



COOLING AFTER CARDIAC ARREST: USE OF THERAPEUTIC HYPOTHERMIA

ARREFECIMENTO PÓS-PARAGEM CARDIORRESPIRATÓRIA: O USO DA HIPOTERMIA TERAPÊUTICA

EL ENFRIAMIENTO DESPUÉS DEL PARO CARDÍACO: EL USO DE LA HIPOTERMIA TERAPÉUTICA

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ABSTRACT

Objective: to analyze the effectiveness of hypothermia therapy performed to the adult patients surviving of cardiac arrest. **Methodology:** research performed based on international databases (EBSCOhost, Cinahl, Medline, Scielo and Cochrane), yielding nine articles published between 2009 and 2011. This systematic review of the literature involved the work of two reviewers who independently assessed the methodological quality of each item selected. It was adopted as a methodological strategy a rigorous research that allows including studies referred to adult patients in cardiac arrest survivors submitted to a therapeutic hypothermia. In order to know the benefits of this therapy, we intend to answer the research question: Is the therapeutic hypothermia held in patients adult survivors of cardiac arrest effective? **Results:** we analyzed nine articles and found that the cardiac arrest is an event that causes high mortality of brain ischemia for hypoperfusion, which leads to severe neurological injury. Therapeutic hypothermia contributes to the improvement of these lesions. This is induced by four-phase and therefore requires a continuous monitoring. **Conclusion:** it was shown that therapeutic hypothermia represents an important advance in improving the neurological lesions of patients survivors of cardiac arrest. Thus, unconscious adult patients with spontaneous circulation after cardiac arrest extra hospital should be submitted to hypothermia when the initial rhythm is ventricular fibrillation or pulse less ventricular tachycardia. However, therapeutic hypothermia may be beneficial for other rhythms and for the environment in the hospital. **Descriptors:** therapeutic hypothermia; post-cardiorespiratory arrest; adult patient.

RESUMO

Objetivo: analisar a eficácia da hipotermia terapêutica realizada ao paciente adulto sobrevivente de paragem cardiorrespiratória. **Metodologia:** pesquisa realizada em bases de dados internacionais (EBSCOhost, Cinahl, Medline, Cochrane e Scielo), obtendo-se nove artigos publicados entre 2009 e 2011. A presente revisão sistemática da literatura envolveu o trabalho de dois revisores, que avaliaram de forma independente a qualidade metodológica de cada artigo selecionado. Adotou-se como estratégia metodológica a pesquisa rigorosa que permitisse incluir os estudos referentes a pacientes adultos sobreviventes de paragem cardiorrespiratória submetidos a hipotermia terapêutica. Com o intuito de conhecer os benefícios desta terapêutica, pretendemos responder à pergunta de investigação: *Será que a hipotermia terapêutica realizada a pacientes adultos sobreviventes de paragem cardiorrespiratória é eficaz?* **Resultados:** foram analisados nove artigos e constatou-se que a paragem cardiorrespiratória é um evento de alta mortalidade que causa isquemia cerebral por hipoperfusão, o que leva a agressão neurológica grave. A hipotermia terapêutica contribui para a melhoria destas lesões. Este procedimento é induzido por quatro fases e por isso necessita de uma monitorização contínua. **Conclusão:** ficou evidenciado que a hipotermia terapêutica representa um importante avanço na melhoria das lesões neurológicas dos pacientes sobreviventes de paragem cardiorrespiratória. Assim, os pacientes adultos inconscientes com circulação espontânea após paragem cardiorrespiratória extra-hospitalar devem ser submetidos a hipotermia quando o ritmo inicial for fibrilhação ventricular ou taquicardia ventricular sem pulso. Contudo, a hipotermia terapêutica pode ser benéfica para os outros ritmos e para o ambiente intra-hospitalar. **Descritores:** hipotermia terapêutica; pós-paragem cardiorrespiratória; paciente adulto.

