Case report

Clonus: an unusual delayed neurological complication in electrical burn injury

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Abstract

Patients surviving high-voltage electrical injury may have early and delayed sequelae. The most apparent neurological complications are known to be cerebral injury, spinal cord lesions, peripheral-nerve injuries and motor neuropathies. In this study, clonus, which is an unusual late neurological sequela in an electrical burn patient and presented as series of rhythmic, monophasic contractions and relaxations of a group of muscles, is presented. Possible mechanisms of this unusual late sequela and the clinical outcome of the patient are discussed. Ankle and patellar clonus was observed in 4 patients and uvular clonus in 1 patient. Clonus started 3 weeks following the injury in our patients and disappeared over a period of 1 yr in 2 patients, and did not disappear in the remaining 2 patients. In the current literature, this is the first report, which presents an unusual sequela following electrical injury. Clonus should also be considered a specific type of neurological sequela following high- or super-voltage electric injury. This may help to inform the patients in the postinjury period and to improve the efficacy of the rehabilitation of the victims. © 2001 Elsevier Science Ltd and ISBI. All rights reserved.

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1. Introduction

An electrical injury is a unique form of trauma [1]. The clinical pictures following cellular damage due to electrical current comprise more of a syndrome than specific injury [2].

Patients surviving high-voltage electrical injury may have early and delayed sequelae. Some of the early complications are amputations, fractures or dislocations resulting from intense muscle spasm, visceral perforations, and heart dysfunctions. However, delayed sequelae have been reported to involve neurological impairment, visual impairment, ischemic cardiac changes and contractures.

The most apparent neurological complications are known to be cerebral injury, spinal cord lesions, peripheral-nerve injuries and motor neuropathies [3]. Occasionally, a long latent time can intervene between electrical injury and the appearance of neurological dysfunction.

In this study, clonus, which is an unusual and late neurological sequela in electrical burn patients presented as series of rhythmic, monophasic contractions and relaxation of a group of muscles. Four cases are presented and possible mechanisms of this unusual late sequela and the clinical outcomes of the patients are discussed.

2. Case reports

Case 1: A 21-year-old patient sustained a lightning injury in September 1996 during a military exercise. He was unconscious on admission to our Burn Centre. Physical examination revealed a 12 cm of full-thickness burn involving the vertex of the scalp, and left ankle...
(Fig. 1). Partial thickness burn was noticed all over the face and neck. Two hours later the patient became conscious and was found to have mild paraesthesia involving both lower extremities. Laboratory findings, ECG and computerised tomography were normal. No abnormality was observed by MRI and EEG. Five days later, the patient underwent an operation and the full-thickness scalp burn was excised. The cranial bone over the vertex was found to be necrotic. The cranial defect was reconstructed using titanium mesh and a free latissimus dorsi muscle flap transfer and skin grafting (Figs. 2 and 3). The full-thickness skin defect over the left ankle was closed by partial thickness skin graft. The patient complained of minimal “shakes” 3 weeks following surgery. Neurological examination of the patient revealed patellar, ankle and uvular clonus, increased deep tendon reflex, vertigo and nystagmus. The overall follow up period is 4 yr and the patient was seen regularly in every 3 months in this period. The clonus persisted over 4 yr.

Case 2: A 15-year-old boy was injured in December 1997 by 20 000 V from a high-tension line while playing alone and was found unconscious. On admission to a regional hospital, circulation of the left upper extremity was disrupted and he was transferred immediately to our centre following fasciotomy. Physical examination revealed full-thickness burn of his left-hand, right patella and ankle. The muscles at the fasciotomy sites were necrotic. The entrance and exit wounds were at the left-hand and right foot, respectively (Figs. 4 and 5). No abnormality was observed by EEG, MRI and CT examination. Both radial and ulnar arteries of the left upper extremity were found to be occluded on angiograms. An irreversible muscle injury and necrosis was observed at 5 days postinjury. Therefore, the patient underwent an operation and disarticulation of left upper extremity at the level of the shoulder was performed. After 5 weeks, the patient had neurological complaints showing as tremors, headache, and minimal weakness of the right foot. Neurological examination revealed increased patellar and ankle clonus, and deep tendon reflexes and decreased pin, touch, temperature and vibration. Clonus and other neurological symptoms ceased in a year.

