

Case Report

An Unexpected Sequelae of a Routine Cardiopulmonary Resuscitation

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Abstract

A 33-year-old woman suffered an out-of-hospital cardiac arrest and was found un-responsive lying on an asphalt parking lot surface. Bystander and Emergency Medical Service (EMS) personnel provided Cardiopulmonary Resuscitation (CPR). However, the victim sustained deep second degree burns on her right upper arm and right forearm. Safety guidelines for victims and rescuers do not address the possibility of skin exposure to extreme surface temperatures in regions where surface temperature varies depending on the season. This case report is a prime example where additional awareness may have prevented secondary complications like thermal cutaneous burns.

ABBREVIATIONS

OHCA: Out-of-Hospital Cardiac Arrest; CPR: Cardiopulmonary Resuscitation; EMS: Emergency Medical Service; ED: Emergency Department; CT: Computerized Tomography; IV: Intra-Venous; AHA: American Heart Association; TBSA: Total Surface Body Area

INTRODUCTION

Out-of-hospital cardiac arrest (OHCA), a condition characterized by sudden and unexpected cardiovascular collapse, is experienced by millions of people world-wide[1,2]. It is a leading cause of death, with incidence of treated OHCA at 50-60 per 100,000 person-years. Resuscitation of these victims is challenging and requires a coordinated set of actions called "Chain of Survival". The links in this chain are scene safety, immediate recognition of cardiac arrest, activation of the emergency response system, early cardiopulmonary resuscitation (CPR), rapid defibrillation, effective advanced life support, and integrated post-cardiac arrest care [3]. Pre-arrival instructions provide callers with step-by-step instructions on how to identify cardiac arrest and perform CPR. However, these instructions do not mention any recommendations related to the temperature of the surface on which the victim is positioned [4].

We report the case of a victim who sustained deep second degree cutaneous thermal burns during her cardiopulmonary resuscitation attempt in an out-of-hospital cardiac arrest setting.

A 33 year old woman with a history of mitral valve prolapse with recurrent near syncope was found lying supine on the

asphalt surface of the parking lot where the ambient temperature was recorded to be 40° C (105° F). On evaluation the victim was un-responsive, cyanotic, and had no detectable carotid pulse on palpation. Bystander CPR was initiated immediately. Four cycles of CPR were administered prior to the arrival of Emergency Medical Service (EMS) arrived.

CASE PRESENTATION**In-Hospital Care**

Emergency Department: CPR was continued upon arrival to the Emergency Department (ED) with pulses returning approximately 6 minutes after arrival. The patient was diagnosed with cardiac arrest (ventricular fibrillation) and respiratory failure. Dobutamine and epinephrine drips were started for blood pressure support. A cooling catheter was placed in the left femoral vein as per hypothermia protocol [5-7]. On physical exam she was noted to have right sided torso burn, right arm burn and a scalp hematoma (Figures 1, 2). Computerized Tomography (CT) of the head demonstrated cerebral edema without intracranial hemorrhage. Chest CT depicted mediastinal hematoma and pulmonary contusions. Labs were significant for elevated lactate and metabolic acidosis.

Medical Intensive Care Unit

During her hospitalization she was intubated, received pressor drips, IV antibiotics and was placed on hypothermic



Figure 1 Wound 1, (Posterior Surface Right Arm).



Figure 2 Wound 2, (Posterior Surface Right Forearm).

protocol. Upon extubation, the patient was treated according to standard wound care and was transferred to the general medicine service. She was discharged 3 weeks after admission.

DISCUSSION

Out-of-hospital-cardiac-arrest can occur in any environment. This episode can have a negative impact on physical, psychological and social wellbeing of survivors. They may be prone to anxiety, depression loss of interest in health and an overall lack of zeal for life depending on the extent of insult [8]. The environment can play an important role in the intervention and at times lead to complications to the victim. American Heart Association (AHA) recommendations provide guidelines for scene safety; however, these recommendations do not include specific details such as surface temperature, texture and duration the victim remains on the surface.

