HHS Public Access

Author manuscript

Scifed J Cardiol. Author manuscript; available in PMC 2019 May 06.

Published in final edited form as:

Scifed J Cardiol. 2019 ; 3(1): .

New Onset Right Bundle Branch Block In Acute Coronary Syndrome and High-Grade Stenosis: A Case Series

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Abstract

Despite advances in diagnostic and therapeutic interventions, coronary heart disease remains as one of the leading causes of death in developed countries. ST-segment elevation myocardial infarction is associated with the highest mortality and is an indication for emergent reperfusion therapy. Current guidelines for emergent reperfusion not only include ST segment elevations but also consider evidence of a new onset Left Bundle Branch Block (LBBB). However, accumulating evidence indicates that RBBB is also associated with poor outcome in coronary artery disease. To-date, guidelines do not comment on the urgency of reperfusion therapy with sole evidence of a new onset Right Bundle Branch Block (RBBB). Particularly we question whether clinicians should focus on new-onset RBBB as a ST-segment elevation equivalent. If so, appropriate management of patients with the new onset RBBB during cardiac ischemia can have a significant impact on cardiac function and outcomes. In this series, we present four cases of new-onset acute RBBB associated with chest pain in the setting of acute myocardial infarction with critical lesions of the left anterior descending artery. We also highlight the need to consider new RBBB as an additional indication for acute reperfusion therapy in acute myocardial infarction. This will call for revision in the current guidelines by American Heart Association following the initiative recently implemented by the European Society of Cardiology 2018.

Introduction

Coronary heart disease is one of the leading causes of death in developed countries [1]. It is the leading cause of death in about 33% of adults above the age of 35 years, despite a decrease in the mortality caused by myocardial infarction in the last 3 decades [2]. ST Segment Elevation Myocardial Infarction (STEMI) is defined as new ST elevation at the J point in at least 2 contiguous leads of ≥2 mm in men or ≥1.5 mm in women in leads V2–V3.

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STEMI is also defined as ≥1 mm ST elevation in other contiguous chest leads or limb leads; all of which are indications for urgent reperfusion therapy [3]. STEMI equivalents are EKG changes that are highly suggestive of total coronary artery occlusion but lack ST-elevation in contiguous leads [3]. One of the conditions that is under investigation for the association of significant occlusion causing myocardial infarction other than EKG changes from STEMI and STEMI equivalents is Right Bundle Branch Block (RBBB). Here we present four cases of new-onset right bundle branch block with chest pain found to have critical lesions of the Left Anterior Descending artery (LAD).

Report of Case 1

A 71-year old African American woman with a past medical history of diabetes mellitus type 2, hypertension, hyperlipidemia, former cigarette smoker, and known coronary artery disease presented to our institution with a chief complaint of chest pain. One year prior, she had a similar presentation, which was diagnosed as a Non-ST Elevation Myocardial Infarction (NSTEMI). Her cardiac catheterization at that time revealed a 99% lesion in her first Obtuse Marginal (OM1) and a 99% lesion in her proximal Left Circumflex arteries (LCx). She ultimately received 2 drug eluting stents. Her estimated ejection fraction by left ventriculography was 55%. Presently she experienced substernal chest pain which began 24 hours prior to ER arrival. She stated that her chest pain was different in nature in comparison to the chest pain from her NSTEMI one year ago. The chest pain a year ago was a burning sandpaper-like sensation, whereas her current pain was more squeezing in nature.

Her EKG on arrival (Figure 1) was unchanged from previous EKG and showed sinus rhythm with premature ventricular complexes. Cardiac biomarkers showed troponin I of 0.24 ng/L and brain natriuretic peptide of 140 pg/mL. Her pain was controlled with nitroglycerin and morphine. Approximately 7 hours into her admission, she began to experience a recurrence of the pain that she described as similar in characteristics to her pain on arrival. Her troponin I increased to 1.58 ng/L and a repeat EKG was concerning for a new RBBB (Figure 2). She was started on dual antiplatelet therapy, Aspirin and Clopidogrel, along with Heparin for anticoagulation.

Approximately 48 hours later, she underwent cardiac catheterization which revealed a 99% lesion in her proximal Left Anterior Descending artery (LAD) and another 99% lesion in her Right Posterior Descending Artery (RPDA). Both lesions received drug eluting stents (Figures 3 and 4). Her transthoracic echocardiography revealed a reduced ejection fraction of 30% with associated a kinesis of the apical inferior, apical septal and apical lateral walls. There was severe hypo kinesis of the anteroseptal wall. Her troponin I reached a peak value of >440.00 ng/L. The patient was discharged in a stable condition on appropriate medications.

