

## Toxicology: Review Questions

Justin A. Barrett, MD

Susan B. Promes, MD

### QUESTIONS

Choose the single best answer for each question.

1. A 61-year-old African-American man presents to the emergency department (ED) complaining of a swollen tongue, drooling, and shortness of breath (Figure 1). He denies fever or chills. Past medical history is significant for diabetes, osteoarthritis, and hypertension. Medications include glipizide and metformin for diabetes and quinapril for hypertension. For the past 4 weeks, the patient has been taking an over-the-counter herbal weight loss supplement containing green tea. The patient also takes aspirin daily. Which of the following is most likely responsible for this patient's symptoms?

- (A) Aspirin
- (B) Glipizide
- (C) Green tea weight loss supplement
- (D) Metformin
- (E) Quinapril

2. A 22-year-old woman with a history of depression presents to the ED 4 hours after ingesting 100 tablets of aspirin (325 mg) in a suicide attempt. She denies any other ingestions. Her vital signs are: blood pressure, 110/60 mm Hg; heart rate, 120 bpm; respiratory rate, 22 breaths/min; temperature, 99.1°F (37.3°C); and pulse oximetry, 98% on room air. On physical examination, the patient is mentating well. Lungs are clear to auscultation bilaterally, and she is tachycardic with a regular rhythm. Extremities are warm without edema. Capillary refill is brisk. Laboratory results are: sodium, 145 mEq/L; potassium, 3.6 mEq/L; chloride, 106 mEq/L; carbon dioxide, 21 mEq/L; blood urea nitrogen (BUN), 8 mg/dL; creatinine, 0.9 mg/dL; and glucose, 122 mg/dL. Serum drug screen reveals a salicylate level of 637 µg/mL and an acetaminophen level of 7.6 µg/mL. Arterial blood gas testing on room air reveals: pH, 7.41; P<sub>CO</sub><sub>2</sub>, 32 mm Hg; P<sub>O</sub><sub>2</sub>, 103 mm Hg; base excess, -4 mEq/L; bicarbonate, 20 mEq/L; oxygen saturation, 97%; and lactic acid, 15.3 mg/dL. What is the most appropriate initial treatment for this patient?



Figure 1. Photograph of the patient in question 1 showing lingual and sublingual edema.

- (A) Acetazolamide intravenously (IV)
  - (B) Hemodialysis
  - (C) Intubation and hyperventilation
  - (D) N-acetylcysteine orally
  - (E) Sodium bicarbonate IV
3. A 69-year-old woman is brought to the ED after her husband found her unconscious at home and could not awaken her. She left a suicide note for her daughter and ingested an unspecified amount of pills. On arrival, the patient's vital signs are: blood pressure, 50/22 mm Hg; heart rate, 120 bpm; respiratory rate, 10 breaths/min; and pulse oximetry, 94% on room air. The patient's pupils are 6 mm equally round and reactive to light. Lungs are clear, and heart rate is rapid with no murmurs, rubs, or gallops. Bowel sounds are decreased. Capillary refill is delayed. Glasgow Coma Scale score is 3. Fingertstick glucose level is 125 mg/dL. The patient's electrocardiogram is shown in Figure 2. All of the following pills were

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Dr. Barrett is an emergency medicine resident, and Dr. Promes is emergency medicine program director and associate professor; both are at Duke University, Durham, NC.

