

Cerebrovascular accident (CVA) in association with a Taser-induced electrical injury

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Abstract Various adverse outcomes related to the use of electrical weapons such as the stun gun or the Taser have been described in the literature over the years. Examples include cardiac arrhythmias, blunt and penetrating injuries, seizure activity, and altered mental status. Imaging findings related to electrical injuries have become more frequent with advancing imaging technologies, such as CT or MRI. However, imaging findings and pathophysiology of electrical injuries that result in significant neurological events remain largely unexplored. We report the case of a patient who developed an ischemic stroke following Taser discharge, raising the possibility of association between the electrical injury and the ischemic stroke.

Keywords Taser · Cerebrovascular accident · Electrically induced injury

Introduction

Electrical weapons have been widely used as a less lethal alternative to conventional firearms. A number of direct and indirect adverse outcomes related to electrical current on exposed subjects have been well reported in the literature,

including cardiac arrhythmias, blunt and penetrating injuries, seizure activity, and altered mental status [2, 4, 8]. Of these entities, significant neurological outcome related to electrical injuries remains uncommon. Electricity-induced coagulation has been suggested, but reports of clinically significant outcomes were poorly described in the literature [9]. We present the case of a 32-year-old male who developed an ischemic stroke following Taser discharge and discuss the potential association between the electrical injury and the ischemic stroke.

Description

A 32-year-old male with past medical history only significant for bipolar and schizoaffective disorder, presented to the ED following Taser discharge during altercation with the police. The patient became briefly unresponsive during the incident. Upon arrival to the emergency department, the patient had persistent change in mental status with speech difficulty. Physical examination revealed abrasions on the forehead from the Taser barb wire and generalized right-sided weakness. The initial work-up including electrolytes and EKG (NSR) were negative. Upon further evaluation, CT of the head demonstrated a nonhemorrhagic acute infarct along the left middle cerebral artery (MCA) territory with surrounding edema and associated mass effect (Fig. 1). CTA and MRI/MRA of the head and neck were subsequently performed which demonstrated filling defects in the distal M1 and proximal M2 segments of the left middle cerebral artery (Fig. 2) with restricted diffusion in the MCA territory (Fig. 3). There were no other intracranial or cervical vessel abnormalities.

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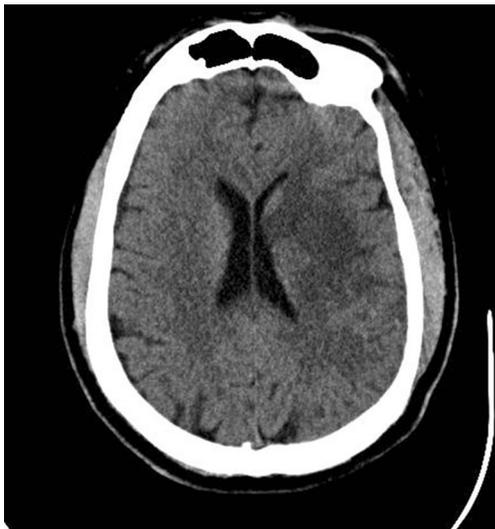


Fig. 1 Axial CT image demonstrates edema with resultant mass effect on the left lateral ventricle involving the left MCA territory

Subsequent work-up in this patient included testing for infectious, inflammatory, and hypercoagulable etiologies, all of which were negative except for mildly decreased level of protein S levels. Transesophageal echocardiogram and transthoracic echocardiogram were negative for embolic source. Drug screening was negative as well. The patient was not obese. HbA1c and lipid studies were negative. History of tobacco use was the only pertinent risk factor. This patient had no prior imaging studies.

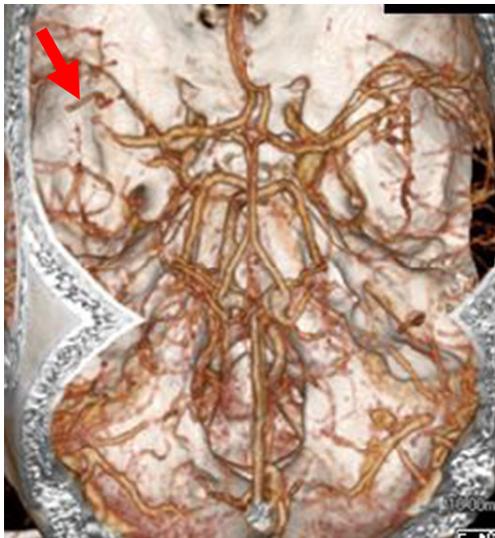


Fig. 2 Three-dimensional reconstructed image of intracranial vessels demonstrates occlusion of left mid M1 (arrow) with paucity of distal vessels