RESUMEN

Objetivo: analizar la eficacia de la terapia de hipotermia realizado en pacientes adultos que sobrevivieron paro cardíaco. **Metodología:** encuesta de bases de datos internacionales (EBSCOhost, Cinahl, Medline, Scielo y Cochrane), dando nueve artículos publicados entre 2009 y 2011. Esta revisión sistemática de la literatura implicó el trabajo de dos revisores que evaluaron de forma independiente la calidad metodológica de cada artículo seleccionado. Fue adoptado como una estrategia metodológica que permita una investigación rigurosa incluyen estudios sobre pacientes adultos en los sobrevivientes de paros cardíacos sometidos a hipotermia terapéutica. Con el fin de conocer los beneficios de esta terapia, tenemos la intención de responder a la pregunta de investigación: *¿Tiene pacientes hipotermia terapéutica realizada adultos sobrevivientes de paro cardíaco es eficaz?* **Resultados:** se analizaron nueve artículos y se encontró que el paro cardíaco es un evento que causa una alta mortalidad de la hipoperfusión cerebral isquémico, lo que conduce a una lesión neurológica grave. La hipotermia terapéutica contribuye a la mejora de estas lesiones. Esta es inducida por cuatro fases y por lo tanto requiere una vigilancia continua. **Conclusión:** se demostró que la hipotermia terapéutica representa un importante avance en la mejora de las lesiones neurológicas de los pacientes que sobrevivieron paro cardíaco. Por lo tanto, pacientes inconscientes con circulación espontánea tras un paro cardíaco fuera del hospital deben ser sometidos a hipotermia cuando el ritmo inicial es la fibrilación ventricular o taquicardia ventricular sin pulso. Sin embargo, la hipotermia terapéutica puede ser beneficiosa para otros ritmos y el medio ambiente en el hospital. **Descritores:** hipotermia terapéutica; después de la detención cardiorrespiratoria; paciente adulto.

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INTRODUCTION

The cardiopulmonary arrest (CPA) is a medical emergency defined as the sudden and unexpected interruption of vital functions, characterized by the absence of heartbeat, no breathing movements and without response to external stimulation. Although there have been developments and improvements in resuscitation, the mortality of CPA patients remains very high.¹ Globally, the average survival rate of extra-hospital arrest is only 6%, and those who survive are at risk for developing neurological injury. Only about 20% of survivors of CPA remain in coma without neurological lesions.² Thus, post-PCR care can reduce premature mortality due to hemodynamic instability and multiple organ dysfunction, and delayed due to brain injury. However, the majority of post-CPA deaths occurs in the first 24 hours after the return of spontaneous circulation.³

In this context, the induction of therapeutic hypothermia in survivors of CPA has been shown to improve these troubling indicators. This fact is justified because it is an effective treatment to promote protection against cerebral ischemia by reducing the consumption of oxygen by the brain. Several lines of evidence suggest that hypothermia reduces mortality of patients survivors of cardiac arrest.^{1,4-6}

Bernard and his collaborators carried out a study in 2002 about 77 adult patients survivors of CPA, of which 43 were submitted to hypothermia even in the intervention extra hospital, at a temperature of 33° C within 12 hours. The other patients remained normothermic. Both groups underwent the same monitoring measures. The good neurological outcome was achieved in 49% of patients with induced hypothermia and only 26% of patients submitted to normothermia had a good neurological outcome.⁴⁻⁶

In the study The Hypothermia After the Cardiac Arrest Study Group (2002), in total 3551 patients with persistent after coma, 275 are submitted to therapeutic hypothermia for 24 hours. The primary outcome of this study was the neurological evaluation six months after the CPA. About the patients who received therapeutic hypothermia 55% had good recovery or moderate recovery with sequelae, compared with 39% of those who received conventional treatment. Mortality at six months was 41% in the group submitted to hypothermia, significantly lower than 55% of the normothermic group.⁴⁻⁶

Based on the evidence described before, both the European Resuscitation Council, as well as the International Liaison Committee on Resuscitation (ILCOR) recommended treatment for patients hypothermic post-CPA, including patients with spontaneous circulation after cardiac arrest extra hospital, for 12 to 24 hours, when the stop rate is ventricular tachycardia or ventricular fibrillation without a pulse. Although there is evidence that they are also included patients with other stopping rhythms as well as occurred in the hospital environment.³

In order to know the benefits of induced hypothermia to survivors of CPA, we intend with this systematic review to answer the research question: Is the therapeutic hypothermia held in patients adult survivors of cardiac arrest effective? As the population - the adult patient survivor of cardiac arrest, intervention - therapeutic hypothermia and the result - if it is effective. Thus, we define the objective of this systematic review: to analyze the effectiveness of hypothermia therapy held for adult patients survivor of cardiac arrest.

