

CASE REPORT

INTERMEDIATE

CLINICAL CASE

Acute STEMI Due to Severe Triple-Vessel Spasm After IV Adenosine Injection During Cryo-Balloon Isolation



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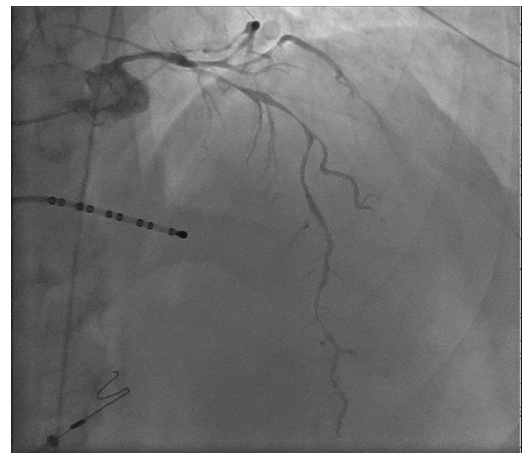
ABSTRACT

Adenosine IV is commonly used after pulmonary vein isolation to check for dormant electrical conduction. Herein, we present the case of a 60-year-old patient who exhibited marked hypotension, conduction abnormalities, and ST-segment elevation after routine adenosine injection. Coronary angiography revealed diffuse coronary spasm that was successfully treated with intracoronary nitroglycerin. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2022;4:617-620) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

The patient underwent uneventful pulmonary vein isolation (PVI) ablation with a second-generation cryo-balloon catheter under moderate sedation in a high-volume atrial fibrillation (AF) center with monitoring via intracardiac echocardiography and invasive arterial pressure during the procedure. At the end of ablation, adenosine 12 mg was injected to check for dormant conduction in the pulmonary veins because ablation of these reconnection sites has been shown to decrease the recurrence of AF.¹⁻⁴ As the second dose of adenosine was injected to check for

FIGURE 1 Initial Image Left Coronary Artery System



Severe diffuse coronary vasospasm of left coronary artery system (left main, left anterior descending, left circumflex) immediately after adenosine injection. Decapolar electrophysiology catheter shown in right ventricle for temporary pacing.

LEARNING OBJECTIVES

- To recognize acute coronary spasm caused by IV adenosine.
- To reconsider the utility of using high-dose adenosine in confirmation of pulmonary vein isolation, given the potential for serious life-threatening complications.

From the State University of New York, Upstate Medical University, Syracuse, New York, USA. The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

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**ABBREVIATIONS
AND ACRONYMS**

- AF** = atrial fibrillation
- AV** = atrioventricular
- IV** = intravenous
- PVI** = pulmonary vein isolation
- RV** = right ventricle

conduction in the left inferior pulmonary vein, self-limited complete heart block resulted, followed by rather unusual (prolonged severe) hypotension. Marked diffuse ST-segment elevation ensued, then left bundle branch block, followed by complete heart block.

PAST MEDICAL HISTORY

A 60-year-old man with a medical history significant for allergic rhinitis, hyperlipidemia, paroxysmal atrial fibrillation, cardiomyopathy, and obesity was referred to the cardiac electrophysiologist to explore treatment for his paroxysmal atrial fibrillation. The patient's paroxysmal atrial fibrillation had been difficult to medically manage, resulting in tachycardia-induced cardiomyopathy. The patient's medications included losartan potassium, loratadine, atorvastatin calcium, folic acid, rivaroxaban, fluticasone propionate, and metoprolol succinate. The patient's beta-blocker was withheld for 2 days prior to ablation. Physical examination revealed an irregular cardiac rhythm, a heart rate of 90 beats/min, and blood pressure of 132/88 mm Hg. The patient reported breathlessness on exertion and 2 recent episodes of blurry vision; he denied chest pain, chest pressure, palpitations, dizziness, lightheadedness, or loss of consciousness. The patient did not have any pre-existing coronary artery disease. After a discussion of the risks and benefits of various treatment options, the patient elected to proceed with cryo-balloon PVI.