Surface and Ambient Temperature

Summer temperatures often exceed 37.8°C (100.04°F) in the west coast and surrounding desert regions. Objects such as parking lots and sidewalk absorb solar radiation and as a result have a significant high temperature. Berens et al [8] reported full thickness pavement burns in three victims who experienced motor vehicle accidents in Phoenix, Arizona. They documented unverified asphalt temperatures of 77.8°C, which caused full thickness contact burns within seconds. [8] Rumney et al [9] looked at the relationship between asphalt temperature and ambient temperatures during summer months in Arizona. The mean daily peak temperature in these months was 68.3°C. Peak temperatures usually occurred around 3 PM and were inversely related to the altitude of the sites measured [9,10]. Investigators from other parts of the country have reported asphalt temperatures sufficient to cause serious burns.[11,12] Harrington *et al* [13] measured pavement temperatures over a 24-hour period to determine when patients are at risk for burns and reported cases of pavement burns with predisposing factors. They measured temperatures of asphalt, cement, and other outdoor materials using a thermocouple thermometer. Asphalt pavement was hot enough to cause burns during the summer months where second-degree burn can occur within around 30 seconds. At its peak temperature, pavement was hot enough to cause second-degree burns in 2 seconds. They also reported that air temperatures from 35°C to 37.8°C were required to produce the 44°C surface temperature capable of causing cutaneous thermal injury [13].

Relationship between Time Interval to Degree Of Burn

Mortiz and Henriques [14] demonstrated the time necessary to induce a cutaneous burn is logarithmically related to the surface temperature of the skin in degrees Celsius. They found that at temperatures between 44°C to 51°C, “the rate at which burning occurs is almost doubled for each degree rise in temperature.” At 44°C, they demonstrated experimentally that 6 hours was required to produce a second-degree burn. The exposure increments were progressively smaller as the temperatures increased. At 47°C, 45 minutes of contact was required to produce a second-degree burn; at 48°C, 15 minutes; at 50°C, 5 minutes; at 53°C, 45 seconds; at 56°C, 15 seconds; at 60°C, 5 seconds; and at 65°C, only 2 seconds. [14] Ripple et al

Table 1: Recommendations for environment evaluation, protection of exposed skin surfaces of the victim, and a thorough skin examination.

	Recommendations
1.	Evaluate surface temperature and texture with palm or back of hand while assessing responsiveness and breathing within initial 5-10 seconds.
2.	Protect exposed skin surfaces by utilizing a barrier that separates direct contact the patient is laying on by clothing or any other object.
3.	Perform thorough examination of skin of all patients post-CPR.

Abbreviations: CPR: Cardiopulmonary Resuscitation

[15] reported that 16.4 joules per square centimeter of skin of heat transfer is needed to produce a second-degree burn. Burn severity increased logarithmically as basal skin temperature increased. He also estimated that clothing provided a “thermal protection factor of 2.5” to protect the skin from thermal burns. [15]

Pathophysiology of Burn

A burn is an injury that occurs due to exposure of tissues to chemical, electrical or thermal energy. The extent of this injury depends on many factors such as temperature, surface area of concentration, duration of exposure, vascularity and thickness of the injured skin [16].

The extent of the burn is expressed as the percentage of the Total Surface Body Area (TBSA) that is involved and can be calculated using specialized age-specific body charts, such as the Lund Browder chart [17]. The extent of injury can also be estimated using the Rule of Nines, which assigns 9% to the head and each upper extremity and 18% to the anterior trunk, the posterior trunk, and each lower extremity. The remaining 1% is assigned to the genitalia. The patient in this scenario, presented with less than 9% of TBSA burns on her right upper limb.

Management of Burns

The goals of local burn wound management are to alleviate pain, reduce the extent of injury, promote rapid healing with minimal scarring and prevent infection. Multiple animal and human studies provide evidence that supports the use of cooling as an immediate measure for burn management [18,19]. Cooling of burns with cold (15-25.8°C) tap water has been shown to reduce pain, depth and extent of the injury. Additionally, the need for surgical excision of the burn, scarring, and mortality is decreased also.

The use of environmental awareness during resuscitation is important in minimizing complications to the victim and potentially the rescuer. (Table 1) shows recommendations for environment evaluation, protection of exposed skin surfaces of the victim and a thorough skin examination post-CPR. This would enable identification of any injury or defect due to the resuscitative effort. While our recommendations are limited to a single patient, further studies should be done to evaluate the benefit of surface temperature awareness and use of protective equipment during resuscitation to develop guidelines in order to prevent these complications.

