CASE RECORDS of the MASSACHUSETTS GENERAL HOSPITAL

Case 2-2023: A 76-Year-Old Man with Dizziness and Altered Mental Status

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PRESENTATION OF CASE

Dr. George Karandinos (Medicine): A 76-year-old man was evaluated in the emergency department of this hospital because of dizziness and altered mental status.

On the day of the current evaluation, the patient was observed crawling on a city sidewalk. He appeared pale and diaphoretic. On evaluation by emergency medical services, he reported feeling dizzy and "weird." A fingerstick blood glucose level was 152 mg per deciliter (8.4 mmol per liter). He was brought to the emergency department of this hospital for further evaluation.

In the emergency department, the patient could not recall recent events, but he reported shortness of breath, as well as chronic back pain and persistent ringing in the ears. He was unable to give additional details of his history, but he provided the name of the hospital where he routinely received care. On a phone consultation, physicians at that hospital reported that the patient had a history of traumatic brain injury, post-traumatic stress disorder, seizure disorder, chronic back pain due to spinal stenosis, hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, gastroesophageal reflux disease, and anxiety. Prescribed medications included lisinopril and transdermal lidocaine. There were no known drug allergies. The patient had consumed alcohol in the past but not for 40 years. His family history was unknown.

The temporal temperature was 36.6°C, the heart rate 92 beats per minute, the blood pressure 183/113 mm Hg, the respiratory rate 27 breaths per minute, and the oxygen saturation 99% while the patient was breathing ambient air. The patient appeared disheveled and diaphoretic. He was somnolent but awakened to verbal stimuli. He was oriented to person, place, and time but only intermittently followed commands. A small superficial skin abrasion was noted above the left eyebrow. There was mild tenderness on palpation of the midback but no other evidence of trauma. The remainder of the examination was normal.

Point-of-care ultrasonography, performed with an approach known as FAST (focused assessment with sonography for trauma), showed no abnormalities. The blood ethanol level was undetectable, and urine toxicologic testing was negative for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, and opi-

ates. The blood levels of lipase, magnesium, and N-terminal pro–B-type natriuretic peptide were normal, as were results of liver-function tests. There was mild normocytic anemia, but the complete blood count with differential count was otherwise normal. Other laboratory test results are shown in Table 1. Testing of a nasopharyngeal swab for severe acute respiratory syndrome coronavirus 2 was negative. Samples of blood and urine were obtained for culture. An electrocardiogram showed sinus rhythm, intraventricular conduction delay, left axis deviation, and nonspecific minor ST-segment and T-wave abnormalities. Imaging studies were obtained.

Dr. Brooks P. Applewhite: Radiographs of the chest and pelvis showed no acute abnormalities. Computed tomographic (CT) angiography of the head and neck (Fig. 1A) revealed nonspecific mild white-matter changes, a nonspecific small focal calcification in the right-peritrigonal white matter, atherosclerosis without high-grade cerebrovascular stenosis, and multilevel spondylotic changes without severe spinal canal stenosis. There was no evidence of acute intracranial hemorrhage or territorial infarction. CT angiography of the chest, abdomen, and pelvis (Fig. 1B and 1C) revealed no evidence of aortic dissection, pulmonary embolism, pneumothorax, pulmonary edema, lung consolidation, or pericardial effusion. There was a left adrenal nodule that measured 19 mm in diameter, a finding consistent with an adenoma.

Dr. Karandinos: Normal saline with 5% dextrose was administered intravenously. During the next 8 hours, the patient was agitated and combative. He repeatedly removed peripheral intravenous catheters and disconnected monitors. He was no longer oriented to place or time. Two doses of olanzapine were administered intravenously, and the patient slept for several hours during the night.