Report of Case 2

A 61-year-old African American man presented with a past medical history of HIV, hypertension, chronic left lower extremity deep venous thrombosis with recurrent pulmonary embolism, and hypothyroidism. He was on antiretroviral therapy and his last CD4 was 461

cells per cubic millimeter three months before presentation. Two months before presentation, he was started on dabigatran for recurrent pulmonary embolism. He presented with central crushing chest pain associated with diaphoresis. His EKG showed new RBBB (Figure 5). His troponin I peaked to 5.39 ng/L.

He underwent cardiac catheterization which revealed significant single vessel coronary artery disease with 100% ostial LAD occlusion and severe left ventricular dysfunction, likely due to ischemic Cardiomyopathy. Unfortunately, PCI was unsuccessful and was complicated with a vascular dissection in the proximal and mid to distal LAD (Figure 6). Ultimately, TIMI 3 flow was confirmed prior to completion of the case, along with resolution of his chest pain. He was treated medically for his lesion.

Report of Case 3

A 69-year-old African American woman with a past medical history of hypertension, hyperlipidemia and type II diabetes mellitus presented to the emergency department with intermittent substernal chest pain for three days. The pain was pressure like, radiating to the back and left shoulder, and associated with vomiting. Her first EKG showed T wave inversions in leads V2-V6 and RBBB. The second EKG after 3 hours showed no RBBB, T wave inversions leads II, III, aVL, V1-V6 and the third EKG after another 3 hours showed repeat RBBB with T wave inversions in I, aVL, V1-V6 (Figures 7, 8 and 9). Her troponin I peaked to 4.3 ng/L. Given her dynamic EKG changes and up trending troponins, she was started on aspirin, clopidogrel and intravenous heparin for anticoagulation. She underwent urgent cardiac catheterization which revealed a tubular 95% stenosis in the mid LAD, 80% stenosis in the distal LAD and a discrete 70% stenosis in the middle third of her distal RCA. She was treated with 2 drug-eluting stents in the mid LAD and distal LAD (Figures 10 and 11). Distal RCA lesion was treated medically. Global left ventricular function was severely depressed by contrast ventriculography and estimated ejection fraction was 35%. It demonstrated severe anterolateral hypo kinesis and severe apical hypo kinesis. The day after PCI, her transthoracic echocardiography showed an ejection fraction of an estimated 60% and there was mild anterior and anteroseptal hypo kinesis.

Report of Case 4

A 63 year-old Caucasian man with a past medical history of hypertension, hyperlipidemia, lymphoma with radiation therapy to his chest eleven years ago, peptic ulcer disease, and depression was brought to our ED after cardiac arrest. He called EMS after he experienced pressure like central chest pain. Once EMS arrived, he collapsed and was found pulse less with ventricular fibrillation. He received two unsynchronized cardio versions and three minutes of Cardiopulmonary Resuscitation (CPR) before achieving Return of Spontaneous Circulation (ROSC). Once he was brought to our ED, his EKG showed new RBBB (Figure 12).

He underwent urgent cardiac catheterization which revealed severe 3-vessel coronary artery disease (LAD, RCA, and circumflex). Ostial LAD showed 100% stenosis associated with a moderate filling defect consistent with thrombus, 2nd obtuse marginal showed a tubular 75%

stenosis and RCA showed discrete 50% stenosis at mid RCA. He was treated with one drug eluting stent at the proximal LAD and placement of an intra-aortic balloon pump for hemodynamic support (Figures 13 and 14). His transthoracic echocardiography the day after PCI revealed anterior, anteroseptal and apical a kinesis, with ejection fraction estimated to be 20%.

Discussion

Coronary heart disease is one of the leading causes of death in developed countries [1]. It is the leading cause of death in about 33% of the adults above the age of 35 years despite a decrease in the mortality caused by myocardial infarction in the last 3 decades [2]. Myocardial infarction (MI) is defined as the damage or death of the heart muscles due to a blockage of the blood supply to that area; about 790,000 Americans have a myocardial infarction every year [4]. According to the American Heart Association, a heart attack can occur approximately every 42 seconds in the average American population [5].

Myocardial infarction is classified according to ST segment changes amongst two main types: ST Segment Elevation myocardial infarction (STEMI) and non ST segment elevation myocardial infarction (NSTEMI). STEMI's account for about 38% of all myocardial infarction in the United States [5]. Fifteen percent of acute myocardial infarction patients will die from its complications, with STEMI mortality rates superseding NSTEMI rates [5].

STEMI is defined as a new ST elevation at the J point in at least 2 contiguous leads of ≥2 mm (0.2 mV) in men or ≥1.5 mm (0.15 mV) in women in leads V2–V3 and/or of ≥1 mm (0.1 mV) in other contiguous chest leads or the limb leads [6]. STEMI is an indication for urgent reperfusion therapy, preferably Percutaneous Coronary Intervention (PCI) [3]. However, there are conditions caused by significant occlusion of coronary territories that do not present with typical EKG findings of a STEMI, and therefore, the mobilization of resources towards primary PCI or urgent thrombolytic therapy is needed. These conditions are known as STEMI equivalents.

