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Case Report

Brugada-pattern electrocardiogram in propranolol intoxication

Abstract

Brugada syndrome is characterized by the electrocardiographic (ECG) pattern of right bundle-branch block (RBBB) with a high take-off, coved ST-segment elevation in the precordial leads V_1 to V_3, and the risk of sudden cardiac death [1]. Typically, there is no evidence of structural heart disease. In many cases, Brugada syndrome has been linked to a mutation of the gene SCN5A, which encodes for the fast cardiac sodium channel. In patients with the Brugada syndrome, pharmacologic sodium channel blockade can increase the degree of ST-segment elevation [2]. Interestingly, even in patients with a normal baseline ECG and no clinical suggestion of the Brugada syndrome, toxic doses of class I antiarrhythmic agents as well as toxicities with several nonantiarrhythmic drugs that possess sodium channel blocking properties can induce the Brugada ECG abnormality [3-5]. Specifically, the β-receptor blocker propranolol, at high doses, binds to the cardiac sodium channels and inhibits sodium uptake [6]. In this report, we describe a case of severe propranolol toxicity, which resulted in the Brugada ECG pattern in an otherwise healthy individual who had no clinical or ECG suggestion of the genetically determined Brugada syndrome.

A 34-year-old white woman with a long history of major depressive disorder and multiple prior suicide attempts presented to our emergency department after ingestion of "large amounts" of clonazepam and propranolol. The exact quantities of tablets were not known. Upon arrival, the patient was unresponsive, bradycardic, and hypotensive with shallow respirations requiring immediate intubation and mechanical ventilation. She received glucagon and naloxone. The initial electrocardiogram (ECG) demonstrated widened QRS complexes with a RBBB pattern, and high take-off, coved ST-segment elevation followed by negative T waves in leads V_1 and V_2 (Fig. 1A). This ECG finding is consistent with a type I Brugada pattern [7].

On the second hospital day, the patient was extubated. She denied any history of syncopal episodes. She had no known family member with a history of unexplained syncope or sudden cardiac death. Repeat ECGs revealed a gradual narrowing of the QRS complexes and resolution of both the RBBB pattern and the ST-segment elevation in leads V_1 and V_2 (Fig. 1B). The patient had an uneventful hospital stay and was discharged to an inpatient psychiatric facility.

Initial laboratory evaluation revealed a normal metabolic panel. The urine drug screen was notable for barbiturates, benzodiazepines, and propranolol. The quantitative urine propranolol level was extremely high at more than 50 000 ng/mL (normal, <5 ng/mL).

Propranolol, a nonselective β-adrenergic blocker, decreases the heart rate, blood pressure, myocardial contractility, and myocardial oxygen demand. β-Blocker toxicity, in general, is associated with ECG changes including sinus bradycardia, first-degree AV block, prolongation of the QRS interval, and prolonged QTc [8]. The prolonged QRS or intraventricular conduction delay appears to be specific for propranolol toxicity; it is thought to be related to its membrane-stabilizing or sodium channel blocking properties [9,10]. In the genetic Brugada syndrome, the differential expression of the cardiac sodium channel between the epicardium and endocardium yields both the characteristic electrocardiographic findings and the increased risk for ventricular tachyarrhythmias and sudden cardiac death [7]. The ability of severe propranolol toxicity to induce the electrocardiographic Brugada pattern in patients who do not have the genetic Brugada syndrome may be related to the fact that propranolol, in high doses, causes an abbreviation in the action potential duration in the ventricular endocardium but prolongation of the action potential duration in the epicardium [11].

In a recent case report, the Brugada syndrome was unmasked in a patient who had an intentional intoxication with propranolol [12]. To our knowledge, the current report is the first to describe a case of the Brugada ECG pattern induced by severe propranolol toxicity in a subject who did not have any clinical or ECG suggestion of the genetic Brugada abnormality.