Sixteen hours after the patient arrived in the emergency department, the temporal temperature was 37.7°C, the heart rate 78 beats per minute, the blood pressure 160/72 mm Hg, the respiratory rate 20 breaths per minute, and the oxygen saturation 100% while he was breathing ambient air. The patient was observed to be breathing deeply. He was able to state his name, but his speech was otherwise nonsensical and dysarthric. He followed commands only when visual cues were given; for example, he stuck out his tongue after the examiner demonstrated the task. Motor, sensory, and reflex examinations were normal; tests of cerebellar function were not performed. Additional laboratory test results are shown in Table 1. The results of electroencephalography (EEG) were normal, without epileptiform abnormalities. Normal saline with potassium chloride was administered intravenously, as was lorazepam. Additional imaging studies were obtained.

Dr. Applewhite: Magnetic resonance imaging (MRI) of the head (Fig. 2) revealed no evidence of acute intracranial hemorrhage or acute or subacute infarction. T2-weighted fluid-attenuated inversion recovery images showed a mild burden of white-matter signal hyperintensities, which are nonspecific but typical of chronic small-vessel disease. The previously detected calcification in the right-peritrigonal white matter correlated with an 8-mm focus of T1 and T2 signal abnormalities with associated susceptibility blooming, a finding suggestive of either a calcified cavernous malformation or sequelae of previous infection or inflammation.

Dr. Karandinos: The patient's mental status did not improve. Twenty-four hours after he arrived in the emergency department, he was admitted to the hospital with a working diagnosis of seizure. The temporal temperature was 37.6°C, the heart rate 77 beats per minute, the blood pressure 151/70 mm Hg, the respiratory rate 22 breaths per minute, and the oxygen saturation 98% while he was breathing ambient air. Respiratory effort appeared increased. He was somnolent, and he followed simple commands but did not open his eyes in response to sternal rub. The blood levels of creatine kinase, fibrinogen, and ammonia were normal. Other laboratory test results are shown in Table 1.

Thiamine was administered intravenously. Additional diagnostic tests were performed.

DIFFERENTIAL DIAGNOSIS

Dr. Antonio Granfone: This 76-year-old man was initially brought to the hospital because of abnormal behavior. While he was in the emergency department, a progressively decreased level of consciousness was observed, along with disorientation. I will first consider common and "cannot miss" causes of altered mental status; I will then use the findings on physical examination and

Table 1. Laboratory Data.*

Variable	Reference Range, Adults†	On Presentation	16 Hr after Presentation	24 Hr after Presentation
Blood				
Sodium (mmol/liter)	135–145	140	145	143
Potassium (mmol/liter)	3.4–5.0	4.3	3.0	3.6
Chloride (mmol/liter)	98–108	106	111	111
Carbon dioxide (mmol/liter)	23–32	15	15	16
Urea nitrogen (mg/dl)	8–25	19	18	20
Creatinine (mg/dl)	0.60–1.50	1.57	1.32	1.42
Glucose (mg/dl)	70–110	142	74	74
Calcium (mg/dl)	8.5–10.5	7.8	7.3	7.7
Albumin (g/dl)	3.3–5.0	3.8	3.8	3.5
Lactate (mmol/liter)	0.5–2.0	2.1	1.1	—
High-sensitivity troponin T (ng/liter)	0–9	41	44	—
Hemoglobin (g/dl)	13.5–17.5	13.2	12.6	11.7
Hematocrit (%)	41.0–53.0	39.7	38.1	36.0
Prothrombin time (sec)	11.5–14.5	30.2	35.9	—
Prothrombin-time international normalized ratio	0.9–1.1	2.9	3.6	—
D-dimer (ng/ml)	<500	2075	—	—
Thyrotropin (μIU/ml)	0.40–5.00	—	0.25	—
Free thyroxine (ng/dl)	0.9–1.8	—	0.8	—
Triiodothyronine (ng/dl)	60–181	—	31	—
Iron (μg/dl)	30–160	—	40	—
Iron-binding capacity (μg/dl)	230–404	—	320	—
Ferritin (μg/liter)	10–200	—	39	—
Vitamin B_{12} (pg/ml)	>231	—	383	—
25-Hydroxyvitamin D (ng/ml)	20–80	—	9	—
Arterial blood gas				
Fraction of inspired oxygen	—	—	—	0.21
pH	7.35–7.45	—	—	7.50
Partial pressure of carbon dioxide (mm Hg)	35–42	—	—	21
Partial pressure of oxygen (mm Hg)	80–100	—	—	68
Bicarbonate (mmol/liter)	24–30	—	—	16
Urine				
Color	Yellow	Yellow	—	—
Clarity	Clear	Clear	—	—
pH	5.0–9.0	6.0	—	—
Specific gravity	1.001–1.035	1.034	—	—
Glucose	Negative	Negative	—	—
Ketones	Negative	2+	—	—
Leukocyte esterase	Negative	Negative	—	—
Nitrite	Negative	Negative	—	—

