Implementation of mild therapeutic hypothermia for post-resuscitation care of sudden cardiac arrest survivors in cardiology units in Poland

Łukasz Kołtowski^{1, A–F}, Karolina Malesa^{1, B–D, F}, Mariusz Tomaniak^{1, A, C, E, F}, Janina Stepińska^{2, A, C, E, F}, Beata Średniawa^{3, A, C, E, F}, Paulina Karolczyk^{1, A–C, F}, Dominika Puchta^{1, A–C, F}, Robert Kowalik^{1, A, C, D, F}, Elżbieta Kremis^{2, A–C, E, F}, Krzysztof J. Filipiak^{1, A, C, E, F}, Marek Banaszewski^{2, A, B, E, F}, Grzegorz Opolski^{1, A, C, E, F}, Marta Bagińska^{1, D}

¹ 1st Department of Cardiology, Medical University of Warsaw, Poland

² Intensive Cardiac Care Clinic, Institute of Cardiology, Warszawa, Poland

³ Department of Cardiology, Congenital Heart Diseases and Electrotherapy, Medical University of Silesia, Silesian Center for Heart Diseases, Zabrze, Poland

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Address for correspondence

Łukasz Kołtowski

E-mail: lukasz@koltowski.com

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Conflict of interest

None declared

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Abstract

Background. The post-cardiac arrest (CA) period is often associated with secondary damage of the brain that leads to severe neurological deficits. The current practice guidelines recommend the use of therapeutic hypothermia (TH) to prevent neurological deficit and improve survival.

Objectives. The aim of the study was to investigate the implementation of medical guidelines in clinical practice and to evaluate the barriers for implementation of TH in cardiology units in Poland.

Material and methods. A telephone survey, fax and online inquiry form were used to assess the implementation of TH in cardiology units in the management of unconscious patients after cardiac arrest (CA). The questions addressed the local practice, TH protocol, reasons for not using TH and outcomes of CA patients.

Results. We obtained information from 79 units out of 150 asked (53%). At the time of the survey, 24 units (30.8%) were using TH as part of their post-CA management. Of all CA patients, 45% underwent TH in cardiac intensive care units (CICU), 37.5% in the coronary care unit (CCU) and 12.5% in the intensive care unit (ICU). The major barrier for the implementation of TH declared by the non-cooling centers was lack of sufficient knowledge regarding the technique and protocol, as well as experience (37%); access to dedicated equipment was not perceived as an obstacle.

Conclusions. The number of cardiology units that provide TH for comatose CA patients is low. The main limiting factor for wider use of TH is lack of knowledge and experience. There is a clear need for urgent educational activities for cardiology units. The benefits of TH still have not reached their potential in cardiology units.

Key words: cardiac arrest, therapeutic hypothermia, resuscitation, hypothermia registry, target temperature management

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Introduction

Cardiac arrest (CA) remains the major cause of sudden death; each year it affects around 375,000 people in Europe. Recovery from cardiac arrest with a delayed return of spontaneous circulation (ROSC) of more than 5 min is usually associated with an anoxic neurologic injury and is recognized as an important factor for increased morbidity and mortality.¹ Therapeutic hypothermia (TH) is a well-established method which has shown a positive impact on these outcomes.^{2–4} The European Society of Cardiology strongly recommends the use of TH early after resuscitation of CA patients presenting acute myocardial infarction with ST-segment elevation (class I, evidence B) who are comatose or under deep sedation.⁵ Similarly, the recent European Resuscitation Council and European Society of Intensive Care Medicine Guidelines for Post-Resuscitation Care 2015 recommend active cooling of patients after CA.⁶ It should be underlined that TH is one of many treatment methods used along the resuscitation care chain and should not preclude implementation of other strategies. Furthermore, in order to ensure a high quality of care and safety, all teams providing TH must undergo dedicated training on the cooling protocol and TH methods.

The last survey, conducted in 2010, before European Society of Cardiology (ESC) guidelines were published, showed that the proportion of intensive care units (ICU) using TH in Poland was only 21.7%.⁷ The ICUs are usually managed by anesthesiologists, whereas patients after CA are often admitted to the cardiac intensive care units (CICU) and treated by cardiologists, therefore it is important to assure that access to TH management is also available in these units. At present, it is unknown what percentages of cardiology centers have a dedicated TH program in place and are able to offer it to their patients in everyday practice. To investigate this matter, and to identify the main barriers for the implementation of a TH program, we have conducted a survey among cardiology centers that treat patients after CA.

