CASE REPORT

Therapeutic Hypothermia in Cardiac Arrest: Feasible? Case Series in a Community Hospital

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Mortality data estimates that there are about 400,000 to 460,000 sudden cardiac deaths (SCD) in the United States.[1] In resuscitated cardiac arrest patients, morbidity and mortality remains high due to cerebral ischemic anoxia. Currently it is believed that following return of spontaneous circulation (ROSC) from successful resuscitation, secondary inflammatory responses characterized by the generation of chemical mediators and free radicals, as well as increased microvascular permeability, lead to further brain injury.[2] Recently, 2 randomized controlled trials (RCT) showed that induced mild hypothermia (32°C-34°C) in comatose patients after out-of-hospital cardiac arrest leads to improved neurologic outcomes and survival.[3,4] In 2002, the International Liaison Committee on Resuscitation (ILCOR) recommended induced mild hypothermia for the management of comatose patients with ROSC after cardiac arrest.[5] Despite the recommendations by ILCOR and the supporting body of evidence proving the benefit of therapeutic hypothermia after cardiac arrest, this treatment remains underused.[6–8]

We present a case series of 8 cardiac arrest survivors treated using a hypothermia protocol at a community hospital.

TREATMENT PROTOCOL

Between June 2006 and December 2006, 8 patients presented to Unity Hospital, (a 200-bed community teaching hospital with a 20-bed intensive care unit [ICU]) in coma following cardiac arrest with ROSC after resuscitation. All the patients were managed using therapeutic hypothermia.

The hospital protocol, developed using the ILCOR guidelines, was used on all patients. The aim was to achieve a core temperature of 32°C to 34°C within 6 to 8 hours and maintain this for 24 hours from the start of cooling. The inclusion criteria were as follows: (1) coma within a 6-hour post–cardiac arrest window preceded by either ventricular fibrillation (VF), pulseless ventricular tachycardia, pulseless electrical activity, or asystole; (2) ability to maintain a blood pressure with or without pressors and/or fluid volume resuscitation after cardiopulmonary resuscitation; and (3) comatose at the time of cooling. The exclusion criteria were as follows: (1) coma from drug overdose, head trauma, stroke, or overt status epilepticus; (2) pregnancy; (3) temperature of <30°C; (4) recent major surgery within 14 days;

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(5) systemic infections; (6) patients with known terminal illness; (7) Glasgow coma scale (GCS) of 10 and above; or (8) known bleeding diathesis or ongoing bleeding.

The Advanced Cardiac Life Support (ACLS) protocol was implemented in both in-hospital and out-of-hospital cardiac arrests. The decision to initiate the protocol was made by the intensivist; however, in out-of-hospital cardiac arrest, the decision was taken in conjunction with the emergency room physician. A bladder temperature probe was used to monitor core body temperature. Cooling was achieved using iced saline gastric lavage and ice packs to the patient's neck, axillae, and groin while a cooling blanket (Mul-T-Blanket; Gaymar Industries, New York) was placed over and beneath the patient. In some cases, a Blanketrol cooling machine (Blanketrol II; CSZ Products, Inc., Cincinnati, OH) was used when available. All patients were maintained at a PaO_2 above 90 mm Hg and $PaCO_2$ around 35 mm Hg. Cisatacurium and midazolam were used to control shivering. Regular insulin intravenous drip was used to maintain tight blood glucose control (target blood glucose level of 140 mg/dL) when necessary. Target systolic and mean arterial blood pressures were 90 mm Hg and 80 mm Hg, respectively. Potassium was replaced to 3.4 mmol/L but not within 8 hours of commencing rewarming. Rewarming was started after 24 hours at a rate of not more than 1°C in 4 hours. Clinical and laboratory parameters were continuously recorded and all patients were evaluated for complications, including electrolyte imbalance, cardiac arrhythmias, and seizures.

CASES

Table 1 summarizes all the cases. There were 4 men and 4 women. The mean age was 70 ± 14 years (range, 44-88 years). The main comorbidities were coronary artery disease (n = 6), hypertension (n = 5), diabetes mellitus (n = 5), and chronic or recurrent cardiac arrhythmia (n = 4). Cardiac arrest occurred out-of-hospital in 5 of 8 patients and was witnessed in 6 of the 8 cases. Ventricular fibrillation (VF) was the initial presenting rhythm in 5 of the 8 cases. The mean time from ROSC to initiation of cooling was 3 ± 1.6 hours. The mean time from ROSC and attaining target temperature (<34°C) was 8.1 ± 4.7 hours. The mean duration of cooling (initiation of cooling to onset of

TABLE 1
General Characteristics of the 8 Patients Who Underwent Therapeutic Hypothermia Treatment

