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Rhabdomyolysis and Myoglobinuria Associated With Acute Water Intoxication

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RHABDOMYOLYSIS AND MYOGLOBINURIA have been associated with variety of syndromes and clinical situations. Classification based on etiology is usually divided into hereditary and sporadic.[1,2] The most common cause of rhabdomyolysis is physical injury to skeletal muscle resulting from exertion or crushing. Common clinical settings include "squat-jump" and related syndromes, convulsions, compression of the body in prolonged coma and ischemia resulting from arterial occlusion. Metabolic causes are somewhat less common and include alcoholism, barbiturate use, nonketotic hyperglycemic hyperosmolar coma, heat cramps and chronic hypokalemia. More recently, rhabdomyolysis has been recognized as a complication of parathyroidectomy and calcium supplementation.[3]

We are reporting a case of rhabdomyolysis and myoglobinuria which was associated with acute water intoxication in an otherwise healthy man.

Report of a Case

A 62-year-old man was admitted to hospital because he was lethargic and confused. He was in good health until one day before admission, when he began drinking a great deal of water. The patient thought that his urine output was too low and tried to remedy this by drinking more fluid. There was no record of the total amount of fluid that the man drank; however, his wife estimated that he had drunk 1 to 2 quarts per hour for eight to ten hours. He became lethargic and confused. At 3 AM paramedics were summoned and he was admitted to hospital.

Two months before admission the results of the patient's annual physical examination were normal except for an inguinal hernia. He took no medications. Activity during the day was limited to light housework. There was no history of renal or endocrine disorders. Physical examination showed blood pressure of 100/50 mm of mercury, a pulse of 64 beats per minute, a temperature of 38.3°C (101°F). The skin turgor was normal. The pupils were the same size and reacted normally to direct light. Results of funduscopic examination were normal with no papilledema. The ears, nose and throat were normal. The neck was supple with no indication of jugular venous distention. The chest was clear to auscultation and percussion. Results of cardiac examination were normal. The abdomen was soft with no organomegaly, although a left inguinal hernia was noted. The prostate was minimally enlarged with no indication of nodules. The extremities were without edema. There was no appreciable muscle swelling or tenderness. Reflexes were active in the ankles, quadriceps and biceps. The peripheral pulses were normal.

The findings of laboratory studies are shown in Table 1. Additional studies carried out the first day in the hospital showed the following: serum osmolality, 242 mOsm per kg, with urine osmolality of 45 mOsm per kg; spot urine sodium, 40 mEq per liter; urine potassium, 99 mEq per liter; urine myoglobin, 38 to 75 mg per liter (differentiation from hemoglobin by counterimmunoelectrophoresis technique, Bioscience Laboratory, Van Nuys, California).

The initial creatinine phosphokinase (CPK) value was 1,014 IU per liter (100 percent MM fraction) and within 36 hours it was 98,000 IU per liter (100 percent MM fraction). Other findings were as follows: serum calcium, 8.0 mg per dl; phosphorus, 2.4 mg per dl; glucose, 110 mg per dl; blood urea nitrogen, 4 mg per dl; creatinine, 0.7 mg per dl; uric acid, 3.1 mg per dl; cholesterol, 173 mg per dl; total protein, 6.1 grams per dl; albumin, 3.6 grams per dl; total bilirubin, 1.6 mg per dl; alkaline phosphatase, 42 units per liter; lactate dehydrogenase, 725 Wacker units; serum glutamic oxaloacetic transaminase, 500 units; globulin, 2.5 grams per dl.

Lumbar puncture yielded clear fluid with a glucose value of 86 mg per dl, protein of 41 mg per dl, five red blood cells and two polymorphonuclear neutrophils per cu mm.

An electrocardiogram showed a first degree atrioventricular block which returned to normal by the third day in the hospital. A roentgenogram of

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the chest showed no abnormalities. Arterial blood gas studies, with the patient breathing room air, showed an arterial oxygen pressure of 64, an arterial carbon dioxide pressure of 34, pH of 7.48 and a bicarbonate value of 25 mEq per liter.

Hospital Course

Fluid intake was restricted and sodium bicarbonate was given to alkalinize the urine. The urine pH was maintained above 7.0. Urine output exceeded fluid intake for the first 48 hours. Diazepam was used for sedation. The serum electrolytes returned to normal levels within 48 hours although the CPK remained greatly elevated. Mental status improved quickly and was normal at the time of hospital discharge. Renal function remained normal. Urine color turned to hazy, red-orange after 24 hours but was free from myoglobin by the fourth hospital day. Hemoglobin level remained stable.

The patient was seen one month after discharge; mental status was normal, as well as hemoglobin level, serum enzymes, renal function and findings on analysis of urine.

