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The effect of cutaneous stimulation on pain perception at arterial puncture site among critically Ill patients in Menoufia University Hospital

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Abstract
Pain caused by some therapeutic and nursing procedures has been a major concern of health care providers and arterial puncture is one of the most painful procedures for many hospitalized patients. So pain management is critical issue in the purview of all health professionals especially nurses because it is an important component of comprehensive nursing care. Nursing efforts should be made to assess and manage acute pain inflicted by insertion of needle in arterial puncture sites among critically ill patients. Aim of the current study was carried out to examine the effect of cutaneous stimulation on pain perception at arterial puncture site among critically ill patients in intensive care units at Menoufia University hospital. Sample: A random sample of hundred critically ill patients who undergoing arterial puncture. The study group (n=50) received cutaneous stimulation plus routine hospital care for pain management before arterial puncture, whereas the control group (n=50) received hospital care for pain management only. Tools: four tools were utilized to collect the data. Tool I: An interviewing questionnaire to assess sociodemographic and clinical data. Tool II: Physiological measure sheet. Tool III: a Visual Analog Scale, and Tool IV: Critical-Care Pain Observation Tool. Results: reveled that there were a statistically significant differences between study and control group related to pain perception of patients in terms of pain score immediately the puncture as well as 5 minutes after the puncture. Conclusions: Cutaneous stimulation is effective in reducing pain perception at arterial puncture site among critically ill patients.

Keywords: effect, cutaneous stimulation, pain perception and critically ill

1. Introduction
Critically ill patients require quick decision making that can mean the difference between life and death. One laboratory test that enhances such decision making is arterial blood gas (ABG) analysis. The results of the analysis allow practitioners to immediately assess a patient's oxygenation status, carbon dioxide levels, and acid-base balance. In order to obtain blood samples for ABG analysis from a patient who does not have a central circulatory or arterial access, an arterial puncture must be performed [1]

Except for intravenous therapy, arterial access is the most common invasive procedure performed on critically ill patients. Arterial puncture is a source of pain and discomfort in critical care. Although pain cannot be completely eliminated during invasive procedures such as obtaining blood from an artery, pain should be minimized [2, 3].

Moreover, *Matheson, et al* [4] *Malley* [5] *Hudson, et al.* [6] *and Sawyer* [7] reported that arterial puncture is one of the most common laboratory procedures used in hospitalized patients. Although this invasive procedure is associated with moderately to severely pain and discomfort, are frequently performed by clinicians/nurses without any pain management.

Strategies for pain management include pharmacological and nonpharmacological intervention. The nonpharmacological approaches are essential component of pain relieve that include relaxation technique, visual imagery, behavioral-cognitive strategies and biophysical interventions such as massage, pressure, and cutaneous stimulation through either heat or cold application. Although most of nurses have a commitment in pain reduction, fewer of them work for alleviation. Effort on pain management from health professionals at all department levels should be implemented as an important measure toward changing ineffective pain management practices [8].

Cutaneous stimulation is defined as stimulation of the skin and underlying tissues for the purpose of decreasing undesirable signs and symptoms such as pain. It also referred to as peripheral technique; describe any form of stimulation of the skin with the goal of pain relief. There are many different methods of cutaneous stimulation such as pressure, massage, heat and/ or cold application. Research evidence show that cutaneous stimulation is an independent nursing intervention that advocated relieving pain and the nurse in practice is qualified to give it accurately [9].

Nursing is a profession based on art and science. This means that a professional nurse learns to deliver care artfully with compassion. Care should always change with new discoveries and innovations. When nurses integrate the science and art of nursing into their practice, the quality of care provided to the patients is at a level of excellence that benefits in innumerable ways. Intensive care unit (ICU) provides care to patients who are seriously ill and require 24-hour care and monitoring [10-11].

In the last not the end, pain is one of the most frequently used nursing diagnoses. Looking for and test applicable pain management techniques are the highest responsibility of the nurses. Precise assessment is crucial in determining the usefulness of the therapies that are used for pain control. In order to provide holistic care, it is the responsibility of the

nurses, as patient advocates, to optimally manage all aspects of the pain experience.