METHOD

A systematic literature review is particularly useful for integrating information from a set of studies held separately on a particular therapy or intervention, which may have conflicting results and / or coincidental, as well as identifying issues that require evidence, assisting in guiding for future investigation.⁷ A systematic literature review consists of "deepening certain aspects of the subject of study and take stock of the situation on their contribution to the advancement of knowledge, in organizing the information and in composing it."^{8:109}

This literature review involved two reviewers' work, who independently assessed the methodological quality of each item selected. The same was done without meta-synthesis and no meta-analysis. We adopted as methodological strategy to "rigorous research that allows to group primary studies extracting from them the best scientific evidence."^{9:29} Thus, we included primary studies that define the objectives, the object of study, justify methodology, and present their results.

Thus, for the realization of this literature review we made an exhaustive search of information about the topic studied in scientific databases, concerning the last three years (2009-2011). The research was

conducted from November to December 2011, in the languages Portuguese, English and Spanish.

The research was conducted in order to find relevant information, reliable and current about what is therapeutic hypothermia, their mechanisms of action and benefits, the phases of this procedure and nursing care to patients submitted to therapeutic hypothermia for cardiac arrest survivors. Thus, in order to find information about the subject under study, we selected as descriptors "therapeutic hypothermia", "after cardiac arrest," "therapeutic hypothermia" and "cardiac arrest", and as Boolean operator "and" and "e".

Initially we conducted our research in the Online Knowledge Library (B-On), which allowed us to access 102 articles, of which we selected three. Subsequently, our research have addressed the *EBSCOhost* database, which allowed us to search in other databases as *Cinahl Plus with Full Text*, and *Medline with Full Text Cochrane Database of Systematic Reviews*. In these articles we access 129, and selected an article from *CINAHL Plus with Full Text* and 1 article of the *Cochrane Database of Systematic Reviews*. Although we perform our search in the database SciELO, on which we accessed 10 articles, 3 of which we selected and researched in the *Journal of Nursing UFPE On Line (REUOL)*, where we selected one article of the 5 articles accessed. In order to enrich our research, we also feel the need to include the same in the European Resuscitation Council Guidelines for cardiopulmonary resuscitation, 2010, because they incorporate the results of a systematic review of a wide range of topics related to cardiopulmonary resuscitation.

The articles included were studies about adult patients in cardiac arrest survivors submitted to therapeutic hypothermia. We excluded animal studies and studies about newborn children, children, teenagers, pregnant women and elderly people. During the selection of studies, the evaluation of the title and summary analysis allowed us to identify whether the articles met the inclusion and exclusion criteria set for selection. When the title and abstracts of the studies were not enlightening, we proceeded to read the entire article not to have the risk of losing important studies for the realization of this systematic review. But many of these items were not available in full-text, so it could not be considered. A second reading deeper and more systematic of the full article allowed us to

determine whether they answered the question that guides this review and further develop certain aspects of the subject. Thus, this systematic review is supported by nine scientific papers and guideline.

RESULTS AND DISCUSSION

By analyzing the works selected we identified four key areas that help us to answer our research question: the concept of therapeutic hypothermia, the mechanisms of action and the phases in which this procedure is, as well as nursing care in critical application of therapeutic hypothermia.

• Concept of Theurapeutic Hyporthermia

During the CPA, the spontaneous circulation ceases and vital organs are no longer perfused. Thus, CPA causes abrupt brain blood flow, producing neuronal ischemia. The extent of neurological injury depends on the degree of hypoxia in which brain tissue is subjected, occurring permanent damage after 5 to 10 minutes of complete interruption of blood flow.¹

Therapeutic hypothermia is still a relatively new concept for the preservation of brain function in patients who are resuscitated after cardiac arrest.¹⁰ This procedure is induced in patients who did not regain consciousness after the return of spontaneous circulation after cardiac arrest.² It is a controlled reduction in core temperature of the patients, usually to 32-34° C for 12-24 hours, with therapeutic predefined.^{4,11}

• Mechanisms of the Therapeutic Hypothermia Action

The hypothermia has "neuroprotective" action against several harmful biochemical mechanisms that occur, becoming the first effective treatment in reducing ischemic neuronal damage in post-CPA patients. However, the improvement of outcomes attributed to hypothermia occurred only when it realized its mechanisms of action, noting that mild hypothermia (32 ° C to 34 ° C), instead of deep hypothermia (≤ 30 ° C) was sufficient to promote neuroprotection, with minor adverse effects. The brain metabolism reduces 6-10% for each 1 ° C drop in temperature. When the temperature drops below 32 ° C, the brain metabolic rate decreases to approximately 50% of what is common, and the oxygen consumption and carbon dioxide production accompanying this decrease proportionately.^{1,11}

