Challenges in Clinical Electrocardiography

A Distinctive Pattern With Coexisting Malignant Arrhythmias

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Case Presentation

A man in his late 50s presented to the cardiology department with spontaneous chest tightness and palpitations in the early hours of the morning. Cardiovascular risk factors included hypertension and cigarette smoking. On admission, physical examination revealed normal findings. The initial electrocardiogram showed no visible abnormalities. Laboratory results revealed normal troponin and electrolyte levels. Echocardiography demonstrated normal left ventricular ejection fraction without focal wall motion abnormalities. During hospitalization, the patient experienced a recurrence of symptoms, accompanied by a sudden drop in blood pressure to 60/40 mm Hg, which resolved spontaneously within 10 minutes. Holter monitoring results during the self-terminating episode are shown in the **Figure**.

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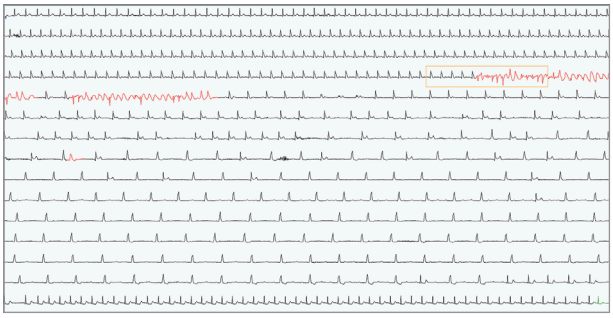
Questions: What is the unusual electrocardiographic pattern and what could be its underlying causes?

Interpretation

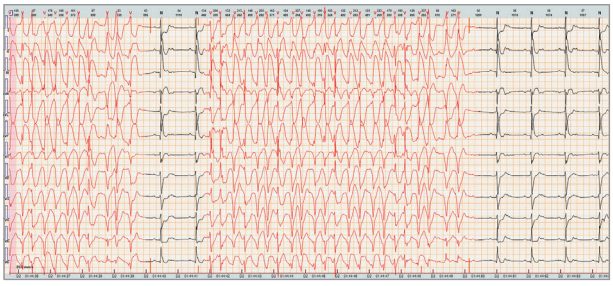
The timing of the arrhythmic episodes was closely correlated with the patient's symptoms. Holter monitoring documented a transient downsloping ST-segment elevation (STE), followed by polymorphic ventricular tachycardia (VT) and 2:1 atrioventricular (AV) block, progressing to complete AV block and subsequent recovery of the STE, with spontaneous reversion to normal sinus rhythm in the Figure. Based on these findings, variant angina was suspected. The QRS-ST-T complexes with downsloping STEs in leads II, III, aVF, and V_6, resembling the lambda-like waveforms, were associated with both types of malignant arrhythmias in this case.

Figure. Electrocardiographic (ECG) Findings

A Single-lead Holter monitoring



B Corresponding 12-lead ECG



A, The episode of markedly down-sloping ST-segment elevation (box) was followed by a brief episode of 2:1 atrioventricular (AV) block, which progressed to complete AV block, complicated by polymorphic ventricular tachycardia (VT) in lead II. B, The ST-segment elevations had a lambda shape in leads II, III, aVF, and V_6, with ST-segment depressions observed in leads I, aVL, and V_1 through V_5, accompanied by the polymorphic VT and 2:1 AV block.

Clinical Course

The ergonovine or acetylcholine provocation test was not performed because of the patient's recent life-threatening arrhythmias. Coronary angiography revealed 95% stenosis in the middle segment, 80% stenosis in the distal segment of the right coronary artery (RCA), and 90% stenosis in the proximal segment of the marginal branch. Subsequently, stent implantation was performed in the RCA. The patient was prescribed aspirin, clopidogrel, diltiazem, isosorbide dinitrate, and atorvastatin. During the 6-month follow-up, the patient remained symptom-free, and no further episodes of arrhythmias were recorded on repeated Holter monitoring.

