signs such as the "South African Flag Sign" (elevation at D1, aVL and V2 with infra at D3) and the "Precordial Whirlpool Sign" (supra at V1-V2 with infra at V5-V6) were identified by Batubara et al. (2025) and Ayyad et al. (2025) as critical markers of proximal occlusions requiring immediate intervention, despite not meeting the standard millimeter criteria.

In addition to the technical limitations, the current paradigm carries implicit demographic biases. Ricci et al. (2025) point out that ST-segment elevation thresholds were derived mostly from male populations of Western ancestry. Women, who physiologically have a lower elevation of the basal J-point, may experience acute occlusions without meeting the strict cut-off criteria (such as 1.5 mm or 2.0 mm), resulting in disproportionate underdiagnosis. Applying proportionality-based criteria, such as the Smith-modified Sgarbossa criteria for Left Bundle Branch Block, helps correct these distortions when assessing the patient's voltage-relative ischemia, rather than using absolute measures.

The reliance on biomarkers, such as troponin, for risk restratification in the absence of ST elevation also presents pitfalls. Although Baro et al. (2019) demonstrated that high-sensitivity troponin T levels above 1000 ng/L are highly predictive of total occlusion, waiting for this elevation contradicts the fundamental principle of "time is muscle", since such levels take hours to manifest. In this context, ECG interpreted from the perspective of OCA offers an instantaneous screening tool that troponin cannot provide in the hyperacute phase, allowing the distinction between the true NSTEMI patient (NOCA) and the occluded patient (OCA) who requires immediate catheterization.

Given the complexity of recognizing these subtle patterns, artificial intelligence (AI) emerges as a promising solution to democratize the diagnosis of excellence. Meyers et al. (2025) demonstrated that an AI model trained on the concept of OCA was able to detect 100% of acute anterior descending artery occlusions in the first ECG performed, drastically exceeding the sensitivity of 62% of STEMI criteria and equaling the performance of human experts. Batubara et al. (2025) reinforce that the integration of machine learning algorithms into clinical practice can reduce the variability of human interpretation and ensure that patients with patterns such as the "Precordial Whirlpool" or "Aslanger" do not have their treatment delayed due to lack of technical recognition.

In summary, the accumulated evidence indicates that the STEMI/NSTEMI classification has become insufficient for the decision of emergency reperfusion, failing to protect a significant portion of patients with acute coronary occlusion. The adoption of the OCA/NOCA paradigm, supported by the recognition of advanced electrocardiographic patterns and the aid of artificial intelligence, presents itself as the necessary evolution to ensure that all patients with myocardium at risk receive reperfusion therapy at the appropriate time. As Frick et al. (2025) suggest, cardiology should evolve from a diagnostic tool-focused approach to a pathology-focused approach, ensuring that the absence of a millimeter sign on paper is not a preventable myocardial necrosis sentence.

6 CONCLUSION

This review critically analyzed acute myocardial infarction with non-ST-segment elevation coronary occlusion, highlighting relevant limitations of the traditional STEMI/NSTEMI paradigm. Studies have shown that a significant part of patients classified as NSTEMI have total coronary occlusion, associated with greater myocardial necrosis, delayed reperfusion, and increased mortality.

The exclusive dependence on ST-segment millimetric criteria is insufficient to identify acute occlusions, especially in view of the limitations of the conventional electrocardiogram. The incorporation of advanced electrocardiographic standards and new diagnostic tools increases clinical sensitivity and can reduce therapeutic delays.

In this context, the OCA/NOCA paradigm emerges as a proposal more aligned with the anatomical and pathophysiological reality of acute coronary syndrome. Evidence shows that the absence of ST-segment elevation should not be interpreted as absence of coronary occlusion. The evolution of contemporary cardiology requires that clinical decision-making be centered on the pathology underlying coronary obstruction, and not only on the electrocardiographic manifestation based on millimetric criteria.

Thus, the transition to an occlusion-based model represents a strategic advance, capable of reducing potentially avoidable myocardial necrosis and improving clinical outcomes in acute myocardial infarction.

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