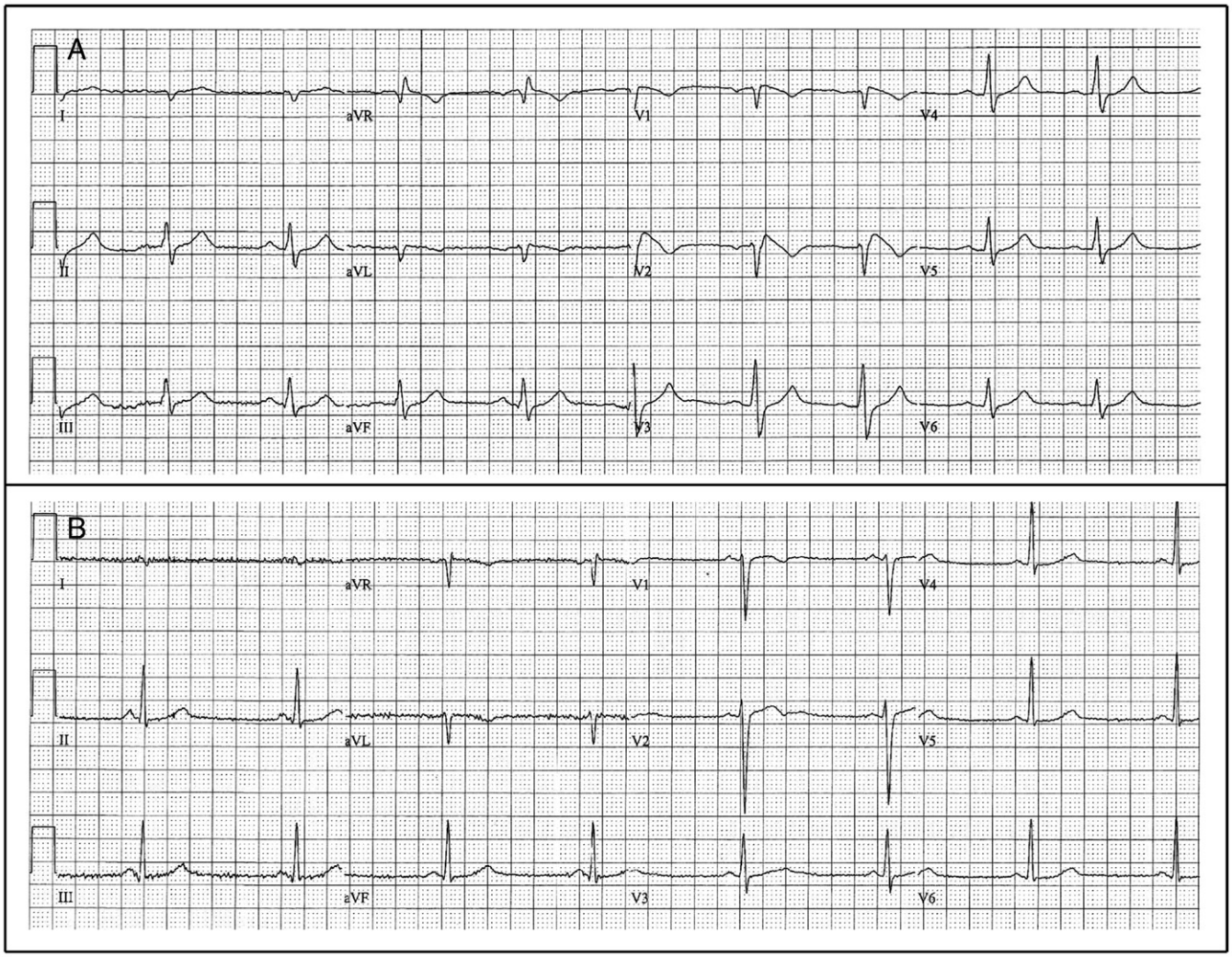

Fig. 1 Electrocardiogram obtained upon presentation to the emergency department (panel A) reveals sinus bradycardia, a rightward QRS axis, and widened QRS complexes measuring 136 milliseconds. Also note the high take-off, coved ST-segment elevation followed by negative T waves in leads V_1 and V_2, consistent with a type I Brugada pattern. The electrocardiogram 3 days later (panel B) continued to show sinus bradycardia with a vertical QRS axis, but the QRS duration was normal (96 milliseconds), and the Brugada pattern was no longer present.

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References

[1] Brugada P, Brugada J. Right bundle branch block, persistent ST segment elevation and sudden cardiac death: a distinct clinical and electrocardiographic syndrome. J Am Coll Cardiol 1992;20:1391-6.
[2] Miyazaki T, Mitamura H, Miyoshi S, et al. Autonomic and antiarrhythmic drug modulation of ST segment elevation in patients with Brugada syndrome. J Am Coll Cardiol 1996;27:1061-70.
[3] Littmann L, Monroe MH, Kerns WP, et al. Brugada syndrome and "Brugada sign": clinical spectrum with a guide for the clinician. Am Heart J 2003;145:768-78.
[4] Hudson CJ, Whitner TE, Rinaldi MJ, et al. Brugada electrocardiographic pattern elicited by inadvertent flecainide overdose. Pacing Clin Electrophysiol 2004;27:1311-3.
[5] Littmann L, Monroe MH, Svenson RH. Brugada-type electrocardiographic pattern induced by cocaine. Mayo Clin Proc 2000;75:845-9.
[6] Frishman WH. Clinical pharmacology of the new beta-adrenergic blocking drugs: I. Pharmacodynamic and pharmacokinetic properties. Am Heart J 1979;97:663-71.
[7] Antzelevitch C, Brugada P, Borggrefe M, et al. Brugada syndrome: report of the second consensus conference. Circulation 2005;111:659-70.
[8] Love JN, Enlow B, Howell JM, et al. Electrocardiographic changes associated with β-blocker toxicity. Ann Emerg Med 2002;40:603-10.
[9] Buiumsohn A, Eisenberg ES, Jacob H, et al. Seizures and intraventricular defect in propranolol poisoning: a report of two cases. Ann Intern Med 1979;91:860-2.
[10] Henry JA, Cassidy SL. Membrane stabilising activity: a major cause of fatal poisoning. Lancet 1986;I:1414-7.
[11] Krishnan SC, Antzelevitch C. Sodium channel block produces opposite electrophysiological effects in canine ventricular epicardium and endocardium. Circ Res 1991;69:277-91.
[12] Aouate P, Clerc J, Viard P, et al. Propranolol intoxication revealing a Brugada syndrome. J Cardiovasc Electrophysiol 2005;16:348-51.