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Impact of Standardized Therapeutic Hypothermia Protocol on Neurological Performance after Resuscitation from Cardiac Arrest

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Abstract**—**We hypothesized that post cardiac arrest patients with Glasgow Coma Scale (GCS) score of less than 8 and who will be exposed to therapeutic hypothermia protocol will exhibit improvement in their neurological performance. 17 subjects were enrolled in this study all over one year. The study was carried out using Quasi-experimental research design. Four tools were used for data collection of this study: Demographic and medical data sheet, Post cardiac arrest health assessment sheet, Bedside Shivering Assessment Scale (BSAS), and Glasgow Pittsburgh cerebral performance category scale (CPC). The mean age was $\bar{X} \pm SD = 53 \pm 8.122$ years, 47.1% were arrested because of cardiac etiology. 35.3% subjects were initially arrested in form of ventricular tachycardia (VT), 23.5% initially arrested in form of ventricular fibrillation (VF), and 29.4% in form of A-Systole. Favorable neurological outcome was seen among 70.6%. There was significant statistical difference in WBC, Platelets, blood gases value, random blood sugar. Also, initial arrest rhythm, etiology of cardiac arrest, and shivering status were significantly correlated with cerebral performance categories score. Therapeutic hypothermia has positive effects on neurological performance among post cardiac arrest patients with GCS score of less than 8. Replication of the study on larger probability sample, with randomized control trial design is recommended with further study for suggesting nursing protocol for patients undergoing therapeutic hypothermia is recommended.

Keywords**—**Therapeutic hypothermia, neurological performance, after resuscitation from cardiac arrest, initial arrest rhythm.

I. Introduction

CARDIAC arrest is still one of the most devastating events worldwide. There was a variation in survival and neurological outcome widely; this may be depending on the arrest time, rhythm, and type. Even for those patients who regained their circulation and admitted to an intensive care service, survival with good neurological outcomes is still poor [1], [10].

According to the American heart association report for heart and stroke statistics, the average survival rate is 10.6% and survival with good neurologic function is 8.3% [9]. These data collected from more than 190 countries show that heart diseases remain number one cause of death with 17.3 million deaths each year, which is expected to rise to more than 23.6 million by 2030.

There is evidence to support that proper management in the post-resuscitation phase plays vital role in improving outcome and therapeutic hypothermia is one important element of such management, it is considered to be one of the most important approaches for management of this syndrome [7], [6].

Nurses are in the first line of responders for cardiac arrest patients. As well, they have a unique role in warm and cold compress therapies. Therapeutic hypothermia is one of the rapidly growing cold compress therapies. Literature cited that, use of therapeutic hypothermia for cardiac arrest patients is a recommended area for researches [2], [8].

In Egypt, researches into this area are scarce therefore, this study can encourage a stronger clinical practice by keeping staff current with ongoing research, providing up-to-date care based on research findings, standard practice, and promoting recognition in nursing excellence. Moreover, it can provide base line data for health professionals regarding management of such patients and generate an attention and motivation for further researches into this area.

II. Material and Methods

Quasi-experimental research design was used in this study on 17 patients who were matching the inclusion criteria all over a period of 12 months. Adult male and female patients were admitted to the intensive care units with witnessed cardiac-arrest, regain circulation in less than 60 minutes after basic or advanced cardiac life support, hemodynamically responsive, and GCS < 8, within the first six hours after successful resuscitation.

The exclusion criteria were: Patients with GCS > 8, hemorrhagic stroke, traumatic brain injury, cardiac arrest due to trauma, active bleeding, pre-existing hypothermia (< 30 °C), Uncontrolled arrhythmias, Refractory hypotension (MAP < 60 mmhg for more than 30 min after starting vasopressor therapy), persistent hypoxemia; O_2 saturation less than 60% for more than 15 min after return of circulation (ROC), Pregnancy, pre-arrest neurological deficit, and renal failure.

Data pertinent to this study was collected utilizing four tools: Tool (1): Demographic and medical data sheet, Tool (2): Post cardiac arrest health, assessment sheet, Tool (3): BSAS, and Tool (4): Glasgow Pittsburgh CPC scale (CPC).

