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Clinical paper

# An observational study of patient selection criteria for post-cardiac arrest therapeutic hypothermia☆

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ABSTRACT

*Background:* To date, there is no comprehensive assessment of how therapeutic hypothermia and post-arrest care are being implemented clinically. At this stage in the translation of post-arrest science to clinical practice, this analysis is overdue. This study examines the first step of post-arrest care – the selection of patients for TH and post-arrest care.
*Methods:* We conducted a systematic review to search for all publicly available TH and post-arrest protocols. Observational data was reported and no statistical inferences were made.
*Results:* Notable variation was observed in the following selection criteria: total ischemic time and hemodynamic requirements. Additionally, only some of the criteria were evidence based.
*Conclusion:* This study demonstrates the wide range and variety of patient selection criteria that are being used for implementation of post-cardiac arrest care. The consequences of this selection criteria variability are currently unmeasured and likely underestimated. Variability is likely to breed inefficiency. Some patients who could benefit do not get treated. Other patients get cooled, yet will never regain consciousness. This variability may be important when considering inter-hospital variation in post-arrest care and outcomes.



## 1. Introduction

The standard of care for cardiac arrest patients with return of spontaneous circulation (ROSC) is mild therapeutic hypothermia (TH) and multidisciplinary post-cardiac arrest care [1,2]. It is evidence based and comprised of early and aggressive management of seizures and hemodynamic optimization. It also includes early identification of ongoing precipitating pathology, such as acute coronary syndrome and pulmonary embolism [2].

There is evidence to suggest gaps in knowledge translation of both TH and post-arrest care by physicians [3–5]. To date, there is no comprehensive assessment of how TH and post-arrest care are being implemented clinically, at the hospital level. At this stage in the translation of post-arrest science to clinical practice, this analysis is overdue. This study seeks to examine the first step of post-arrest care – the selection of patients for the comprehensive and time-intensive treatment of TH after cardiac arrest.

## 2. Methods

We conducted a systematic review to search for all available TH and post-arrest protocols. The following search strategy was developed to obtain the most comprehensive results: [“therapeutic hypothermia” OR “post-cardiac arrest”] AND [“protocol” OR “order set”]. The search strategy was employed in Google, Google Scholar, PubMed, and the National Institute for Health and Clinical Excellence (NICE) clinical guideline database. For those searches that yielded an abundance of results, a pre-determined limit of 500 results was set for review.

For inclusion, the protocols must have been associated with a hospital and demonstrated clear patient selection criteria. Protocols were excluded if they were associated only with a ground or air emergency medical services agency. The search was not limited by country. Additionally, protocols without clear patient selection criteria were not included for review.

Prior to analyzing any TH protocols, definitions for expected patient selection criteria were predetermined from the Bernard and

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**Table 1**
Patient selection criteria.

| |
|---|
| Initial rhythm |
| Witnessed arrest |
| Arrest location |
| Time to basic life support (BLS) |
| Total ischemic time |
| Time since ROSC |
| Baseline body temperature |
| Level of consciousness |
| Age |
| Pregnancy |
| Advanced directives |
| Terminal illness |
| Baseline neurologic status |
| Etiology of coma |
| Hemodynamic status |
| Hematologic factors |
| Etiology of cardiac arrest |
| Co-morbidities |
| Trauma/surgery |

HACA trials [6,7] and the Utstein criteria [8]. Also included were patient selection criteria based on the most recent evidence of factors associated with survival from cardiac arrest (i.e. total ischemic time [9,10]). Among the protocols that were obtained from the search strategy, all patient selection criteria were recorded. For those patient selection criteria that were not defined in the literature, a definition was determined by consensus of the authors.

A preliminary review was conducted on 15% of the TH protocols discovered through our search strategy in order to assess the applicability of our pre-determined patient selection criteria. From this review, additional criteria were added as needed by consensus. The final list of patient selection criteria reviewed is found in Table 1. The proportion of hospitals that considered each patient selection criteria was determined. No statistical inferences were made. JMP (SAS, Cary, NC) was utilized to calculate proportions and generate tables.