DIFFERENTIAL DIAGNOSIS

The patient presented with ST-segment elevation myocardial infarction toward the end of his PVI ablation and after IV adenosine was administered. He experienced an acute deterioration of his hemodynamic status. The differential diagnosis included vasospasm from cryoablation, allergic reaction to IV contrast material, or idiosyncratic reaction to IV adenosine infusion. Vasospasm from cryoablation was excluded because the timing of the symptoms correlated with the administration of adenosine, which was almost 20 minutes after completion of the cryoablation therapies. The patient had no history of allergic reactions to IV contrast material. He underwent cardiac catheterization the same day and the subsequent day and had no reaction to the contrast material.

INVESTIGATIONS

Immediate coronary angiography was performed via the arterial line already in situ (Figures 1 and 2).

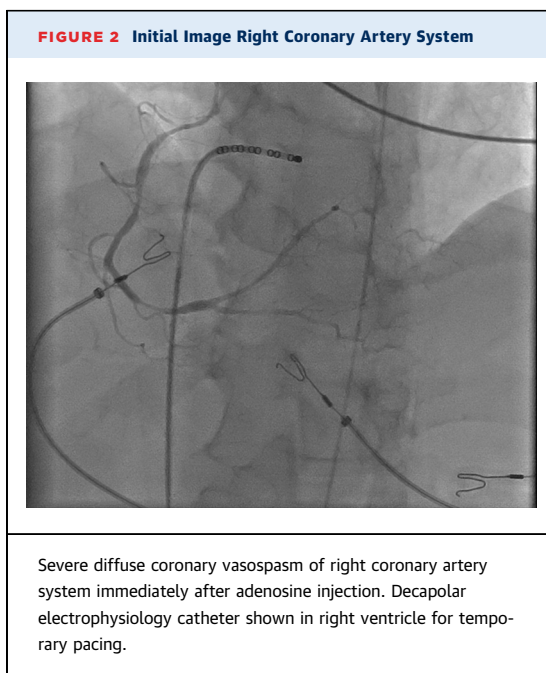


FIGURE 4 Improvement Right Coronary Artery System



Image obtained after administration of intracoronary nitroglycerin injection, showing improvement in right coronary artery system.

FIGURE 5 Repeated Coronary Angiogram Left Coronary Artery System



Follow-up coronary angiogram 24 hours after ablation shows resolution of coronary spasms and return of normal flow to left coronary artery system.

Severe diffuse coronary artery spasm was observed in both the right and left coronary arteries.

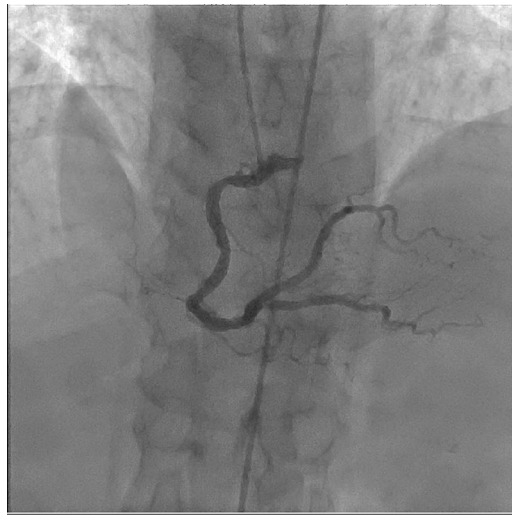
MANAGEMENT (MEDICAL/INTERVENTIONS)

Temporary RV pacing was initiated at 600 ms, and immediate coronary angiography was performed via the arterial line already in situ (Figures 1 and 2). Severe diffuse coronary artery spasms were observed in both the right and left coronary arteries. Intracoronary nitroglycerin progressively relieved the spasm and improved flow over the next 30 minutes, with resolution of the complete heart block and ST-segment elevation (Figures 3 and 4). The patient was transferred to the coronary care unit and given maintenance IV nitroglycerin drip. His troponin I peaked at 15 ng/mL, and a repeated coronary angiogram the following day showed no significant residual epicardial coronary artery abnormality (Figures 5 and 6).