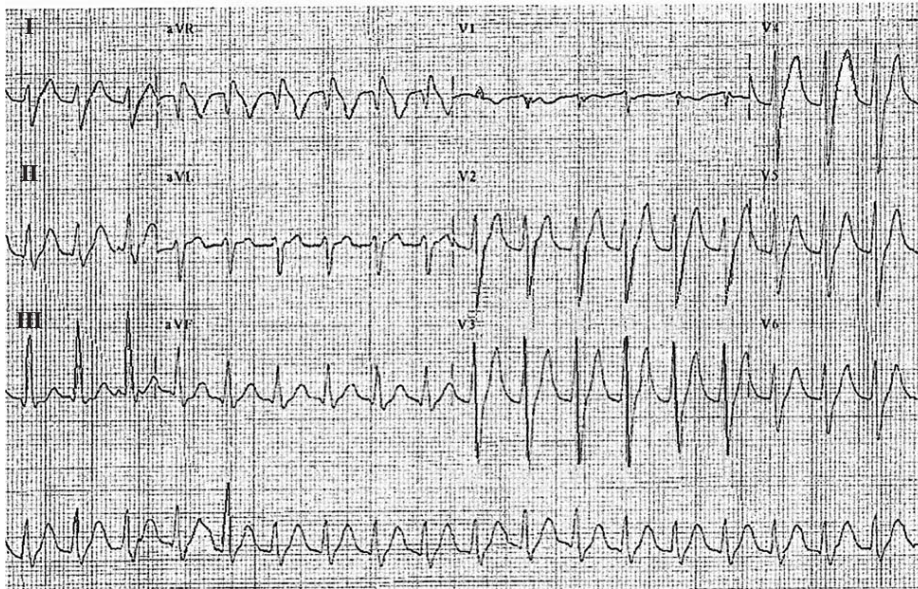


Figure 2. Electrocardiogram of the patient in question 3.

found in the home. Which medication is most likely responsible for this patient's symptoms?

- (A) Amitriptyline
- (B) Esomeprazole
- (C) Gabapentin
- (D) Gemfibrozil
- (E) Hydrocodone

4. A 40-year-old man with no significant past medical history presents to the ED complaining of dyspnea on exertion. He admits to smoking crack cocaine approximately 20 minutes prior to presentation. He denies chest pain but complains of diaphoresis and palpitations along with dyspnea. Vital signs are: blood pressure, 114/65 mm Hg; heart rate, 134 bpm; respiratory rate, 25 breaths/min; temperature, 100.8°F (38.2°C); and pulse oximetry, 97% on 2 L of oxygen. Physical examination is significant for agitation, diaphoresis, and tachycardia. Initial cardiac enzymes are within normal limits, and the electrocardiogram shows sinus tachycardia with nonspecific ST-T wave changes. Which of the following is the most appropriate intervention to treat this patient's agitation?

- (A) Haloperidol intramuscularly (IM)
- (B) Midazolam IV
- (C) Phenobarbital IM
- (D) Propranolol IV
- (E) Ziprasidone IM

5. A 17-year-old girl presents to the ED by ambulance unresponsive. Her friends state that before becoming unresponsive the patient was observed stumbling and fell on at least 2 occasions. The patient's vital signs are: temperature, 100°F (37.8°C); blood pressure, 152/80 mm Hg; heart rate, 116 bpm; respiratory rate, 28 breaths/min; and pulse oximetry, 98%

on room air. Lungs are clear to auscultation bilaterally. Heart is tachycardic. The abdomen is soft and nontender and has bowel sounds. Extremities are warm and dry, and there is no cyanosis or edema. She has a gag reflex and withdraws in response to painful stimuli. Results of laboratory testing include: white blood cell count,  $8.7 \times 10^3/\mu\text{L}$ ; hemoglobin, 11.9 g/dL; platelet count,  $317 \times 10^3/\mu\text{L}$ ; sodium, 145 mEq/L; potassium, 4.1 mEq/L; chloride, 105 mEq/L; bicarbonate, 25 mEq/L; BUN, 13 mg/dL; creatinine, 0.8 mg/dL; and glucose, 110 mg/dL. Serum osmolality is 352 mOsm/L. Acetaminophen and salicylate levels are not detected. What is this patient's osmolar gap?

- (A) 22 mOsm/L
- (B) 40 mOsm/L
- (C) 52 mOsm/L
- (D) 167 mOsm/L
- (E) 196 mOsm/L

#### ANSWERS AND EXPLANATIONS

1. (E) **Quinapril.** Angiotensin-converting enzyme (ACE) inhibitors are a common cause of angioedema, particularly in African-American patients. Twenty percent to 58% of ED visits for angioedema are due to ACE inhibitor use. Angioedema occurs in approximately 0.1% to 0.2% of patients treated with ACE inhibitors.<sup>1</sup> Although one half of cases occur within 1 week of initiation of ACE inhibitor therapy, angioedema may occur up to several years later. Aspirin is associated with angioedema but is a less common cause as compared with ACE inhibitors. Between 17% and 33% of angioedema cases are caused by allergen exposure. Other common triggers include foods, contrast dyes,

inhalants, environmental allergens, drugs, and insect stings. Glipizide, metformin, and weight loss supplements containing green tea are not frequently associated with angioedema.

