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Electrocardiographic changes in amitriptyline overdose

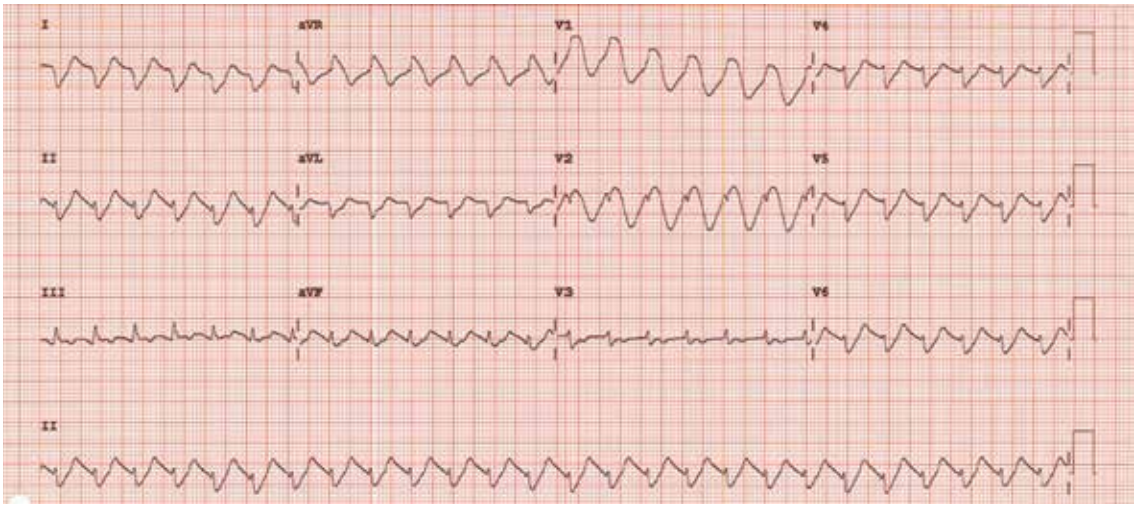

FIGURE 1. The 12-lead electrocardiogram shows regular wide-complex tachycardia with a ventricular rate of 157 beats/min, a QRS duration of 198 msec, a corrected QT interval of 505 msec, and a QRS axis of +179 degrees. Note the negative QRS complexes in leads I and aVL and the R wave amplitude greater than 3 mm in aVR, features typical of amitriptyline overdose.

Blood pressure 64/22 mm Hg
Heart rate 121
Respirations 14
O_2 sat 88% on room air

A 49-YEAR-OLD WOMAN WITH a history of depression, bipolar disorder, and chronic back pain was brought to the emergency department unresponsive after having taken an unknown quantity of amitriptyline tablets.

On arrival, she was comatose, with a score of 3 (the lowest possible score) on the 15-point Glasgow Coma Scale. Her blood pressure was 65/22 mm Hg, heart rate 121 beats per minute, respiratory rate 14 per minute, and oxygen saturation 88% on room air. The rest of the initial physical examination was normal.

She was immediately intubated, put on mechanical ventilation, and given an infusion of a 1-L bolus of normal saline and 50 mmol (1 mmol/kg) of sodium bicarbonate. Norepinephrine infusion was started. Gastric lavage was not done.

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Results of initial laboratory testing showed a serum potassium of 2.9 mmol/L (reference range 3.5–5.0) and a serum magnesium of 1.6 mmol/L (1.7–2.6), which were corrected with infusion of 60 mmol of potassium chloride and 2 g of magnesium sulfate. The serum amitriptyline measurement was ordered at the time of her presentation to the emergency department.

Arterial blood gas analysis showed:

- pH 7.15 (normal range 7.35–7.45)
- $Paco_2$ 66 mm Hg (34–46)
- Pao_2 229 mm Hg (85–95)
- Bicarbonate 22 mmol/L (22–26).

The initial electrocardiogram (ECG) (**Figure 1**) showed regular wide-complex tachycardia with no definite right or left bundle branch block morphology, no discernible P waves, a QRS duration of 198 msec, right axis

