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Epilepsy secondary to brain injury by electrocution: A case report

Gabriella Telles Almeida, Camilla Nunes Proença Formoso, Daniel Antunes Pereira, Gilberto Canedo Martins Jr, Antônio Marcos da Silva Catharino

ABSTRACT

Introduction: According to the Yearbook of Accidents of Electrical Origin for the year 2022, 853 accidents due to electric shock were reported in Brazil, of which 592 died, a reduction of 12.2% in mortality compared to the previous year. Three conditions elucidate trauma switches caused by the passage of electric current, the regulatory alterations by the passage of electric current, the conversion of electrical energy into thermal, known as the Joule effect, and muscle damage by the electrical stimulus of exacerbated contractions.

Case Report: A 51-year-old male patient was followed up on an outpatient basis due to a nervous breakdown caused by accident with a high-voltage electrical discharge 15 years ago. After the event, he evolved with conduction aphasia, homonymous hemianopia on the right, hypoesthesia on the right side of the body, dysmetria on the right upper limb, and epileptic seizures of focal onset, evolving into tonic-clonic seizures. For seizure control, carbamazepine 200 mg 3 times a day was administered, with complete seizure control since then.

Conclusion: Therefore, it is important to emphasize that the damage caused by electrocution to the central nervous system (CNS) is varied. Still, due to the patient's clinical presentation, his neuroimaging findings, and his history, this is epilepsy secondary to electrocution. Encephalomalacia demonstrates a large scar in the brain tissue, and its control of seizure episodes with the adopted pharmacotherapy also corroborates.

Keywords: Brain diseases, Electric injuries, Epilepsy

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INTRODUCTION

According to the Yearbook of Accidents of Electrical Origin for the year 2022, 853 accidents due to electric shock were reported in Brazil, of which 592 died, a reduction of 12.2% in mortality compared to the previous year. The main associated factor is the vulnerability of the facilities, poor quality of the materials used in them, and lack of professional qualification in the area, generating a higher incidence in residential environments, adding to the precarious reality of a large part of the population [1].

The organic barrier with the highest electrical resistance is the skin, unlike the nervous tissue, which due to its low resistance, is the conduction path in electrical shock accidents, causing injuries to the central nervous system (CNS) visible in imaging tests such as tomography of skull and magnetic resonance imaging (MRI), different from other conditions, such as neurocognitive and psychological disorders, and those originating from the peripheral nervous system (PNS), where neuroimaging is not useful [2, 3].

The mechanisms of trauma caused by the passage of electric current are elucidated by three conditions, the physiological alterations caused by the passage of electric current, the conversion of electrical energy into thermal energy, known as the Joule effect, and muscle damage caused by the electrical stimulus of exacerbated contractions [2, 3].

The most severe outcome of accidental electrocution in a living organism is ventricular fibrillation. The electric current alters cardiac electrophysiology, generating asynchronous contractions, depending on the intensity and duration, cardiorespiratory arrest. In addition to extensive burns, the most common cause in urgent and emergency departments is hydroelectrolytic disorders, rhabdomyolysis due to muscle damage, compartment syndrome, fractures due to falls, amputations, and CNS and peripheral injuries [2, 4].

Considered a hazardous activity, the execution of work with an electric source is regulated with safety standards based on institutions that advocate public safety and preventive actions, seeking to reduce low and high-voltage electrical trauma [3, 5].

This report presents therapy implemented in a patient who was the victim of a work accident with high-voltage electrical discharge, causing irreversible neurological damage and, as a factor that aggravated the clinical condition, duly controlled generalized tonic-clonic seizures.

CASE REPORT

Male patient, 51 years old, electrician, a victim of a work accident with high voltage electrical discharge, >600 volts, was followed up with cardiorespiratory arrest for 15 years. After the incident, he evolved with conduction aphasia, right homonymous hemianopia, hypoesthesia in the right hemibody, sensory dysmetria in the right upper limb, and epileptic seizures of focal onset evolving to tonic-clonic seizures, being followed up in a neurology outpatient clinic. In the emergency department, a skull tomography was performed after electrical trauma, with changes in left parieto-occipital hypodensity and a simple skull radiograph that revealed a solution of bone continuity in the left parietal region (Figure 1).