STEMI equivalents are EKG changes that are highly suggestive of total coronary artery occlusion but lack ST-elevation in contiguous leads. STEMI equivalents includes: STEMI in the setting of left bundle branch block (LBBB) with Sgarbossa's Criteria or Smith's modification [7, 8], ST depression in ≥2 precordial leads (V1–V4) may indicate transmural posterior injury [6], multi-lead ST depression with coexistent ST elevation in lead aVR, which has been described in patients with left main or proximal left anterior descending artery occlusion [9], and hyperacute T-wave changes with precordial ST-segment depression at the J-point early in STEMI, known as De Winter's waves in a proximal LAD occlusion [10]. In these situations, urgent reperfusion therapy is recommended as it has been shown to significantly improvement outcomes [6].

The association of significant occlusion causing myocardial infarction and EKG changes other than STEMI and STEMI equivalents is under investigation. One of the conditions is development of a new Right Bundle Branch Block (RBBB) in a clinical setting of chest pain or chest pain equivalent. Hazem, et al. conducted a meta-analysis to study the relationship

between acute myocardial infarction and new or old RBBB, They concluded that there is a greater chance of all-cause mortality in 30-day follow-up compared to those without bundle branch block [11]. A new onset RBBB likely indicates proximal occlusion of the LAD resulting with high mortality rate, as the blood supply of the right bundle branch is primarily from the left anterior descending artery [12].

Our cases highlight the question about the association between new-onset RBBB and acute myocardial infarction. Wang, et al. demonstrated the prognostic value of association of RBBB with the LAD, and concluded that a new RBBB in an acute myocardial infarction is associated with a higher incidence of cardiogenic shock and increased long term mortality [13]. Due to the multiple studies on the association between RBBB and acute myocardial infarction, the latest European Society of Cardiology guidelines for acute myocardial infarction management suggests a primary PCI when persistent ischemic symptoms occur in patients with RBBB [14].

Consequently, we suggest more independent studies with a focus on the RBBB in the appropriate clinical setting, and its association with myocardial infarction and coronary heart disease. This will allow for a better understanding of the implications of transient and persistent new onset RBBB and the ramifications on prognosis, outcome and management in cases of myocardial infarction.

Conclusion

Acute myocardial infarction is a serious condition associated with high mortality especially amongst STEMI patients. Urgent reperfusion therapy is associated with significant improvement and favorable outcomes. In this manuscript we presented four cases of NSTEMI associated with new onset RBBB highlighting the need to consider new RBBB in the setting of acute chest pain, as a new indication for acute reperfusion therapy in American Heart Association guidelines, pursuant to the recent initiative recently implemented by the European Society of Cardiology 2018.

New onset RBBB in the context of ischemic symptoms should raise the suspicion of critical coronary occlusion, which ultimately demands immediate intervention.

Acknowledgement

This work is supported, in part, by the efforts of Dr. Moro O Salifu MD, MPH, MBA, MACP, Professor and Chairman of Medicine through NIH Grant number S21MD012474.

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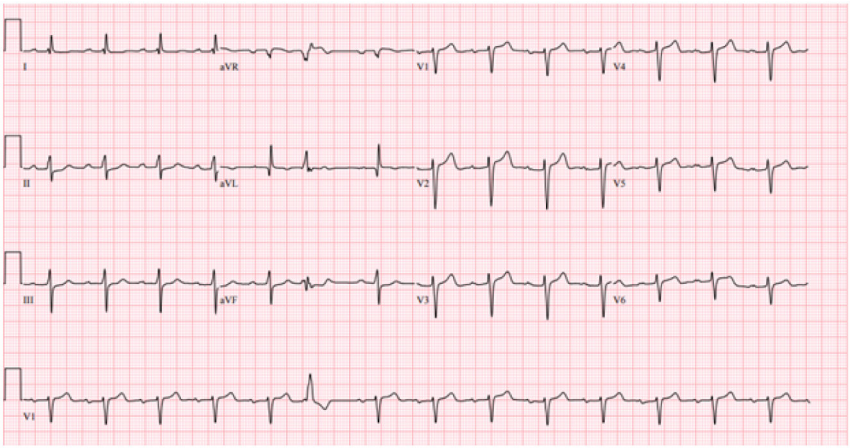

Figure 1:
EKG of Patient 1 on Arrival Revealed Sinus Rhythm with Premature Ventricular Complexes