Table 1. (Continued.)

Variable	Reference Range, Adults†	On Presentation	16 Hr after Presentation	24 Hr after Presentation
Blood	Negative	1+	—	—
Protein	Negative	Negative	—	—
Erythrocytes (per high-power field)	0–2	10–20	—	—
Leukocytes (per high-power field)	<10	<10	—	—
Bacteria	None	None	—	—

* To convert the values for urea nitrogen to millimoles per liter, multiply by 0.357. To convert the values for creatinine to micromoles per liter, multiply by 88.4. To convert the values for glucose to millimoles per liter, multiply by 0.05551. To convert the values for calcium to millimoles per liter, multiply by 0.250. To convert the values for lactate to milligrams per deciliter, divide by 0.1110. To convert the values for free thyroxine to picomoles per liter, multiply by 12.87. To convert the values for triiodothyronine to nanomoles per liter, multiply by 0.01536. To convert the values for iron and iron-binding capacity to micromoles per liter, multiply by 0.1791. To convert the values for vitamin B_{12} to picomoles per liter, multiply by 0.7378. To convert the values for 25-hydroxyvitamin D to nanomoles per liter, multiply by 2.496.

† Reference values are affected by many variables, including the patient population and the laboratory methods used. The ranges used at Massachusetts General Hospital are for adults who are not pregnant and do not have medical conditions that could affect the results. They may therefore not be appropriate for all patients.

laboratory testing to narrow the differential diagnosis.

INTOXICATION OR WITHDRAWAL

The negative urine toxicologic testing makes intoxication from drugs that are commonly associated with substance use disorders unlikely. Although alcohol withdrawal could cause altered mental status, ethanol was not detected, and the patient reportedly had not consumed alcohol for 40 years.

TOXINS AND MEDICATIONS

The history obtained from the patient, although limited, does not suggest potential exposure to poisons. Lisinopril and transdermal lidocaine are the only known prescribed medications, and neither agent is associated with altered mental status. However, it remains possible that the patient had been taking nonprescription medications or supplements that can cause altered mental status.

CENTRAL NERVOUS SYSTEM DISORDERS

The absence of fever, headache, nuchal rigidity, and leukocytosis makes an infection involving the central nervous system unlikely. However, causes of viral encephalitis — such as herpes simplex virus, West Nile virus, eastern equine encephalitis virus, and Powassan virus — should be considered in this patient. Given his history of seizure disorder, seizure was considered in the emergency department, and an EEG was obtained. The normal EEG makes seizure unlikely but does not rule out an underlying seizure disorder or a postictal state as the cause of altered mental status. However, I would expect an elevated creatine kinase level to be detected if the patient had had a seizure. In addition, I would expect his altered mental status to improve with time if it was due to a postictal state; this patient's altered mental status worsened.