A. Ethical Consideration

An official permission to conduct the study was obtained from the research ethics committee. Written informed

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consents were obtained from the legal representative after explanation of the nature and purpose of the study. Confidentiality and anonymity of each subject was assured through coding of all data.

B. Procedure

The current study was carried out on two phases, designation and implementation phases.

Designation phase concerned with the construction and preparation of the data collection tools, in addition to the managerial arrangement to carry out the study. Construction and preparation of the two data collection tools were made after extensive review of literatures, related studies, research articles, web site searches, and seeking expert's advice. Then the purpose and the nature of the study were explained to physicians and nursing staff to gain their cooperation, sharing, and support to carry out the study.

A pilot study was carried out to test the feasibility, objectivity, and applicability of the study tools.

Implementation phase: Data of the current study were collected after permissions were granted; all the patients whom fulfilled the criteria of inclusion were recruited into the present study during one year.

The procedure started with fulfilling the demographic and medical data sheet (tool 1 &2). Then the induction phase of therapeutic hypothermia started by cooling to reach the targeted temperature within 4 hours.

When the target temperature was achieved at any time during the induction phase, the maintenance phase started and maintained to keep the target body temperature between 32-34 °C for 12 hours. During this phase the external cooling methods (ice packs) were maintained. When the body temperature was exceeding the level of 34 °C, infusion of cold intravenous fluids was also reapplied until reaching the temperature of 34 °C.

After maintaining the target temperature for 12 hours, re-warming phase started using passive re-warming.

Assessment of shivering using the bedside shivering assessment scale (BSAS) (tool 3) was applied through all the phases and controlled by sedation after physician prescription.

Glasgow Pittsburgh cerebral performance category (CPC) scale was used to assess the neurological performance after re-warming and until discharge.

Subjects were continuously monitored for hemodynamic status, blood glucose level, ECG rhythm, serum electrolytes, fluid balance, skin condition, neurological assessment, and shivering, during all the cooling phases and prescribed intervention were carried out accordingly by the caregivers with the researcher help.

C. Statistical Analysis of Data

Upon completion of the data collection, data were tabulated and analyzed using SPSS software (version 20).

D. Limitation of the Study

Lack of familiarity with the therapeutic hypothermia procedure among the ICU staff was one of the most important limitations of this study.

III. Results

The research hypothesis was supported by the revealed results. The study revealed that about three quarter of the studied subjects (70.6%) were having good neurological performance (Fig. 1). Initial arrest rhythm of 35.3% of the studied subjects was ventricular tachycardia, followed by 29.4% arrested in form of A-Systole, then 23.5% were arrested in form of ventricular fibrillation, and 11.8% were arrested in form of bradycardia (Fig. 2).

Among those who were having good neurological outcome (CPC of 1 or 2), there were 35.2% with initial arrest rhythm Ventricular tachycardia (VT), 17.6% with initial arrest rhythm Ventricular fibrillation (VF), 11.7% with bradycardia, and 5.8% with A-Systole Table I.

There was a statistically significance difference in partial arterial pressure of oxygen (PaO2) across the three time points as p = .000, also there was statistically significance difference in PaCO2 across the three ^{time} points as p = .031, HCO_3 as p = .047, and SaO2 as p = .009 Table II.

There was a statistically significance difference in white blood cells (WBC) across the three time points as p = .004, also there was statistically significance difference in platelets across the three time points as p = .000, Table III.

TABLE I
PERCENTAGE DISTRIBUTION OF NEUROLOGICAL OUTCOME BY INITIAL ARREST RHYTHM

Initial arrest rhythm	CPC of 1 or 2 at hospital discharge	
	N	%
VT	6	35.2%
VF	3	17.6%
Bradycardia	2	11.7%
A-Systole	1	5.8%

TABLE II
FRIEDMAN TEST FOR ARTERIAL BLOOD GASES, DURING THE THREE ASSESSMENTS FOR THE STUDIED SUBJECTS (N = 17)