TH, defined as controlled cooling of patients after cardiac arrest to a temperature between 32 and 34°C for a period of at least 24 h, aims to temper the post-cardiac arrest syndrome inflammatory cascade. One of the underlining mechanisms that provide beneficial effects is the reduction of release of excitatory amino acids and free radicals, which terminate activating programmed cell death pathways. Moreover, the intracellular consequences of excitotoxin exposure are minimized. Furthermore, hypothermia influences cerebral blood volume, cerebral metabolic rate of oxygen and intracranial pressure, which are all decreased. As a consequence, oxygen demand and the function of the brain might be improved.¹

In recent years, the development of TH programs across Poland has been actively supported by the Polish Cardiac Society, which, among others, included the

foundation of the Polish National Registry of Therapeutic Hypothermia. In January 2014, the National Health Fund announced a dedicated reimbursement code for TH that ultimately eliminated the financial barriers for this method. The growing number of scientific reports on the clinical benefits of TH increases the awareness of this method among Polish cardiologists.^{8–11} Positive results are more likely to be achieved if strict criteria for inclusion and exclusion are applied.

The primary aim of the survey was to determine the implementation of the ESC and ERS guidelines in the clinical practice of cardiology units.

Material and methods

The data was prospectively collected from June to December 2014, using telephone survey, fax, online and printed inquiry form (Supplement 1). The investigators made an attempt to contact each of the 150 CICUs located in Poland. The answers were obtained from members of the CICU medical team, in particular the head of the department or designated physician. In case there was no answer to the initial email/letter with the questionnaire, the center was contacted by phone. In total, up to 3 attempts were made to contact each center. A detailed questionnaire investigated the experience of the center with TH (questions 1–4), the local practice in place for the management of the patient (question 5), type of the mild TH protocol (questions 6–8 and 11–14), mode of cooling and temperature control (questions 9–10), obstacles related to the employment of TH in clinical practice (questions 15–16) and educational training received by the unit (questions 17–19). The investigators collected declarative data on the number of patients that were managed at each CICU and those successfully discharged from the hospital.

Descriptive statistics were used to present the results; the categorical data was presented as percentage and nominal numbers. The percentages were reported in reference to the number of centers that provided the answers unless clearly stated otherwise.

Results

Out of the 150 CICUs approached in the survey, approx. half provided answers to the questionnaire (53%, $n = 79$). Most centers replied to the questionnaire sent by traditional post (49%, 38), 36% (28) provided answer after telephone contact from the investigators, 16.5% (13) submitted their answers via email.

Twenty-four centers confirmed the active use of TH in CA patients, 63% of them declared using hypothermia in a pre-hospital setting (Table 1). Almost half of the centers cooled less than 5 CA patients per year (Fig. 1). All treating centers have a dedicated TH protocol in place; nearly

Fig. 1. Therapeutic hypothermia usage per year

all (96%, $n = 23$) used the target temperature range from 32 to 34°C. In most cases (58%, $n = 14$), the target temperature was maintained for 12–24 h, and in 38% it lasted for more than 24 h. The induction phase was usually performed using an intravenous infusion of cold fluids (96%, $n = 23$). External cooling methods were applied more often (75%, $n = 18$), usually without control equipment (42%, $n = 10$). Every 4th center was equipped with an intravascular cooling system. The comparison of the main features of the TH protocols revealed that patients were qualified for the procedure regardless of the type of the 1st cardiac rhythm (ventricular fibrillation, ventricular tachycardia, asystole or pulseless electrical activity).

Among the centers that do not perform TH, only 33% ($n = 18$) are considering using TH in the future as part of the local protocol for management of post CA patients. The main barrier for starting a TH program is lack of knowledge and experience (37%, $n = 20$). The centers were not aware that dedicated TH educational training is available (96%, $n = 22$) (Table 2). Only 37% ($n = 20$) of the centers had participated as least once in a dedicated TH workshop on the risks and benefits related to the procedure (Table 3).