METABOLIC DISORDERS

Both hyperthyroidism and hypothyroidism can cause altered mental status. Initial laboratory testing revealed a low thyrotropin level, as well as low free thyroxine and triiodothyronine levels. This pattern is consistent with central hypothyroidism, but this diagnosis is unlikely because the patient did not have signs or symptoms of other pituitary-hormone deficiencies. Alternative explanations for this pattern on thyroid-function testing are euthyroid sick syndrome and malnutrition. In the context of euthyroid sick syndrome, instead of converting thyroxine to triiodothyronine, the body tries to conserve energy by converting thyroxine to reverse triiodothyronine. The patient's level of triiodothyronine was more reduced than his level of free thyroxine, which is consistent with malnutrition.[1]

Hypocalcemia is another potential cause of altered mental status, and the blood calcium level was low. The patient had concurrent alkalosis, which enhances the binding of calcium to

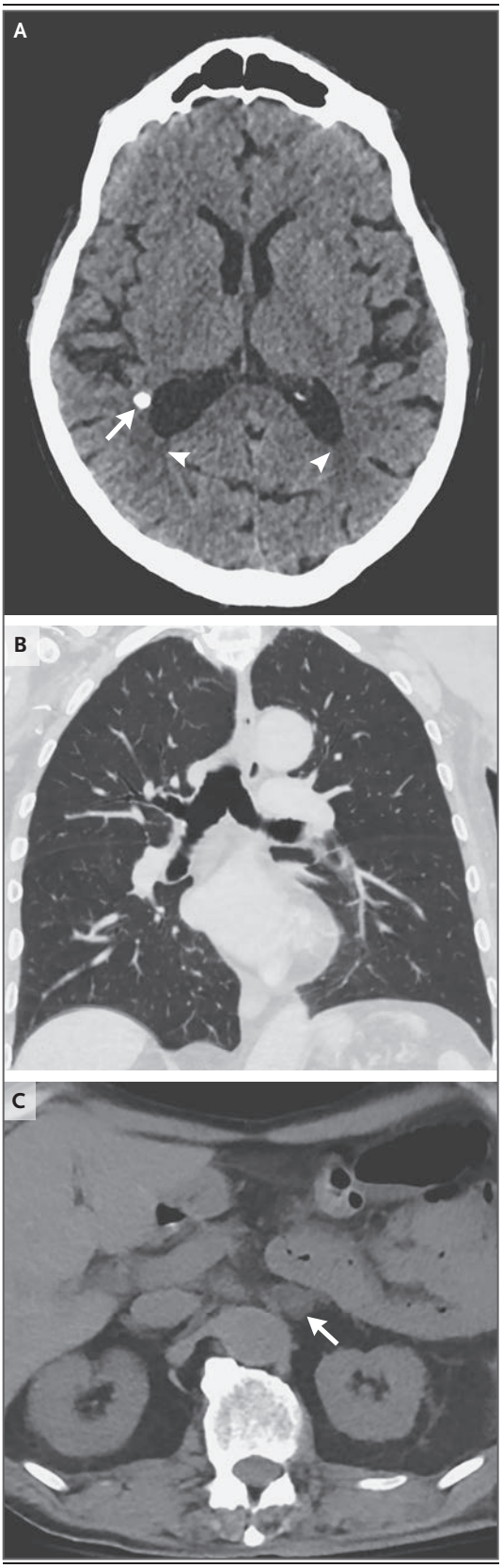

Figure 1. Initial Imaging Studies.

An axial image from CT angiography of the head (Panel A), obtained before the administration of contrast material, shows nonspecific mild white-matter changes (arrowheads) and a nonspecific small right-peritrigonal calcification (arrow). A coronal image from CT angiography of the chest (Panel B), obtained after the administration of contrast material, shows no pulmonary edema, consolidation, or pneumothorax. An axial image from CT angiography of the abdomen (Panel C), obtained before the administration of contrast material, shows a left adrenal nodule (arrow) with an attenuation level of less than 10 Hounsfield units, a finding consistent with an adenoma.

albumin and further decreases the free calcium level. The ionized calcium level is not reported, so the amount of physiologically active calcium is unknown. To rule out hypocalcemia, I would obtain an ionized calcium level, but severe hypocalcemia is unlikely to be the cause of this patient's altered mental status.

