Myocardial Necrosis by Electrocution: Evaluation of Noninvasive Methods

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We present the case of a young man who suffered severe anteroapical myocardial necrosis caused by electrocution. In addition to the enzymatic and electrocardiographic changes suggesting necrosis, a clear positive segmental image on ^{99m}Tc-pyrophosphate scintigraphy and a defect on a ^{201}Tl SPECT scan at rest were also found. Although these tests were indicative of extensive anteroapical transmural myocardial necrosis, the echocardiographic study only revealed mild anteroapical hypokinesia.

Key Words: acute myocardial infarction; electrocution; technetium-99m-pyrophosphate; thallium-201; echocardiography.

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Every year 1200 people die in the U.S because of an electrical accident (*1*). Lightning is the cause of death in at least 100 people every year (*2*). The pathway of the electrical current through the body determines the effects on the cardiovascular system. The most frequent causes of cardiac damage are the direct currents from arm to arm and from arm to leg. After an accident by electrocution, myocardial necrosis has been demonstrated in necropsial series. In clinical practice, cardiac damage can be detected by electrocardiogram, increased isoenzymes (*3*) and contractility defects in echocardiography and radionuclide or contrast ventriculography. We report a case in which ^{99m}Tc-pyrophosphate scintigraphy resulted in a positive image.

CASE REPORT

A 22-yr-old man suffered an electrical shock while he was drilling a wall, which led to loss of consciousness. Ten minutes later, he arrived at the hospital with cardiorespiratory arrest and ventricular fibrillation. After 5 min of resuscitation maneuvers, including eight countershocks of 360 J, he recovered sinus rhythm.

On admission to the intensive care unit, the patient was intubated under sedative and myorelaxing drugs. In his right hand, he had lineal erosion corresponding to the point of entry of the electrical damage. Blood pressure was 130/70 mmHg and peripheral pulses were present. Heart sounds were normal, and the lungs were clear. The abdomen was normal. On neurologic examination, the pupils were 5 mm wide and constricted to 2 mm in response to light, and corneal reflexes were absent. An electrocardiogram showed sinus rhythm at a rate of 80 per minute, ST elevation in leads I, aVL and V2-6 (maximum 22 mm in V3) and a small ST-segment depression in II, III and aVF (Fig. 1). The laboratory values were normal except for the following enzyme levels: AST 1,456 UI/liter, CK 13,368 UI/liter and CK-mB 504 UI/liter.

When the patient was extubated 48 hr later, he was disoriented with spontaneous eye opening and no other neurological abnormalities. Cranial CT and MRI were normal. On the second hospital day, Doppler echocardiography showed a nondilated left ventricle with anteroapical hypokinesis and mildly depressed systolic function. Technetium-99m-pyrophosphate cardiac scintigraphy depicted an intense and extensive positive image, including the cardiac apex (Fig. 2). A ^{201}Tl SPECT scan at rest revealed an anterior, septal-inferior and apical defect (Fig. 3).

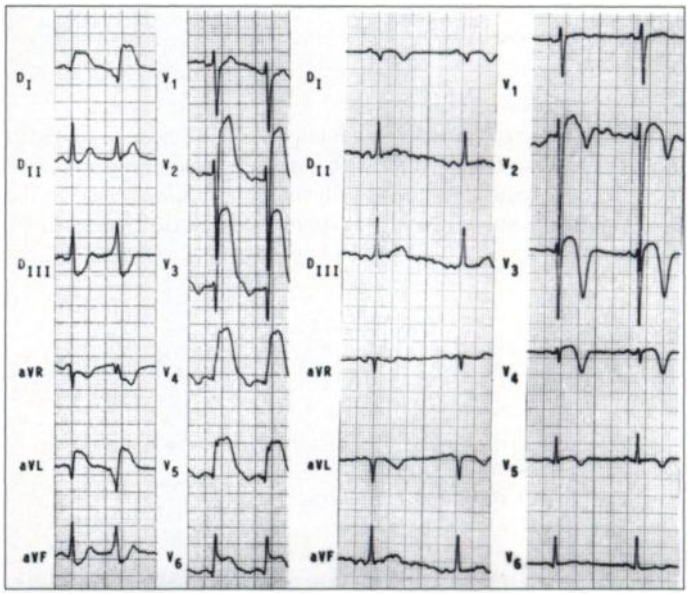

FIGURE 1. ECG on admission (left) and on the sixth day of evolution (right).

On the sixth hospital day, ECG showed an already normal ST-segment with negative and deep T waves in V2-5 (Fig. 1). There were no cardiovascular complications. The main clinical problem was neurological, as the patient remained disoriented and agitated for the next 3 mo.

DISCUSSION

Cardiac effects that can be observed after an electrical accident may be a direct consequence of the electrical shock of the pathway through the heart causing asystolia or ventricular fibrillation. The respiratory center also can be damaged, leading to cardiorespiratory arrest.

Within the hours after the accident, nonspecific changes of the T wave, ST-segment and sinus tachycardia are the most frequent cardiac effects. Changes in the T wave, ST-segment and QT interval can be attributed to the direct effect on myocardial tissue or to electrical damage to the central nervous system.