During ischemia-reperfusion of the brain

that begins with the cardiac arrest, a major reduction of the molecules of high energy occurs, such as adenosine triphosphate. The immediate consequence of this phenomenon is the change in cellular metabolism of brain from aerobic to anaerobic. The anaerobic glycolysis increases intracellular levels of phosphate, lactate and hydrogen ions, resulting in intra and extracellular acidosis, which promotes the influx of calcium into the cells. Calcium influx is very damaging to the cell, producing mitochondrial dysfunction and disturbances in the operation of pumps of sodium and potassium, leading to depolarization of cell membranes and release of glutamate, an excitatory neurotransmitter, into the extracellular space. The intracellular acidosis stimulates cellular destructive processes and apoptosis. The hypothermia inhibits these excitatory processes damage to the cell. Hypoxia is also responsible for changes in cell membranes that determines the formation of cytotoxic edema and disruption of the blood-brain barrier. The result is the development of intracranial hypertension, which leads to a vicious cycle of brain ischemia. The hypothermia has the ability to reduce vascular permeability, minimizing the appearance of brain edema.^{1,2} Another mechanism involved in the effects "neuroprotective" of hypothermia seems to be the inducing of anti-coagulant effects, which occur at temperatures below 35 ° C.¹

The suppression of epileptic activity is more likely a beneficial effect of hypothermia in anoxic encephalopathy, because the convulsive and non-convulsive attacks determine a large increase in oxygen consumption by the brain.¹

● The Therapeutic Hypothermia Stages

The therapeutic hypothermia occurs in four stages. As such: the identification stage of the patients, the induction stage of hypothermia, the maintenance stage of hypothermia and finally the warming stage.^{1,11}

● The identification of patients stage

Since 2003, the International Liaison Committee on Resuscitation (ILCOR) recommends the use of hypothermia therapy in all cardiac arrest survivor patients who remain in coma after resuscitation, regardless of the pace of the CPA and the place where the event occurred. They should be excluded: patients resuscitated for more than sixty minutes; those with return of spontaneous circulation for more than six hours; patients in coma prior to CPA; pregnant women; patients with active bleeding or coagulopathy; patients

in post surgery for major surgery less than fourteen days; patients with cardiogenic shock or septic shock and terminal patients.¹

The therapeutic hypothermia is indicated for adults in coma who had a witnessed cardiac arrest whose initial cardiac rhythm was ventricular fibrillation or pulseless ventricular tachycardia, and who recovered the spontaneous circulation in less than 60 minutes with basic and advanced life support. They are regarded as absolute contraindications for the use of therapeutic hypothermia the hemorrhagic stroke (which must be proved by axilla computed tomography) and cardiac arrest due to trauma. Other important contraindications are a Glasgow Coma Scale value of 8 or higher before the beginning of therapy with hypothermia; the cardiac arrest due to drug overdose; pre-existing hypothermia (<34 ° C) before the arrival of first aid; active uncontrolled bleeding, and cardiac arrhythmias that put the patient hemodynamically unstable. The relative contraindications include coagulopathy, severe hypotension (mean arterial pressure <60 mmHg) that is not corrected by fluid therapy, vasopressors, or by invasive hemodynamic support; the prolonged cardiac arrest (> 60 minutes); pregnancy and patients with terminal illness or unable to perform simple activities of daily life.⁵ It is important to note that thrombolytic therapy is not a contraindication to the achievement of therapeutic hypothermia.^{4,11}

● The induction stage of hypothermia

The aim of the induction phase is to make the patient reaches the target temperature of 32 ° C to 34 ° C. The target temperature is considered to be a balance between the clinical benefits and side effects, which are exacerbated at lower temperatures. Cardiac arrhythmias are common below 31 ° C and below 28 ° C the risk of ventricular fibrillation increases dramatically. Furthermore, this range of temperature (32° C to 34° C) is easily achieved using non-invasive cooling methods.¹

There are data that suggest that the therapeutic hypothermia may be instituted as soon as possible after the return of spontaneous circulation, but, according to several studies, it may be effective even when the onset is delayed until six hours after the return of spontaneous circulation.^{1,5} The data presented by the studies did not show benefits because of therapeutic hypothermia is initiated before the patient reaches the hospital.⁵