CONCLUSION

In conclusion, we report a case of a victim who developed an unexpected burn sequelae during an out of hospital cardiac arrest. As a survivor, she has made remarkable recovery with acceptable skin healing, minimal scarring and continues to enjoy a significantly improved quality of life. We believe that awareness and use of protective equipment in OHCA is critical to prevent burn injury consequences.

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The patient was informed that the case would be submitted for publication and she consented to this.

REFERENCES

1. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. *Resuscitation*. 2010; 81: 1479-1487.
2. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. *JAMA*. 2008; 300: 1423-1431.
3. Field JM, Hazinski MF, Sayre MR, Chameides L, Schexnayder SM, Hemphill R, et al. Part 1: executive summary: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2010; 122: 640-656.
4. Lerner EB, Rea TD, Bobrow BJ, Acker JE 3rd, Berg RA, Brooks SC, et al. Emergency medical service dispatch cardiopulmonary resuscitation prearrival instructions to improve survival from out-of-hospital cardiac arrest. *Circulation*. 2012; 125: 648-655.
5. Morrison LJ, Deakin CD, Morley PT, Callaway CW, Kerber RE, Kronick SL, et al. Part 8: Advanced life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation*. 2010; 81: 93-174.
6. Burgess S. How effective is hypothermia for neuroprotection in adults after cardiopulmonary resuscitation. *Austral J Paramedicine*. 2012; 8: 5.
7. Dumas F1, Grimaldi D, Zuber B, Fichet J, Charpentier J, Pène F, et al. Is hypothermia after cardiac arrest effective in both shockable and nonshockable patients? Insights from a large registry. *Circulation*. 2011; 123: 877-886.
8. Berens JJ. Thermal contact burns from streets and highways. *Jama*. 1970; 214: 2025-2027.
9. Rumney TN, Jimenez RA. Pavement temperatures in the southwest. *Highway Research Record*. 1971.
10. Way GB, Peters RJ. Environmental factor determination from in-place temperature and moisture measurements under Arizona pavements. Arizona Department of Transportation. 1980.
11. Straub AL, Schenck Jr HN, Przbycien FE. Bituminous pavement temperature related to climate. *Highway Research Record*. 1968.
12. Kallas BF. Asphalt pavement temperatures. *Highway Research Record*. 1966; 150: 1-11.
13. Harrington WZ, Strohschein BL, Reedy D, Harrington JE, Schiller WR. Pavement temperature and burns: streets of fire. *Ann Emerg Med*. 1995; 26: 563-568.
14. Moritz AR, Henriques FC. Studies of Thermal Injury: II. The Relative Importance of Time and Surface Temperature in the Causation of Cutaneous Burns. *Am J Pathol*. 1947; 23: 695-720.
15. Ripple GR, Torrington KG, Phillips YY. Predictive criteria for burns from brief thermal exposures. *Journal of occupational medicine*. : official publication of the Industrial Medical Association. 1990; 32: 215-219.
16. Henriques FC, Jr. Studies of thermal injury; the predictability and the significance of thermally induced rate processes leading to irreversible epidermal injury. *Arch Pathol*. 1947; 43: 489-502.
17. Lund CC, Browder NC. The estimation of areas of burns. *Surg Gynecol Obstet*. 1944; 79: 8.
18. Gazmuri RJ1, Nadkarni VM, Nolan JP, Arntz HR, Billi JE, Bossaert L, et al. Scientific knowledge gaps and clinical research priorities for cardiopulmonary resuscitation and emergency cardiovascular care identified during the 2005 International Consensus Conference on

ECC [corrected] and CPR science with treatment recommendations: a consensus statement from the International Liaison Committee on Resuscitation (American Heart Association, Australian Resuscitation Council, European Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, and the New Zealand Resuscitation Council);

the American Heart Association Emergency Cardiovascular Care Committee; the Stroke Council; and the Cardiovascular Nursing Council." *Circulation*. 2007;116: 2501-2512.

19. Jandera V, Hudson DA, de Wet PM, Innes PM, Rode H. Cooling the burn wound: evaluation of different modalities. *Burns : J Int S Burn Injuries*. 2000; 26: 265-270.

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