SAS Journal of Medicine
Abbreviated Key Title: SAS J Med
ISSN 2454-5112
Journal homepage: https://saspublishers.com

OPEN ACCESS

Cardiology

Beyond QRS Widening: Flecainide Toxicity as a Novel Cause of Pacemaker Failure: A Case Report

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DOI: https://doi.org/10.36347/sasjm.2025.v11i05.030 | **Received:** 14.04.2025 | **Accepted:** 19.05.2025 | **Published:** 23.05.2025

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Abstract **Case Report**

Background: Flecainide is a class Ic antiarrhythmic agent used for the management of atrial fibrillation. However, it has a narrow therapeutic index and can cause significant toxicity, particularly in patients with renal impairment. We present a case of flecainide intoxication in a pacemaker-dependent patient, resulting in massive pacemaker dysfunction. ***Case Report:*** A 62-year-old male with a history of atrial fibrillation and sick sinus syndrome, managed with flecainide and a dual-chamber pacemaker, presented to the emergency department following a syncopal episode. He had recently been diagnosed with renal impairment due to dehydration. Initial ECG revealed a markedly widened QRS complex and absence of sinus rhythm. Pacemaker interrogation showed significantly increased atrial and ventricular thresholds (2V and 5V, respectively) and reduced device longevity despite recent implantation. A sodium bicarbonate test resulted in significant clinical improvement, supporting the diagnosis of flecainide toxicity. ***Conclusions:*** Flecainide toxicity can lead to life-threatening pacemaker dysfunction, particularly in patients with renal impairment. Prompt recognition and treatment with sodium bicarbonate can reverse the toxic effects and restore pacemaker function.

Keywords: Flecainide intoxication, pacemaker dysfunction, sodium bicarbonate, renal impairment.

BACKGROUND

Flecainide is a class Ic antiarrhythmic agent commonly used for the treatment of atrial fibrillation and other supraventricular arrhythmias in patients without known structural or ischemic cardiac disease [1]. While effective, flecainide can cause significant toxicity, due to its narrow therapeutic index, decreased clearance in kidney or liver injury and interaction with other medications, particularly in patients with structural heart disease [2]. Toxicity may manifest as QRS widening, bradycardia, cardiac arrest, acute heart failure and, in pacemaker-dependent patients, pacemaker dysfunction [3, 4]. All of which can be life-threatening if not promptly recognized. We present a case of flecainide intoxication secondary to an acute kidney injury in a 62-year-old male with dual-chamber pacemaker, highlighting the challenges in diagnosis and management.

CASE PRESENTATION

A 62-year-old male with a history of atrial fibrillation and sick sinus syndrome, managed with flecainide 100 mg twice daily and a dual-chamber pacemaker implanted two years prior, presented to the emergency department following a syncopal episode. In the days leading up to his presentation, he had been evaluated by his primary care physician and found to have impaired renal function secondary to dehydration.

On arrival, the patient was hemodynamically stable but reported generalized weakness and lightheadedness. Physical examination revealed no focal neurological deficits. Initial ECG demonstrated a markedly widened QRS complex (280 ms) and absence of sinus rhythm. Laboratory studies revealed elevated serum creatinine, consistent with acute kidney injury. *Echocardiographic evaluation demonstrated neither signs of ischemic pathology nor impairment in the left ventricular ejection fraction.*

A pacemaker interrogation was performed, it revealed a significant increase in pacing thresholds, with atrial and ventricular thresholds rising to 2 V and 5 V, respectively. Additionally, the pacemaker exhibited reduced longevity despite being implanted only two years prior. These findings were consistent with flecainide-induced increases in myocardial capture thresholds.

Serum flecainide levels were unavailable due to resource limitations. Nevertheless, given the clinical suspicion of flecainide toxicity, a sodium bicarbonate test was performed. Administration of intravenous sodium bicarbonate resulted in significant narrowing of the QRS complex and improvement in pacemaker capture, confirming the diagnosis. Flecainide was immediately discontinued, and the patient was started on supportive care, including hydration and close monitoring.

Over the following days, the patient's condition stabilized, with resolution of symptoms and normalization of renal function. His followup pacemaker interrogation showed a significantly improved capture threshold (from 5V to 2V). He was discharged with instructions to avoid flecainide and transitioned to an alternative antiarrhythmic agent.

