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Case Report: Three Cases of Acute Myocardial Infarction Resulting from Acute Occlusion of the Right Coronary Artery

Yue Kang[1,2,a], Maowei Li[2,b], Dongsheng Shang[2,c], Linjun Yu[2,d], Lianyou Wang[2,e,*]

[1]Xinxiang Medical University, Xinxiang, China
[2]Department of Cardiovascular Medicine, The 988 Hospital of PLA, Zhengzhou, China
[a]1449604874@qq.com, [b]lmaowei@163.com, [c]wanglianyoucbnkw3@126.com,
[d]lemonlilyx@163.com, [e]quantin_wly@163.com
[*]Corresponding author

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Abstract: In this study, we present a comprehensive analysis of the electrocardiogram (ECG), coronary angiography, and optical coherence tomography (OCT) findings in three patients who experienced acute myocardial infarction (AMI) resulting from acute occlusion of the proximal and mid-segments of the right coronary artery (RCA). The findings demonstrate that the all-encompassing evaluation of both positive and negative coronary blood flow in the context of acute myocardial infarction (AMI) plays a decisive role in determining not only whether the ST segment on the electrocardiogram (ECG) leads pertaining to the affected myocardium undergoes changes, but also the inherent characteristics of said changes, whether it manifests as elevation, depression, or remains unchanged. However, the intricate relationship between ST-segment elevation and the composition of thrombus components within the infarct-related artery (IRA) remains an enigma that awaits further exploration.

1. Introduction

In the year 1983, Spodick made a proposition that Acute Myocardial Infarction (AMI) could be divided into two distinct categories: Q-wave myocardial infarction and non-Q-wave myocardial infarction[1]. However, as the new century dawned, a revolutionary concept emerged in the realm of emergency coronary revascularization - the idea of "promptly opening infarct-related vessels."[2] This concept prompted the industry to redefine acute myocardial infarction into two distinct subtypes: acute ST segment elevation myocardial infarction (STEMI) and acute non-ST segment elevation myocardial infarction (NSTEMI). Grounded on this classification, an emergency coronary revascularization strategy gradually took shape[3].

Currently, there is a prevailing belief that the incidence of occlusion in the infarct-related artery (IRA) among patients with ST-segment elevation myocardial infarction (STEMI) is high, with red thrombus being the predominant type. Prompt implementation of both emergency coronary intervention and thrombolytic therapy is deemed vital for the well-being of these patients.

Conversely, the occlusion rate of the IRA in non-ST-segment elevation myocardial infarction (NSTEMI) patients is comparatively low, with the primary type of thrombus being white in nature[4]. While NSTEMI patients can benefit from emergency coronary intervention, intravenous thrombolysis is not recommended. Recent evidence suggests that approximately one third of NSTEMI patients exhibit acute complete occlusion of the IRA, emphasizing the importance of timely coronary revascularization to prevent avoidable undesirable clinical outcomes[5].

Furthermore, it is an incontrovertible verity that patients diagnosed with non-ST elevation myocardial infarction (NSTEMI) are characterized by the presence of two distinct objective realities: namely, ST segment depression and ST segment non-deviation. Nevertheless, one must ponder whether the presence or absence of ST segment depression differentiates two distinct cohorts of patients.

2. Case Presentations:

Case 1: The subject of this case study is a 64-year-old male who presented to our hospital's emergency department with a chief complaint of "persistent chest tightness and dyspnea for a duration of 5 hours". Upon admission, electrocardiography revealed the presence of ST segment elevation in leads II, III, and aVF, combined with an ischemic J wave in the context of atrial fibrillation. Conversely, leads I, aVL, and V1-V4 exhibited ST segment depression. Subsequent emergency coronary angiography unveiled a complete occlusion of the right coronary artery (RCA) beyond its initial bend, without any collateral circulation from other blood vessels. Additionally, optical coherence tomography (OCT) diagnostic imaging revealed localized red thrombus formation within the infarct-related lesions (Figure 1).