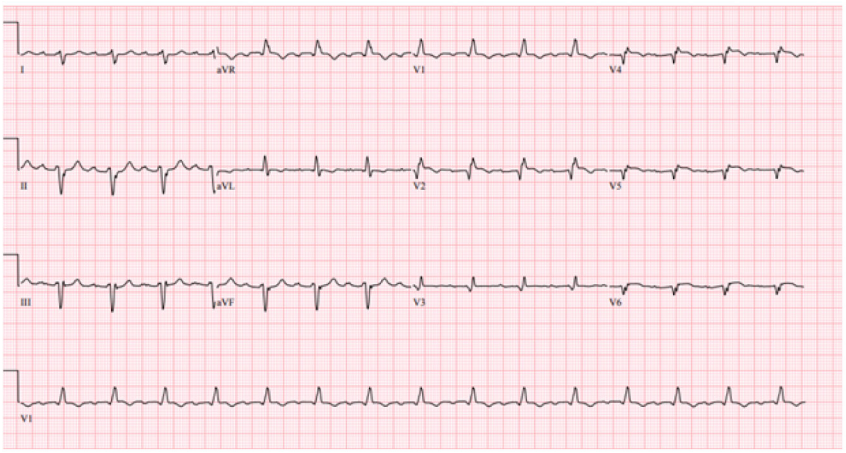

Figure 2:
EKG of Patient 1 after Admission Concerning for a New RBBB

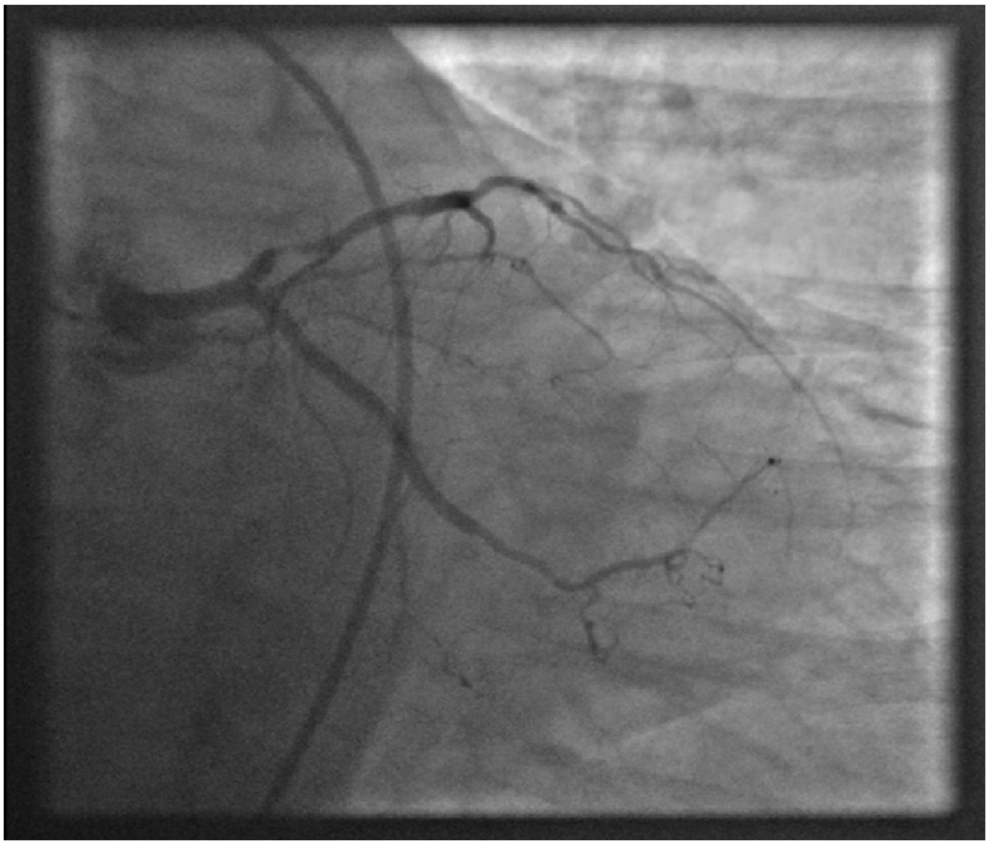

Figure 3:
Cardiac Catheterization of Patient 1 Revealing 99 % Lesion in the Proximal LAD

Figure 4:
Cardiac Catheterization of Patient 1 Revealing 99 % Lesion in the Right Posterior Descending Artery