Patients	Age (Years)	Sex	Comorbidities	Location at the Time of Arrest	Witnessed Arrest?	Initial Rhythm	Time of Collapse to ROSC	Presenting GCS	Time from ROSC to Cooling Initiation (Hours)	Time from ROSC to Target Temperature of <34°C (Hours)	Duration of Cooling (Cooling Initiation to Rewarming) (Hours)	Duration of Target Temperature Maintenance (Hours)	Onset of Passive Rewarming to Attainment of Temperature of >36°C (Hours)	Complications by Day 5	Outcome at Discharge
A	64	M	DM, CAD, SSS, PTCA, PM, CHF, COPD	OOH	Yes	VF	8 min	3	1.7	1.7	16.9	24	6	Pneumonia, hypokalemia, seizures	Death
B	43	F	Mitral valve prolapse	OOH	Yes	VF	12 min	5	6.3	5.3	12.0	24	7	Hypokalemia	Good recovery
C	64	M	CAD, CABG	IH	No	VF	7 min	5	1.4	1.5	10.0	24	7.5		Good recovery
D	76	F	DM, HTN, CAD, PM	OOH	Yes	PEA	36 min	6	1.7	1.6	4.2	24	5	Hypokalemia	Death
E	88	F	DM, HTN, CAD, AFIB, CHF, COPD	IH	Yes	Asystole	6 min	3	1.9	4.9	5.2	22.2	9.3	Hypokalemia, elevated creatinine	Death
F	70	F	DM, HTN, CABG, PTCA, COPD	OOH	Yes	VF	15 min	5	1.4	2.1	5.6	18.3	3	Seizures	Death
G	71	M	CAD, CABG, AICD	OOH	No	VF	>20 min	3	4.7	4.6	6.7	22.5	12.3	Hypokalemia, elevated creatinine, VT and VF	Death
H	82	M	HTN, CAD, AFIB, CHF	IH	Yes	Asystole	19 min	3	2.8	2.5	4.3	22.5	51	Elevated creatinine	Death

Abbreviations: AFIB, atrial fibrillation; AICD, automatic implantable cardioverter defibrillator; CABG, coronary bypass graft; CAD, coronary artery disease; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; HTN, hypertension; IH, in-hospital; min, minutes; PEA, pulseless electrical activity; OOH, out-of-hospital; PM, pacemaker; PTCA, percutaneous transluminal coronary angioplasty; SSS, sick sinus syndrome; VF, ventricular fibrillation.

rewarming) was 23.8 ± 0.6 hours. The mean duration at which target temperature was maintained (attainment of 32°C-34°C to onset of rewarming) was 18.6 ± 4.6 hours. The median time from onset of passive rewarming to attaining temperature of <36°C was 7.25 hours. Two patients survived and were discharged to home (Patients B and C). Patient B had mild cognitive deficits on discharge.

DISCUSSION

There is substantial clinical and public health concern over increasing incidence of sudden cardiac deaths despite decreasing overall mortality from coronary heart disease.[6]

Supportive management has been the norm for comatose patients following cardiac arrest until recently, when induced hypothermia was shown to have favorable outcomes in 2 landmark prospective RCTs.[3,4] Supportive management often led to prolonged unconsciousness due to severe anoxic brain injury, which eventually led to high morbidity and mortality rates.[9,10] The Hypothermia after Cardiac Arrest Study Group (HACA) study[4] revealed that 6 patients would need to be treated with therapeutic hypothermia to prevent an adverse neurologic outcome, while 7 patients would need to be treated to prevent 1 death. Other authors have reported improved outcomes with induced hypothermia used in patients resuscitated following cardiac arrest.[11–14]

Despite strong and encouraging evidence, therapeutic hypothermia has not been readily accepted into daily clinical critical care practice.[6–8] In an Internet-based survey of physicians by Abella et al.,[6] 87% of respondents (comprised of emergency medicine and critical care physicians, and cardiologists) had not used this treatment modality following cardiac arrest. Reasons given by most physicians included insufficient data to support the use of therapeutic hypothermia, technical difficulties including the immense amount of resources required, as well as inadequate training. Merchant et al.,[7] using an Internet-based survey also sought to ascertain the degree of therapeutic hypothermia use from physicians in the United States, the United Kingdom, Australia, and Finland. They found that 74% of respondents in the United States and 64% of respondents outside of the United States were yet to use induced therapeutic hypothermia. Factors predicting the use of therapeutic hypothermia by physicians were found to include practice in an academic hospital with more than 250 beds, critical care specialty training, and location of the hospital outside of the United States. Similarly, the major reasons given for nonutilization of therapeutic hypothermia in this study include lack of supportive data and technical difficulties. In yet another study by Laver et al.,[8] 73% of respondents (ICUs in the United Kingdom) revealed that therapeutic hypothermia after cardiac arrest had not been used in their service. They also gave the same reasons for nonusage as in the aforementioned studies.

In this case series we have presented our experience with therapeutic hypothermia in comatose patients following cardiac arrest. Evaluation of our cooling process compares favorably with the findings of the HACA study[4]: In our study, the mean time from ROSC to cooling initiation was 180 ± 66 minutes compared to a median of 105 minutes (interquartile range, 61–192 minutes) in the HACA study; mean time between ROSC and attaining target temperature was 8.1 ± 4.7 hours in our study compared to a median of 8 hours in the HACA study; mean duration of cooling in our study was 23.8 ± 0.6 hours compared to a median of 24 hours in the HACA study; target temperature was maintained for a mean duration of 18.6 ± 4.6 hours in our study compared to a median of 24 hours in the HACA study; and last, median time from passive rewarming to attainment of temperature greater than 36°C in our study was 7.25 hours compared to 8 hours in the HACA study.

There were few complications observed in this case series. These include hypokalemia, mildly elevated creatinine levels, and seizures. One patient developed pneumonia. Other potential complications of therapeutic hypothermia include cardiac arrhythmias, sepsis, hyperglycemia, coagulopathy, acid-base disturbances, and electrolyte imbalance.[15] The studies by Bernard et al.[3] and the HACA;[4] however, revealed no clinically significant unfavorable outcomes in the patients randomized to receive hypothermia treatment.

Our experience based on this case series leads us to conclude that therapeutic hypothermia is feasible in the community hospital setting. In our 200-bed community teaching hospital, a multidisciplinary approach involving intensivists, emergency room physicians, internists, residents, and nursing staff lessens the technical difficulties associated with implementing a seemingly cumbersome

yet inexpensive and effective treatment modality. Therapeutic hypothermia should be considered in appropriate patients in coma after resuscitation from cardiac arrest.

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