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Neurolinguistic Sequelae of Electrical Shock: A Case Study of Broca's Aphasia

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Abstract: ***Introduction: The electric shock (ES) occurs upon contact of a human body part with any source of electricity that causes a sufficient current through the skin, muscles and hair. Aphasia is a disturbance of the comprehension and formulation of language caused by dysfunction in specific brain regions. Broca's aphasia is a type of nonfluent aphasia, so called because speech production is halting and effortful. Damage is typically in the anterior portion of the left hemisphere. Current literature contains relatively little about the present state of knowledge concerning the neurological effects of electrical injury to man. Case study: A 50 year old case reported C U Shah Medical College and Hospital, Surendranagar with complaint of electric shock in his right hand. He lost consciousness and when he retained consciousness he had right side hemi paresis and had lost speech ability an. The CT scan (fig 1) finding showed infracts in left frontal lobe. The patient was assessed with the first part of the Western Aphasia Battery (WAB) (Kertesz, 1974)[1]. His spontaneous speech, repetition, naming are severely affected while auditory comprehension was relatively better. He was diagnosed with Broca's aphasia. Pathology: The pathology of Aphasia due to electrical shock involves blood vessel damages. Electrical shock result into heating and electrolytic and mechanical effects along with electrostatic effect. Conclusion: There are many neurological effects of electrical shock and Aphasias are one of them. We need to assess all these possibilities while working with the persons who have suffered electrical shock.***

Keywords: Electric shock, Broca's aphasia, Electrical injury, Stroke, Neurological complications

Broca's aphasia as a consequence of electric shock – A case study

1. Introduction

The electric shock (ES) occurs upon contact of a human body part with any source of electricity that causes a sufficient current through the skin, muscles and hair. Typically the expression is used to describe an injurious exposure to electricity. Electrical injury can result from direct contact with any source of electricity. While some electrical shocks may result in minor burns, there still may be serious internal damage hence, producing a complex pattern of injury and clinical manifestations. The exact pathophysiology of an electrical injury is very difficult to predict due to the large number of variables that cannot be measured or controlled when an electrical current passes through tissue. (Mechanism of electrical injury, Chicago Electrical Trauma Research Institute, April 27, 2010)[2].

Accidental contact with exposed parts of electrical appliances or wiring, flashing of electric arcs from high-voltage power lines, lightning, machinery or occupational-related exposures or poking metal objects into an electrical outlet are all possible causes of electrical injury. High-voltage electrical trauma mainly observed in electrical workers produce some of the most devastating of physical injuries. Repeated removal of the damaged tissue and extensive rehabilitation are common while limb amputation rates for victims who experience direct electrical contact can be as high as 75%. In general, most victims who survive high-voltage electrical shock are left permanently disabled.

Away from the workplace, most electrical injuries are due to either indoor household low-voltage (less than 1000 V) electrical contact or outdoor lightning strikes. Domestic household 60-Hz electrical shocks are common and usually result in minor peripheral neurological symptoms or occasionally in skin surface burns. However, more complex injuries may result depending on the current path, particularly following biting or chewing on household appliance cord disclosures or outlets in small children. Compared to a high-voltage shock that usually is mediated by an arc, low-voltage shocks are more likely to produce a prolonged, "no-let-go" contact with the power source. This "no-let-go" phenomenon is caused by an involuntary, current-induced, muscle spasm. (Mechanism of electrical injury, Chicago Electrical Trauma Research Institute, April 27, 2010).

The clinical effects on the nervous system resulting from electrical shock accidents can best be classified as immediate, secondary, and late manifestations. (John Silverside, MD, 1964)[3]. Immediate effects include loss of consciousness with confusion, headache, agitation, and convulsion. Effects without loss of consciousness include deafness and severe pain. Motor signs including respiratory paralysis, tremor and compete paralysis. Sensory complaints include paresthesia and hypoesthesia. Burns are also observed. Intermediate effects include temporary paralysis, pain in trunk, autonomic disturbances and headache. Late effects include effects on central as well as peripheral nervous system including Aphasia, hemilplegia and cerebral dysfunction which were observed in our case.

Electrical injury, also, often leads to problems with neurocognitive function, affecting speed of mental processing, attention, concentration, and memory. The high frequency of psychological problems is very well established and may be multifactorial in aetiology (Reilly, 1994)[4]. As with any traumatic and life-threatening

experience, electrical injury may result in post traumatic psychiatric disorders which can be as life-changing as a major physical deformity (Pliskin, 2006) [5]. The larger currents can causes fibrillation of the heart and damage to the tissues and it can be electrocution (Reilly. J. Patrick (1998). Many people survive electrical trauma only to find a host of injuries including loss of consciousness, seizures, aphasia, visual disturbances, headaches, tinnitus, paresis, and memory disturbances (Pliskin, 1994) [6].

Aphasia
Aphasia is a disturbance of the comprehension and formulation of language caused by dysfunction in specific brain regions (Damasio, AR. (1992)) [7].

Aetiology of Aphasia
It typically occurs after a stroke, head injury, brain tumour, infection or degenerative diseases leading to damage in areas of the brain cells controlling language. Stroke is the most common cause of aphasia, and it has been estimated that about 20-40% of stroke patients develop aphasia. (Wade et al 1986)[8].