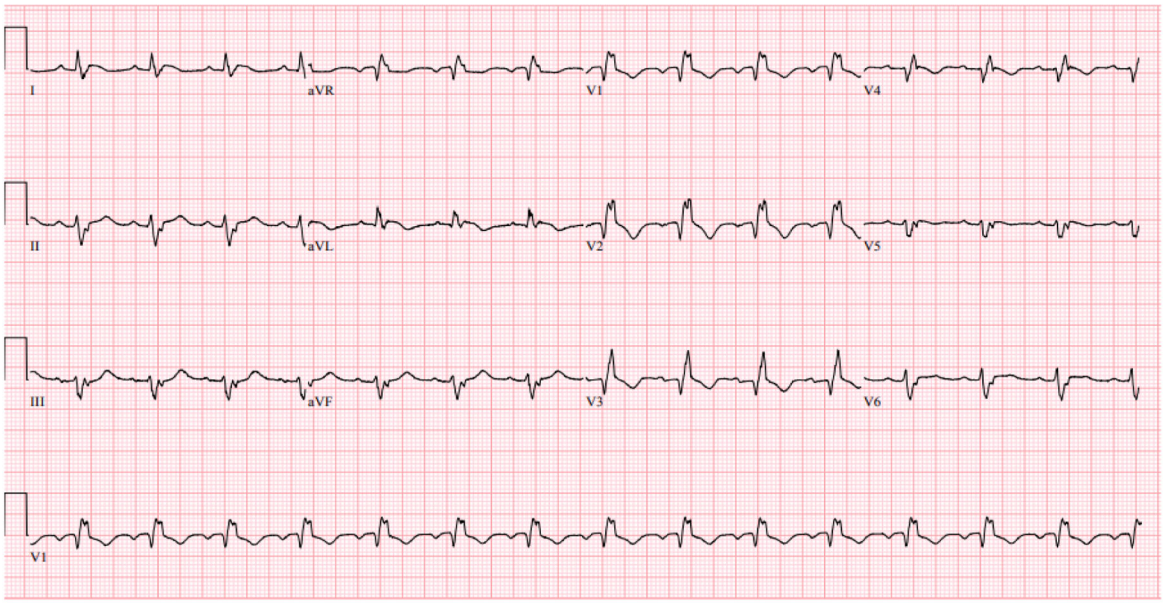

Figure 5:
EKG of Patient 2 Demonstrating New RBBB

Figure 6:
Cardiac Catheterization of Patient 2 Revealing 100% Ostial LAD Occlusion

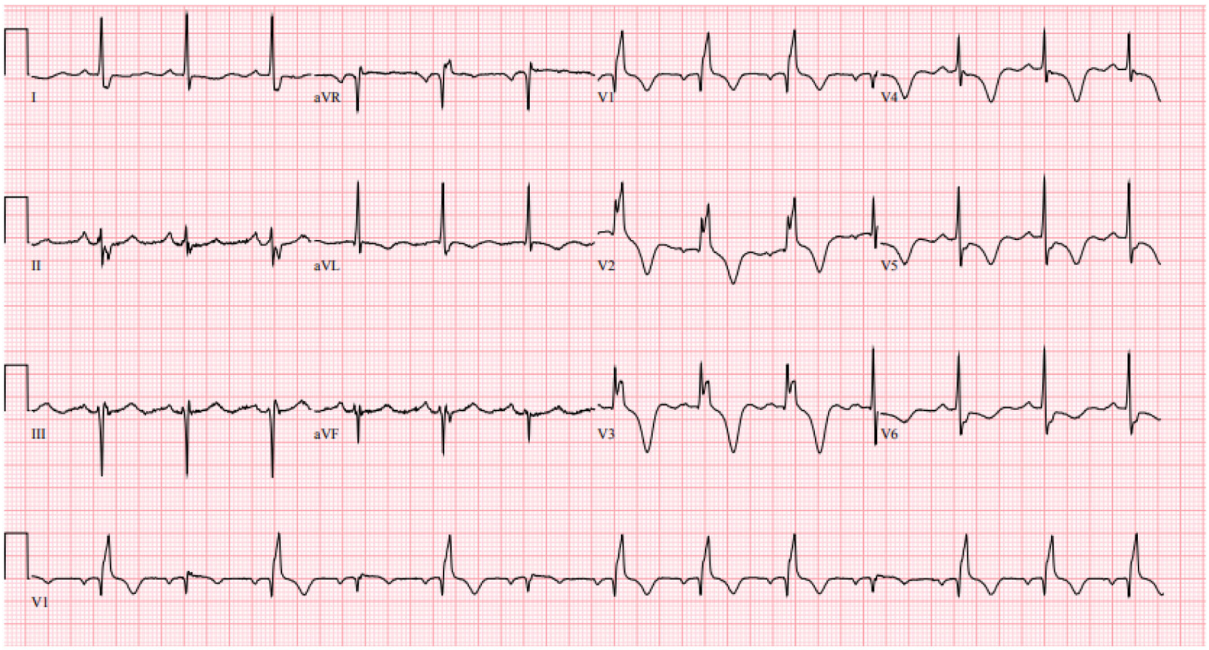

Figure 7:
EKG of Patient 3 on Admission Demonstrating T Wave Inversions in Leads V2-V6 and RBBB

