CASE REPORT

Clinical Significance of Upsloping ST Depression on Resting Electrocardiogram

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Introduction: Upsloping ST depression is generally not associated with myocardial ischemia, yet there have been published reports that suggest otherwise.

Case History: A 34-year-old pregnant female presented with chest pain and palpitations. She was found to have supraventricular tachycardia, which resolved with intravenous adenosine. Few minutes later her ECG showed upsloping ST depression in leads V4–V6 that persisted for 1 hour after the resolution of the tachycardia. The patient was discharged in stable condition with outpatient follow-up.

Conclusion: Upsloping ST depression in resting electrocardiogram may indicate cardiac ischemia in the presence of active cardiac symptoms. In the absence of ongoing symptoms however, it may be secondary to conditions other than ischemia.

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ECG; upsloping ST depression; ischemia

INTRODUCTION

Upsloping ST depression has not been considered an electrocardiographic manifestation of ischemia, as it is often seen with increased heart rate.¹ The current Third Universal Definition of Myocardial Infarction document states that horizontal or downsloping ST depression is a sign of ischemia, whereas upsloping ST depression pattern is not specified as indicative of ischemia.² Moreover, guidelines by both American Heart Association/American College of Cardiology³ and European Society of Cardiology⁴ do not recognize upsloping ST depression as indicative of ischemia. Nevertheless, over the past few decades, there have been several published reports suggesting a link between upsloping ST depression and myocardial ischemia.^{5–8} Therefore, accurate interpretation of upsloping ST depression seen on ECG is important, as it directs decision-making in patient management. We hereby present a case of a young pregnant female, who had transient upsloping

ST depression after resolution of an episode of supraventricular tachycardia. Using this case as an example, we attempt to explain the importance of interpreting ECGs in the appropriate clinical context.

CASE HISTORY

Our patient was a 34-year-old female with no significant past medical history, who presented to the Emergency Department with intermittent palpitations for the past 5 hours. The palpitations were accompanied with mild chest pressure, and the episodes lasted few minutes. She denied shortness of breath, dizziness, lightheadedness, and syncope. She was 16 weeks pregnant, and her course of pregnancy had been unremarkable. She denied ever having any history of palpitations, known arrhythmia or syncope. There was no significant family history of cardiac disease. She

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Figure 1. Twelve lead electrocardiograms of the patient. (A) Initial ECG obtained on presentation to the Emergency Room showing supraventricular tachycardia, (B) postadenosine ECG showing conversion to normal sinus rhythm, along with upsloping ST depressions in leads V4–V6, (C) resolution of upsloping ST depressions on repeat ECG obtained an hour later

denied history of cigarette smoking, alcohol and drug abuse. Apart from supplemental iron pills and multivitamin tablets, she was not taking any other medications.

On presentation, she was found to have heart rate of 181 beats per minute and arterial blood pressure of 106/64 mmHg. Physical examination was unremarkable. A 12-lead electrocardiogram (Fig. 1A) revealed supraventricular tachycardia, likely an AV nodal reentrant tachycardia. Of note, there were 1-mm upsloping ST depressions in leads V4–V6 in addition to horizontal ST depression in the inferior leads. She was given intravenous adenosine 6 mg, with subsequent conversion to sinus rhythm. The immediate postconversion

ECG (Fig. 1B) continued to show upsloping ST depressions with tall T waves in leads II, aVF, and V4–V6. These changes resolved after one hour as seen on the subsequent ECG (Fig. 1C). Laboratory work up was unremarkable with negative cardiac enzymes and hemoglobin of 15.6 mg/dL. The patient was discharged in stable condition with outpatient follow up.

DISCUSSION

The clinical significance of upsloping ST depressions in patients with or without tachycardia has been a subject of debate over the years, and mostly

been ignored. Unlike for horizontal or downsloping ST depression, several experts have downplayed the correlation between upsloping ST depression and myocardial ischemia.⁹

In 1955, Pruitt et al.⁵ described a patient who presented with acute onset of severe chest pain. After an hour of presentation, the ECG showed new upsloping ST depression with tall T waves in leads V3–V5. Following day, the patient demonstrated mild ST elevation in V2–V3 followed by terminal T wave inversion in the precordial leads, indicating postischemic changes. In this case, upsloping ST depression in the presence of chest pain clearly indicated myocardial ischemia. In 2008, de Winter et al.⁶ described the same ECG pattern in patients with proximal left anterior artery (LAD) subtotal occlusion based on retrospective review of database of percutaneous coronary interventions. These findings were described as 1- to 3-mm upsloping ST-segment depression at the J point in leads V1–V6 that continued into tall, positive symmetrical T waves. The QRS complexes were not significantly widened, and there was poor R wave progression in some cases. These ECG findings of upsloping ST depression were seen in 30/1532 (2%) patients with proximal LAD occlusion. Later on, Nikus et al. described a patient with acute myocardial infarction secondary to left circumflex subocclusion that presented with similar ECG pattern of upsloping ST depression.⁷ It has also been described that patients presenting with such an ECG pattern may progress to typical ST elevation myocardial infarction.¹⁰ Recently, a consensus document recommended that this pattern, if seen in a patient with suggestive ongoing symptoms and without tachycardia, should be considered as an indication for urgent reperfusion therapy by percutaneous coronary intervention.¹⁰

All of the above described findings suggest correlation between upsloping ST depression and myocardial ischemia. However, it is of paramount importance to understand that this association only holds true in the appropriate clinical context, that is, presence of cardiac symptoms to suggest ischemia, as emphasized by Pruitt et al.⁵ and Birnbaum et al.¹⁰ In our patient, transient upsloping ST depression after an episode of supraventricular tachycardia does not warrant any further ischemic work up. The pattern of cardiac electrical activity as depicted by ECG is affected by a several factors, including ischemia, reperfusion or presence of necrosis.¹⁰ Accurate

interpretation of ECG is therefore important to guide management of patients, especially those present with cardiac symptoms. The accuracy is much improved if ECG interpretation is done at bedside, taking into account the clinical picture of the patient.

CONCLUSION

In summary, if an ECG is seen with upsloping ST depressions in a patient with active cardiac symptoms without tachycardia, he or she should be dealt like someone having active ischemia due to subocclusion of an epicardial coronary artery and urgent coronary angiography should be considered. On the other hand, if an ECG is seen with upsloping ST depressions in an asymptomatic patient, or if presentation is atypical, it may not indicate ischemia, as seen in our patient.

DISCLOSURES

The authors declare no competing interests. There has been no prior publication of any part of this manuscript. The manuscript is not under consideration or review at any other journal. No funding was obtained from any individual or organization for this manuscript.

AUTHORS' CONTRIBUTIONS

YB conceived the idea to write the case report and helped draft the manuscript. UK carried out the literature search, reviewed the case history and participated in the write-up of the manuscript. Both authors read and approved the final manuscript.

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