Classification of aphasia:
Aphasics are generally grouped as being fluent or nonfluent (Kearns, 1997)[9]. Nonfluent aphasics exhibit impaired flow of speech, effortful speech production with usually good comprehension skills, and varying degrees of difficulty with repetition. The nonfluent aphasics tend to display agrammatical or telegraphic speech (omission of function words) and depend primarily on the use of key content words (pain. . . leg). Nonfluent aphasia is typically seen in Broca's, transcortical motor, and global aphasia. Fluent aphasics exhibit a smooth flow of speech with arying degrees of deficits in comprehension and repetition. They may also exhibit circumlocution (speaking around a target word); paraphasic errors (use the word sister for mother or penkle for pencil); and neologisms (made up words [ie, gargot]). Typically Wernicke's, conduction, transcortical sensory, and anomic aphasia are grouped in the fluent category.

Broca's Aphasia:
It is a type of nonfluent aphasia, so called because speech production is halting and effortful. Damage is typically in the anterior portion of the left hemisphere. The dominant feature is agrammatism (impaired syntax). Content words (nouns, verbs) may be preserved but sentences are difficult to produce due to the problems with grammar, resulting in "telegraphic speech." In its more severe form, spoken utterances may be reduced to single words. Comprehension is typically only mildly to moderately impaired, and impairments are primarily due to difficulty understanding complex grammar. Repetition of words and sentences is usually poor.

In India there are very limited studies available on aphasia due to electric shock.

2. Case Study

A 50 year old case reported to medicine department at C U Shah Medical College and Hospital, Surendranagar with complaint of electric shock in his right hand. He got electric shock when he was searching some household article due to the loose connection of electric switch board. He lost consciousness and when he retained consciousness he had right side hemi paresis and had lost speech ability an. The CT scan (fig 1) finding showed infracts in left frontal lobe and he was diagnosed from medicine CVA with hemiplegic. He was referred to Speech therapy department for the loss of speech and language due to electric shock. The details speech and language evaluation done and these were the findings.

Evaluation of speech and language
The patient was assessed with the first part of the Western Aphasia Battery (WAB) (Andrew Kertesz, 1974)**.** This part of WAB assesses fluency and information content of speech, naming, Comprehension and repetition and writing. It is sufficient to determine the type of aphasia and it yields a measure of severity of aphasia, the Aphasia Quotient (AQ), ranging from 0 to 100, with scores above 93.8 being considered normal (non-aphasic).

Scores obtained on each subtests are given in table 1. Following were the findings:

Spontaneous speech He was able to say only few words and needed phonemic and functional cues. He correctly responded to two items. He was expressing in single words which was effortful. Total score obtained was 5 out of 20.

Auditory verbal Comprehension
His auditory comprehension was reduced for both short and long phrases, and for yes/no questions. Auditory word recognition was also impaired. He was using few gestures and blinks for the items which he could not identify. Total scored obtained was 82 out of 200.

Repetition
His repetition was good for word level utterances but could not repeat sentence as well complex sentence. Total obtained score was 14 out of 100.

Naming
In object naming he could name 3 items without any cue and 9 items with tactile and phonemic cues. In word fluency he could not name three animals in given one minute time while for the sentence completion task and responsive speech task he completed 3 items out of 5. Total score obtained was 29.

Total scores obtained on different subtests of WAB was calculated (table 2) and the patient was diagnosed with Broca's aphasia.

Table 1: WAB scoring on different subtests

Sponteneous Speech	Patient Score	Total Score
Information content	03	10
Fluency	02	10
Total	05	20
Auditory Verbal Comprehension		
Yes/no questions	46	60
Auditory word recognition	31	60
Sequential command	05	80

Total	82	200
Repetition	14	100
Total	14	100
Naming		
Object naming	15	60
Word fluency	03	20
Sentence completion	05	10
Responsive speech	06	10
Total	29	100

Table 2: Total scores on WAB
Aphasia Quotient (AQ) And Cortical Quotient (CQ)

Fluency	02	
	Aphasia Quotient (AQ)	Cortical Quotient (CQ)
Auditory Comprehension	4.1	8.2
Repetition	1.4	
Naming	2.7	

3. Discussion

Current neurological literature contains relatively little about the present state of knowledge concerning the neurological effects of electrical injury to man. It is common knowledge that it is not the voltage which determines the effects of electrical shock on the human individual but rather the amount of current actually flowing through the body. In direct hand-to-hand current passages, fatalities are high (approximately 60%), whereas in hand-to-foot current passage fatalities are very much lower, around 20%. (Alexander, 1941)[10]

The pathology of Aphasia due to electrical shock involves blood vessel damages. Blood vessel damage is fairly common and usually severe, especially involving large basal vessels; occasionally vessel rupture has been noted. (Hassin, 1949)[11]

Pritchard (1934)[12] suggested that in the usual electrical accidents, if the victim is grounded, the current passes through the body producing heating and electrolytic and mechanical effects. However, if grounding does not occur the electrical charge builds up in the body producing electrostatic effects. The electrostatic force upon a charged body is derived from mechanical repulsion that is exerted between all similarly charged particles and bodies. Thus, all the separate constituents of the body that carry the charge will be repelled from one another. The sudden expansile force of the body tissues acts as if the atmospheric pressure were suddenly reduced, giving rise to waves of decompression under the skin, and this is the force which affects the central nervous system tissues, most of the effects being evident where tissue rigidity or cohesion is least marked, as in the fluid spaces of the central nervous system. This may be possible pathology of Broca's Aphasia as post electrical shock incidence.

4. Conclusion

Involvement of experienced consultants and a supportive environment are required to facilitate rehabilitation, return to gainful employment, and normal family and social functioning for the management of persons with electrical shock injury ((Mechanism of electrical injury, Chicago Electrical Trauma Research Institute, April 27, 2010). There are many neurological effects of electrical shock and Aphasias are one of them. We need to assess all these possibilities while working with the persons who have suffered electrical shock.

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