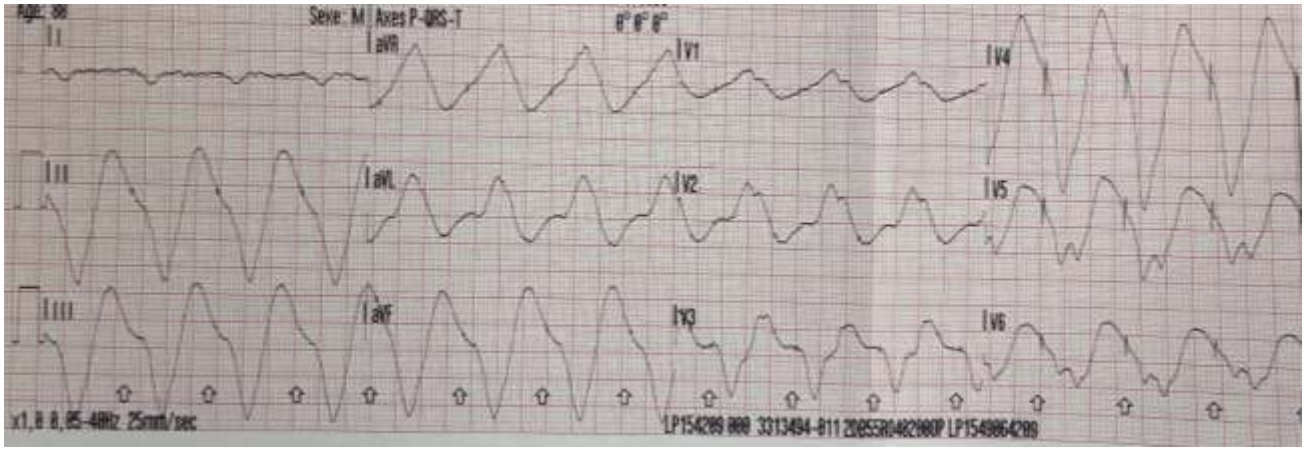

Figure 1: Initial electrocardiogram demonstrating an atrial flutter with a ventricular paced rhythm. We note marked QRS widening (280 ms) due to sodium channel blockade, negative T waves in V1-V3 indicating abnormal re-polarization, as well as intermittent loss of ventricular capture correlating with syncope