The initial monitoring of the patient submitted to therapeutic hypothermia should include continuous electrocardiogram, water balance, invasive blood pressure measurement and measurement of core temperature through a catheter bladder, esophageal thermometer or catheter pulmonary artery, if there is an indication for the use of the latter. The intra-arterial pressure monitoring is very important because the development of hypotension during therapeutic hypothermia is common and often leads to the use of vasoactive drugs. Thus, it may occur hypovolemia because the hypothermia is responsible for profuse diuresis. The blood oxygenation and ventilator settings are best assessed by arterial blood gas analysis, because the pulse oximetry is not an appropriate parameter during the therapeutic hypothermia, due to skin vasoconstriction induced by hypothermia. The cooling causes intracellular flow of potassium, magnesium, calcium and phosphorus, resulting in low serum levels of these ions, what may cause serious arrhythmias, so it must begin replacing the electrolytes in the induction phase and its suspension during reheating.¹ The appropriate analgesia and sedation are important aspects during induction of therapeutic hypothermia.¹⁻²

The tremor is a normal physiological response in an attempt to maintain body temperature. However, in this case, the occurrence of shivering is counterproductive because it generates heat, which slows down the cooling process, and increases the oxygen consumption and intracranial pressure. It is often necessary to add neuromuscular blocking to the scheme sedation, in an attempt to avoid the jitters.¹

In relation to methods of cooling, it can be said that the ideal method would be capable of: inducing hypothermia quickly without risk of over-cooling; maintaining a desired temperature during the maintenance phase, without large variations; provide a controlled and slow rewarming; being minimally invasive and have low costs.^{1,12}

The heat removal can be induced in a non-invasive or invasive way.^{1,6,11} The non-invasive methods, or conventional, include the use of packages of ice, the use of heating blankets and the use of commercial equipment of cooling surface.^{1,4,11-12} These methods are effective to induce hypothermia, but the rate control of the temperature change is less reliable and the risk of over-cooling is increased, and they impose a greater difficulty during reheating.¹

In relation to invasive methods, perhaps the most practical method is the quick infusion of a crystalloid solution at 4 ° C at a dose of 30 to 40 mL / kg, intravenously, which is capable of producing a temperature drop of 2 ° C to 4 ° C.^{1-4,11-12} Together with the use of cold saline, the application of ice packs on the surfaces of the neck, the armpits and the groin is a simple and easy to maintain cooling.¹

Currently, a more effective method to produce hypothermia is the use of endovascular catheters, which deliver an excellent temperature control for induction, the maintenance and during reheating. This is a system that uses a special central venous catheter, metal coated, through which water flows, connected to an external device that cools. The catheter can be introduced via femoral, subclavian or jugular and has risks of mechanical complications, and risk of infection and venous thrombosis. Some of them have an extra route for infusion of medication and blood sampling. It's fast to induce hypothermia, lowering the temperature at a rate of 2 ° C to 2.5 ° C per hour. The experience of its use is still limited and its cost is high, however, it has numerous advantages over conventional methods.^{1,12}

The hospital protocols to induce therapeutic hypothermia may involve multiple methods simultaneously to cool the patient, and each one has a number of advantages and disadvantages which should be considered.¹²

• Maintenance stage of hypothermia

The ideal time for maintenance of therapeutic hypothermia in patients post-CPA who recovered the spontaneous circulation is unknown. However, the recommendations of the International Liaison Committee on Resuscitation (ILCOR) and the European Council Resuscitation suggest 12-24 hours. Thus, the aim is to keep the temperature between 32 ° C and 34 ° C for 12-24 hours, with the minimum possible oscillations.⁴

The ideal measure would be the temperature measurement of intraventricular brain temperature, which is impractical in the patient post-CPA.⁴ Thus, the most used means for monitoring the core temperature are the rectal temperature, bladder and esophageal temperature measured by a catheter pulmonary artery. The rectal temperatures and bladder are unreliable, while the esophageal temperature is a method for less invasive and with a high degree of reliability. However, the temperature is evaluated by the pulmonary artery catheter the reliable

method, however it involves a lot of risks, such as infection.⁵

An important point in the care of these patients are hemodynamic parameters. Levels of mean arterial pressure above 80 mmHg are recommended in patients with post-CPA and may require fluid resuscitation and vasopressor infusion to achieve these values. The hypothermia is a cause of insulin resistance. Thus, blood glucose monitoring should be done with blood from the venous access, because the skin vasoconstriction may alter the results. It is not indicated feeding patients during treatment with hypothermia because there is a delay in gastric emptying in these patients. Furthermore, there is an increased risk of pneumonia associated to mechanic ventilator, due to possible aspiration during CPA and due to the decrease in immunity associated with hypothermia. The occurrence of severe arrhythmias or bleeding at this stage requires the suspension of cooling.¹