HYPERTENSIVE ENCEPHALOPATHY

This patient's initial blood pressure of 183/113 mm Hg suggests the possibility of hypertensive encephalopathy. However, the absence of headache, papilledema, acute coronary syndrome, imaging findings consistent with changes in the brain, and laboratory evidence of end-organ damage argues against hypertensive encephalopathy as the cause of his altered mental status.

WERNICKE'S ENCEPHALOPATHY

Wernicke's encephalopathy is an important consideration in this patient with altered mental status. He reportedly did not drink alcohol, but he could still be at risk for Wernicke's encephalopathy in the context of malnutrition. Patients with Wernicke's encephalopathy can present with metabolic acidosis, respiratory alkalosis, and hyperventilation. Dysarthria, ataxia, and ocular abnormalities may also be present; ataxia and ocular abnormalities were not described in this case. Wernicke's encephalopathy would be more likely if the altered mental status had developed after prolonged exposure to dextrose before thiamine was administered. However, this patient had altered mental status on presentation and received only a minimal amount of dextrose before thiamine was administered, so Wernicke's encephalopathy is unlikely.

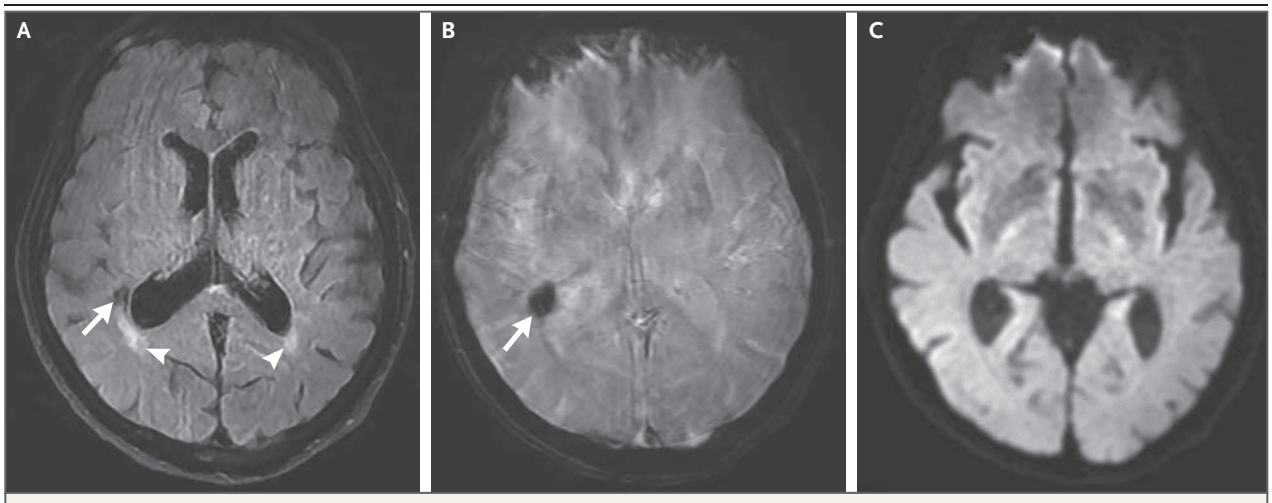

Figure 2. MRI of the Head.

MRI of the head confirmed the findings on CT, showing no acute or subacute infarction, mass, or acute intracranial hemorrhage. A T2-weighted fluid-attenuated inversion recovery (FLAIR) image (Panel A) and a susceptibility-weighted image (Panel B) show right-peritrigonal signal abnormalities (arrows) that correlate with the small calcification observed on CT, a finding suggestive of either a calcified cavernous malformation or sequelae of previous infection or inflammation. The T2-weighted FLAIR image (Panel A) also shows nonspecific mild white-matter changes (arrowhead). A diffusion-weighted image (Panel C) shows no abnormal restricted diffusivity.