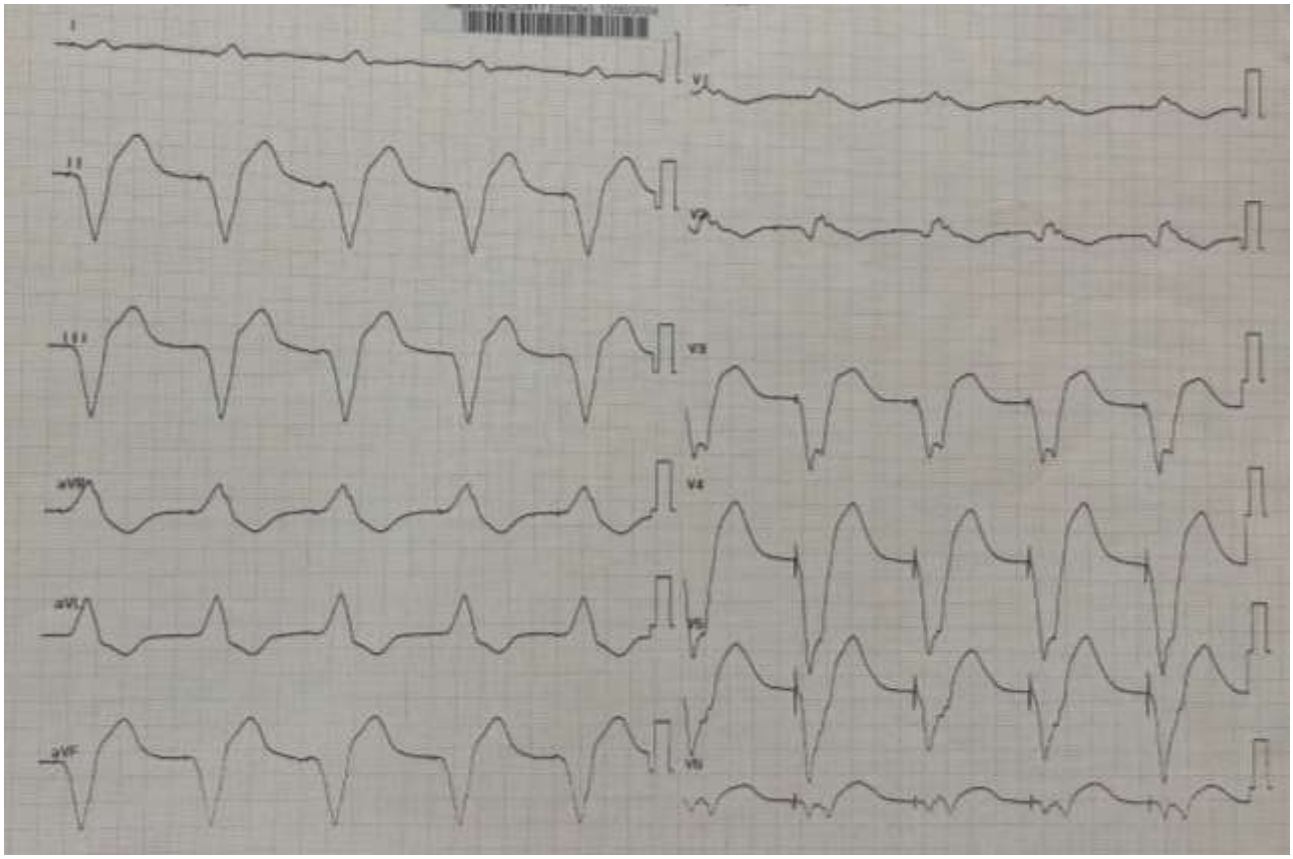

Figure 2: Subsequent electrocardiogram demonstrating ventricular paced rhythm after pacemaker reprogrammed to VVI with a base rate of 65 bpm. We note narrowing of the QRS (200ms)

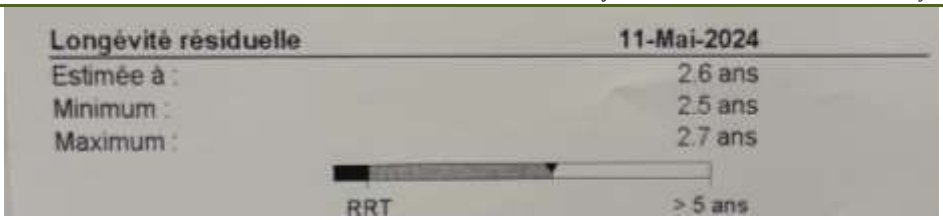

Figure 3: Device interrogation data showing flecainide induced battery depletion: pacemaker longevity reduced to 2.6 years Vs expected 5 years duration

