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Case Report

Electrical Injury and Drowning in a Pediatric Patient. Case Report

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Abstract

Introduction: Burns and drowning are among the leading causes of death caused by unintentional injuries. The objective of this report is to present the general aspects of these pathologies, as well as to recognize the importance of early basic cardiopulmonary resuscitation and prevention.

Clinical Case: Pediatric patient who suffered a thermal trauma injury due to electricity and drowning. She was admitted to a private hospital with cardiorespiratory arrest (ventricular fibrillation), where the initial treatment was provided, later on she was transferred to the General Hospital of Puebla "Dr. Eduardo Vázquez Navarro" (Puebla, Mexico) she continued her treatment in the Pediatric Intensive Care Unit. The patient progressed towards improvement.

Discussion: Comprehensive management was available with emphasis on the neurological and cardiovascular systems, which are usually the most affected according to literature.

Conclusion: Drowning and burns are complex pathologies that require a multidisciplinary team of health care professionals for their management. Prevention measures are required that are included in public health policies in our country. They are conditions rarely seen together that represent a challenge of approach and treatment for all health personnel.

Keywords: *Burn; Electricity; Drowning*

Introduction

Unfortunately, the non-intentional injuries continue to be one of the first causes of death in the pediatric patient. All around the world, these injury cause more than 830,00 deaths (more than 2000 deaths everyday are cause by non-intentional injuries) in pediatric patients, millions of children suffer non-mortal injuries that requires hospitalization and prolonged rehabilitation therapies [1].

The world report on prevention for injuries in children, it's a document written by more than 180 experts from all around the world and coordinated by the World Health Organization, and the fund for united nations in infants (UNICEF), which distinguishes, the top five first causes of death by non-intentional causes are the ones described later in this article, which are [2]:

1. Traffic injuries
2. Drowning
3. Electrical burn
4. Non intention.

Drowning is the process which causes respiratory failure due to submersion or immersion in liquid environment [3], which concludes in any of these three scenarios: fatal, non-fatal or non-fatal with injury or disease [4]. The research of these disease has described the sequence of drowning: 1) fight for maintaining the airway out of the water, 2) first submersion and holding the breath, 3) water aspiration, 4) loss of consciousness, 5) cardiac arrest and 6) death. Drowning is a serious problem in matter of public health, which affects people of any age, causing approximately 1000 deaths per day in the world [4].

According to the international classification of diseases 11th edition, suffocation is a potentially mortal disease in which oxygen is unable to reach the organs due to an obstruction in the airway; it includes every disease that alter or impede breathing [6]. Drowning by submersion in liquids, suffocation, choking, obstruction of the airway by objects, aspiration of gastric content, decreased oxygen environments among other causes, are the main mechanism of suffocation [7].

In Mexico, drownings and traffic accidents are the main causes of accidental deaths [8]. The most frequent drowning mechanism in Mexico occurs while being in natural waters [7]. The number of drownings reached in 2013, among 735 deaths in children. Cases tend to rise in between 15% to 20% during vacation periods [8].

In other terms, burns are trauma caused by the acute transferred energy (mechanical, thermically, electrical, chemical, radiation, biological or cold) with local manifestation (redness of the area and necroptosis) accompanied with systemic inflammatory response, which intends to stop and repair the damage [9].

Around the world, burns represent a problem in public health. The WHO reports 180,000 deaths per year, also infants are the most vulnerable victims (along with women); this position burns as the fifth mas common cause of non-fatal injury on infants [10].

In Mexico, burns also affect importantly to all population. According to record on the national system of epidemiological vigilance, during the first eleven weeks of surveillance in 2022, there has been 1264 burn victims, in 1) Mexico City (142 cases), 2) Chiapas (126 cases, and 3) Jalisco (95 cases) [11].

In thermal Trauma caused by electricity, the extension and severity of the injuries depend often on many factors, such as: type of current, resistance of the tissues, duration of the contact, voltage, and environment factor such as rain and humidity. Generally, this type

of injuries is the result of contact with electrical cables which are electrically active. The four main mechanism of injury generated by electricity are: direct tissue damage, transformation of the electrical to thermically energy, mechanical injury and electroporation [15].

