Case Report on Propafenone Toxicity: Terminal R Wave in Lead aVR and Wide QRS Not Specific for TCA Toxicity Only

Patrick Bruss*

The Toledo Hospital, USA

*Corresponding Author: Patrick Bruss, The Toledo Hospital, USA.

Received: September 17, 2019; Published: October 14, 2019

Abstract

Tricyclic Antidepressant (TCA) overdose is associated with terminal R-waves in lead aVR, a wide QRS and other findings due to its Na blocking effects. This case report demonstrates that Na+ blocking medications (like Propafenone in this case) can also have similar finding on the ECG. In this case report, a 71-year old male presented to the ER with a wide complex tachycardia secondary to a supratherapeutic dose of Propafenone. The initial ECG showed WCT with terminal R-waves. Post cardioversion ECG showed a wide QRS and significant terminal R wave present in lead aVR consistent with the hypothesis that Na+ blocking effect of propafenone produces similar ECG findings as TCA overdose.

Keywords: Tricyclic Antidepressant (TCA); ECG; WCT; QRS; aVR

Introduction

To understand the ECG changes associated with various drugs, physicians must have a clear understanding of basic myocardial cell function for Na+ channels. The myocardial cell membrane in its resting state is impermeable to Na+ (Figure 1) [1]. The Na+/K+ ATPase actively pumps three Na+ ions out of cardiac cells while pumping in two K+ ions to maintain a negative electric potential of approximately 90 mV in the myocyte (phase 4). Depolarization of the cardiac cell membrane is caused by the rapid opening of Na+ channels and subsequent massive Na+ influx (phase 0). This Na+ influx causes the rapid upstroke of the cardiac action potential as it is conducted through the ventricles and is directly responsible for the QRS interval of the ECG. The peak of the action potential is marked by the closure of Na+ channels and the activation of K+ efflux channels (phase 1) [1].

The Na+ channel blockers bind to the transmembrane Na+ channels and decrease the number available for depolarization [2]. This creates a delay of Na+ entry into the cardiac myocyte during phase 0 of depolarization. As a result, the upslope of depolarization is slowed and the QRS complex widens [3]. In some cases, the QRS complexes may take the pattern of recognized bundle branch blocks.

Case Report

Presented here is a case of wide complex tachycardia secondary to propafenone (Rythmol) toxicity and the associated ECG findings. A 71-year-old male presents to the ER with palpitations, chest pain, diaphoresis and lightheadedness. He has a history of Atrial Fibrillation and Atrial Flutter and takes Rythmol 225 mg, 1.5 tabs BID. He also has “pill-in-the-pocket” therapy in which the patient takes a single oral dose of an antiarrhythmic drug at the time of the onset of palpitations. On the same day of presentation, in the morning he felt a flare up of his aflutter and took 2 extra tablets of Rythmol. Since his symptoms were not changing he took another 2 tablets equaling a total of...
Case Report on Propafenone Toxicity: Terminal R Wave in Lead aVR and Wide QRS Not Specific for TCA Toxicity Only

*Figure 1:* Cardiac cycle with electrocardiographic tracing. The dotted line represents resulting alterations due to Na⁺ channel blocker toxicity while the dashed line represents alterations due to K⁺ efflux blocker toxicity.

900 mg of Rythmol. By midnight, the patient was not feeling well and was diaphoretic and his palpitations were getting worse, therefore he decided to come to our emergency room. He was found to be in an unstable wide complex tachycardia with HR of 220. He underwent successful synchronized cardioversion and admitted to the hospital. Rythmol was held for 2 days and he was discharged home with no complications.

His ECGs are indicative of the sodium channel toxicity properties of the Rythmol. Figure 2 is his initial ECG on arrival which shows the wide complex tachycardia. Figure 3 is the ECG after cardioversion and figure 4 is his ECG 2 days after holding the Rythmol.

**Citation:** Patrick Bruss. "Case Report on Propafenone Toxicity: Terminal R Wave in Lead aVR and Wide QRS Not Specific for TCA Toxicity Only". *EC Emergency Medicine and Critical Care* 3.11 (2019): 02-06.
There are several differences between figure 3 and figure 4 that are of interest especially in the setting of sodium channel toxicity:

1. **Right axis deviation.** The axis in figure 3 is deviated to the right at 159 degrees while the axis in figure 4 is 17 degrees.
2. **Prolongation of the QRS.** 174 in figure 3 while QRS is 164 in figure 4.
3. **Prolongation of the QTc.** 469 in figure 3 and 448 in figure 4.
4. **Terminal R wave in aVR.** An R wave in aVR greater than 3 mm or an R wave greater than an S wave in aVR is present in figure 3 but not figure 4.
5. **The initial wide complex tachycardia, the improvement of the right axis deviation, the QRS prolongation, the QTc prolongation and the terminal R wave after holding Rythmol reflects the ECG findings suggestive of sodium channel toxicity in this clinical setting.**