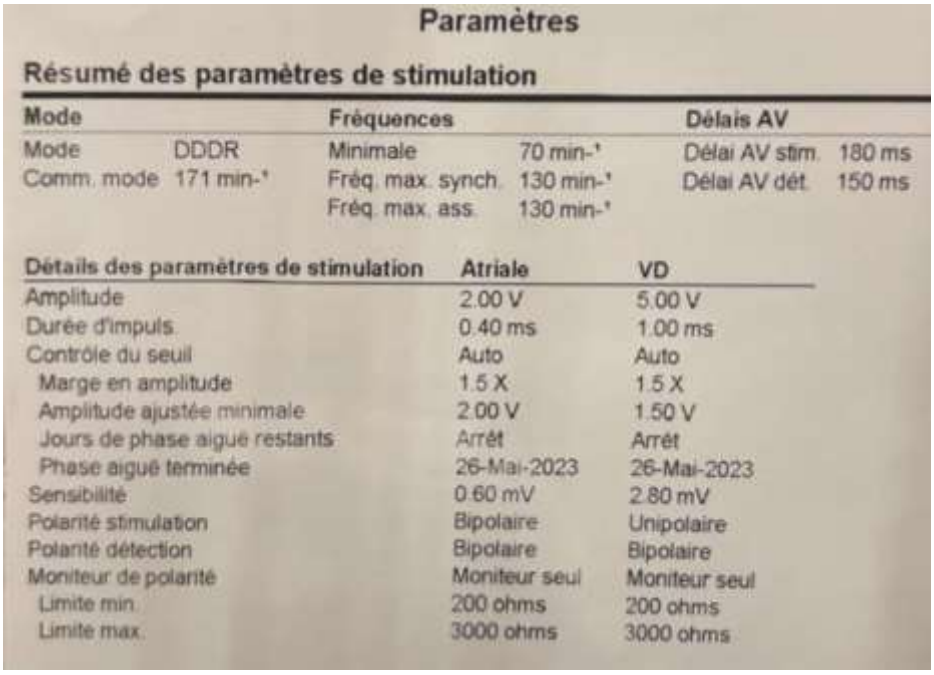

Figure 4: pacemaker interrogation during flecainide toxicity showing ventricular and atrial threshold elevation to 5V at 1.0ms (vs baseline 1.5V) and 2V at 0.4ms (vs normal <1,3V) respectively

DISCUSSION

We describe a case of flecainide toxicity, likely mediated by acute renal failure, in a pacemaker dependent patient, which led to significant impairement of the pacemaker functions.

Flecainide toxicity is a well-documented complication of therapy, particularly in patients with renal impairment or structural heart disease [1, 2]. Its mechanism of action involves the blockade of cardiac sodium channels, which slows the influx of sodium ions during phase 0 of the cardiac action potential. This results in a prolongation of depolarization, manifesting as QRS widening and QT interval prolongation on the ECG [5]. Other reports of flecainide toxicity have demonstrated ECG findings such as right and left bundle branch block. In addition to its electrophysiological effects, flecainide exerts a reversible negative inotropic effect on the left ventricle [6] and has been shown to increase myocardial capture thresholds, even at therapeutic doses [7].

Flecainide's adverse clinical effects may include nausea, vomiting, visual disturbances, and seizure. In major cases, it can lead to unstable bradycardia and cardiogenic shock. In our patient, the QRS complex was found to be severely widened, with a duration greater than 200ms, and pacemaker interrogation demonstrated a significant increase in pacing thresholds, resulting in ventricular capture latency. The intermittent failure to capture can be explained by the device attempting to pace, while the myocardium is in an extended refractory period due to the slowing of the action potential in the conduction system [4].

Although elevated capture thresholds have been well-documented in both atrial and ventricular myocardium in the literature, pacemaker failure secondary to acute flecainide intoxication remains rarely reported [8]. In addition, our case highlights a significantly reduced device longevity in the setting of the intoxication, as well as a rapid reversibility of symptoms following systemic clearance of the drug.

Sodium bicarbonate is a well-established treatment for flecainide toxicity. Its mechanism of action involves alkalization and competitive inhibition of sodium channel blockade, leading to rapid reversal of QRS widening and restoration of pacemaker function

[9]. The marked increase in pacing thresholds, reduced device longevity, as well as the positive response to sodium bicarbonate in this case, were key diagnostic clues to support the diagnosis of flecainide toxicity.

This case also highlights an important clinical consideration: Flecainide is primarily excreted renally, and its half-life is significantly prolonged in patients with renal dysfunction [7]. In this instance, the patient's recent dehydration and subsequent acute kidney injury likely led to flecainide accumulation and toxicity. This consideration underscores the importance of monitoring renal function in patients on flecainide and adjusting or discontinuing the drug in the setting of acute kidney injury. An initial maximum oral dosage of 100mg daily is typically recommended in patients with moderate to severe renal failure as well as in elderly patients [10].

Additionally, clinicians should be aware of the potential for flecainide to cause pacemaker dysfunction, even in patients with recently implanted devices, and must generally be used with caution due to the high probability of undiagnosed coronary artery disease, especially in elderly patients [8].

CONCLUSION

Although Flecainide has many beneficial effects on arrythmia control, its toxicity can lead to life-threatening pacemaker dysfunction, particularly in patients with renal impairment. This case highlights the importance of recognizing flecainide toxicity in pacemaker-dependent patients and the utility of sodium bicarbonate in reversing its effects. Clinicians should exercise caution when prescribing flecainide to patients with renal dysfunction and consider alternative antiarrhythmic agents in high-risk populations.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Availability of data and materials

All data analysed during this study are included in the published articles cited in the section « references »

Competing interests: None.

Funding: None to declare.

Acknowledgements: None to declare.

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