Variable $\bar{X} \pm SD$	N	Mean /Standard deviation			Chi-square	p/ value
		1ST Assessment	2nd Assessment	3rd Assessment		
Ph	17	7.3341± .11214	7.3882± .04889	7.3988± .02956	4.571	.102
PaO2	17	86± 3.29661	91± 5.03444	95± 2.52488	23.477	.000*
PaCo2	17	38± 10.83461	37± 7.06273	35± 6.28373	6.923	.031*
HCo3	17	21± 1.63397	22± 1.06757	23± 1.35242	6.125	.047*
SaO2	17	91± 5.14496	93± 2.99018	95± 2.50294	9.364	.009*

IV. Discussion

The current study revealed that 70.6% of the studied subjects were having good neurological performance. This finding is in concordance with [3] which concluded that about three quarter of the studied subjects were having good neurological performance in therapeutic hypothermia group, about 50% survived six months with a good outcome (home or rehabilitation facility discharge).

The current study revealed that about two third of the studied subjects were having no shivering, and around one third were having mild shivering according the BSAS. This result is in concordance with [5] which studied Pharmacological Management of Therapeutic Hypothermia,

concluded that depending on the method of cooling the incidence has been ranged from 8% to 85% despite active prevention in most protocols.

The current study revealed that among those who were having good neurological outcome, there were 35.2% with initial arrest rhythm VT (17.6%) with initial arrest rhythm VF, (11.7%) with bradycardia, and (5.8%) with A-Systole. In this regard, [2] studied either to cool or not to cool non-shockable cardiac arrest patients and found that there was more success rate with the schockable rhythm than the non-schockable one. Also, there were minority of the OHCA schockable cases. Therapeutic hypothermia achieved better neurological outcomes with the shockable group without significant effects of TH in non-shockable group [3].

The current study revealed that there was a statistically significance difference in white blood cells (WBC) across the three time points (p = .004). In this regard, [1] studied hemostasis in cardiac arrest patients treated with mild hypothermia initiated by cold fluids, concluded that among the studied subjects' hematocrit and platelet count significantly decreased. Reference [4] tested individual responses to graded severe hypothermia with thromboelastography concluded that the lower the blood temperature, the more significant effect on blood coagulation decline.

TABLE III
FRIEDMAN TEST FOR COMPLETE BLOOD PICTURE, DURING THE THREE ASSESSMENTS FOR THE STUDIED SUBJECTS (N = 17)

Variable $\bar{X} \pm SD$	N	Mean /Standard deviation			Chi- square	p/ value
		1st Assessment	2nd Assessment	3rd Assessment		
Hemoglobin	17	11± 1.27	10.9± 1.25	10.8± 1.287	2.000	.368
Hematocrit	17	34± 4.8	34± 4.812	33± 4.688	3.000	.223
RBCs	17	4.061± .4245	4.056± .63727	4.050± .46002	6.000	.050
WBCs	17	9902.9412± 2749.759	9951.7647± 2793.310	10028.2352± 2866.125	11.20	.004
Platelets	17	302176± 85089.83	300941 ± 84095.5	283558± 103082.77	30.581	.000

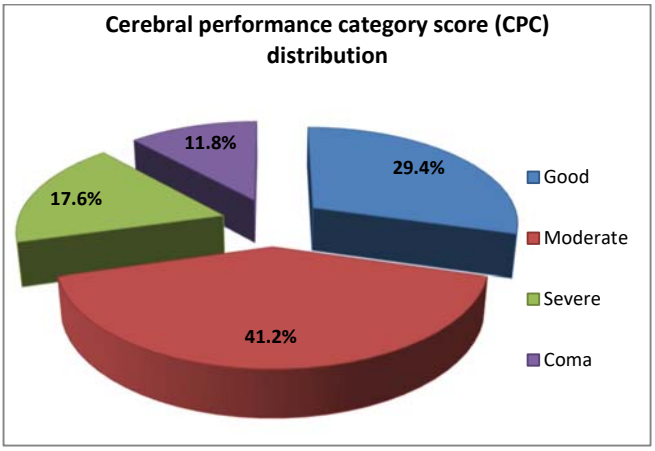

Fig. 1 Percentage distribution of the studied group as regards to their CPC score (n = 17)