Discussion

The extended data surveillance conducted between June and December 2014 that included 150 CICUs in Poland revealed that 30.3% (24) of units use TH in their daily practice. This data is complimentary to the previously conducted survey among Polish ICUs, which revealed that 21.7% of the anesthesiology units surveyed have a TH program in place.⁷ A direct comparison of this data with the present study has some clear limitations and should not be used to draw firm conclusions as the profile of the patients treated in ICUs and CICUs differs; there has been over 5 years' time difference, and meanwhile the reimbursement of TH has been introduced and there has been much more clinical evidence supporting temperature control in CA patients published recently. Still, the observed differences in the applied cooling methods show that over the years there was an increase in the usage

Table 1. Procedural characteristics and implementation of TH in units that routinely perform TH ($n = 24$)

Type of unit performing TH procedure	
cardiac intensive care unit	50% (12/24)
coronary intensive unit	12.5% (3/24)
intensive care unit	37.5% (9/24)
Split of units ($n = 24$) according to:	
The target temperature used	
32–34°C	95.8% (23/24)
<32°C	0% (0/20)
>34°C	4.2% (1/24)
The duration of the maintenance phase (at target temperature)	
<12 h	4.2% (1/24)
12–24 h	58.3% (14/24)
>24 h	37.5% (9/24)
The use of cold fluids for induction of TH	
yes	95.8% (23/24)
no	4.2% (1/24)
The type of techniques used for maintaining hypothermia	
surface cooling without temperature feedback (ice packs, cold pads)	41.7% (10/24)
surface cooling system with temperature feedback	29.1% (7/24)
endovascular cooling system with temperature feedback	25% (6/24)
two techniques: surface and endovascular systems with temperature feedback	4.2% (1/24)
The site for temperature monitoring	
esophagus	18.2% (4/22*)
bladder	36.4% (8/22*)
concomitant esophagus and bladder	45.4% (10/22*)
Qualifying ECG criteria for TH	
any rhythm	87.5% (21/24)
only VF/VT	12.5% (3/24)
only PEA, asystole	0% (0/24)
Qualifying CA location criteria for TH	
any place	70.8% (17/24)
prehospital CA	16.7% (4/24)
in-hospital CA	12.5% (3/24)
Use of neuromuscular-blocking agents	
routinely	41.7% (10/24)
only when muscle shivering occur	58.3% (14/24)

CA – cardiac arrest; PEA – pulseless electrical activity; TH – therapeutic hypothermia; VF – ventricular fibrillation; VT – ventricular tachycardia; * – missing data ($n = 2$).

of dedicated cooling devices with temperature feedback (7% in 2010 vs 20% in 2014). The use of temperature probes connected to the cooling device – a controlled feedback system – allows for continuous measurements of the patient's temperature and the adjustment of cooling elements accordingly. This approach is associated with increased safety and survival.^{12,13}

Table 2. Barriers for wider deployment of TH in Poland – answers from units that do not perform TH (n = 54)

Does your unit plan to introduce TH in the future?	
yes	33% (18/54)
no	67% (36/54)
What are the main obstacles to implementation of TH in the unit?	
lack of knowledge, experience	37% (20/54)
lack of equipment	20% (11/54)
lack of reimbursement	17% (9/54)
lack of local protocol	6% (3/54)
lack of confidence in method	4% (2/54)
lack of medical staff	2% (1/54)
>3 of mentioned above	15% (8/54)

TH – therapeutic hypothermia.

Table 3. Participation of units in dedicated therapeutic hypothermia training

Did your center participate in a TH training course?	
yes	37% (20/54)
no	62% (34/54)
Would your center be willing to participate in a dedicated TH training course (only centres that have not taken part in a training so far, n = 34)	
yes	68% (23/34)
no	32% (11/34)
Are you aware of the available TH training opportunities? (centres willing to take part in a TH training, n = 23)	
yes	4% (1/23)
no	96% (22/23)

The duration of active cooling in the present study was 12–24 h in 58.4% (14/24) of centers, 37.5% (9/24) of centers cooled for more than 24 h and only 4.2% (1/20) used TH for less than 12 h. Although the current recommendations support 24 h of active cooling, there is some weak evidence to extend this time to 36 h.¹⁴ Likewise, the value of the target temperature is becoming a hot topic for discussion, given the recent results by Nielsen et al., who showed no benefit of 33° or 36°C.¹⁵ We identified 1 cardiology center in Poland that conducts the target temperature management at 36°C.

The main barrier for not using TH by cardiologists in Poland is the lack of knowledge and experience, which is an obstacle for 37% of cardiology centers. Financial restrictions were raised by 17% of centers, which is comparable to that reported by other European countries, i.e., Austria and the Czech Republic.^{16,17} However, given that the reimbursement of therapeutic hypothermia is available to each and every CICU, and there are flexible modes for renting the TH equipment, this problem is probably more an issue of local awareness than actual financial constraints. In fact, access to the equipment is not per-

ceived as a major problem, with only 7.7% of units indicating that it prevents them from running a TH program for comatose post-CA survivors.