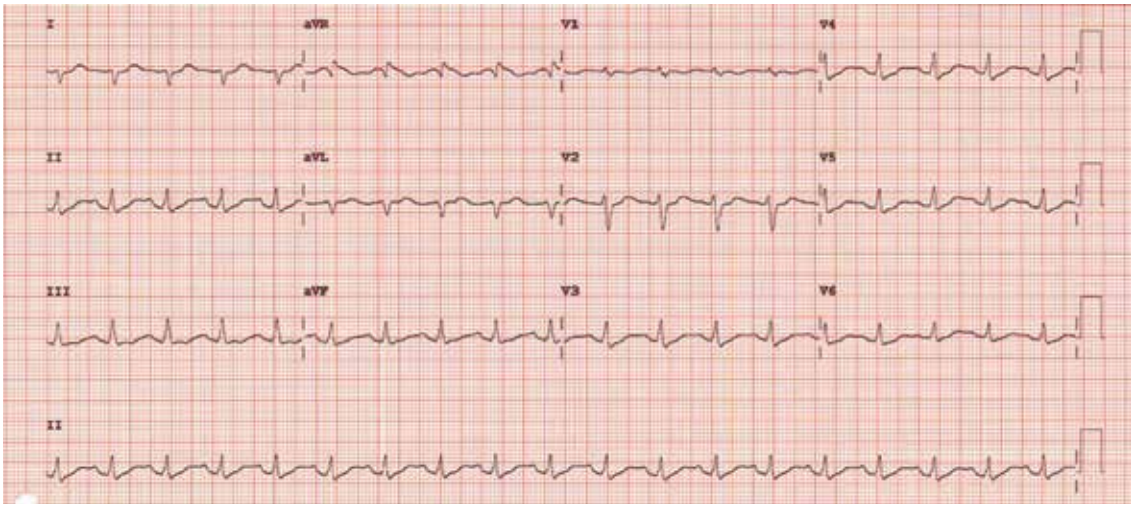

FIGURE 2. The patient's electrocardiogram 1 minute after infusion of 100 mmol of sodium bicarbonate shows sinus tachycardia with a ventricular rate of 113 beats/min, a QRS duration of 116 msec, a corrected QT interval duration of 478 msec, and a QRS axis of +112 degrees. Note the marked narrowing of the QRS complexes and the reduction of the R wave amplitude to less than 3 mm in lead aVR.

deviation, and no Brugada criteria to suggest ventricular tachycardia.

She remained hypotensive, with regular wide-complex tachycardia on the ECG. She was given an additional 1-L bolus of normal saline and 100 mmol (2 mmol/kg) of sodium bicarbonate, and within 1 minute the wide-complex tachycardia resolved to narrow-complex sinus tachycardia (**Figure 2**). At this point, an infusion of 150 mmol/L of sodium bicarbonate in dextrose 5% in water was started, with serial ECGs to monitor the QRS duration and serial arterial blood gas monitoring to maintain the pH between 7.45 and 7.55.

TRANSFER TO THE ICU

She was then transferred to the intensive care unit (ICU), where she remained for 2 weeks. While in the ICU, she had a single recurrence of wide-complex tachycardia that resolved immediately with an infusion of 100 mmol of sodium bicarbonate. A urine toxicology screen was negative, and the serum amitriptyline measurement, returned from the laboratory 48 hours after her initial presentation, was 594 ng/mL (reference range 100–250 ng/mL). She was eventually weaned off the norepinephrine infusion after 20 hours, the sodium bicarbonate infusion was discontinued after 4 days, and she was taken off mechanical ventilation after 10 days. Also during her ICU stay, she had seizures on day 3 and developed aspiration pneumonia.

From the ICU, she was transferred to a regular floor, where she stayed for another week and then was transferred to a rehabilitation center. This patient was known to have clinical depression and to have attempted suicide once before. She had recently been under additional psychosocial stresses, which likely prompted this second attempt.

She reportedly had no neurologic or cardiovascular sequelae after her discharge from the hospital.

In amitriptyline overdose, sinus tachycardia is the most common finding on ECG

AMITRIPTYLINE OVERDOSE

Amitriptyline causes a relatively high number of fatal overdoses, at 34 per 1 million prescriptions.[1] Death is usually from hypotension and ventricular arrhythmia caused by blockage of cardiac fast sodium channels leading to disturbances of cardiac conduction such as wide-complex tachycardia.

Other manifestations of amitriptyline overdose include seizures, sedation, and anticholinergic toxicity from variable blockade of gamma-aminobutyric acid receptors, histamine 1 receptors, and alpha receptors.[2]

Of the various changes on ECG described with amitriptyline overdose, sinus tachycardia

is the most common. A QRS duration greater than 100 msec, right to extreme-right axis deviation with negative QRS complexes in leads I and aVL, and an R-wave amplitude greater than 3 mm in lead aVR are indications for sodium bicarbonate infusion, especially in hemodynamically unstable patients.[3] Sodium bicarbonate increases the serum concentration of sodium and thereby overcomes the sodium channel blockade. It also alkalinizes the serum, favoring an electrically neutral form of amitriptyline that binds less to receptors and binds more to alpha-1-acid glycoprotein, decreasing the fraction of free drug available for toxicity.[4]

In patients with amitriptyline overdose, wide-complex tachycardia and hypotension refractory to sodium bicarbonate infusion can be treated with lidocaine, magnesium sulfate, direct-current cardioversion, and lipid resuscitation.[5,6] Treatment with class IA, IC, and III antiarrhythmics is contraindicated, as they block sodium channels and thus can worsen conduction disturbances.

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