1.1 Aim of the Study

The aim of the current study was to examine the effect of cutaneous stimulation on pain perception at arterial puncture site among critically ill patients in intensive care units at Menoufia University hospital**.**

1.2 Research Hypothesis

The following research hypothesis was formulated to achieve the aim of the study

There will be a reduce in pain perception after applying cutaneous stimulation at arterial puncture site in study group compared to control group among critically ill patients in intensive care units at Menoufia University hospital.

1.3 Operational definitions

- **Cutaneous stimulation:** It is the application of ice cubes wrapped in gloves and placed on radial arterial puncture site 5 minutes before the arterial puncture
- **Pain perception**: the patient's level of pain feeling**.**

2. Material and Methods

2.1 Material

i) Design

A quasi experimental research design was utilized to achieve the aim of this study.

ii) Setting

The study was conducted in intensive care units at Menoufia University hospital, Menoufia Governorate, Egypt.

iii) Subjects

Based on the effect size observed in previous studies, 100 patients are required to achieve a power of 80% at an alpha value set at 0.05**.** So purposive hundred critically ill patients who undergoing arterial punctures and fulfilled the inclusion criteria during the study period were selected and randomly divided into two equal groups, study and control group.

iv) Inclusion criteria

- Adult patients of both sexes
- Ability to report their pain verbally
- A score of 15 on Glasgow coma scale
- Willing to participate in the study
- Connecting with the monitor

v) Exclusion criteria

- Arterial puncture not from the radial artery
- Diagnosis of Raynaud's syndrome
- Failure to palpate radial pulse, infection or burn/scar over the puncture site, ulnar circulatory impairment (positive Allen test)
- Using opiate or sedative over the past 8 hours
- Allergies to cold applications

vi) Tools

In order to achieve the aim of the study, four tools were utilized for data collection as:

Tool I: An interviewing questionnaire: It was constructed by the researchers to assess patients' sociodemographic and clinical data. It included two parts:

- **Part one:** *Sociodemographic data*: It included information about: patients' age, sex, residence, marital status, educational level and occupation.
- **Part two:** *Clinical data.* It included data about medical diagnosis, need of the procedure, numbers of arterial puncture, site of puncture, and patient's worry from puncture.

Tool II: Physiological measures sheet: It included systolic and diastolic blood pressure, heart rate, and respiratory rate.

Tool III: Visual Analog Scale (VAS): The scale consisted of 10 cm line that was numerated from zero to ten in which: 0 = no pain, 1-3 = mild pain, 4-6 = moderate pain and 7-10 = sever pain. The reliability co-efficient using cronbach-Alpha coefficient value for VAS was 0.9 in the study by Tran *et al* [12].

Tool IV: Critical-Care Pain Observation Tool (CPOT): It was developed on the basis of retrospective chart reviews to determine common pain notations and findings with focus groups of ICU clinicians. This instrument is designed for use in critical care patients. It contains four domains; 1) facial expressions, 2) body movements, 3) muscle tension, and 4) vocalization. The CPOT contains evidence-based descriptors that are operationally defined for each domain, and the content validity index of all indicators was 0.88 to 1.0, according to an analysis of the results of a questionnaire provided to physicians and critical care nurses. Its Interrater reliability: weighted κ coefficient = 0.52-0.88 [13-15]. As well as *Gelinas, et al.* [16] mentioned that the CPOT are considered the most valid and reliable tool for use with adults in medical, surgical, and trauma ICUs.

2.2 Methods

1. An official permission to carry out the study was obtained by the researchers from responsible authorities after explanation of the aim of the study before initiating the study.
2. Tools development: The tool I and II were constructed by the researchers after reviewing the relevant literature, so tool I and II were tested for content validity by 5 experts in Nursing and Medical fields. Then these tools were tested for reliability by using a test-retest method and Pearson correlation coefficient formula was used. Modifications were done accordingly to ascertain relevance and completeness. But tool III and IV were used as it and its validity and reliability were tested before in the other studies.
3. Ethical consideration: patients who met the inclusion criteria were included in the study, and then a clear and simple explanation about the nature and aims of the study was given to each participant. After that, an informal consent was obtained from each participant to get his/ her acceptance as well as cooperation. All participants were informed about confidentiality of the data and they have the right to withdraw from the study at any time without any effect on their routine care they received.
4. Prior to the actual study, a pilot study was conducted on 10% of the study sample (10 patients) to test tools for its clarity, feasibility and applicability and determine the

required time to fulfill these tools and then necessary modifications were carried out accordingly. Those who shared in the pilot study were excluded from the study sample.