The electrical injuries are classified in high voltage (>1000 volts) or low voltage (<1000 volts) [16].

The low voltage injuries usually present higher mortality rather than the high voltage injuries, usually because the high voltage tends to push away the victim from the electric source, limiting the exposed contact time with electricity [13]. Low voltage injuries are the most common type and prevail in approximately 60 to 70% in electrical injuries on children from 3 to 6 years, these are commonly caused by biting of the cable or direct contact in electrical outlets at home [17]. It is important to emphasize that burn victims caused by electricity tends to have a main impact on the raise on mortality rate and hospital long term recovery time [15,18].

Objective of the Study

The objective of this article it to announce the general aspects on these diseases (drowning and thermically trauma caused by electrical injury), the importance of early cardiopulmonary resuscitation in these injuries and prevention.

Clinical Case

We present a 6 years old, female patient which on the 16th of January 2022 at 16:00 hours, suffers an accident by drowning. The fathers of the child tell that while the patient was at a jacuzzi at home, an electrical cable falls inside the jacuzzi. Causing the thermal electrical injury.

He was admitted to the urgency department in cardiac arrest with ventricular fibrillation, the patient was given 25 minutes of cardiopulmonary resuscitation until obtaining sinus rhythm, the patient received post cardiac arrest care and treatment, antibiotics were administered suspecting pneumonia caused by water aspiration.

Also, thoracic CT scan after cardiac arrest showed bilateral acute pulmonary edema, showing 85% of the lung parenchyma was compromised (Figure 1), this confirmed the water aspiration.

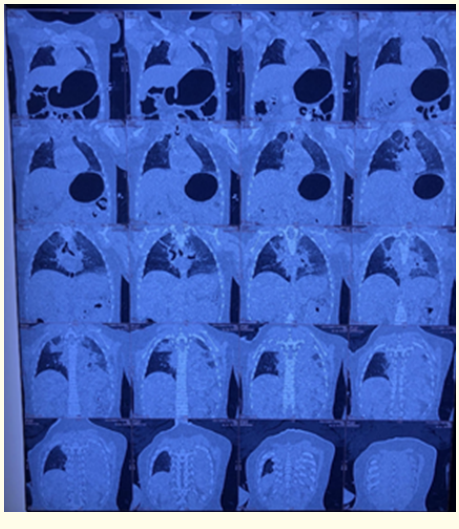

Figure 1: *Computerized thorax axial tomography (CT). We observe pulmonary acute bilateral edema, predominant of the left lung, compromising 85% of the lung. Both lungs with alveoli occupation. Finding related with water aspiration caused by drowning.*

On the second day the patient was referred to the Hospital General de Puebla "Dr. Eduardo Vazquez Navarro" (Puebla, Mexico). The patient was admitted with hemodynamic support with norepinephrine, sedated, and with ventilation support using a ventilator. The patient presented an injury in the right arm consisting in a small bruise caused by the entry point of electricity due to the incident (Figure 2). It was requested laboratory studies (Table 1) where we observed elevated cardiac enzymes and lactic dehydrogenase, we also observed electrolyte imbalance. The Gas blood test (Table 2) revealed an acid-base disorder consisting in normoxemic metabolic alkalosis, normolactatemic and hypoventilation.

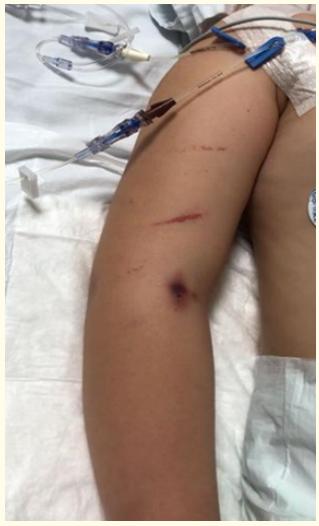

Figure 2: *Injury in left arm and forearm with defined borders and purple coloring, related to the thermal injury caused by electricity.*