As the exam of choice for follow-up and evolution of the condition, MRI of the brain was performed, which showed an area of temporo-parieto-occipital encephalomalacia on the left in T1 coronal and axial views and T2 coronal and axial views (Figures 2–5). To control the seizures, therapy with carbamazepine 200 mg 3 times a day was adopted, with complete control since then.

Figure 1: Lateral skull X-ray showing temporal-parietal discontinuity.

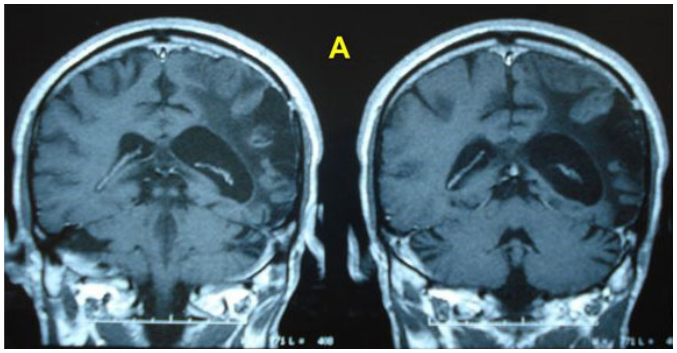

Figure 2: Magnetic resonance imaging of the skull demonstrating an extensive area of encephalomalacia with gliosis in the temporal-parietal-occipital region on the left (A—T1 sequence coronal cut).

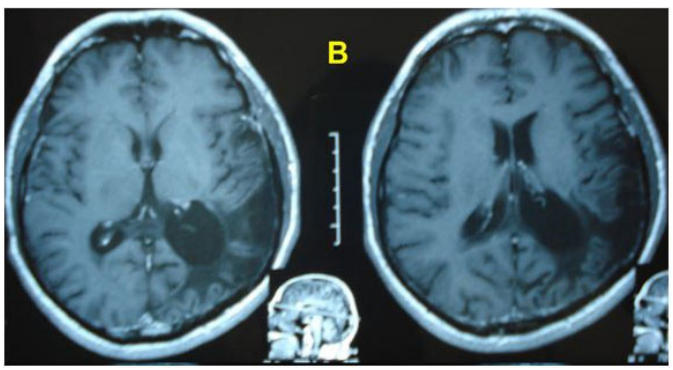

Figure 3: B—Sequence T1 axial cut.

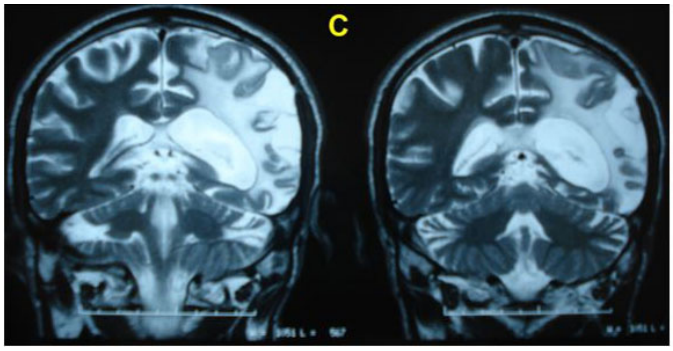

Figure 4: C—Sequence T2 coronal cut.

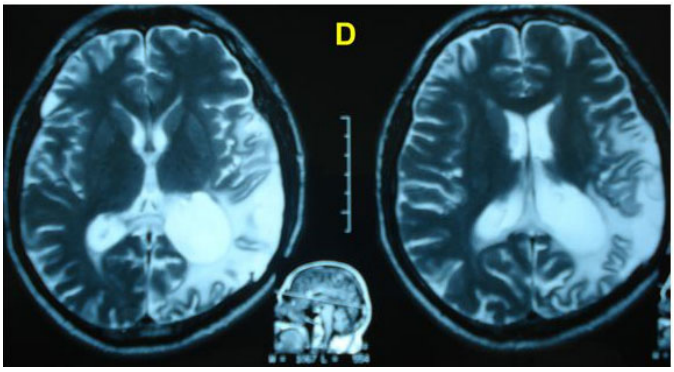

Figure 5: D—Sequence T2 axial cut.