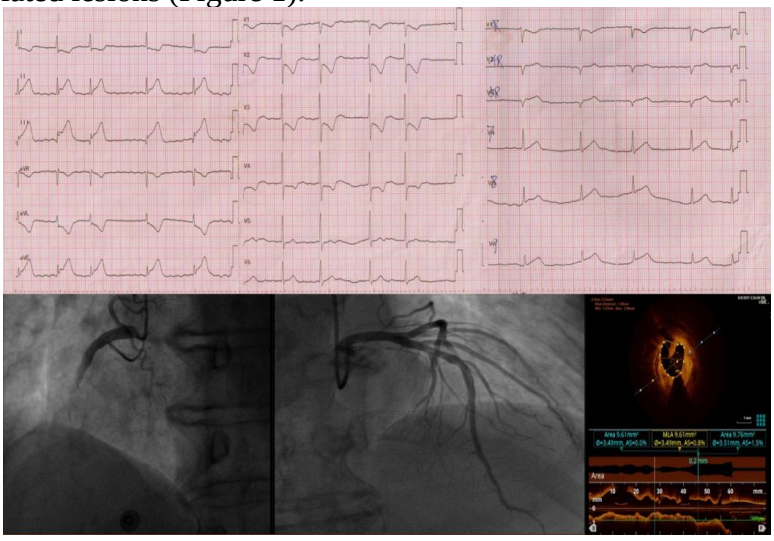

Figure 1: In situation 1, the ECG exhibited elevated ST segments in the inferior lead and depressed ST segments in aVL lead. Subsequent angiographic evaluation revealed complete occlusion of the RCA in both the proximal and middle segments, with no apparent development of collateral circulation. OCT further unveiled intracoronary red thrombi within the culprit lesion of the IRA.

Case 2: The subject of this aforementioned case, a 44-year-old male, presented to our hospital's emergency department with an acute complaint of "sudden chest pain with a duration of 3 hours". Upon admission, electrocardiographic findings revealed a depression of the ST segment in leads II, III, and aVF, while an elevation of the ST segment was observed in lead aVL. Emergency coronary angiography subsequently confirmed a complete occlusion of the right coronary artery (RCA) beyond its initial bend, and no other blood vessels were found to contribute to collateral circulation.

Furthermore, optical coherence tomography (OCT) analysis demonstrated localized red thrombus formation within the infarct-related lesions (Figure 2).

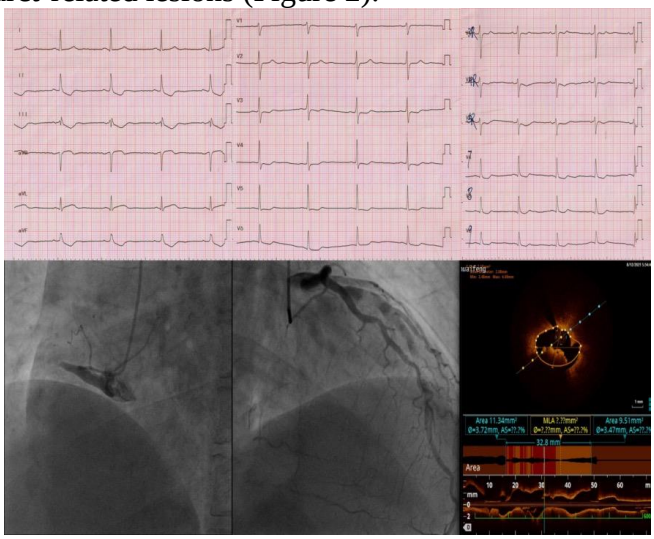

Figure 2: In the second case, the ECG demonstrated sinus rhythm, with notable depressions of the ST segment in leads II, III, and aVF, while lead aVL exhibited an elevation. Subsequent coronary angiography revealed the presence of complete occlusion in both the proximal and middle segments of the RCA, without any discernible development of collateral circulation. Further assessment utilizing OCT unveiled intracoronary red thrombi within the culprit lesions of the IRA.

Case 3: In this particular instance, a 56-year-old female sought medical attention at our hospital's emergency department due to persistent symptoms of "intermittent chest pain lasting for a duration of 11 hours". Upon evaluation, the initial electrocardiogram (ECG) indicated a normal sinus rhythm, with no noticeable deviations in the ST segment across all leads. Subsequent emergency coronary angiography revealed a complete occlusion of the right coronary artery (RCA) beyond its initial bend, while collateral circulation originating from the left anterior descending branch towards the RCA was observed. In addition, optical coherence tomography (OCT) examinations predominantly revealed the presence of white thrombus in relation to the affected ischemic lesions (Figure 3).

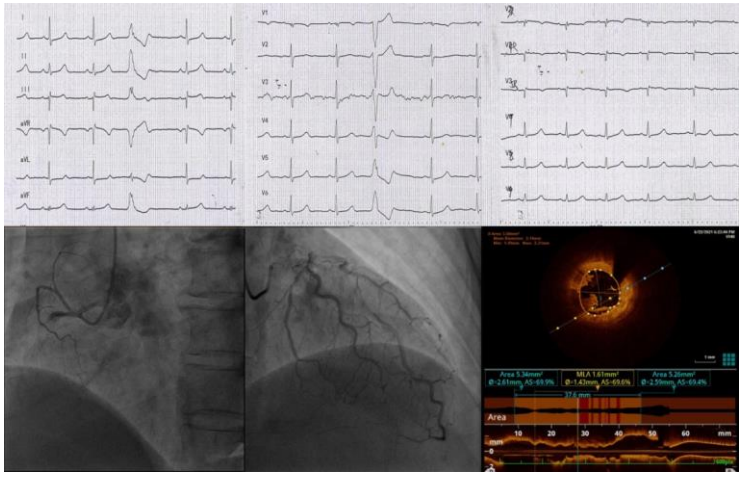

Figure 3: The ECG of case 3 did not exhibit any alterations in the ST segment within the inferior lead. Subsequent coronary angiography revealed the occlusion of the RCA in both the proximal and middle segments, accompanied by the discernible presence of collateral circulation from the LAD to the RCA. Further examination utilizing OCT ascertained that the lesions within the IRA predominantly consisted of white thrombus.

