Conversion of Infarction-Associated Atrial Fibrillation by Restoration of Atrial Perfusion

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ABSTRACT

We report a patient who presented with new onset atrial fibrillation in the setting of inferior ST-segment elevation myocardial infarction (STEMI). Cardiac catheterization revealed proximal occlusion of the left circumflex artery. Balloon angioplasty and stenting restored flow to a large left atrial branch, with prompt conversion of the rhythm to atrial flutter, and then to sinus rhythm. To our knowledge this represents the first demonstration of restoration of sinus rhythm by reversing left atrial ischemia in the setting of STEMI.

Introduction

Atrial fibrillation (AF) is a well described complication of acute coronary syndromes.¹ The pathophysiology by which AF develops in this setting is not completely understood. We report a case of inferior ST-segment elevation myocardial infarction (STEMI) with acute development of AF at the onset of chest pain, with prompt restoration of sinus rhythm during reperfusion and restoration of blood flow to a large atrial branch of the left circumflex artery (LCX).

Case Report

A 64-year-old man with a history of insulin-dependent diabetes mellitus and cigarette smoking was admitted with alcohol intoxication and a major depressive disorder. While hospitalized, he was treated with chlorthalidone for symptoms of alcohol withdrawal.

Within 72 hours of admission, he began to experience severe substernal chest pressure that radiated to his jaw. His discomfort was incompletely relieved by therapy with sublingual nitroglycerin. Physical exam was unremarkable except for the presence of newly-diagnosed atrial fibrillation. An ECG revealed atrial fibrillation, inferior Q-waves, and 1 mm ST-segment elevation in leads II, III, and aVF. He was treated with aspirin, β -blockade, 300 mg of clopidogrel, and intravenous heparin. He was referred for emergent cardiac catheterization.

Coronary angiography revealed proximal thrombotic occlusion of the left circumflex artery (Figure 1). The right coronary artery (RCA) had a discrete proximal 80% stenosis and supplied collateral flow from its posterior-lateral branch to the second obtuse marginal branch of the LCX. The left

main and left anterior descending arteries were without significant obstruction.

Therapy with intravenous heparin and eptifibatide was instituted and coronary intervention targeting the LCX was performed. Using standard interventional techniques, the lesion was dilated using a 3.0 $\times$ 9 mm balloon. Thrombolysis in myocardial infarction (TIMI) flow grade 3 was then observed through the previously occluded segment as well as throughout the remainder of the vessel. Following successful balloon dilation, a large left atrial branch originating from the LCX, just distal to the occlusive lesion became apparent (Figure 2). The diseased segment was then further dilated to facilitate placement of 2 overlapping bare-metal stents (3.5 $\times$ 16 mm, 3.5 $\times$ 8 mm), which were then post-dilated with a 3.5 mm noncompliant balloon (Figure 3). At 11 minutes following initial balloon dilation and the appearance of the previously occluded left atrial branch, the patient's rhythm converted from AF to atrial flutter and subsequently to sinus rhythm 5 minutes thereafter (Figures 2, 3).

The patient remained in sinus rhythm throughout the duration of his hospitalization. He was subsequently discharged on a regimen of aspirin, clopidogrel, a β -blocker, statin, and an angiotensin-converting enzyme inhibitor.

Discussion

To our knowledge, this report is the first direct demonstration of immediate cardioversion from AF by restoring left atrial perfusion in a patient with STEMI. In this case, the patient presented with chest pain, new inferior ST-segment elevations, and previously undocumented AF. Restoration

Figure 1. Coronary angiogram demonstrating proximal complete thrombotic occlusion of the left circumflex artery (arrow), in the setting of atrial fibrillation on ECG.

of blood flow via balloon angioplasty of an acutely occluded proximal LCX revealed a large left atrial branch that had been involved in the initial thrombotic event. Following restoration of perfusion through the previously occluded vessel, the patient converted from AF to the more organized atrial flutter, then to sinus rhythm.

Atrial fibrillation is a known complication of acute myocardial infarction (MI), occurring in approximately 10% to 20% of cases.^{1–3} The development of AF during the course of MI portends a worse prognosis.^{2,4} In patients aged ≥ 65 , the presence of AF during hospitalization for MI, either on presentation or during hospitalization, is an independent risk factor for death in-hospital as well as subsequent mortality.² Importantly, these findings come from studies that did not distinguish between AF arising concomitantly with MI, vs AF arising hours to days after MI. Additionally, the majority of reported patients had non-ST-segment elevation myocardial infarction (NSTEMI), rather than STEMI.

The proposed mechanisms for AF arising after MI include: increased left atrial pressure as a consequence of left ventricular dysfunction, pericarditis, increased vagal stimulation, and atrial ischemia.^{2,5,6} In patients presenting with acute STEMI and simultaneous AF, atrial ischemia has been proposed as the most likely cause.⁵ In earlier case studies, AF arising concomitantly with STEMI was rare, documented in only 3% of cases.⁵ Prior to the reperfusion era, the mortality associated with acute STEMI and AF approached 90%.⁴ During the reperfusion era, Hod et al demonstrated that of the 3% of STEMI patients in which AF arose within 3 hours of the onset of chest pain, all cases

Figure 2. Following balloon angioplasty of the occluded segment (long arrow), a large left atrial branch (short arrows) is seen to arise from the previously occluded, nonperfused segment of the left circumflex artery. With restoration of left atrial blood flow, ECG documents that the atrial rhythm has converted from atrial fibrillation to atrial flutter.

Figure 3. Following placement of overlapping stents in the proximal left circumflex artery, achievement of normal flow through the left atrial branch (arrows) is associated with ECG documentation of conversion to sinus rhythm.

were associated with inferior MI.⁵ In the same series, all 7 cases were shown to involve occlusion of a left atrial branch, with 5 involving acute LCX occlusion proximal to an left atrial branch and the remaining 2 cases involving RCA occlusion with concomitant total occlusion of the left atrial branch. These investigators hypothesized that

AF occurring coincident with STEMI is caused by atrial ischemia. In support of this, all 7 cases of AF resolved minutes to hours after administration of thrombolytics. However, some of these patients received antiarrhythmic medications, and in none of the cases was the timing of left atrial reperfusion able to be correlated directly with conversion to sinus rhythm.

In our report, we clearly demonstrate the immediate termination of AF with restoration of blood flow to the left atrium in a patient with STEMI. This provides direct evidence to support the hypothesis that left atrial ischemia can result in AF during acute MI and that mechanical reperfusion of occluded atrial branches can result in termination of this potentially dangerous arrhythmia with conversion to normal sinus rhythm.

References

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