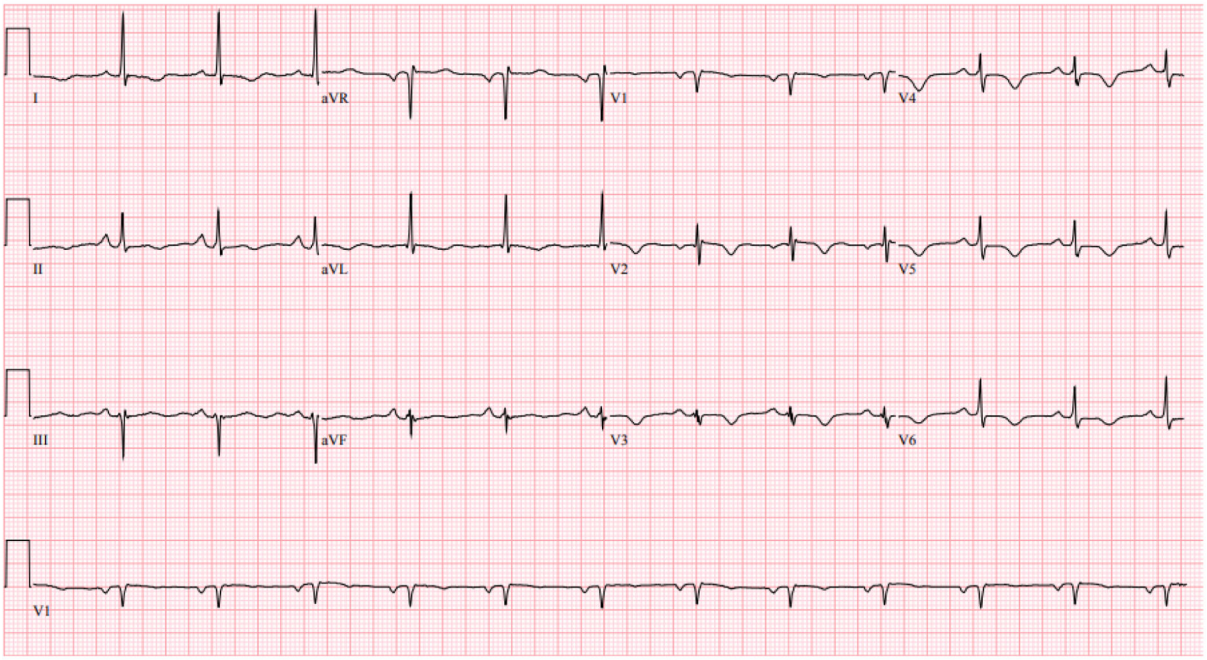

Figure 8:
EKG of Patient 3 after 3 Hours of Admission Demonstrating no RBBB, T Wave Inversions Leads II, III, aVL, V1-V6

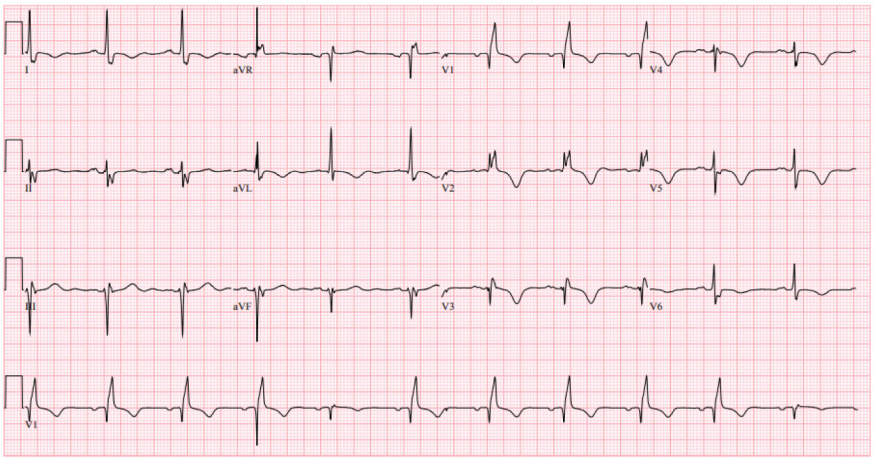

Figure 9:
EKG of Patient 3 after 3 Hours of Admission Demonstrating RBBB with T Wave Inversions in I, aVL, V1-V6