Case Report on Propafenone Toxicity: Terminal R Wave in Lead aVR and Wide QRS Not Specific for TCA Toxicity Only

Discussion

It is well-established that TCA agents can generate potentially fatal cardiovascular and neurological effects in poisoned patients, including through overdose [1,4]. Moreover, Na+ channel blocker toxicity is largely attributed to intentional overdose. Propafenone (or Rythmol) is an example of a drug that can induce cardiac Na+ channel blockade [1]. Na+ channel blockade leads to different forms of effects as attested by their impacts on the myocyte action potential. Depending on the potency, class 1 agents reduce slope and amplitude of phase 0, such that it decreases the rate of depolarization, as well as, conduction velocity by means of the myocyte [2]. In turn, this results in a slower depolarization of the cell making it essential for the desired therapeutic suppression of tachydysrhythmias by means of reentrant mechanisms. Indeed, generally, Na+ channel blockers such as Propafenone can lead to metabolic, cardiac, and neurologic symptoms, such as the male patient in this case. Propafenone is noteworthy in that is involved in beta-blocking and calcium blocking activities that can exacerbate toxicity, such that heart failure can ensue as a result of reduced inotropy [2].

It is also important to note that Na+ channel blockers cross the blood-brain barrier and behaves through different systems. For example, these blockers prevent gamma-aminobutyric acid (GABA) system (primarily lidocaine), “activate the sodium ouabain-sensitive current, stimulate 5-TH2C receptors, antagonize H1 receptors and block all noradrenaline activating effect” [2]. These actions result in adrenergic stimulation. In large doses, these medications can also result in convulsions through the aforementioned mechanisms.

Patients, such as the male in the case study, who have potential Na+ channel blocker toxicity, immediately need an ECG. Notably, the ECG has emerged to be a widely-used tool for evaluating TCA toxicity. While the patient’s history and physical examination play primary roles in the assessment of the patient with potential TCA poisoning or overdose, the presence or absence of features of the TCA toxidrome are enough to detect or exclude toxicity from this class of drugs. Moreover, different ECG findings occur with TCA toxicity. Just as importantly, ECG is an important tool in toxicology cases as medications often result in conduction anomalies. Literature recommends ECG predominantly for TCA overdose screening, however, we argue that it can also be used in screening for other Na channel blocking agents [1,2,5]. TCA overdose is associated with terminal R waves in lead aVR, wide QRS/prolonged QRS, and right axis deviation - Na blocking agents in general produce similar ECG findings. Propafenone (or matter of fact any Na blocking agent) can produce identical patterns. Ultimately the ECG is a sensitive but not specific test in helping identify the etiology of the offending agent as determined by their mechanism of action. As for ED physicians, the constraints on availability of laboratory testing make the cost-efficient, and, swift bedside ECG a preferred diagnostic tool [6]. Consequently, it is crucial for the ED physician to recognize findings that may point to severe cardiotoxicity. A highly significant initial finding in severe TCA overdose is a prolonged QRS duration, which was observed in the male patient. Toxicity of Na+ channel blockers results in the widening of the QRS complex, as well as, lengthening of the QT interval, changes in the right axis, “bradydysrhythmias, ventricular tachycardia, ventricular fibrillation or torsades des pointes” [2]. Another adverse effect is brugada phenocopy, which is a sodium channelopathy disorder that may occur in severe toxicity.

Conclusion

The aforementioned ECG findings are not unique to TCA overdoses. These ECG findings can be secondary to any sodium channel blocker toxicity (cocaine, benadryl, dextropropoxyphene, thioridazine, and beta blockers), and have been empirically investigated and extensively discussed in literature. These ECG changes are sensitive but not specific. Patient management is contingent on the ingestions and varies dramatically despite similar ECG aberrations. As with all emergency medicine ECG is a tool which helps guides the clinician but is an adjunct to the remains of the history, physical and laboratory evaluation. This case study has important implications for health professionals, particularly physicians. TCA agents that inhibit sodium channels, also referred to as sodium channel blockers, are classically associated with a terminal R wave in lead aVR and a widened QRS wave on an ECG. Propafenone may be associated with those same ECG changes; therefore, ED physicians need to be aware of these associations in order to determine the timeliest, and best intervention.

Bibliography

Case Report on Propafenone Toxicity: Terminal R Wave in Lead aVR and Wide QRS Not Specific for TCA Toxicity Only


Volume 3 Issue 11 November 2019
©All rights reserved by Patrick Bruss.