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OLGU SUNUMU - CASE REPORT

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NON-CONTACT HIGH VOLTAGE ELECTRICAL INJURY THROUGH THE ANTENNA OF A PORTABLE COMMUNICATION DEVICE: A CASE REPORT

Ilknur TUĞCU[1], Rıdvan ALACA[1], Harun TUĞCU[2], Mustafa Özer ULUKAN[2], Ertan HALAÇ[3], Ali Fuat IŞIK[4], Birol DEMİREL[4]

ABSTRACT

Electrical injuries cause high mortality and morbidity due to the thermal and non-thermal effects of electricity. High voltage injuries may occur when the electrical potential exceeds the resistance of the air between the source of electricity and a conductor at or near earth potential.

We report a 21-year-old man who sustained severe high voltage injuries. This young man touched a portable communication device that had a 3 m antenna. The device was placed approximately 4 m below a 31,500 V high-voltage transmission line on a misty night.

He had full and partial thickness burns with entry wounds through the hands, head, and neck. The exit wounds were on both feet. He remained in a coma for three days and required partial resection of the left ear and bilateral below the knee amputation. Within the rehabilitation period of two years he developed tetraplegia, cataract of the left eye, and urethral stricture.

Deaths or injuries due to high-voltage electrocution are most frequently accidental but they are not limited to workplaces. These cases are not only clinically heterogeneous but also pose specific difficulties in forensic investigations. We provide a brief discussion of these aspects.

Key Words: Electrical Injury, High Voltage, Portable Communication Device.

PORTATİF İLETİŞİM CİHAZI ANTENİNTEN TEMAS OLMAKSIZIN YÜKSEK VOLTAJ ELEKTRİK YARALANMASI:

BİR OLGU SUNUMU

ÖZ

Elektrik yaralanmaları, elektriğin termal ve termal olmayan etkilerine bağlı olarak yüksek mortalite ve morbiditeye sahiptir. Yüksek voltaj yaralanmaları; elektriksel potansiyel, elektrik kaynağı ile yer ya da yere yakın bir iletken arasındaki hava direncini aştığında meydana gelebilir.

Olgumuz, yüksek voltaj yaralanmasına maruz kalan 21 yaşında bir erkek olup 3 metre anteni olan taşınabilir bir iletişim cihazına teması söz konusudur. Bu cihaz, 31500 voltluk bir elektrik nakil hattının 4 metre altına yerleştirilmiştir.

Olgunun, ellerinde, kafasında ve boynunda tam kat ve kısmi yanıklarla birlikte olan giriş yaraları mevcut olup çıkış yaraları ise her iki bacakta tespit edildi. Olgu, 3 gün komada kaldı ve sol kulağın parsiyel rezeksiyonu ve bilateral diz altı amputasyonu yapılması gerekti. 2 yıllık bir rehabilitasyon programında tetrapleji, sol gözde katarakt ve üretral darlık gelişti.

Yüksek voltaj yaralanmalarına bağlı ölümler ya da yaralanmalar sıklıkla kaza sonucu meydana gelmektedir. Fakat bunlar sadece çalışma sahaları ile sınırlı değildir. Bu olgular yalnızca heterojen kliniğe sahip olmayıp aynı zamanda adli araştırmalarda özel bir zorluğa sahiptir.

Anahtar Kelimeler: Elektrik Yaralanması, Yüksek Voltaj, Taşınabilir İletişim Cihazı.

[1] Turkish Armed Forces Rehabilitation Center Gülhane Military Medical Academy and School of Medicine, 06018, Ankara, Turkey
[2] Gülhane Military Medical Academy and School of Medicine Department of Forensic Medicine, 06018, Ankara, Turkey
[3] Gülhane Military Medical Academy Department of Biomedical Engineering, 06018, Ankara, Turkey
[4] Gazi University School of Medicine Department of Forensic Medicine, 06500 Ankara, Turkey

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INTRODUCTION

Electrical injuries cause a high incidence of mortality and morbidity and cases are generally accidental.1-3 In the United States, annually about 52,500 cases of electrical accidents are recorded by the health services.2 It has been reported that 2% of the 169 legal death cases were due to electrical accidents.4

The mechanism of tissue injury caused by electricity is related to both the direct effect and the thermal effect of electricity. The severity of injury is affected by the density of electricity current, resistance of tissue, direction of the current through the body, and duration of contact.3,5-7

The degree of burned area, myocardial necrosis, hepatic necrosis, pancreatic necrosis, central nervous system damage, and secondary multiple organ insufficiency affect the rate of mortality and morbidity in high voltage (>1000 V) injury.6,8 The treatment of these cases includes scar excision, decompression of nervous tissue, and amputation of extremities when necessary.2,3,9

Confusion, coma, agitation, emotional alterations, amnesia, cognitive disorders, and aphasia may be found clinically.10,11 In cases of high voltage or lightning injuries, neurological findings are due to damage to the medulla spinalis rather than peripheral nervous injury, and this is generally irreversible.2

Ophthalmological findings of electricity injury are iritis, macular alterations, obliteration of the central retinal artery, cataracts, intraocular hemorrhagia, thrombosis, uveitis, retinal detachment, and fracture of the orbita.12,13

In cases of alternating current injury, fractures of long bones and vertebrae are seen due to violent contractions of muscles.12 Functional disorder of hands due to tissue necrosis may be progressive.14

Sudden death may be seen due to paralysis of the muscles of respiration, ventricular fibrillation, or asystole, and also if the current passes through the brain or central nervous system6.