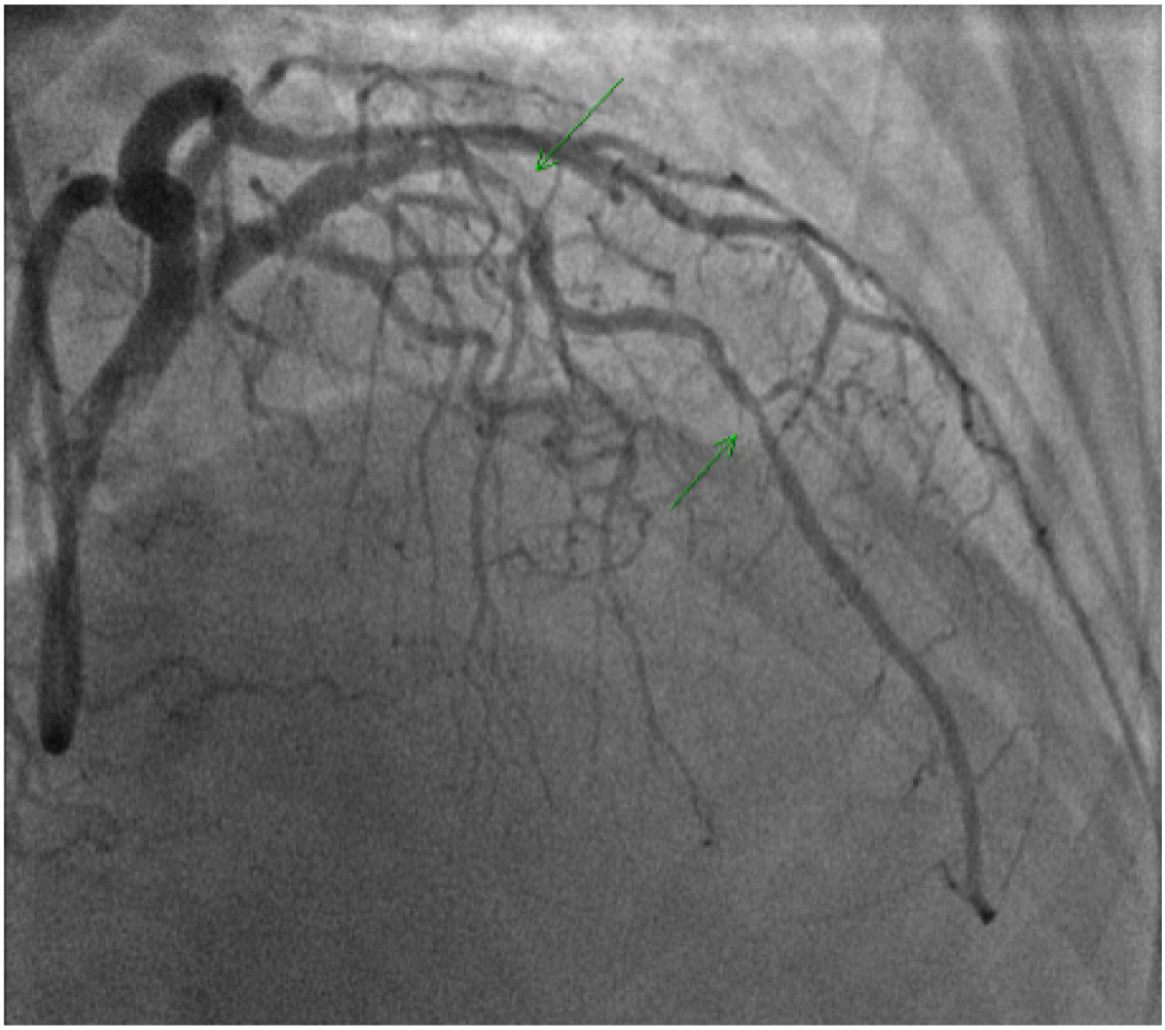

Figure 10:
Cardiac Catheterization of Patient 3 Revealing 95% Stenosis in Mid LAD, 80% Stenosis in Distal LAD

