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# Outcomes of asphyxial cardiac arrest patients who were treated with therapeutic hypothermia: A multicentre retrospective cohort study

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ABSTRACT

*Introduction:* While therapeutic hypothermia (TH) is in clinical use, its efficacy in certain patient groups is unclear. This study was designed to describe the characteristics and outcomes of patients with out-of-hospital cardiac-arrest (OHCA) caused by asphyxia, who were treated with TH.
*Patients and methods:* A multicentre, retrospective, registry-based study was performed using data from the period 2007–2012. Comatose patients who were treated with TH after asphyxial cardiac arrest were included, while those who with cardiac arrest attributed to hanging, drowning or gas intoxication were excluded.
*Results:* Of a total of 932 OHCA patients in the registry, 111 were enrolled in this study. The mean age was 65.8 ± 16.3 years with individuals who were ≥65 years of age accounted for 61.3% of the cohort. Foreign-body airway obstruction was the most common cause (70.3%) of the cardiac arrest. Eighty patients (72.1%) presented with an initial non-shockable rhythm. In all institutions target TH temperatures were 32–34 °C, but TH maintenance times varied. A total of 52 patients (46.8%) survived, of whom six patients (5.4%) showed a good neurologic outcome (cerebral performance category scale 1–2). The pupil light reflex, corneal reflex and time to return of spontaneous circulation ($p = 0.012$, 0.015 and 0.032, respectively) were associated with survival. Witnessed arrest, age, previous lung disease, bystander basic life support and time factors were not associated with survival.
*Conclusion:* About half of patients who underwent TH after asphyxial cardiac arrest survived, but a very small number showed a good neurologic outcome. The TH maintenance times were not uniform in these patients. Additional research regarding both the appropriate TH guidelines for patients with asphyxial cardiac arrest and improvement of their neurologic outcome is needed.


## 1. Introduction

Patients who reach return of spontaneous circulation (ROSC), yet who remain comatose after cardiac arrest can be treated with therapeutic hypothermia (TH) to improve their survival and neurologic prognosis.[1,2] In the Guidelines 2010, the International Liaison Committee on Resuscitation (ILCOR) classified the use of TH in patients with out-of-hospital ventricular fibrillation (VF)-related cardiac arrest as a class I intervention. Different studies have shown that TH in these patients produced successful results,[3] although outcomes in patients following non-shockable cardiac rhythms showed contrasting effects,[4–6] perhaps due to non-cardiac aetiologies.[7–9]

Causes of cardiac arrest differ; cardiac, drowning, drugs, asphyxia, exsanguination, hanging, trauma as well as potentially many others aetiologies can play a role. Often, the exact cause, or contributing factors, may be unknown, such as drugs used as part of a downing suicide attempt. Although animal experiments and clinical trials have examined the effects of following ROSC after many different causes, in asphyxial cardiac arrest most of research has concentrated on the role of TH in perinatal asphyxia,[9–11] with

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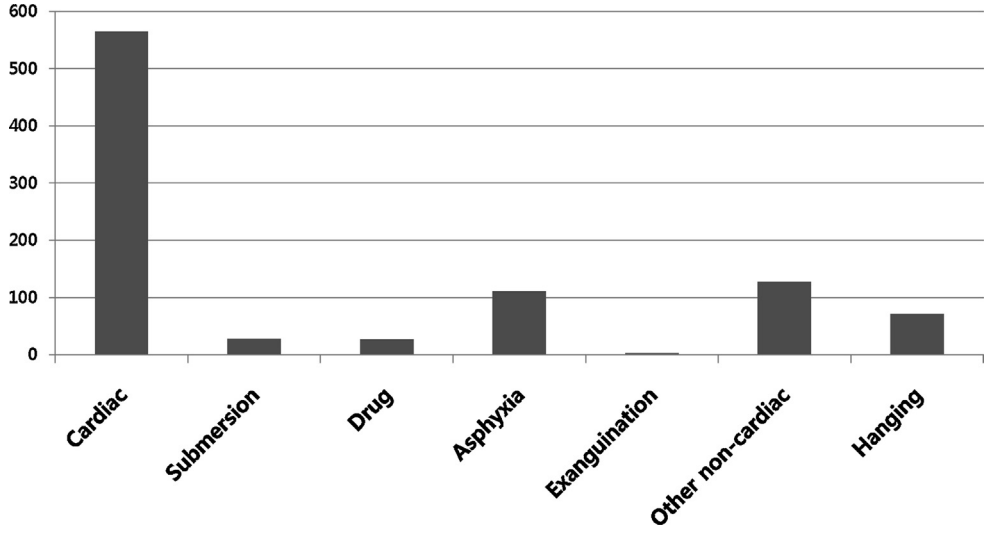


**Fig. 1.** Composition of survivors of out-of-hospital cardiac arrest who were treated with therapeutic hypothermia in the KORHN registry.

but a few studies focusing on adults.[12,13] Previous studies included cardiac arrest patients secondary to hanging, drowning, or gas intoxication.[9,10] Thus, the actual cause of the arrest may have been affected by factors other than a lack of oxygen. Therefore, we investigated the effects of TH following cardiac arrest in survivors in whom hypoxia was the principle cause of the asphyxial cardiac arrest.