3. Data collections

Data were collected over a period of nine months from the beginning of February to the end of October 2016.

- Patients who had orders for arterial blood gases were approached before the procedure to inquire if they would be willing to participate in the study.
- The researchers initiated data collection by assessing sociodemographic data, clinical data and through interviewing each participant individually using tool I.
- The control group received routine hospital care (no pain management) before the arterial puncture. Cutaneous stimulation in the form of ice cubes wrapped in gloves was applied over the radial artery before the puncture and was secured with a loose bandage for 5 minute. A 10-minute application of ice recommended for tissue cooling and analgesia in previous studies [17-18] but due to possibility of arterial spasm and failure to access the radial artery the researcher decreased the duration of ice cubes application to 5 minutes based on other study performed by *Bastami, et al.,* [19] as well as *Farreed, et al* [20]. Arterial puncture were performed by one researcher experienced with the procedure to maintain the consistency. The puncture site was cleaned using aseptic technique. All arterial blood gases samples were drawn using 24-gauge needles and 3-mL blood syringes. Physiological measure sheet, Visual analog scale (VAS) and Critical Care Pain Observation Tool (CPOT) were measured immediately and 5 minute after arterial puncture.
- The comparison between two groups was done.

Statistical Analysis

The collected data were categorized, tabulated, and summarized. Data were computerized and analyzed using appropriate descriptive and inferential statistical tests were used to examine the research hypothesis. Descriptive statistics used in the study were frequencies, percentage, mean, and standard deviation. Chi square, and t-tests were used for inferential statistics as deemed appropriate. A statistical package for the social studies (SPSS) version 17 was used for statistical analysis of data. The *p*-value was considered as**:**

- Non-significant difference if $P > 0.05$
- Significant difference if $P < 0.05$
- Highly significant difference if $P < 0.001$

4. Results

Table 1: Sociodemographic characteristics for both studied groups

Sociodemographic Characteristics		Study Group (I) (N=50)		Control Group (II) (N=50)		X^2	P
		No.	%	No.	%		
Age (Years)	20-	3	6.0	2	4.0	0.24	0.97 NS
	30-	1	2.0	2	4.0		
	40-	18	36.0	19	38.0		
	50≤60	28	56.0	27	54.0		
	X ± SD	48.33± 9.47		49.80±7.94			
Sex	Male	31	62.0	32	64.0	0.04	0.83 NS
	Female	19	38.0	18	36.0		
Residence	Urban	22	44.0	24	48.0	0.16	0.68 NS
	Rural	28	56.0	26	52.0		
Marital Status	Married	38	76.0	39	78.0	0.06	0.81 NS
	Single	12	24.0	11	22.0		
Levels Of Education	Illiterate	9	18.0	9	18.0	0.24	0.99 NS
	Read And Write	6	12.0	7	14.0		
	Primary	6	12.0	6	12.0		
	Secondary	19	38.0	17	34.0		
	University	10	20.0	11	22.0		
Occupation	Worker	20	40.0	22	44.0	0.22	0.89 NS
	Not Worker	17	34.0	15	30.0		
	House Wife	13	26.0	13	26.0		

NS: Not Significant

Table (I) illustrates the sociodemographic characteristics for both studied groups. The findings showed that, the age between 50 to 60 years old represented the highest percentage, 56% for the study group and 54% for control group. The majority of both groups, study and control group were male (62% & 64% respectively). In addition to, the majority of both groups were married (76%) for study group and (78%) for control group. In relation to level of education, secondary education was representing the majority level of education (38% & 34%) for the study group and control group respectively. Regarding occupation, worker represent the majority of the sample for both study group and control group (40% & 44% respectively).

So the findings revealed that, no statistical significant differences were existed between study groups and control group in relation to sociodemographic characteristics.