DISCUSSION

As far as we know, this study is the first to relate electric shock to secondary epilepsy. The relevance of this case is whether the electrical injury that the patient suffered induced epilepsy or whether this is an atypical case of epilepsy.

High-voltage shock is responsible for most of the severe and persistent complications of electrocution. The potential for injury to the nervous system in an electric shock is directly related to the ability of the body to transmit electric current through nerves and blood vessels due to the low resistance of these tissues. Lesions in the CNS that pass through the brain are called primary and can lead to loss of pyramidal cells, reduction of Purkinje cells, demyelination, neuronal loss, and creation of excessive neuronal activity [6, 7]. In this sense, possibly all these changes in the CNS generated by the high voltage promoted the patient's epileptic seizures.

The International League Against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE) define an epileptic seizure as a transient occurrence of signs and/or symptoms due to excessive or abnormal synchronous neuronal activity in the brain. It is not a singular disease entity but a variety of disorders that reflect underlying brain dysfunction that can result from many different causes. Epilepsy, on the other hand, is defined as a brain disorder characterized by a lasting predisposition to generate epileptic seizures and by neurobiological, cognitive, psychological, and social consequences [8]. The correct definition is necessary for the understanding and accurate classification of the patient. In this case report, the patient presents post-electrocution characteristics that characterize an epileptic seizure of focal onset evolving into tonic-clonic seizures.

Knowing that epilepsy is not a singular disease entity but a variety of disorders that reflect underlying brain dysfunction that comes from many causes, the possibility of electrocution fomenting the seizure is possible.

A Danish cohort study concluded that victims of electric shock might have CNS sequelae that include an increased risk of epilepsy, Parkinson's disease, and amyotrophic lateral sclerosis (ALS), manifesting for the first time a significant time after the electric shock. The study also shows clear patterns of association between electrical injury and epilepsy, with odds ratios of around [1.5:2.0] and similar risk ratios in time to event analysis [9].

Cranial MRI, which was requested for follow-up of the condition, showed an area of encephalomalacia temporal-parietal-occipital to the left. It is claimed that parietal lobe epilepsy accounts for 6% of patients receiving epilepsy surgery in large epilepsy centers. Diagnosis in parietal lobe seizures can be challenging due to the subjective nature of the episodes. It can be said that sensorimotor phenomena and vestibular hallucinations are present. There may be vertigo symptoms, paresthesias, visual hallucinations, somatic illusions, language impairment, and auras. This shows that, even though it is rare, cerebral alteration in the brain site indicated after the electric shock points to a secondary epileptic seizure in this patient because the area affected by the shock matches the patient's symptoms [10, 11].

In a study reporting epilepsy in the parietal lobe, the patients had contralateral sensory deficits, including contralateral two-point discrimination, the smallness of the contralateral extremities, arm, and leg, in 8% visual field defects in the contralateral lower quadrant, impaired written language and another a mild aphasia [12]. The patient also presented symptoms such as conduction aphasia, right homonymous hemianopia, hypoesthesia in the right side of the body, and sensory dysmetria in the right upper limb. It is then observed that the post-electrocution structural alterations generated similar signs to patients with primary epilepsy in the parietal lobe.

The literature on epilepsy secondary to electrocution is limited, with no study specifically on the subject.

CONCLUSION

It is important to emphasize, therefore, that the damage caused by electrocution to the CNS is varied. Still, due to the clinical presentation by the patient and his neuroimaging findings, and his history, this is epilepsy secondary to electrocution. Encephalomalacia demonstrates a large scar in the brain tissue, and its control of seizure episodes with the adopted pharmacotherapy also corroborates.

Finally, further studies on this relationship between electrocution and epilepsy are in order, given the limited literature found.

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Author Contributions

Gabriella Telles Almeida – Conception of the work, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Camilla Nunes Proença Formoso – Conception of the work, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Daniel Antunes Pereira – Conception of the work, Interpretation of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Antônio Marcos da Silva Catharino – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission

The corresponding author is the guarantor of submission.

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Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.