CK	255 UI/L
CK-MB	225 U/L
Dímero D	2 ug FEU/ml
PRO-BNP	75 pg/ml
Troponina	364 ng/L
ALT	392 UI/L
AST	208 UI/L
GGT	55 UI/L
DHL	621 UI/L
FA	260 UI/L
Sodio	151 mmol/L
Potasio	2.6 mmol/L
Cloro	117 mmol/L
Calcio	7.8 mg/dL
Magnesio	1.9 mg/dL

Table 1: *Laboratory result at admission.*

pH	7.54
PCO_2	22 mmHg
PO_2	97 mmHg
HCO_3	18.8 mmol/L
Lactato	1.2 mmol/L
BEF	-3.7 mmol/L

Table 2: *Arterial blood gases in admission.*

During the patient stay at the hospital the patient improved on January 19th, 2022, this day the patient stopped receiving vasopressors and began hemodynamic stability, also the patient was extubated and began receiving supplementary oxygen by simple facial mask at 5 liters/per minute. We noticed improvement in her acid-base state based on gasometrical parameters (Table 3). Her neurological status was assessed clinically and showed improvement, her CT and head MRI (magnetic resonance), electroencephalogram in physiological sleep stage and echocardiogram remained with no disturbances. The heart activity was assessed with and EKG (electrocardiogram) and echocardiogram, this one showed a normal left ventricular ejection fraction of 88% con light tricuspid regurgitation.

pH	7.48
PCO_2	35 mmHg
PO_2	91 mmHg
HCO_3	26.1 mmol/L
Lactato	0.9 mmol/L
BEF	2.5 mmol/L

Table 3: *Arterial blood gases post extubation.*

On January 25th, 2022, the patient presented with cough, fever with no specific source, and low oxygen saturation levels. A SARS-COV2 test was ordered and resulted positive for covid-19. The patient was referred on January 26th, 2022, from our hospital to be transferred to a covid hospital.

Discussion

The result and survival of the drowned patients, usually depends on 2 factors which are variable: the first one is the time in which the drowned victim if retrieved from the water and second, the speed in which appropriate CPR (cardiopulmonary resuscitation) is administered [4]. In the drowning event, the central nervous system usually is the most affected organ. We make emphasis in factor such as anoxia or ischemia cause cerebral edema by cellular injury, causing increase in the intracranial pressure [19], unfortunately, the patient didn't showed alterations in image scans. This was a crucial factor in its outcome. The WHO, through his document "Global report on drowning: preventing a leading killer recommends community measures, effective policies and legislations and a correct investigation of the effective way to reduce the number of cases of drownings [4].

Burns caused by electricity are produced due to current passage through the organism. Are deep injuries that it varies rather than other burn causes in a very small detail which is that burn injuries caused by electricity the extension of the burn in the skin is not proportional to the magnitude of the real damage to the body [20]. In this patient, we observed a well-defined injury, consisting in a damaged

zone on the right arm and forearm, consisting in a well-defined bruise, which has a purple color, and corresponded to a burn injury caused due to electricity (Figure 1).

Among al complications associated to electricity, the alterations, and disturbances in the cardiovascular system specially arrythmias, are considered important, in this case, heart evaluation was assessed using clinical examination, electrocardiogram and echocardiogram, and laboratory heart markers.

Generally, in the drowned victims, the cardiac arrest is usually related to bradycardia followed by cardiac activity with no pulse and finally asystole [21]. In our case, the patient was admitted to the hospital in ventricular fibrillation: arrythmia related to electricity shock. In conclusion we may say that the cause of this arrythmia was electricity not the drowning itself.

Conclusion

Complications in drowned patients are usually related with respiratory and neurological alteration, meanwhile burn victims caused by electricity, usually tend to damage the entering site of the electricity and the cardiovascular system. Both injuries are complex diseases, which require a multidisciplinary team of doctors. These diseases should be reduced in number of cases presented through measures included in public policies that prevent them from happening in our country and all around the world. These diseases area rarely seen together, and represent a challenge in diagnosis, assessment and treatment for every health care professional. The patients that present cardiac arrest caused by drowning should receive efficient and effective CPR, which increases their over life and lowers the mortality rate and long-term sequels.

Conflict of Interest

Authors reclaim to have no conflict of interest in this article.

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