3. Discussion

Undeniably, there exist two objective realities in patients presenting with NSTEMI: ST segment depression and ST segment non-deviation, such as cases 2 and 3.Research have shed light upon the fact that the occurrence of single vessel occlusion in the ST-segment unbiased group surpasses that in the ST-segment depressed group[6]. The results obtained through OCT investigations have further corroborated our findings, highlighting the preponderance of red or mixed thrombus types. By synthesizing the insights gleaned from the relevant literature, we have proffered the proposition of differentiating NSTEMI into acute ST-segment unbiased myocardial infarction and acute ST-segment depressed myocardial infarction. This novel classification method represents a notable advancement over the conventional dichotomy of ST segment elevation or not. So, it behooves us to accentuate the ECG characteristics and underscore the scientific quandary surrounding acute IRA occlusion in AMI patients.

The blood supply to the myocardium is primarily reliant on antegrade circulation, with some contribution from retrograde flow. When the coronary artery becomes completely occluded in the proximal and middle regions, the adequacy of retrograde blood supply becomes pivotal in determining the reversibility and magnitude of myocardial injury. As the disease progresses, the restoration of antegrade circulation and the extent of reperfusion injury will collectively impact the overall prognosis of the patient[7]. In cases where the epicardial vessels, particularly their proximal and middle segments, are occluded, a well-developed collateral circulation can provide roughly 1/4 to 1/5 of the normal blood flow[8]. In this study, all three cases presented acute complete occlusion of the proximal segment of the right coronary artery. Cases 2 and 3 exhibited collateral blood supply that prevented ST segment elevation in the inferior lead, yet failed to alter the underlying nature of myocardial necrotizing injury.

When acute complete occlusion of the right coronary artery (RCA) leads to a complete interruption of blood supply to the inferior myocardium, resulting in a myocardial infarction, aVL lead will display depression, apart from the expected ST segment elevation in the inferior leads - a frequently observed clinical phenomenon, as demonstrated in case 1 of this study. Conversely, in case 2, the ECG of the patient revealed a dramatic departure from the aforementioned pattern, with ST segment depression in the inferior leads and elevation in the aVL lead[9]. This finding can be attributed to the presence of collateral circulation that ensures sufficient blood supply to the local myocardium, consequently leading to ischemic but not necrotic damage. Additionally, the elevation of ST segment in the aVL lead can be considered a mirror image counterpart of the depression observed in the inferior leads. With regards to case 3, the ECG exhibited yet another manifestation - the depression of ST segment in the inferior leads was less than 0.05mv. This subtle deviation can be ascribed to the collateral circulation providing a certain level of blood supply, which albeit sufficient to prevent the elevation of ST segment in the inferior leads, fails to alter the fundamental nature of myocardial necrotizing injury.

Through the utilization of angioscopy, optical coherence tomography (OCT), and thrombus aspiration techniques in clinical practice, the composition of thrombi within occluded blood vessels has become subject to ongoing debate[10]. Initially, we must inquire whether the presence of ST segment elevation is intricately linked to specific thrombus components in the culprit infarct-related artery (IRA). Furthermore, we ought to assess the significance of such a relationship. According to observations made using the OCT technique, one case of ST-segment elevation myocardial infarction (STEMI) and two cases of non-ST segment elevation myocardial infarction (NSTEMI) demonstrated the presence of red or mixed thrombi within the IRA. Clearly, further exploration and advancements in this field are required to deepen our understanding of this intricate matter.

In summary, this paper offers an analysis and discussion of the findings from ECG, coronary

angiography, and OCT in three patients diagnosed with acute myocardial infarction (one presenting with ST-segment elevation myocardial infarction, and the other two with non-ST-segment elevation myocardial infarction), all resulting from acute occlusion in the proximal and middle segments of the right coronary artery (RCA). Based on the findings, the following conclusions can be drawn: (1) It is apparent that acute complete occlusion of a major coronary artery on the epicardial surface is not the sole dominant factor contributing to ST-segment elevation on the electrocardiogram (ECG). The openness of collateral circulation emerges as an equally crucial determinant for this phenomenon. Consequently, the combined assessment of positive and negative coronary blood supply ultimately determines whether there will be ST-segment elevation, depression, or no change in the leads corresponding to the affected myocardial region. (2) Additional investigation is necessary to ascertain the intricate relationship between ST-segment elevation and the composition of the thrombus within the infarct-related artery (IRA).

Overall, this study sheds light on the multifaceted aspects of acute myocardial infarction, highlighting the significance of collateral circulation and thrombus components in influencing ST-segment changes on the ECG.

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