DISCUSSION

Adenosine IV exerts its antiarrhythmic effects on the sinus node, AV node, and atrial tissue owing to its effects on potassium conductance and antiadrenergic actions, resulting in slowed AV node conduction and block as well as sinus slowing and arrest.⁵ It is a safe pharmacological agent used during noninvasive stress testing,⁶ is occasionally suspected as a cause of chest pain, electrocardiographic changes of ST-segment elevation, coronary spasm, heart block,^{7,8} and rarely myocardial infarction.⁹ We present a clearly documented case of such an effect, occurring unusually in the context of PVI, the standard protocols of which frequently call for multiple high-dose central venous or intracardiac adenosine injections to check for dormant conduction.¹⁻³ The use of IV adenosine to check for dormant conduction in PVI ablation is a common practice, although there are conflicting data to support the utility of further ablating for such conduction.¹⁰

FIGURE 6 Repeated Coronary Angiogram Right Coronary Artery System



Follow-up coronary angiogram 24 hours after ablation shows resolution of coronary spasms and return of normal flow to right coronary artery system.

FOLLOW-UP

The patient returned the following day for repeated coronary angiography, which showed no significant coronary artery disease (**Figures 5 and 6**).

CONCLUSIONS

Given the rare but life-threatening potential complications of IV adenosine and the common use of it for checking for latent PVI conduction, there should be increased awareness, prompt recognition, and adequate intervention protocols set in place. We also advance that repeated use of IV adenosine and similar-class medications should be deemed contraindicated in patients noted to have this paradoxical response.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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REFERENCES

1. Squara F, Liuba I, Chik W, Santangeli P, et al. Electrical connection between ipsilateral pulmonary veins: prevalence and implications for ablation and adenosine testing. *Heart Rhythm*. 2015;12:275-282.
2. Arentz T, Macle L, Kalusche D, et al. "Dormant" pulmonary vein conduction revealed by adenosine after ostial radiofrequency catheter ablation. *J Cardiovasc Electrophysiol*. 2004;15:1041-1047.
3. Hachiya H, Hirao K, Takahashi A, et al. Clinical implications of reconnection between the left atrium and isolated pulmonary veins provoked by adenosine triphosphate after extensive encircling pulmonary vein isolation. *J Cardiovasc Electrophysiol*. 2007;18:392-398.
4. Miyazaki S, Kuwahara T, Kobori A, et al. Impact of adenosine-provoked acute dormant pulmonary vein conduction on recurrence of atrial fibrillation. *J Cardiovasc Electrophysiol*. 2012;23:256-260.
5. Wilbur SL, Marchlinski FE. Adenosine as an antiarrhythmic agent. *Am J Cardiol*. 1997;79(12, suppl1):30-37.
6. Cerqueira MD, Verani MS, Schwaiger M, Heo J, Iskandrian AS. Safety profile of adenosine stress perfusion imaging: results from the Adenoscan Multicenter Trial Registry. *J Am Coll Cardiol*. 1994;23:384-389.
7. Golzar J, Mustafa SJ, Movahed A. Chest pain and ST segment elevation three minutes after completion of adenosine pharmacological stress testing. *J Nucl Cardiol*. 2004;11:744-746.
8. Raza JA, Khan NU, Mustafa JS, Movahed A. ST segment elevation during adenosine pharmacological stress testing in a patient with coronary artery disease. *Am Heart Hosp J*. 2009;7:E122-E124.
9. Polad JE, Wilson LM. Myocardial infarction during adenosine stress test. *Heart*. 2002;87:E2.
10. Dixit S, Lin D, Frankel DS, Marchlinski FE. Catheter ablation for persistent atrial fibrillation. *Circ Arrhythm Electrophysiol*. 2012;5:1216-1223.

KEY WORDS adenosine, atrial fibrillation, pulmonary vein isolation, ST-segment elevation myocardial infarction, vasospasm