Case 3: A 21-year-old electricity technician was injured on October 1997 by 18 000 V from a high-tension line while at work. Physical examination revealed deep second degree burn on his right-hand, full-thickness burn on the right and left feet. The entrance and exit wound were at his right-hand and both feet, respectively. Circulation of both feet was found to be disrupted, so fasciotomy was performed on admission. Even following fasciotomy, both feet were pulseless, cyanotic and cold. Therefore, Syme amputation of the right foot and amputation of the left leg at below knee level were performed. After 2 weeks, neurological complaints such as tremor, headache, dizziness and anxiety were noticed by the patient. Neurological examination revealed increased patellar clonus and deep tendon reflexes. Soon after these complaints, myoclonus was observed. Sometimes, the myoclonus was apparent during sleep resulting in the patient falling from the bed. The overall follow up period is 3 yr and the patient was seen regularly every 3 months over this period. Until recent follow up, his neurological complaints persisted with minimal improvement and the patient has been followed by neurologists.

Case 4: A 21-year-old wireless operator was injured on June 1998 from high-voltage current. Immediately after the injury, he was admitted to our centre and
found to be was unconscious. Physical examination revealed deep second degree burn over his right shoulder and trunk, and full-thickness burn on his right toe. The entrance wound was at his shoulder and the exit wound was at his right toe. Laboratory findings, ECG and CT were normal. No abnormality was observed by EEG, MRI and CT examination. Debridement and skin grafting were performed in the 7 days postburn. He complained of shakes, tingling and light-headedness after a week. Neurological examination revealed increased patellar, ankle clonus and deep tendon reflexes. Clonus and other neurological symptoms ceased in a year.

3. Discussion

Neurologic disorders from electrical injury may be classified as cerebral syndromes (hemiplegia, striatal syndromes), spinal syndromes (spinal atrophic palsies, hematomyelia, spastic paraplegia), peripheral nerve syndromes (isolated or multiple radiculopathies or neuropathies) [3]. Neurological complication involving either cerebral complication (loss of consciousness, seizures, decreased memory, emotional liability, learning impairment, headache) or peripheral complaints (sensorimotor loss, paraesthesias, paralysis, paresis, dysthesias, causalgia) have also been described in the current literature [4].

Transient spinal cord complaints have been described following high-voltage electric injury. These transient lesions appear early and rapid recovery within hours to days is seen. The more severe form of spinal injury is progressive and permanent. Spinal cord injuries that manifest immediately have better prognosis than those that appear later, although partial recovery may occur. Some authors have reported 3 kinds of injury: amyotrophic lateral sclerosis, ascending paralysis, and transverse myelitis [5,6]. Paraplegia, quadriplegia, im-

Fig. 2. Case 1. The cranial bone defect was reconstructed by use of a titanium mesh fixed by screws.

Fig. 3. Case 1. The appearance of the patient on 6 months postoperatively.
Fig. 4. Case 2. The entrance wound on left upper extremity of the patient is seen.

Potency and bladder dysfunction have all been described in the current literature [7]. Upper-motor neuron-type of motor deficit is seen most often, with lower extremities being affected more commonly [6–8]. Delayed central and spinal cord lesions are recognised but are uncommon. Therefore, it is likely that the sequelae from high- or super-voltage electric injury are largely related to the injured systems or specific pathways in cortical neuron system as well as affected peripheral nerves or spinal cord. The neurological symptoms may vary from patient to patient according to the specific injury.

In this report, 4 patients with clonus as a late neurological sequela was presented. When considering the entry and exit sites, the pathways of currents were from arm to arm or arm to leg, which cross through the spinal cord except in the patient who had a high-voltage injury. All patients had neurological and cardiological consultations on admission and also are on follow up period regularly. Only 2 of them who had persistent clonus were given medication, which includes vitamin B.

We observed ankle and patellar clonus in 4 patients and uvular clonus in 1 out of 4. Clonus started 3 weeks following the injury in most of our patients and disappeared in 1 yr in 2 patients. Clonus in the other 2 patients did not disappear until the last follow up. The clonus depends on the synchronisation of the contraction-relaxation cycle of muscle spindles and ceases immediately upon cessation of stretch. Another type of clonus, called palatal nystagmus or myoclonus, depends upon a less well understood central mechanism [9]. It occurs with lesions of any type which interrupt the central tegmental tract(s) in the brainstem, presumably disinhibiting the inferior olivary nucleus and the olivo-cerebral fibers to the contralateral cerebellar cortex and dentate and interpositus nuclei. Upper-motor neuron-type deficit causes clonus. In our 3 patients electricity passed across the spinal cord and injured the upper-motor neurons. We felt that lightning caused destruction...
in central tegmental tracts in the patient who was injured from lightning.

Many neurological complications and sequelae have been reported following high- or super-voltage electric injury. Our cases present an unusual sequela following electric injury. Clonus should also be considered as a possible and specific type of neurological sequela following high- or super-voltage electric injury. This may help to inform the patients in postinjury period and to improve the efficacy of the rehabilitation of the victims.

References