• The warming stage

This phase starts after 12 to 24 hours of the beginning of induction of the procedure and cooling must be slow at a speed of 0.2 ° to 0.4 °C per hour for 12 hours until they reach a temperature between 35 ° C and 37 ° C.¹ The plasmatic concentrations of electrolytes, the effective intravascular volume and metabolic rate can change quickly during rewarming, so this should be achieved slowly, however the ideal rate of rewarming is not known, but the consensus is currently about 0.25° - 0.5 °C per hour.¹¹

The rewarming may be passive (approximately 0.5 °C per hour) or active (using thermal blanket, by about 1 ° C per hour). Completing this idea, the passive rewarming to a central temperature of 35 ° C usually takes about eight hours. If it is done with the help of thermal blanket, it should be removed when the temperature reaches 35 ° C. If commercial equipment external cooling or endovascular catheters are used, the speed of the reheating is programmed. This is a major benefit of such equipment, which is to promote better control of the velocity of temperature change.^{1,4}

The hemodynamic instability with peripheral and hypotension vasodilation is very common as the temperature increases, which may require the use of higher doses of vasopressors. Another concern of the reheating stage is the development of hyperkalemia, because the potassium which has migrated into the cell during hypothermia

returns to the extracellular space. This can occur quickly and also causes arrhythmias. All the solutions containing potassium or magnesium should be interrupted as well as the insulin infusion, for the risk of hypoglycemia during this phase.¹⁻² When the temperature reached 35 ° C, the continuous sedation is suspended. After the end of therapeutic hypothermia it is recommended to treat fever aggressively, if it occurs, because it is normally associated with unfavorable outcomes.¹

• Nursing Care

Nurses have a vital role in the prevention, detection and treatment of adverse effects and complications of therapeutic hypothermia. The care of patients submitted to the therapeutic hypothermia is complex and requires nursing monitoring. The therapeutic hypothermia suppresses the inflammatory response, increasing the risk of infection. So it is important to ensure control measures and prevention of infection, to prevent infections associated with central venous catheterization, mechanical ventilation and urinary tract infections. The nurse must perform some practices to prevent pneumonia associated to the ventilator, how to position the patient at 30 to 45°, to held a proper oral hygiene and aspiration, to remove the food waste and manage carefully prescribed therapy. The vasoconstriction caused by hypothermia can cause lesions in the dermis. Thus, the nurse frequently must assess the patient's skin in order to detect problems early. They still shall establish measures to prevent the development of pressure ulcers.²

The family facing a critical situation of their relative experiences feelings such as fear, worry, anxiety and helplessness, and need emotional support from health professionals. To minimize these feelings, the nurse should explain and demystify the procedures, encourage communication and expression of emotions.²

CONCLUSION

The health professional who seeks the improvement of their knowledge and skills of its view that an early diagnose and treat cardiac arrest can make the difference between life and death of a patient.¹³

In relation to the research question outlined for carrying out this systematic review and to the established objective, we believe that the results show that, until now, therapeutic hypothermia is the only treatment

that has been shown to reduce consistently the mortality and improve the neurological sequelae in patients successfully resuscitated after cardiac arrest.

By the demonstrated evidence about the effectiveness of induced hypothermia to survivors of cardiac arrest, intensive care units should proceed with the implementation of protocols for hypothermia.⁴ For the preparation of "successful" protocols in which adverse effects are minimized, it is essential to understand the mechanisms of action by which hypothermia exerts its "neuroprotective."¹⁰ In these care units, it is necessary to have a competent and committed multidisciplinary team, which will retrieve the patient with quality of life and with minimal sequelae.^{1,6}

Knowing that research has a very important role in the area of scientific knowledge and finding that therapeutic hypothermia is a new concept, we consider that it is necessary to develop more research studies in order to have systematic and regular updates of the literature concerning the effectiveness of this procedure.

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