Discussion

Prinzmetal angina,[1] also known as vasospastic angina (VA), is characterized by transient STE accompanied by episodic chest pain, often triggered by coronary vasospasm, with or without significant organic stenosis. VA is strongly associated with life-threatening arrhythmias, such as polymorphic VT, ventricular fibrillation, high-degree AV block, and asystole.[2] These arrhythmias increase the risk of syncope and/or sudden cardiac death.[3] A previous study revealed that the risk of sudden death within 26 months following hospital discharge was 42% in patients with VA who have documented malignant arrhythmias during spontaneous attacks compared to only 6% in patients without arrhythmias.[4]

The electrocardiographic features observed in this case are particularly noteworthy. An uncommon pattern in the inferior and anterolateral leads was defined as the lambda wave in a young man without underlying myocardial ischemia.[5,6] The lambda wave has been reported to be associated with polymorphic VT, ventricular fibrillation, and sudden cardiac death.[6] This waveform has been reported in other cardiac conditions, including Takotsubo cardiomyopathy, acute STE myocardial infarction, hemopericardium, and acute myopericarditis.[7] Recently, this waveform in VA, as a high-risk marker of lethal arrhythmias, was termed the lambda pattern in multiple leads. Consequently, VA should be considered a relevant differential diagnosis in patients presenting with lambda-like STE in the inferior and anterolateral leads.

Episodes of the lambda pattern associated with a single arrhythmia due to coronary vasospasm have been described; however, the

lambda pattern followed by coexisting tachyarrhythmic and bradyarrhythmic complications has rarely been featured in the medical literature. In our case, the lambda pattern in the inferior and anterolateral leads was associated with high-degree AV block complicated by polymorphic VT, which led to hemodynamic instability.

Transient STEs with reciprocal depressions, indicating transmural myocardial ischemia due to the total occlusion of 1 or more vessels by vasospasm, are typical electrocardiographic changes in VA.[2] Coronary vasospasm primarily occurs at sites of preexisting organic stenosis and is often superimposed on these lesions.[3] In patients with critical fixed lesions, even minimal changes in coronary artery caliber can trigger lethal arrhythmias. Nevertheless, no direct relationship has been established between the severity of coronary stenosis and the occurrence of malignant arrhythmias.

The type of arrhythmia primarily depends on the coronary vessels involved. Bradyarrhythmias are commonly associated with STE in the inferior leads, typically resulting from RCA vasospasm. In contrast, ventricular arrhythmias may be associated with STE in the anterior leads, associated with vasospasm of the left anterior descending artery. In addition, ventricular arrhythmias can be related to STE in the inferior leads.

However, the precise underlying mechanisms remain unclear. Both types of arrhythmias are closely correlated with the severity of myocardial ischemia, as measured by the degree, extent, and duration of STE. The lambda pattern reflects increased transmural heterogeneity of ventricular repolarization, which increases the susceptibility to ventricular tachyarrhythmias in VA.[3] This is particularly true in the setting of myocardial ischemia.

Identifying and addressing the underlying cause of the lambda pattern are crucial for reversing malignant arrhythmias and preventing recurrence. Percutaneous coronary stent implantation can prevent the recurrence of life-threatening arrhythmias in patients with VA and severe organic stenosis. Calcium channel antagonists and nitrates, in addition to smoking cessation, are highly effective in preventing coronary vasospasm and related arrhythmias.[2] Although more definitive recommendations for the application of implantable cardioverter defibrillator or permanent pacemaker in patients with refractory VA require further investigation, current medical literature suggests that such interventions can be lifesaving.[2,3] This case demonstrates the importance of the prompt identification of the lambda pattern and its evaluation for a reversible underlying cause.

Take-Home Points

- Holter monitoring can play a supportive role in establishing a diagnosis of VA and assessing the effectiveness of medical therapy.
- The lambda pattern has rarely been reported to be associated with the coexistence of both types of malignant arrhythmias during an angina event.
- The lambda pattern, which reflects the severity of myocardial ischemia, may indicate impending and coexisting malignant arrhythmias, which can result in hemodynamic compromise in variant angina.
- Understanding the underlying causes of the lambda pattern can guide diagnostic and therapeutic decisions.

ARTICLE INFORMATION

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