Discussion

A Taser gun uses approximately 50,000 V to deliver electrical energy through a propelled barb system. The resultant electrical current stimulates the presynaptic motor neurons, leading to a refractory period in which voluntary control of skeletal muscle is lost [1]. Initially, when the Taser gun was introduced, the incidence of adverse outcomes was thought to be minimal, but adverse outcomes related to direct and indirect effects of electrical injury continue to be reported. In the past literature, neurological injury associated with an electrical exposure was thought to be sequela of thromboembolic or hypoperfusion events from cardiac injury [3, 4]. Asian et al. reported thromboembolic cerebellar infarcts in a patient with an electrical injury with signs of cardiac ischemic [5].

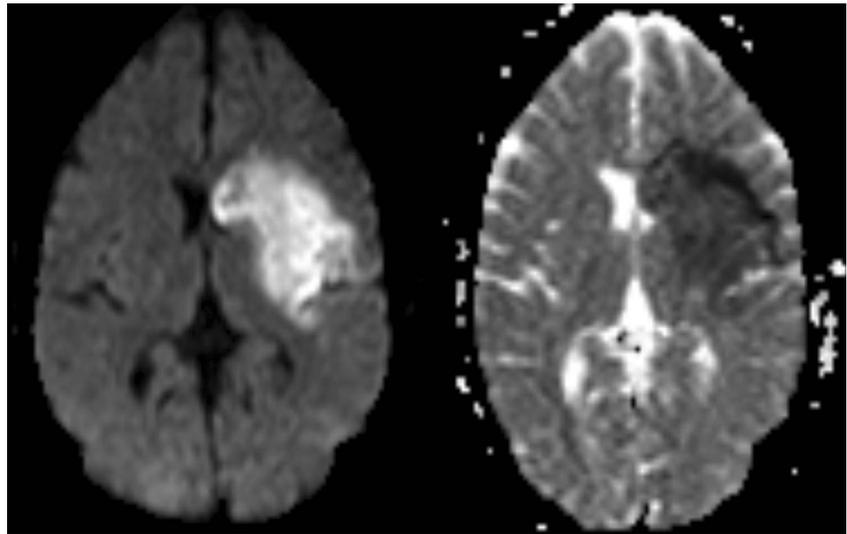
Isolated neurological injuries related to electrical exposures have been infrequently reported in the literature. Chen et al. reported a case of a diabetic, coagulopathic patient who suffered a stroke following electrical low-voltage exposure [6]. Johansen et al. depicted a case of a reversible neurological injury that resolved 6 months following a high voltage electrical injury [7]. Bui et al. presented a case of a patient who developed a seizure after being struck in the head by the Taser [8]. In case of our patient with normal cardiac work-up and history of smoking as the only risk factor, isolated electrical neurovascular injury is more plausible than cardiac-related neurologic complication.

The mechanism of electric injury to a vessel is incompletely understood, but several mechanisms have been proposed. Acute stroke may result from a combination of endothelial injury and vasospasm. Thermal injury, caused by large quantities of heat produced by the flowing current, may result in subsequent thrombosis of the injured vessel [9]. Vessel spasms may occur from direct electrical effects or indirectly following vessel injury [11]. Current takes the path of least resistance from the source, and in case of our patient where the source originated from the wire in the forehead, primary involvement of the brain as beginning of the circuit pathway is anticipated. It has been speculated that a more diffuse process such as a chemical reaction may be responsible for neurovascular injury; however, this is less likely in our case given a focal involvement of a large intracranial vessel [10].

Summary and conclusion

A stroke in an otherwise healthy young male is an uncommon diagnosis and usually warrants an extensive work-up. In this particular case, the evaluation for possible infectious, inflammatory, and thromboembolic etiologies were essentially

Fig. 3 Axial diffusion weighted (*left*) and ADC (*right*) images demonstrate restricted diffusion in the left MCA territory, consistent with acute infarction



negative. While cardiac abnormalities such as paroxysmal atrial fibrillation were not discovered during this patients' hospital stay, cardiac-related causes remain possible. The temporal relationship of the development of a stroke and Taser discharge on the head in an otherwise young healthy individual suggests the likelihood of electrical injury-induced stroke from a combination of vasospasm and endothelial thermal injury. Imaging modalities such as MRI and CT can provide clues to early diagnosis and management.

Conflict of Interest The authors declare that they have no conflict of interest.

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