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CASE REPORT

Inducing Therapeutic Hypothermia in Cardiac Arrest Caused by Lightning Strike

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Only limited clinical scenarios are grounds for induction of therapeutic hypothermia. Its use in traumatic cardiac arrests, including those from lightning strikes, is not well studied. Nonshockable cardiac arrest rhythms have only recently been included in resuscitation guidelines. We report a case of full neurological recovery with therapeutic hypothermia after a lightning-induced pulseless electrical activity cardiac arrest in an 18-year-old woman. We also review the important pathophysiology of lightning-induced cardiac arrest and neurologic sequelae, elaborate upon the mechanism of therapeutic hypothermia, and add case-based evidence in favor of the use of targeted temperature management in lightning-induced cardiac arrest.

Key words: cardiac arrest, critical care, trauma, lightning, induced hypothermia, resuscitation

Introduction

Therapeutic hypothermia was endorsed only in the past decade as a legitimate treatment for unresponsive cardiac arrest patients with return of spontaneous circulation (ROSC). Definitive research has detailed neurologic benefits, and usage has expanded in recent years. These narrowly defined studies have not attempted to provide insight into its use in many clinical scenarios, including cardiac arrest after lightning strike. This lack of substantive clinical evidence to either support or refute the benefits of therapeutic hypothermia in lighting-induced cardiac arrest has resulted in a lack of guidance in the literature. To this end, we report a fourth unique instance of successful use of therapeutic hypothermia in the setting of lightning-induced pulseless electrical activity (PEA) cardiac arrest.

Case Presentation

An 18-year-old woman sustained an indirect lightning strike and subsequent cardiac arrest while in contact with a tree during a thunderstorm. A bystander provided immediate cardiopulmonary resuscitation (CPR) for approximately 5 minutes. Paramedics then arrived, followed advanced cardiac life support (ACLS) protocols, intubated, and achieved ROSC after a PEA of sinus tachycardia. At the local hospital, the patient experienced a second PEA arrest that again resolved with ACLS efforts. Therapeutic hypothermia was initiated using cooling blankets and ice packs, and the patient was transferred to our level 1 trauma facility.

Upon arrival, her Glasgow Coma Scale (GCS) was 3 without medication. Vital signs on arrival were a blood pressure of 133/103 mm Hg, heart rate of 99 beats/min, mechanically ventilated respiratory rate of 24 breaths/min, pulse oximetry of 100%, and end-tidal carbon dioxide of 28 mm Hg. Pupils were 3 mm and sluggishly reactive bilaterally. A Lichtenberg figure was noted across the rib cage and soot was seen overlying the sternum and posterior neck (Figures 1 and 2). Burns conferred by a necklace were also present around her neck (Figure 2). A blanchable area of erythema was discovered overlying the thoracolumbar junction. No further significant injuries were noted.

Within minutes after arrival to the trauma bay, she had a GCS of 8 with spontaneous eye opening, flexor activity, and decorticate posturing with no movement in the lower extremities. She was sedated with fentanyl, propofol, and cisatracurium to facilitate further imaging studies. An electrocardiogram revealed sinus tachycardia without ectopy. Chest radiograph, focused ultrasonography in

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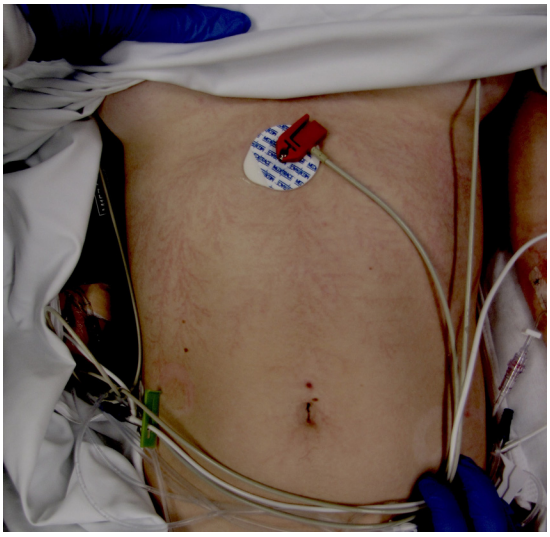

Figure 1. Lichtenberg figure conferred by lightning strike. Photo credit: Forensic Nurse Examiners Team at Christiana Care Health System.

trauma (FAST), and computed tomography of the head, cervical spine, chest, abdomen, and pelvis found no signs of traumatic injury.