## 2. Materials and methods

In 2011, a research group called the Korean Hypothermia Network (KORHN) was created by emergency physicians active in 24 general hospitals within the Republic of Korea to study the effects of TH in survivors of out-of-hospital cardiac arrest (OHCA), with as ultimate goal further improvement in outcomes. The KORHN implemented a web-based database, following the approval of the study protocol by the Institutional Ethic Committees. Registration targeted all documented OHCA patients in whom a TH strategy was initiated, even if the patients died or if TH was prematurely terminated. Patients younger than 18 years old or those with suspected traumatic cardiac arrest were excluded. Each hospital designated a faculty-level employee as data manager, who was also specifically trained in the registry variables before being allowed to input data. A data-qualifying committee within the KORHN council manages the overall registry data. Within the registry, causes of cardiac arrests were classified into seven categories, according to suspected aetiology: asphyxia, drugs, cardiac, drowning, exsanguination, hanging and a rest category of unknown or miscellaneous, non-cardiac origins.

This study presents data from patients who experienced cardiac arrest due to asphyxia. Parameters which were examined are: gender; age; witnessed or not; bystander basic life support (BLS); the initial electrocardiogram (EKG); previous medical disease; emergency medical service (EMS) airway management; the cause of asphyxia; the time from arrest detection to ROSC. The neurologic status, including the Glasgow Coma Scale, spontaneous respiration, pupillary light reflex, corneal reflex, was assessed immediately following ROSC. The time from ROSC to induction of TH; the TH maintenance time; TH technique; complications; the rewarming time; survival; and the cerebral performance category scale (CPC) at discharge. A good neurologic outcome was deemed to be CPC scores of 1 or 2.

The research focused on data entered in the period from January 1st, 2007 to December 31st, 2012. The data were recorded and analysed using SPSS 18 (SPSS Inc., Chicago, IL, USA) and were dichotomised into survivors and non-survivors. Continuous variables are described as mean and standard deviation (SD) or median and interquartile range (IQR). Categorical variables are presented as numbers and percentages. The student's *t*-test was used for continuous variables and a chi-squared test was used for categorical variables. A value of $p < 0.05$ was considered statistically significant.

## 3. Results

A total of 932 OHCA patients had been registered during the study period, of which 565 patients (60.0%) with cardiac arrest attributed to a cardiac origin, 27 patients (2.9%) following drug intoxications, 28 patients (3.0%) had drowned, 111 patients (11.9%) following asphyxia, 3 patients (0.3%) after exsanguination, 71 patients (7.6%) following hanging and a rest group of 127 patients (13.6%) had experienced cardiac arrest of miscellaneous non-cardiac, or unknown origins (Fig. 1).

All 111 patients who had cardiac arrest due to asphyxia underwent TH and were included in this study.

Within this cohort, the average age was $65.8 \pm 16.3$ years, with 68 patients (61.3%) older than 65. Foreign body airway obstruction was the most common cause of asphyxia (78 patients, 70.3%). Respiratory failure leading to cardiac arrest attributed to asthma, chronic obstructive pulmonary disease, or pneumonia occurred in 28 patients (25.2%) and a low oxygen environment, such as due to being locked in a completely closed space, was the cause in 5 patients (4.5%). Seventy-one patients (64.0%) were male. In 85 patients (76.6%) the cardiac arrest was witnessed. Bystander BLS had been provided to 26 patients (23.4%) and 6 patients (5.4%) underwent out-of-hospital EMS advanced airway placement. Overall in the cohort, 32 patients (28.8%) were healthy and without underlying disease prior to the arrest, whereas 23 patients (20.7%) had histories of pulmonary disease (Table 1).

In 60 (54.1%) asystole was the initial EKG rhythm, in 20 patients (18.0%) pulseless electrical activity (PEA) with 1 patient (0.9%) exhibited an unknown, but shockable rhythm and 30 patients (27.0%), with rhythms unknown or missing for analysis. Cooling was performed with an endovascular technique for 34 patients (30.6%) or a topically (hydrogel pad or blanketrol) for 32 (28.8%) and 30 (27.1%) patients, respectively. All hospitals have TH target temperatures of 32–34 °C. TH was maintained for 12–24 h in 79% of patients, and for 24–36 h in 10% of patients (Fig. 2). In 22 patients