## 3. Results

### 3.1. Search strategy

The search using Google yielded 49,600 results. The first 500 results were reviewed and 8 TH protocols identified. Of note, one link identified through the search yielded a collection of 56 TH protocols provided by the University of Pennsylvania Center for Resuscitation. The Google Scholar search yielded 4480 results. The first 500 results were reviewed and 0 protocols were identified. The PubMed search yielded 210 results. From the PubMed search, 0 protocols were obtained. The NICE search yielded 1 result. However, it was not included because it was not a protocol. A diagram of the search strategies, elimination process, and final number of protocols are demonstrated in Fig. 1. Patient selection criteria from the 64 final protocols are summarized in Table 2. The protocols elicited by our search strategy originated from the United States and the United Kingdom.

Notable observations were made in the following categories. Total ischemic time (TIT) is utilized by 59% of the protocols to determine whether to provide advanced post-arrest care. Of the hospitals that regard a non-shockable rhythm as a relative exclusion, the location or TIT, in combination with the initial rhythm, is factored in to the final decision to provide TH. For example, one hospital considers including non-shockable rhythms with TIT of less than 1 h. Another hospital will initiate TH for a patient with PEA if the TIT is less than 30 min. Among those hospitals that consider providing post-arrest care to un-witnessed arrests, TIT is a limiting factor.

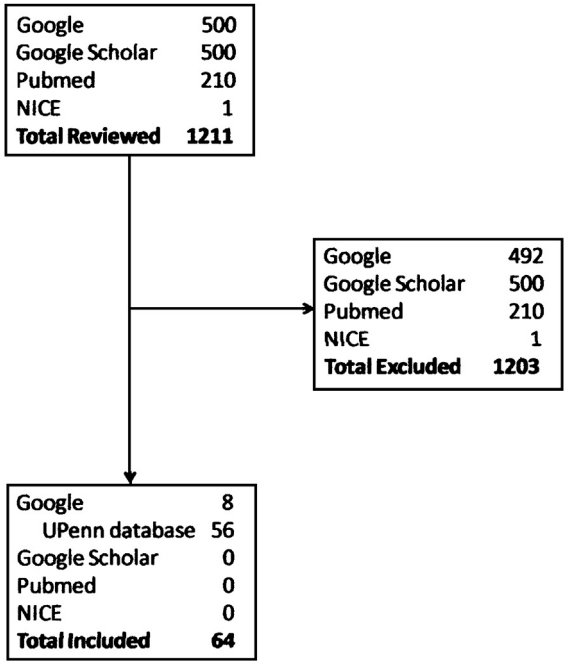


**Fig. 1.** Protocol flowsheet.

Regarding level of consciousness (LOC), there is significant variation in this as a selection criterion. Subjective descriptions of LOC include: comatose, unresponsive, encephalopathy, not awakening, not alert and oriented, altered level of consciousness, or unable to follow commands. Glasgow Coma Scale (GCS) requirements for post-arrest care range from 5 to 12. Of note, 10 hospitals require patients to demonstrate various brainstem reflexes prior to initiating TH.

Among the hospitals that consider blood pressure as a selection factor for post-arrest care, there is a wide range of hemodynamic restrictions. Thirty-nine hospitals provide specific BP parameters (systolic blood pressure (SBP), mean arterial pressure (MAP), or both) that must be met prior to initiating TH. The range of SBP is from 70 to 90 mmHg. The range of MAP considered is from 50 to 75 mmHg. The remaining hospitals provide only subjective descriptors of hemodynamic status, such as “instability” or “shock”, and then only for exclusion purposes.

Regarding recent surgery as a selection criterion, 23 protocols indicate that there is a time restriction on recent surgery. The time from recent surgery ranges from 72 h to 14 days. Other protocols specify constraints on the type of surgery, including: cardiovascular, intra-cranial, intra-thoracic, intra-abdominal, major surgery, or any surgery where the incision is >5 cm.

There were a handful of patient selection criteria that were not included in our primary investigation. For example, 3 hospitals exclude patients if they are receiving mannitol. Seven hospitals exclude on the basis of “anything that precludes the chance of meaningful survival.” Two protocols have body size restrictions. One protocol requires patients to be between 4 ft 9 inches tall and 6 ft 3 inches tall. Another requires that the patient weigh more than 50 kg. Height and weight restrictions are possibly related to the device utilized at each facility. Finally, a single hospital excludes patients with a history of cryoglobulinemia.

## 4. Limitations

This study is limited by its design. Firstly, we limited our review to the first 500 results, or 50 pages, in Google. Our review did not yield any new protocols after the first 26 pages. With this