In this study, we describe the risk of electrocution while carrying portable communication devices and similar equipment near high voltage lines.

OLGU SUNUMU

A 21-year-old man sustained severe high voltage injuries. This young man touched a portable communication device that had a 3 m antenna. The device was placed approximately 4 m below a 31,500 V high-voltage transmission line on a misty night.

Totally a 14.3% second and third degree burned area was determined in the region of the left temporoparietalis, left side of the face, left ear, left periorbital region, and at the lower extremities in

Figure 1: View of bilaterally below knee amputation.

Figure 2: View of flexion contracture of both hand.

the emergency room. Tendons and bones were exposed in the lower extremities. Bilateral amputation below the knees was performed (Figure 1).

While the facial scars were treated with grafting, the sacral decubitis injury was treated with rotational grafting. He had three days of amnesia, cataract of the left eye and could see just light. Urethral stricture developed in three months. He was operated on seven times for urethral stricture and enrolled in the rehabilitation program at the Spinal Cord Injury Rehabilitation Unit.

Three years after the incident, a detailed neurologic examination revealed the following functional status: bilateral shoulder abduction and flexion, 5/5; right elbow flexion and extension, 5/5; right wrist extension, 4/5; flexions, 3/5; and extension of left fingers, 4/5. In the examination of the joints' range of motion, flexion of the left elbow was limited to 30 degrees, flexion and extension of the left wrist were minimally limited, and bilateral proximal interphalangeal joints especially at the right had flexion contractures (Figure 2).

In the examination of lower extremities, flexion of left hip was limited to 80 degrees, the range of hip motion was normal, the right knee had flexion contractions and the left knee was stiff. Regarding the Ashworth scale, spasticity of the upper extremities was grade 1-2 while spasticity of the lower extremities was grade 3. Deep tendon reflexes were bilaterally hyperactive. The left leg was amputated 18 cm below the knee and the right one 15 cm.

DISCUSSION

In high voltage injuries, there is no need for direct contact with the source.7 The distance that electricity can jump is related to the voltage and some graphics were prepared for showing distances. It is suggested that no one should pass within 36 inch (91.44 cm) of the source, unless taking precautions, if the voltage is between 15 and 37 kV.15 In our case, electricity current of 31,500 V jumped a distance of 1 m and the weather was misty.

Wide body burns can be observed due to high voltage.16 Decompression of the peripheral nerve is seen at the narrow sites of extremities and at the region where the nerves come close to facial bands.2

In the experimental study by Sances et al. on pigs, it is suggested that electric lesions generally occur at the arteries and nerves, followed by muscles, fatty tissue, bone marrow, and the cortex of bone.17

In our case, a totally 14.3% second and third degree burned area was determined in the region of the left temporoparietalis, left side of the face, left ear, left periorbital region, and at the lower extremities and tendons and bones were exposed in the lower extremities.

Generally cataract is seen in 6% to 10% of electrical injury cases but it can reach 50% in high voltage injuries.7 Cataract of the left eye was seen in our case.

Neurological symptoms and findings are generally seen in electrical injuries. Postneurologic symptoms generally include neuropathy but reflex sympathetic dystrophy may also occur.

Degeneration of the central nervous system and medulla spinalis are generally seen in high voltage electrical injury, lightning, and electrocution cases.18

There are several hypothesis on the degeneration of nervous tissue by electricity. Degeneration of nerves by electricity can be explained by thermal effect, sympathetic stimulation, vascular injury, histological and electrophysiological alterations, and direct mechanical trauma.2 The hypothesis on the sensitivity of myelinated nerves to electricity is generally accepted.10

The damage to the medulla spinalis by electricity may be reversible or irreversible. Late complications of electricity on the medulla spinalis occur by vascular obliteration due to endothelial and intimal fibrosis and also ischemia of microvascular circulation.19

Various monopathies can be seen in damage to the plexus or peripheral nervous system.1,2 Motor neuron damage may also occur.20 In the study by Sirdofsky et al., a case of amyot-

rophic lateral sclerosis due to electricity was described.19

Injury to the medulla spinalis may develop due to muscle contractions, injury to ligaments due to blunt trauma, or fractures. Electricity may also damage the medulla spinalis directly.10 In our case the medulla spinalis degeneration was thought to occur by the direct effect of electricity.

High voltage electricity can throw a person through the effect of the current and can cause fractures in addition to the electrical injuries. Short duration of contact with the electricity could decrease its harmful effects.21

Magnetic resonance imaging can be used in the determination of spinal damage. The most sensitive region of the brain to hypoxia is the hippocampus. Damage to this area characteristically results in amnestic syndromes.5

Necrosis of hand muscles may progressively affect the function of the hand.14 In our case, flexion contraction and limited movement of both hands were determined.

Deaths or injuries due to high-voltage electrocution are most frequently accidental but they are not limited to workplaces. These cases are not only clinically heterogeneous but also pose specific difficulties in forensic investigations. In the determination of the origin of electrical injury cases, a detailed scene investigation and determination of entry and exit wounds are important.

The personnel working around or under high voltage power lines should be educated and must be ordered to wear special clothes. They should also be informed and warned about the danger of electrical arc currents in the field.

Correspondence Addres
Birol DEMİREL
Gazi University School of Medicine Department of Forensic Medicine
Ankara-06500/Turkey
Tel: 0.312.2025890
E-mail address: biroldemirel@yahoo.com

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