Catecholamine spillover after an electrical accident causes sinus tachycardia and hypertension. Arrhythmias, such as ventricular ectopy, ventricular tachycardia, atrial tachycardia, sinus bradycardia, and conduction disorders, such as bundle-branch block or advanced AV block, have been described (*1*). Some

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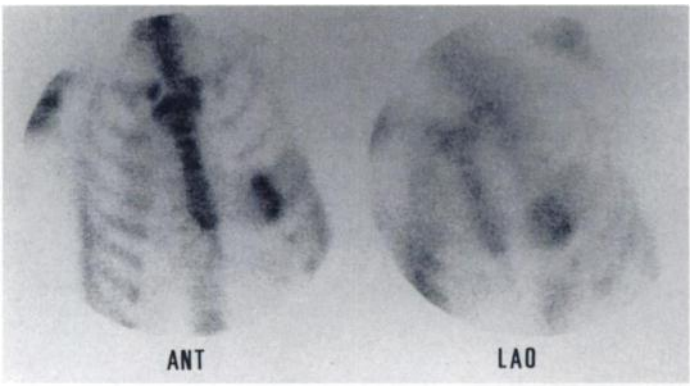

FIGURE 2. Technetium-99m-pyrophosphate cardiac scintigraphy shows a markedly positive image located on the anteroapical wall of the left ventricle. ANT= anterior view; LAO = left anterior oblique view.

cases of pericardial effusion and, less commonly, cardiac rupture, have also been reported (*1*).

Acute myocardial infarction due to electrocution is certainly a rare complication. Sometimes, the diagnosis cannot be definitively made because the electrocardiographic signs are nonspecific and CK-MB elevation can be related to skeletal muscle necrosis, and echocardiographic disorders do not persist. In some necropsy series (*4*), myocardial necrosis has been demonstrated, revealing a clear correlation between the CK-MB elevation and the myocardial damage. These necropsy studies confirmed that electrocution was the cause of the myocardial infarction in cases of no previous coronary artery disease. Electrical shock may produce necrotic bands in the nonstriated muscles of the coronary arteries and also arterial thrombosis.

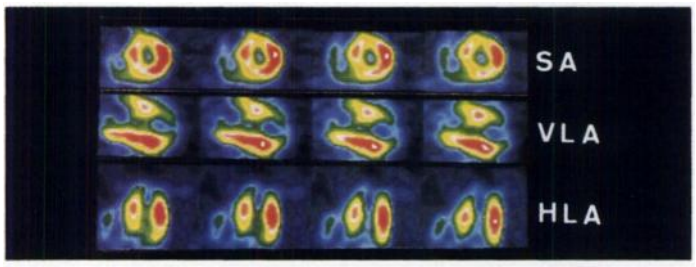

FIGURE 3. Thallium-201 SPECT scan at rest shows perfusion defects on the anteroapical and septal-wall. HLA = horizontal long-axis; SA = short-axis; VLA = vertical long-axis.

The right coronary artery, because it is closest to the thoracic wall, is the most vulnerable to electrocution.

In our patient, electrocardiographic evolution and myocardial enzyme elevation were characteristic of an anterior myocardial infarction. Technetium-99m-pyrophosphate scintigraphy confirmed acute myocardial damage with a clear segmental anteroapical location. Some cases with segmental defects on ^{201}Tl scintigraphy have been described. Additionally, a case of a positive image on ^{99m}Tc-pyrophosphate scintigraphy after radiofrequency application has been reported (*5*). Electrical defibrillation has been reported to induce positive cardiac images with ^{99m}Tc-pyrophosphate scintigraphy (*6*), but these are diffuse and rare (*7*). In our patient, echocardiography showed only mild hypokinesia in the anterior wall in contrast with ECG, cardiac enzymes and scintigraphic images. Although coronary arteriography was not performed in our patient, the findings may represent an occlusion-reperfusion phenomenon in the left descending anterior coronary artery.

CONCLUSION

Although arrhythmias following electric shock are not unusual, this case reports a previously healthy young man who developed classic findings of myocardial infarction following such an episode. Although coronary angiography data are lacking, the myocardial perfusion defect corresponds to a distal LAD occlusion.

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ECT Treatment and Cerebral Perfusion in Catatonia

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A 40-yr-old woman with a diagnosis of schizoaffective disorder developed catatonia in the context of a depressive episode. A dramatic decrease in perfusion of the inferior frontal, posterior temporal and parietal lobes bilaterally and in posterior frontal lobes corresponding to the motor cortices was noted on the ^{99m}Tc-HMPAO SPECT scan obtained in the acute phase. The most dramatic decreases compared to normal control subjects were observed in the left parietal and left motor cortices. The patient was treated with a five-treatment course of electroconvulsive therapy (ECT), which resulted in a complete resolution of catatonia and some resolution of her symptoms of depression. The repeat HMPAO-SPECT scan showed improved perfusion in all areas. The most dramatic increases occurred in the left parietal and left motor cortices. Decreased perfusion in motor and parietal cortices could be state-specific to catatonia. Thus, SPECT imaging may be a useful method for monitoring catatonia treatment response.

Key Words: catatonia; SPECT; electroconvulsive therapy
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The term "catatonia" describes a syndrome that involves dramatic changes in the level and quality of psychomotor