After the above-mentioned published randomized trial by Nielsen et al. that compared 2 target temperature strategies (33° vs 36°C), the view on the role of therapeutic hypothermia in post-resuscitation care has been extensively discussed.¹⁵ The most recent “Guidelines for Resuscitation 2015” published by the European Resuscitation Council include an option to use the target temperature of 36°C instead of the previously recommended 32–34°C. As the present study describes experience before the year 2015, we have intentionally maintained the term TH. However, it should be underlined that in order to comply with the current evidence and guideline terminology, future methodology should implement the notion of target temperature management.

The major limitation of our study was a low response rate (53%) from CICUs. However, publication of the current results might in the future encourage other units to take part in a study and, more importantly, to start using TH in their wards. A direct comparison of anesthesiology units and cardiology units might be misleading as they differ in terms of patient profiles and indications for cooling. Nonetheless, one would expect that both types of units should have much higher rates of TH availability than is currently reported. The questionnaire used in the study had not been validated previously, therefore the results obtained should be interpreted causally. Nevertheless, we encourage authors of future studies to consider using this tool, which might provide additional data to validate it.

Conclusions

The use of TH in comatose patients after CA with ROSC is low. Scientific evidence supports the use of TH in this population to improve prognosis and quality of life. Financial restrictions have been eliminated recently, which could improve the adherence to the guidelines which recommend using TH in such patients. Therefore, a lack of knowledge and experience remain the greatest barriers for wide deployment of TH. There is an urgent need to expand education and training among cardiologists, provided by centers experienced in TH.

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Supplement 1

Implementation of therapeutic hypothermia in post-cardiac arrest patients treated in cardiac intensive care and coronary care units.

Contact details:

- I. Centre name:
- II. Address:
- III. Type:
 - a. cardiac intensive care unit (CICU)
 - b. coronary care unit (CCU)
- IV. Name of the contact person:

Questions:

1. How many post-cardiac arrest patients (CA) were treated at your centre in recent year?
Number:
2. Is your centre using therapeutic hypothermia (TH) in post-CA patients?
 - a. Yes
 - b. No
3. How many patients were treated with TH last year?
Number:
4. How many patients treated with TH survived until discharge?
Number:
5. Which unit is treating post-CA patients at your center?
 - a. cardiac intensive care unit (CICU)
 - b. coronary care unit (CCU)
 - c. intensive care unit (ICU)
6. What is the target temperature in your protocol?
 - a. 32–34°C
 - b. <32°C
 - c. >34°C
7. What is the cooling time in your protocol?
 - a. <12 h
 - b. 12–24 h
 - c. >24 h
8. Do you use cold fluids for the inductions of TH?
 - a. Yes
 - b. No
9. What cooling methods do you use for the TH procedure?
 - a. Surface cooling with temperature feedback
 - b. Surface cooling without temperature feedback (ice, cold pads)
 - c. Intravascular cooling with temperature feedback
10. Site for temperature measurement?
 - a. Esophageal
 - b. Bladder
 - c. Rectal
 - d. At least 2 of the above (which?)

11. Which primary rhythms leading to CA are included in TH procedure?
 - a. VT/VF
 - b. PEA, asystole
 - c. Both above
12. Inclusion for TH depending on the setting of CA:
 - a. Pre-hospital CA
 - b. In-hospital CA
 - c. Both settings
13. Is there a TH protocol in place at your center?
14. Do you use muscle relaxants for TH:
 - a. Yes, routinely
 - b. Only in case of muscle shivering
15. Do you plan to implement TH in the future (only if TH is not yet used)
 - a. Yes
 - b. No
 - c. N/a
16. What is the barrier for implementation of TH at your centre? (only if TH is not yet used)
 - a. Lack of knowledge, experience
 - b. Lack of reimbursement
 - c. Lack of TH protocol
 - d. Limited medical staff
 - e. Lack of TH equipment
 - f. Not convinced with the current body of evidence for the TH method
 - g. Other (which?)
17. Have you participated in TH Training?
 - a. Yes
 - b. No
18. Are you willing to take part in a TH Training? (only centers that have not participated in a training)
 - a. Yes
 - b. No
19. Do you know that TH Training is available and where to find it?
 - a. Yes,
 - b. No
20. If you are not willing to answer this questionnaire please share the reason why.

Thank you!