HYPERVENTILATION AND RESPIRATORY ALKALOSIS

The patient initially reported dyspnea and was noted to have both deep breathing and increased work of breathing. In addition, arterial blood gas measurements were consistent with respiratory alkalosis, a finding that further supports the possibility of hyperventilation. In patients with hyperventilation, alkalinization of the blood increases the oxygen avidity for hemoglobin, which decreases the availability of oxygen to perfuse tissues, including brain cells. Hypocapnia leads to increased vascular resistance, vasoconstriction, and decreased cerebral blood flow. Patients may report breathlessness, dizziness, lightheadedness, or confusion, symptoms similar to those reported by this patient. He had a history of mild pain and anxiety, but there was no evidence of psychosis, fever, intracranial abnormalities, or cardiopulmonary disorders that would be driving hyperventilation. However, many widely available substances — such as salicylates, methylxanthines, catecholamine analogues, and nicotine — can cause hyperventilation.

ANION-GAP METABOLIC ACIDOSIS

In addition to respiratory alkalosis, the patient had an elevated anion gap (19 mmol per liter), which indicates concurrent anion-gap metabolic acidosis. He had mild lactic acidosis and suspected malnutrition, with 2+ ketones in the urine, but there was no evidence of diabetic ketoacidosis or severe renal failure. Anion-gap metabolic acidosis, in combination with hyperventilation with respiratory alkalosis and altered mental status, is suggestive of salicylate toxicity.[2]

SALICYLATE TOXICITY

Sources of salicylate include not only oral medications but also foods, herbs,[3] supplements, and topical products such as liniments and ointments. One teaspoon (5 ml) of some of these products contains up to 7 g of salicylate, which is equivalent to the amount in more than 21 full-dose tablets of acetylsalicylic acid (aspirin). Salicylates are rapidly absorbed through the gastric mucosa; the peak blood level typically occurs within 1 hour after ingestion but may be reached more slowly with enteric-coated and extended-release preparations.[4] After absorption, 90% of the salicylate molecules are protein bound. Salicylates are metabolized in the liver to salicyluric acid, which is then excreted through the kidneys. Overdose and toxicity lead to peak levels that are higher and occur later (especially with enteric-coated or extended-release preparations), which may saturate hepatic detoxification mechanisms, increasing the level of non–protein-bound molecules in circulation and prolonging

the half-life from 2 to 4 hours to up to 30 hours. Unbound molecules are excreted through the kidneys but are rapidly reabsorbed through the epithelium of the renal collecting tubule, which exacerbates toxicity.

Salicylates activate the respiratory center of the medulla, causing hyperventilation and respiratory alkalosis. Tachypnea and increased respiratory effort, which were observed in this patient, can be clues for early diagnosis of salicylate toxicity. Salicylates cause metabolic acidosis through interference with both cellular metabolism in the Krebs cycle and oxidative phosphorylation, as well as through accumulation of unbound salicylate molecules.[5,6] Oxidative phosphorylation uncoupling leads to an elevated lactate level, which was seen in this patient. Unbound salicylate molecules easily cross the blood–brain barrier, which leads to altered mental status, neuroglycopenia,[7] and cerebral edema. An elevated blood salicylate level correlates with altered mental status, and hemodialysis may be considered in patients with salicylate toxicity and altered mental status.[8,9] Tinnitus, which was reported by this patient, is a side effect that can occur even with the use of therapeutic doses of salicylates, but it can also be a clue to salicylate toxicity.

Salicylate toxicity can explain this patient's altered mental status, hyperventilation with respiratory alkalosis, and anion-gap metabolic acidosis. The patient had received a prescription for lidocaine patches for back pain and may have been taking other, nonprescription medications for pain. I suspect that the diagnostic test in this case was measurement of the blood salicylate level.