Relevant laboratory findings included an arterial blood gas indicating a metabolic acidosis with a pH of 7.26, partial pressure of carbon dioxide of 40 mm Hg, bicarbonate level of 18.8 mEq/L, lactate of 3.9 mEq/L, creatinine kinase of 1019 IU/L, troponin of 0.17 ng/mL, and white blood cell count of 19.6 $10^3/mm^3$.

The patient was admitted to the surgical intensive care unit and a triple lumen femoral Icy Catheter (ZOLL Medical Corporation, Chelmsford, MA) was placed to achieve a temperature goal of 34°C (Figure 3).

By the third hospital day, gradual 24-hour rewarming had been completed. Subsequently, she was following

Figure 2. Imprint and soot from lightning strike and presence of metallic necklace. Photo credit: Forensic Nurse Examiners Team at Christiana Care Health System.

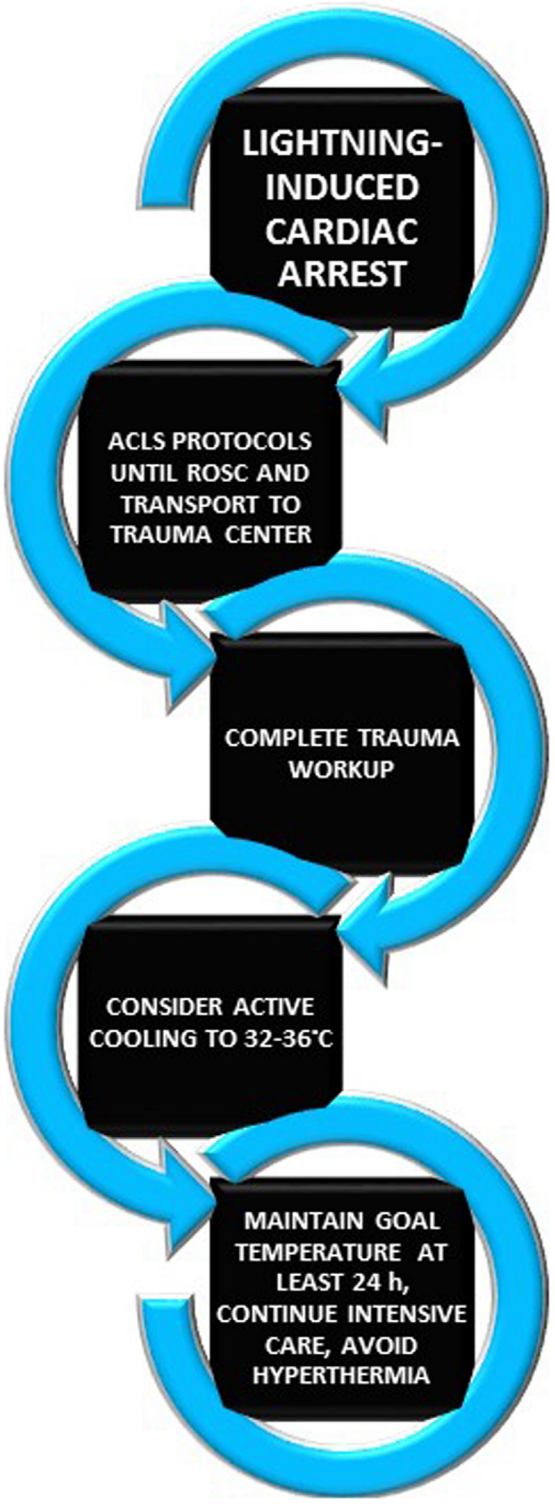

Figure 3. Sample simplified protocol for utilizing therapeutic hypothermia.

commands but experiencing episodes of sinus tachycardia up to 160 beats/min when stimulated. This was palliated with fentanyl and midazolam, and she