Discussion

There are several known causes of myoglobinuria that should be considered in reference to this case. Hypokalemia has been associated with rhabdomyolysis and myoglobinuria. Whether hypokalemia by itself is a cause of rhabdomyolysis remains a debatable point. In many of the earlier reported cases linking hypokalemia and rhabdomyolysis, patients were receiving medication that may have had some direct myotoxicity. In a case reported by Heitzman,[4] steroids were used in a patient who had regional enteritis and in whom severe hypokalemia and myoglobinuria developed during treatment. Other patients with rhabdomyolysis associated with hypokalemia were receiving such medications as glycyrrhetic acid, carbenoxolone sodium and amphotericin B.[5-7] In another instance rhabdomyolysis was associated with hypokalemia of renal tubular acidosis.[8] Our patient was receiving no medications and was not acidotic. The question of isolated hypokalemia causing rhabdomyolysis is still not settled, but in most cases where the major metabolic derangement is hypokalemia the serum potassium is severely reduced, often below 2.0 mEq per liter. Our patient's lowest recorded value of 3.0 mEq per liter, although abnormal, is not uncommon and is not a cause of rhabdomyolysis.

Hyponatremia accounts for the confusion and lethargy but is not known to be a cause of rhabdomyolysis by itself. In many reported cases of abnormal metabolic states, hyponatremia is one of several abnormalities. The degree of hyponatremia in this case, while abnormal, is not uncommon in clinical medicine. The use of diuretic medication, syndromes of unusual antidiuretic hormone secretion, acute and chronic dilutional states, essential hyponatremia and hyponatremic dehydration are among the more common situations. Acute psychogenic polydipsia as a cause of hyponatremia is not rare. Rhabdomyolysis is not associated with these hyponatremic conditions.

Several laboratory values were absent. Hyperuricemia, hyperkalemia, and hyperphosphatemia are often seen with rhabdomyolysis but were not observed in this case. The overall dilutional state present in the patient on admission is adequate explanation for lack of these abnormalities early in the course of the illness, and the preservation

TABLE 1.—*Findings of Laboratory Studies*

Date, Time	Serum Sodium mEq/L	Serum Potassium mEq/L	BUN, mg/dl	CPK	SGOT U/L	LDH U/L	Hbg gm/dl	WBC 10^3/cumm	Urinalysis							
									pH	Specific Gravity	Occult Blood	Color	Glucose	Protein	RBC	Myoglobin mg/L
8/21, 3 AM	116	3.0	5	1,014	42	150	..	..	..	..	..	..	..	..	..	..
8/21, 9 AM	119	3.7	..	..	..	..	12.4	8.0	5.5	1.001	3+	pink	neg.	1+	2-4	38-75
8/21, 6 PM	120	3.5	..	..	..	..	13.3	8.4	7.5	1.005	3+	red orange	neg.	4+	25-35	..
8/22, 9 AM	126	3.5	6	78,000	720	2,630	..	..	..	..	..	..	..	..	..	..
8/22, 6 PM	132	3.6	5	98,000	..	..	..	..	..	..	..	..	..	..	..	..
8/23	138	4.0	4	89,000	1,115	2,010	..	..	..	..	..	..	..	..	..	..
8/24	139	4.2	7	44,600	..	..	13.8	7.2	7.0	1.044	3+	yellow	trace	neg.	5-10	..
8/25	135	3.8	9	39,000	..	..	..	..	..	..	..	..	..	..	..	neg.
8/26	135	4.7	13	14,200	..	..	..	..	..	..	..	..	..	..	..	..

BUN = blood urea nitrogen
CPK = creatinine phosphokinase
SGOT = serum glutamic oxaloacetic transaminase
LDH = lactic dehydrogenase
Hbg = hemoglobin
WBC = white blood cells
RBC = red blood cells

of normal renal function during the hospital course prevented the appearance of hyperuricemia, hyperkalemia and hyperphosphatemia.

The high spot urine potassium value in the presence of hypokalemia seems to account for the renal excretion of potassium preventing hyperkalemia.

Exertion, especially in a warm environment, is a common cause of rhabdomyolysis.[9] The patient was admitted to hospital on a warm August day with temperatures reaching 93°F. However, the patient's exertion was not unusually excessive; household chores such as cleaning and cooking, and light yard work were all that were decribed. As the patient's mental status became abnormal, some agitation and confusion were noted. Administration of diazepam was required in the hospital because of the patient's repeated attempts to climb out of bed. However, documentation of a convulsive episode was not present.

The causes of psychogenic polydipsia are poorly understood. Many patients are severely disturbed, even psychotic. However, anxiety may be the only psychological disturbance evident. How this emotional state severely alters thirst is unknown. Our patient was scheduled to be admitted to another hospital for elective repair of an inguinal hernia the same day that the acute water intoxication developed. The patient later freely admitted feeling anxiety about this surgical procedure.

It seems likely that the cause of the observed rhabdomyolysis and myoglobinuria was multifactorial. In the metabolic setting of acute hypokalemia and hyponatremia, exertion (agitated behavior) and temperature elevation were enough to cause muscle cell injury and release of myoglobin. Fortunately, renal failure did not occur and conservative measures such as sedation, fluid restriction and alkalinization of the urine were all that were necessary.[10]

Summary

Rhabdomyolysis and myoglobinuria were observed in an otherwise healthy 62-year-old man following acute water intoxication. Pronounced hyponatremia and hypokalemia were present on admission. Various possible causes of rhabdomyolysis including hypokalemia, hyponatremia and exertion are discussed.

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