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STUDIUM PRZYPADKU / *CLINICAL VIGNETTE*

Electrical storm secondary to theophylline prescription in a patient with implantable cardioverter defibrillator

Burza elektryczna u chorego z wszczepialnym kardiowerterem defibrylatorem wtórna do przyjętej teofiliny

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We report the case of a 73-year-old obese man (body mass index 32 kg/m^2), with sleep apnoea syndrome, atrial fibrillation, and non-ischaemic dilated cardiomyopathy (left ventricular ejection fraction 30%), who received a biventricular implantable cardioverter defibrillator (ICD) 10 years ago as secondary prevention after several episodes of ventricular tachycardia. He was on optimal medical therapy (candesartan 8 mg/d, bisoprolol 2.5 mg/d, spironolactone 25 mg/d, amiodarone 200 mg/d, and oral anticoagulation). No ventricular arrhythmia was detected since ICD implantation. The patient was referred to the emergency department for dizziness, palpitations, and several ICD shocks. No signs of heart failure were observed on clinical examination. Electrocardiograms showed several premature cardiac complexes. Telemetry revealed an electrical storm with 9 episodes of ventricular fibrillation and tachycardia appropriately treated with shocks and anti-tachycardia pacing (Fig. 1). No abnormalities were found on blood tests. The patient reported theophylline intake for an asthma-like bronchitis for the two preceding weeks at a dose of 400 mg/day concomitant with beta-blocker withdrawal. A favourable outcome was obtained after theophylline suppression, even in the absence of beta-blocker reintroduction. At follow-up, no ventricular arrhythmia was observed during the next 12 months. Triggering factors precipitating an electrical storm in ICD patients are only identified in less than 25% of cases. Theophylline is a phosphodiesterase inhibitor that increases calcium concentration, leading to an increased inotropism and promoting the emergence of post-diastolic late potentials involved in arrhythmogenesis (Fig. 2). The pharmacokinetics of theophylline are moderately vulnerable with a narrow therapeutic range, and are largely influenced by the patient's age and weight. Indeed, in elderly and obese patients, the theophylline half-life can be easily doubled. Furthermore, the clearance of theophylline is significantly reduced in heart failure. For the above reasons, the arrhythmogenic effect of theophylline was potentialised in our patient. To the best of our knowledge, this is the first case of electrical storm due to theophylline prescription in an ICD patient. To conclude, caution should be paid when prescribing theophylline in patients with arrhythmic vulnerability.

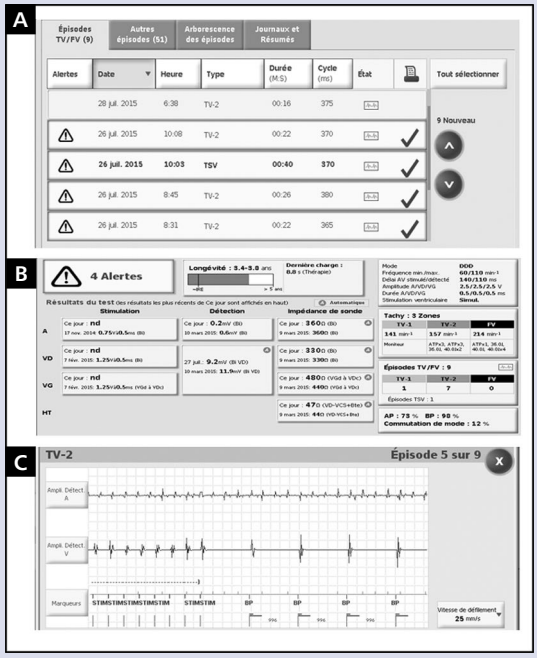

Figure 1. Electrical storm recorded by telemetry; **A.** > 3 episodes of ventricular tachycardia (VT) occurring within 24 h detected by telemetry (in addition to atrial fibrillation [AF] episodes); **B.** Overall summary of the telemetry parameters (9 episodes of ventricular arrhythmias); **C.** VT detected and treated with anti-tachycardia pacing (in addition to AF episodes)

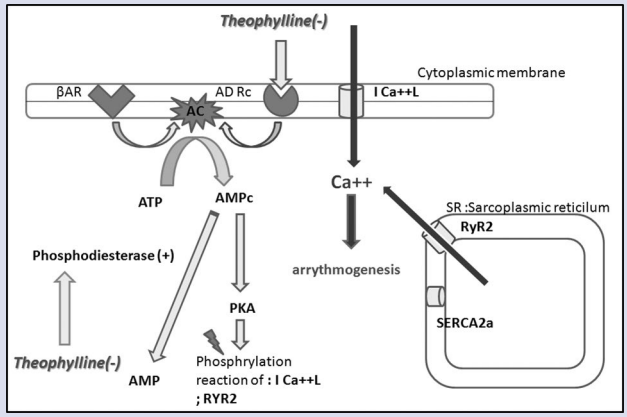

Figure 2. Mechanisms of arrhythmogenic effect of theophylline. Two pathways are involved in the arrhythmogenic effect of theophylline: 1 — The inhibition of the phosphodiesterase which inactivates AMPc. As a result, the increase level of AMPc activates protein kinase A, phosphorylating serine, and threonine residues of a large number of proteins, including L-type Ca^{2+} channel, RyR2, and the SERCA2a-inhibitor phospholamban, which contribute to the arrhythmogenic response via a transient elevation of cellular concentration Ca^{2+}; 2 — The antagonisation of adenosine A1 receptors resulted in an important arrhythmogenic effect. The adenosine receptor is coupled to a GI (inhibitory) protein that inhibits adenylate cyclase. This leads to increased intracellular level of AMPc; βAR — beta-adrenoceptor; AC — adenylyl cyclase; AD Rc — adenosine receptor; AMPc — cyclic adenosine monophosphate; ATP — adenosine triphosphate; I Ca++L — L-type Ca^{2+} channel; PKA — protein kinase A; RyR — ryanodine receptor channel; SERCA2a — sarco/endoplasmic reticulum Ca^{2+}-ATPase

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Conflict of interest: *none declared*