DR. ANTONIO GRANFONE'S DIAGNOSIS

Salicylate toxicity.

PATHOLOGICAL DISCUSSION

Dr. Soma Jobbagy: The diagnostic test in this case was measurement of the blood salicylate level. The patient had a salicylate level of 56 mg per deciliter (4.05 mmol per liter; reference value, <20 mg per deciliter [1.45 mmol per liter]), a finding that confirmed the diagnosis of salicylate toxicity.

The assay that is used to measure the salicylate level relies on hydroxylation and simultaneous decarboxylation of salicylate by the enzyme salicylate hydroxylase to yield catechol, along with concomitant stoichiometric oxidation of the reduced form of nicotinamide adenine dinucleotide (NADH) to nicotinamide adenine dinucleotide (NAD^+). The consumption of NADH is measured spectrophotometrically according to the change in absorption at 340 nm.[10]

Salicylate hydroxylase does not have complete substrate specificity. Medicinal salicylate preparations include esters and analogues of salicylic acid, and these compounds are substrates with variable efficiency.[11] Salicylic acid is a commonly used topical medication for dermatologic conditions, and toxic effects from percutaneous absorption have been reported.[12] Acetylsalicylic acid (aspirin) undergoes rapid enteric and hepatic hydrolysis to salicylic acid, which is the preferred substrate for salicylate hydroxylase. However, the enzyme also shows activity toward the acetyl ester. Likewise, methylsalicylate — found in topical analgesic agents, mouthwash, and oil of wintergreen — is metabolized to salicylic acid but also is itself a low-efficiency substrate.[13] Other therapeutically relevant salicylate analogues that may be detected by the assay include 5-aminosalicylate (mesalamine) and the antitubercular compound 4-aminosalicylate. Results of salicylate testing should be interpreted within the context of the clinical history to determine the intoxicating agent.

PATHOLOGICAL DIAGNOSIS

Salicylate toxicity.

DISCUSSION OF MANAGEMENT

Dr. Biff F. Palmer: The acute form of salicylate toxicity often occurs in young persons who have a history of an overdose or a psychiatric condition.[14] The diagnosis tends to be straightforward because patients often report the overdose or possess containers partially filled with salicylates. However, this patient's case is most consistent with the chronic form of salicylate toxicity, because there is no indication of previous abuse of salicylates or clear history of excess ingestion. Chronic salicylate toxicity often occurs in older patients who inadvertently con-

sume an excessive amount of nonprescription drugs that contain salicylates to treat a variety of conditions, including chronic back pain.

With the chronic form, the tissue burden of the drug is high, and pathways for salicylate elimination are nearly or fully saturated.[14,15] The blood salicylate level at which symptoms develop is lower with the chronic form than with the acute form, sometimes overlapping with the upper limit of the therapeutic range. Neurologic manifestations are more prominent with chronic toxicity than with acute toxicity and include agitation, confusion, hallucinations, slurred speech, seizures, and coma. Failure to recognize chronic salicylate toxicity in patients with neurologic manifestations can lead to unnecessary neurologic investigations, which delay the implementation of appropriate therapy and ultimately contribute to the higher morbidity and mortality associated with the chronic form than with the acute form.[16]

A clue to the diagnosis in this patient was the presence of respiratory alkalosis in association with anion-gap metabolic acidosis. The decrease in the blood bicarbonate level was greater than that predicted from the increase in the anion gap, which suggests the coexistence of hyperchloremic metabolic acidosis with a normal anion gap. This pattern is present in approximately 20% of patients with salicylate toxicity. It is due to the urinary excretion of sodium and potassium salts of ketoacids and salicylate, with the indirect loss of sodium bicarbonate from the body.[17]

The patient had hypokalemia, which is typical of salicylate toxicity. It is due to increased urinary excretion of potassium, which has resulted from increased delivery of sodium to the distal nephron in the context of increased mineralocorticoid activity.[18] In addition, the blood glucose level was elevated on admission and then promptly decreased during the hospitalization. In the early stages of toxicity, transient or prolonged hyperglycemia is due to the combined effect of increased production and decreased tissue uptake of glucose.[14] In the later stages, depletion of glycogen stores and impaired gluconeogenesis confer a predisposition to hypoglycemia.[19] Furthermore, a high salicylate level in the lumen of the proximal tubule can interfere with urate reabsorption and cause hyperuricosuria.[14] Formation of microcalculi can injure the tubular epithelium, which potentially explains the microhematuria that was noted on urinalysis in this patient.

