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■ Editorial ■

# Do We Successfully Achieve Therapeutic Hypothermia?

Woo Jeong Kim, M.D., Ph.D.

Department of Emergency Medicine, Jeju National University Hospital, School of Medicine, Jeju National University, JeJu, Korea

Treatment for cardiac arrest (CA) primarily focuses on restoring spontaneous circulation, after which further interventions are performed to achieve the best possible neurological outcome and to ultimately enable CA patients to resume their normal daily activities. As an attempt to reduce brain damage, the 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations recommended the use of therapeutic hypothermia (TH) (32-34℃ for 12-24 hours) for patients who achieve return of spontaneous circulation, but remain unconscious.[1]

The recommendation for TH is largely based on the results of two randomized, prospective studies. One of these studies involved the use of a mattress to deliver cold air and ice packs to induce TH at 32-34℃ for 24 hours in five European countries. After TH, rewarming was performed slowly. Fifty-five percent of the hypothermia group demonstrated good neurological outcome, whereas only 39% of the control group exhibited good neurological outcome.[2] In another study conducted in Australia, ice packs were placed around the head and body of patients to induce TH at a targeted temperature of 33℃ for 12 hours, and active rewarming began at 18 hours. Induced TH resulted in improved neurological outcome in 49% of the hypothermia group, while the same outcome was seen in only 26% of the control group.[3] In these two studies, induced TH effectively improved neurological outcome in patients with ventricular fibrillation out-of-hospital cardiac arrest. However, it has not yet been established whether TH is an effective treatment strategy for CA patients presenting with nonshockable rhythm, such as pulseless electric activity and asystole.[4,5] In addition, researchers are divided in their opinions on various elements of TH, including appropriate target temperature, cooling methods and period, and rewarming speed, calling for further studies.

When performing TH, we strive to take a simple and minimally invasive approach in order to cool the body quickly and easily. External cooling techniques such as cooling blankets and helmets or ice bags are typically used at the beginning of treatment. Endovascular cooling has also been used to provide faster cooling and a steady maintenance phase via a cooling catheter introduced into the central venous system and a water-circulating cooling device. Different cooling methods vary in times of initiation of cooling, achievement of the target temperature and maintenance of TH. However, neurological recovery and mortality rates do not appear to vary significantly based on the cooling method used.[6,7] Recently, amid increasing recognition of its fast cooling effect, a large-volume (30 mL/kg), ice-cold (4℃) intravenous fluid infusion is widely used in the early stage of TH along with other cooling methods.[8]

Rates of cooling and rewarming are the most important factors to consider when performing

**Woo Jeong Kim**
Department of Emergency Medicine, Jeju National University Hospital, School of Medicine, Jeju National University, 15 Aran 13-gil, Jeju 690-767, Korea
Tel: +82-64-717-1921
Fax: +82-64-717-1079
E-mail: gurum21@jejunuh.co.kr

ORCID
Woo Jeong Kim
http://orcid.org/0000-0002-8269-4581

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TH. Although most cooling methods aim to achieve TH quickly at a targeted temperature, there was no significant difference in neurological outcome between early and late initiation of TH. However, a higher mortality rate was observed in patients who received early TH compared to those who received late TH.[9] Delay to target temperature adversely affects neurological outcome, however; thus, reaching target temperature as quickly as possible is important once the decision is made to use TH.[10] While neurological outcomes are not affected by differences in rewarming speed,[11] international guidelines support controlled rewarming at a rate of 0.25-0.5℃/hr.

The target temperature recommended is 32-34℃ during TH. As recently developed cooling techniques are able to achieve high target temperature accuracy, international guidelines for target temperature should be more specific. Patients who received TH of 32℃ demonstrated better outcomes than those who received TH of 34℃, suggesting the need for further studies on target temperature and potential revision of the recommended target temperature.[12]

Although TH could help reduce brain damage, prediction of neurological outcome in patients who survive CA remains a challenge. In general, pupillary reactions and corneal reflexes are examined and motor responses are assessed during neurological examination. In addition, electroencephalography and somatosensory evoked potential[13] are used for electrophysiological tests. Creatine kinase BB isoenzyme, neuron specific enolase,[14] S-100B protein,[15] lactate dehydrogenase, procalcitonin and lactate are commonly used as biomedical markers. Computed tomography, diffusion-weighted magnetic resonance imaging (MRI) and functional MRI are commonly used for neuroimaging. These tools can be useful for estimating neurological prognosis, but there is not optimal tool to predict prognosis yet.

In 2011, Korean hospitals that provide TH implemented a new TH protocol and shared their experiences through the Korean Hypothermia Network. Further studies are expected on TH treatment via the enhanced data collection and joint research opportunities provided through this nationwide network.

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