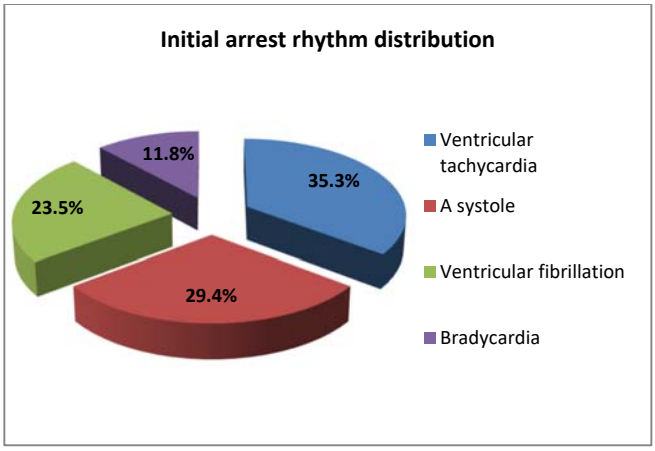

Fig. 2 Percentage distribution of the Studied group as regards to their initial arrest rhythm (n = 17)

V. CONCLUSION

Based on the result of the current study, it can be concluded that the hypothesis was supported and the therapeutic hypothermia has positive effect on neurological performance for post cardiac arrest patients as 70.6% were having good neurological performance. There was significant association between CPC and initial arrest rhythm, shivering status, and gender.

REFERENCES

[1] Alexander O. Spiel, Andreas Kliegel, Andreas Janata, Thomas Uray, Florian B. Mayr, Anton N. Laggner, et al. (2017). Hemostasis in cardiac arrest patients treated with mild hypothermia initiated by cold fluids. resusctatio , 762–765.

[2] Nicolas Deye, Jasmin Arrich, & Alain Cariou. (2013). To cool or not to cool non-shockable cardiac arrest patients: it is time for randomized controlled trials. Intensive Care Medicine, 966-969.

[3] P F Beccaria, S Turi, M Cristofolini, S Colombo, & C Leggieri. (2010). Post cardiac arrest therapeutic hypothermia in adult patients, state of art and practical considerations. HSR Proc Intensive Care Cardiovasc Anesth., 2(2): 93–103.

[4] Ruzicka, Jiria, Stengl, Milana, Bolek, Lukas, Benes, Jiri, et al. (2012). Hypothermic anticoagulation: testing individual responses to graded severe hypothermia with thromboelastography. Blood Coagulation & Fibrinolysis, 285-289.

[5] Xi Liu-DeRyke, PharmD, Denise H, & Rhoney. (2016). Pharmacological Management of Therapeutic Hypothermia-Induced Shivering. critical care medicine, 86-89.

[6] Bro-Jeppesen J, Kjaergaard J, Wanscher M. Systemic Inflammatory Response and Potential Prognostic Implications After Out-of-Hospital Cardiac Arrest: A Substudy of the Target Temperature Management Trial. Crit Care Med 2015;1223-32.

[7] Bernard SA, Gray TW, Buist MD, Jones BM, Silvester W, Gutteridge G. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. N Engl J Med. 2002;346:557–63

[8] Cronberg T, Lilja G, Horn J. Neurologic Function and Health-Related Quality of Life in Patients Following Targeted Temperature Management at 33 degrees C vs 36 degrees C After Out-of-Hospital Cardiac Arrest: A Randomized Clinical Trial. JAMA Neurol 2015; 634-41

[9] Deakin CD, Morrison LJ, Morley PT, Callaway CW, Kerber RE, Kronick SL. Part 8: Advanced life support: 2010 International

Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.
[10] Nicolas Deye, Jasmin Arrich, & Alain Cariou. (2013). To cool or not to cool non-shockable cardiac arrest patients: it is time for randomized controlled trials. Intensive Care Medicine, 966-969
[11] Sulzgruber P, Kliegel A, Wandaller C. Survivors of cardiac arrest with good neurological outcome show considerable impairments of memory functioning. Resuscitation 2015;88:120.