Rapid clinical assessment and supportive therapy to ensure adequate respiration and stable circulation are the initial approaches to the treatment of salicylate toxicity.[14] Once the patient's condition has been stabilized, therapy is focused on decreasing gastrointestinal absorption of the remaining salicylate and initiating measures to enhance removal of salicylate from the body.

Treatment with activated charcoal can be effective, particularly when it is administered within 2 hours after ingestion, but it should be given only to alert and cooperative patients.[20] Dosing outside this window and repeat dosing may be justified in patients who are at risk for prolonged retention of the drug in the gastrointestinal tract. Enteric-coated, extended-release, and high-dose preparations of salicylate all have a slowing effect on gastric emptying. A bezoar should be suspected when the salicylate level continues to rise or does not decrease despite appropriate management. Repeat doses of activated charcoal and whole-bowel irrigation with polyethylene glycol may also be useful when persistent retention of the drug in the gastrointestinal tract is suspected.[21,22]

Urinary alkalization is a key element in the management of both acute and chronic salicylate toxicity.[14,23] After filtration across the glomerular basement membrane, salicylate undergoes both secretion and reabsorption by the proximal tubule. In the undissociated form, salicylic acid is lipid soluble and partially reabsorbed by nonionic diffusion. Since salicylic acid is a weak acid with a pKa of 3, alkalization increases the ionized fraction of salicylate, which is poorly permeable in the tubular membrane. Increasing the urine pH to a level higher than the blood pH traps salicylate in the tubular lumen and increases urinary excretion.[14,23] This effect of pH on solubility is also relevant to the distribution of salicylate in tissues outside the kidney. Systemic acidosis increases tissue penetration of salicylate into the central nervous system and can worsen clinical manifestations. Maintenance of an alkaline blood pH ensures that more than 99% of the drug is in an ionized state and cannot permeate cell membranes. In addition, decreased circulating lipid-soluble sa-

licylate creates a favorable gradient for movement of the drug out of the central nervous system, which reduces the tissue concentration.

Hemodialysis is the most efficient way to enhance elimination of salicylate from the body.[14] Physiochemical characteristics such as the small molecular size, the low volume of distribution, and the lack of tissue binding make salicylate an ideal substance for dialysis. Hemodialysis should be considered in patients with altered mental status, kidney insufficiency, acute respiratory insufficiency that has led to the administration of supplemental oxygen, and failure of standard therapy. A salicylate level of more than 90 mg per deciliter (6.52 mmol per liter) is an indication for dialysis, regardless of signs and symptoms.[24]

FOLLOW-UP

Dr. Karandinos: After salicylate toxicity was identified in this patient, poison control was consulted, and an infusion of bicarbonate was initiated for urine alkalinization. The nephrology service was consulted regarding possible hemodialysis if the patient's clinical condition worsened or the salicylate level increased. Serial measurement of the salicylate level was performed; the level was within the reference range in 26 hours. During the next 2 days, the patient's mental status improved, and he reported that he had taken aspirin regularly for lower back pain and had recently increased his use after losing access to prescribed opioids for back pain. He was discharged from the hospital with planned follow-up for adrenal and thyroid abnormalities, but 18 months later, he has had no further medical encounters in our health care system.

FINAL DIAGNOSIS

Chronic salicylate toxicity.

This case was presented at the Medicine Case Conference.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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