**2. (E) Sodium bicarbonate IV.** Treatment of aspirin toxicity includes administration of IV sodium bicarbonate and monitoring urine pH (goal pH, 7.2–7.5). Alkalinization of the urine promotes salicylate excretion. Administration of acetazolamide would alkalinize the patient's urine but is not indicated in the treatment of aspirin toxicity. Acetazolamide, a carbonic anhydrase inhibitor, reduces bicarbonate reabsorption and as a result raises urine pH and enhances salicylate excretion. However, this effect lowers arterial pH and promotes salicylate movement into the central nervous system. Although dialysis can be used to treat severe aspirin toxicity, this patient does not have an indication for hemodialysis (eg, altered mental status, renal insufficiency interfering with salicylate excretion, volume overload preventing treatment with sodium bicarbonate, serum salicylate levels > 100 mg/dL, clinical evidence of pulmonary or cerebral edema, deterioration in clinical status despite appropriate aggressive care). *N*-acetylcysteine is used in acetaminophen overdose and has no role in the treatment of salicylate toxicity. Forced hyperventilation is not indicated.

**3. (A) Amitriptyline.** Sinus tachycardia is present in most patients with clinically significant tricyclic antidepressant (TCA) overdose. Delayed right ventricular activation from TCA intoxication results in a deep, slurred S wave in leads I and aVL as well as an R wave in lead aVR, as seen in Figure 2. A cohort study showed that the risk of seizures and ventricular arrhythmias was significantly increased in patients with RaVR greater than 3 mm and QRS duration longer than 100 msec.<sup>2</sup> A prolonged QTc interval and PR interval are also seen in TCA intoxication but are much less reliable for confirming the diagnosis. Esomeprazole is well tolerated except for diarrhea. There are no known cardiovascular or neurologic side effects associated with esomeprazole, and no deaths have been reported. Large doses of gabapentin typically produce central nervous system depression (eg, drowsiness, dizziness, lethargy) as well as diarrhea but do not cause cardiovascular problems. An overdose of

gemfibrozil results in gastrointestinal and musculoskeletal complaints with elevated liver function tests and creatine kinase levels. Patients who overdose on narcotics generally present with pinpoint pupils and respiratory depression, which can lead to bradycardia and ultimately pulseless electrical activity if respiratory drive is not addressed.

**4. (B) Midazolam IV.** First-line interventions for patients presenting with symptoms of myocardial infarction after cocaine use are aspirin, nitrates, and benzodiazepines (eg, midazolam). Propranolol is a nonselective  $\beta$ -blocker and is not recommended in patients who have ingested cocaine because of the theoretical risk of unopposed  $\alpha_1$  stimulation. Haloperidol and ziprasidone are used to treat agitation due to underlying psychiatric pathology. Phenobarbital has sedative effects but is not considered a first-line agent in the treatment of patients with a myocardial infarction due to cocaine use.

**5. (C) 52 mOsm/L.** Serum osmolarity can be calculated using the following formula:

$$\text{Serum osmolarity} = 2(\text{sodium}) + \text{glucose}/18 + \text{BUN}/2.8 + \text{ethanol}/4.6 + \text{mannitol}/18$$

This patient's calculated osmolarity is approximately 300 mOsm/L. The patient's osmolar gap can be obtained by subtracting the calculated serum osmolarity from the measured serum osmolarity (352–300 = 52). Thus, the patient has an osmolar gap of 52 mOsm/L. An osmolar gap occurs when a solute other than sodium, glucose, or urea is added to the plasma. When another solute is present, the osmolarity calculated from the above formula will be less than the actual measured value, causing an osmolar gap. An osmolar gap of 25 mOsm/L or greater is highly suggestive of ethylene glycol or methanol intoxication. Both of these intoxications should be entertained as etiologies of this patient's symptoms.

## REFERENCES

1. Thompson T, Frable MA. Drug-induced, life-threatening angioedema revised. *Laryngoscope* 1993;103(1 Pt 1): 10–2.
2. Liebelt EL, Francis PD, Woolf AD. ECG lead aVR versus QRS interval in predicting seizures and arrhythmias in acute tricyclic antidepressant toxicity. *Ann Emerg Med* 1995;26:195–201.