CASE REPORTS

Successful Therapeutic Hypothermia in Patients with Congenital Long QT Syndrome

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Therapeutic hypothermia has been shown to improve neurological outcomes in patients who remain comatose following resuscitation from cardiac arrest. While there are numerous reports of patients who have had a successful course after induction of therapeutic hypothermia, such therapeutic intervention has not been described in patients with congenital long QT syndrome (LQTS). We report outcomes in two patients with LQTS who had therapeutic hypothermia following a ventricular fibrillation arrest. Careful and routine monitoring of the QT interval in this patient population is necessary due to the potential for worsening electrical instability during induced hypothermia.

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Congenital long QT syndrome (LQTS) is an inherited channelopathy associated with increased likelihood of torsades de pointes and sudden cardiac death.¹ It is characterized by prolonged ventricular repolarization that manifests in the electrocardiogram (ECG) as a prolongation in the QT interval. Patients who remain comatose after resuscitation from cardiac arrest due to ventricular fibrillation (VF) should be considered for aggressive postresuscitation care, including therapeutic hypothermia as recommended by the International Liaison Committee on Resuscitation.² However, the effects and outcomes of patients with congenital LQTS who have suffered a cardiac arrest requiring therapeutic hypothermia has not been previously described. We describe two patients with congenital LQTS who were resuscitated from cardiac arrest and successfully treated with therapeutic hypothermia.

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A 7-year-old boy was in his usual state of health until the morning of admission when his father

found the patient unresponsive, apneic, pulseless, and cold to touch. Minutes earlier the father had accidentally triggered the house alarm and was surprised that his son was not awakened by the siren. Cardiopulmonary resuscitation (CPR) was initiated by his mother, and on arrival of emergency medical services, an automatic external defibrillator showed VF and the patient was successfully defibrillated and intubated. Minutes later, he had recurrent VF requiring repeat defibrillation. Further history revealed the patient was recently started on methylphenidate 20 mg once daily and bupropion 37.5 mg twice daily for the treatment of attention deficit disorder.

On arrival to our medical center, he was found to have no motor response to verbal and tactile stimuli. He was afebrile, blood pressure was 105/57 mmHg, and he was in sinus rhythm at 80 beat per minute (Fig. 1). On auscultation, he was found to have a split S2, but no extra heart sounds or murmurs. His electrolytes were within the normal range and urine toxicology screen was negative. A transthoracic echocardiogram

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Figure 1. Top: Presenting ECG showing QT interval prolongation. Bottom: Telemetry during therapeutic hypothermia showing nonsustained polymorphic VT.

(TTE) showed normal left ventricular (LV) systolic function. Therapeutic hypothermia was initiated using the Arctic Sun system (Medivance, Inc, Louisville, CO). A core temperature of 33°C was maintained for 24 hours. During the period of hypothermia, he developed electrical instability including ventricular bigeminy, ventricular couplets, and multiple runs of polymorphic nonsustained ventricular tachycardia (VT) (Fig. 1). His VT remained refractory to lidocaine and electrolyte supplementation and only resolved once normothermia was achieved. His neurologic recovery was complete and ultimately an epicardial dual-chamber implantable cardioverter defibrillator (ICD) was implanted for secondary prevention of cardiac arrest. During outpatient follow-up, he continues to exhibit QT prolongation with corrected QT (QTc) intervals ranging 480–500 msec. Commercially available genetic

testing did not identify any of the known LQTS mutations.

A 22-year-old woman who delivered a healthy baby boy was discharged to home 3 days after delivery but returned 3 days later with complaints of abdominal pain. She was diagnosed with endometritis and was started on intravenous antibiotics (ceftriaxone). Prior to admission, the patient had suffered a witnessed syncopal episode while at home and was reportedly “down” for a period of 5 minutes. An ECG showed a prolonged QT interval and telemetry monitoring was initiated (Fig. 2). TTE showed normal LV function. While in the hospital, she developed torsade de pointes requiring CPR and external defibrillation. Her hospital medicines included azithromycin, ciprofloxacin, promethazine, granisetron, and loratadine as needed. Prior to the cardiac arrest, her electrolytes were unremarkable. She remained

Figure 2. ECG showing sinus rhythm with QT prolongation.

comatose after resuscitation and so therapeutic hypothermia was initiated (as above). Following rewarming, she demonstrated full neurologic recovery. She continued to have very prolonged QT intervals (QTc ranging 480–540 msec) despite being off all drugs that could prolong the QT interval. She was started on beta-blockers and a dual-chamber ICD was implanted. Screening ECGs of family members has since revealed LQTS in multiple family members.

DISCUSSION

Cardio-cerebral resuscitation of patients suffering a cardiac arrest emphasizes neurological protection and aggressive postresuscitation care including therapeutic hypothermia.³ Therapeutic hypothermia was first described by Benson et al. in the late 1950s⁴ and two randomized controlled trials have demonstrated its effectiveness in cardiac arrest survivors.^{5,6} Several series have reported on the beneficial neurologic outcomes of patients treated with therapeutic hypothermia; however, there are no reports to our knowledge of the use of this therapeutic modality in patients with congenital LQTS.

Hypothermia, defined as a core body temperature less than 35°C can produce several ECG changes, and the classic findings is the Osborn (J)

wave. Other ECG findings seen with hypothermia include sinus bradycardia and prolongation of the PR, QRS, QT, and QTc intervals.⁷ Concern has been raised over the QT prolongation that can occur during induced hypothermia and the potential for refrillation.⁸

In our patients who presented with VF and baseline prolongation in the QT interval, therapeutic hypothermia was successfully initiated and completed. In the first patient, ventricular dysrhythmias were frequent and at times concerning enough where discontinuation of induced hypothermia was considered; however, due to the nonsustained nature of the ventricular dysrhythmia the decision was made to complete the full protocol. The mechanism of the observed electrical instability during therapeutic hypothermia seen in the first patient is unknown, but may be due to bradycardia-induced effects on repolarization and/or as of yet unknown pathologic effects of hypothermia on potassium channel activity in patients with congenital LQTS.

In cardiac arrest survivors, who remain comatose after resuscitation, induced hypothermia is the only available measure that has a meaningful impact on neurologic recovery, and so it is now implemented readily at our medical center. Even though the two patients described herein had baseline QT interval prolongation that were further

potentiated with induced hypothermia, both were able to complete the full duration of induced hypothermia and neurologic recovery was complete in both.

In conclusion, therapeutic hypothermia may be implemented in patients with congenital LQTS who suffer a cardiac arrest. During the period of induced hypothermia, electrical instability may occur, and if nonsustained, the full duration of hypothermia may be completed. Caution is however advised when applying therapeutic hypothermia to patients with LQTS. Further studies evaluating the safety and efficacy of therapeutic hypothermia in patients with LQTS are needed.

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