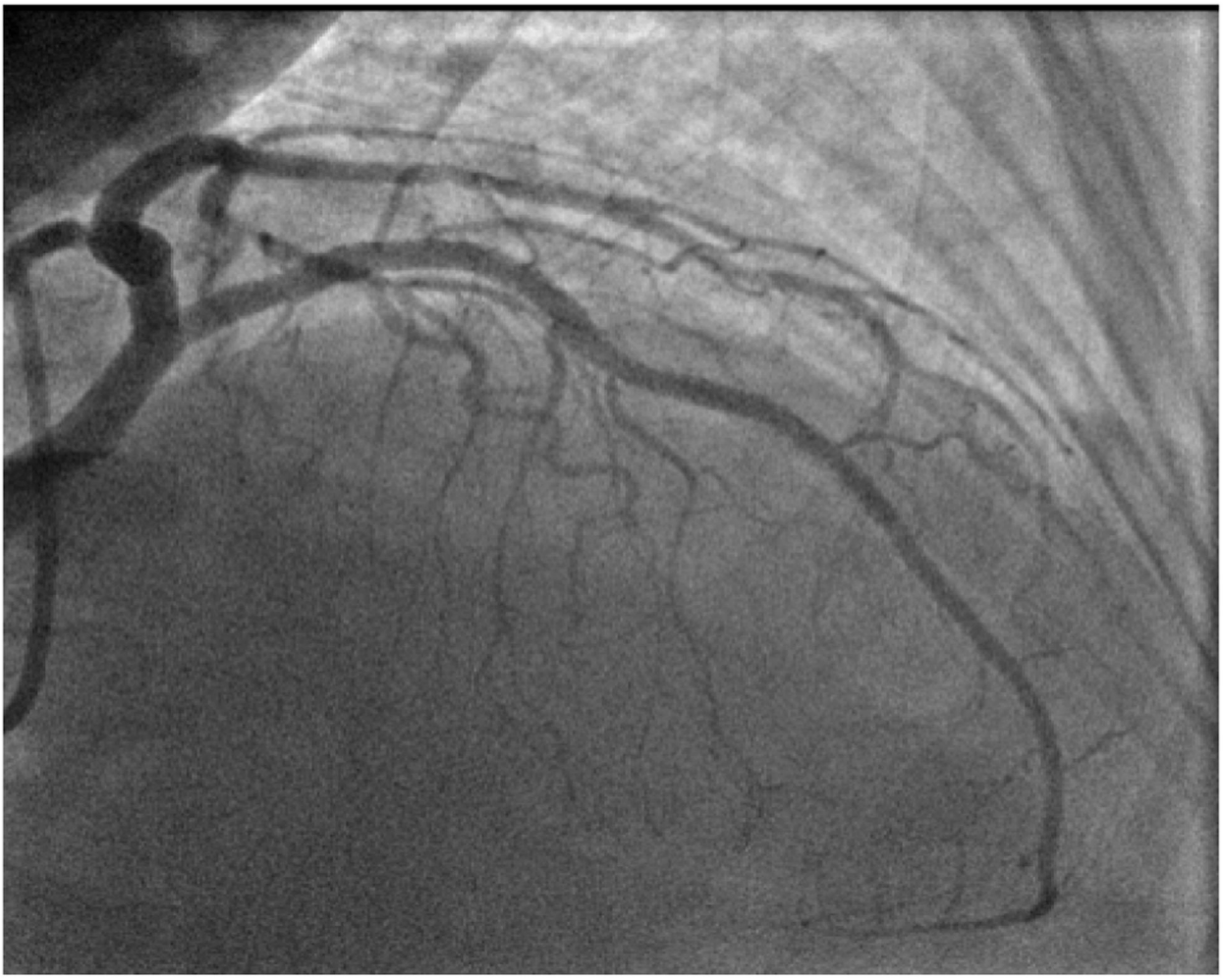

Figure 11:
Cardiac Catheterization of Patient 3 Revealing LAD Segment after Stenting

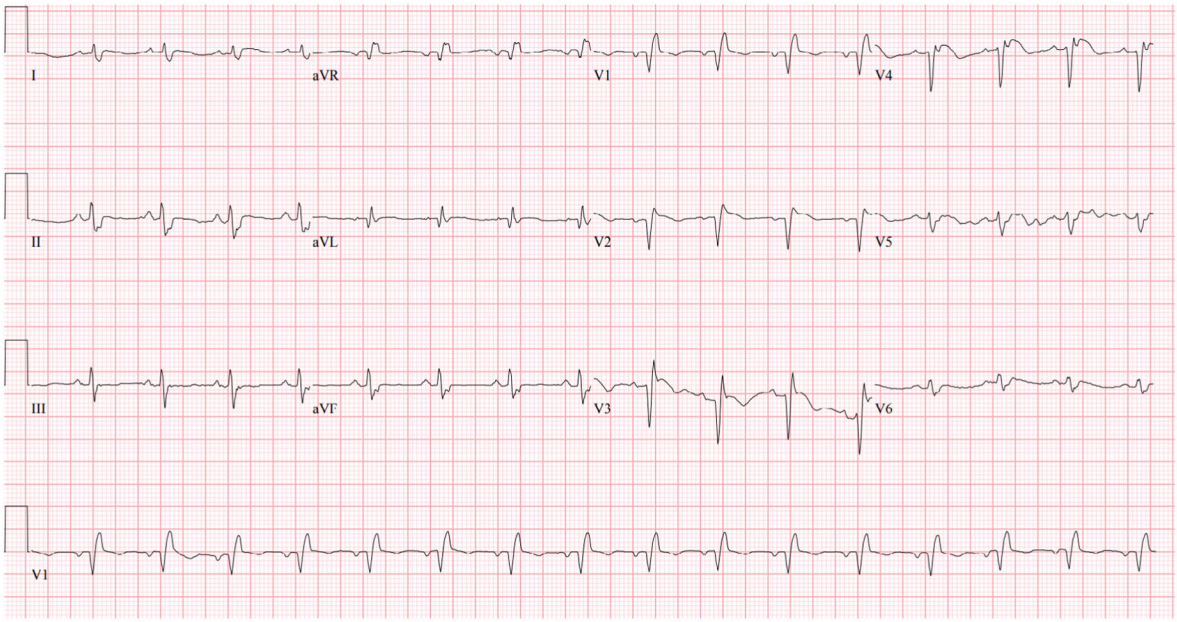

Figure 12:
EKG of Patient 4 Demonstrating New RBBB

Figure 13:
Cardiac Catheterization of Patient 4 Revealing Evidence of Triple Vessel Disease with 100% Ostial LAD Occlusion

Figure 14:
Cardiac Catheterization of Patient 4 Revealing LAD Segment after Stenting