Table 2: Clinical data for both studied groups

Clinical data		Study group (I) (n=50)		Control group (II) (n=50)		X^2	P
		No.	%	No.	%		
Medical diagnoses	Respiratory	15	30.0	14	28.0	0.68	0.95 NS
	Cardiac	14	28.0	13	26.0		
	Renal	10	20.0	10	20.0		
	Mixed diagnosis of the above	7	14.0	8	16.0		
	Others	4	8.0	5	10.0		
Need of arterial puncture	Being emergency	35	70.0	34	68.0	0.05	0.82 NS
	Cold	15	30.0	16	32.0		
Numbers of arterial blood sample	1	18	36.0	19	38.0	0.04	0.83 NS
	≥2	32	64.0	31	62.0		
Site of arterial blood sample	Right Redial artery	23	46.0	18	36.0	1.03	0.30 NS
	Left Redial artery	27	54.0	32	64.0		
Patient's worry from the puncture	Yes	31	62.0	32	58.0	0.04	0.83 NS
	No	19	38.0	18	42.0		

NS: Not Significant

The findings of the table (II) reveals that, Regarding to, medical diagnosis, the majority of both study and control group had respiratory disease (30% & 28% respectively). Concerning to the need of arterial puncture 70% of the study group had emergency need of arterial puncture as well as 68% of control group. Moreover, the highest percentage of both study and control group had more than two punctures (64% & 62% respectively) and were taken from left radial artery (54% & 64% respectively). In addition to, the majority of both study and control group became worry from the puncture (62% & 58% respectively).

Finally, no statistical significant differences were existed between study group and control group regarding to clinical data.

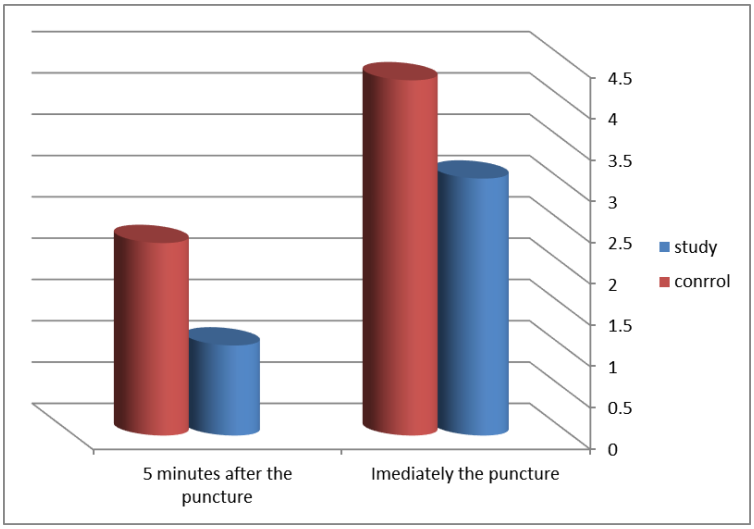

Fig 1: Evaluation of effect of cutaneous stimulation on pain perception for both Study and Control group in terms of pain scores on VAS immediately and 5 minutes after puncture

Figure (I) shows that there was a statistically significant difference between control and study group related to pain score immediately after the puncture as well as 5 minutes after the puncture.

Table 3: Distribution of pain intensity as perceived in both study and control group immediately and 5 minutes after puncture

Pain intensity levels		Study group (I) (n=50)		Control group (II) (n=50)		χ^2 test	P value
		No	%	No	%		
Immediately the puncture	No /absent	2	4.00	0	0.00	50.24	< 0.01 S
	Mild	42	84.0	10	20.0		
	Moderate	6	12.0	16	32.0		
	Severe	0	0.00	24	48.0		
5 minutes after the puncture	No /absent	16	32.0	3	6.00	21.55	< 0.01 S
	Mild	30	60.0	26	52.0		
	Moderate	4	8.0	15	30.0		
	Severe	0	0.0	6	12.0		

NS: Not Significant, S: Significant

Table (III) clears that, the majority of study (84.0%) had mild pain immediately after the puncture and the majority of control group (48.0%) had severe pain immediately after the puncture, while 5 minutes after puncture 32% of study group had no pain while 6% of control group had no pain. There was statistically significant differences were existed between study group and control group on pain intensity levels immediately and 5 minutes after puncture.

Table 4: Observational characteristics of pain as perceived in both study and control group immediately and 5 minutes after puncture

Characteristics			Study group (n=50)		Control group (n=50)		χ^2 test	P value
			No	%	No	%		
Facial expression	Immediately the puncture	Relaxed, neutral	20	40.0	13	26.0	6.62	0.03 S
		Tense	18	36.0	23	46.0		
		Grimacing	12	24.0	14	28.0		
	5 minutes after the puncture	Relaxed, neutral	40	80.0	22	44.0	13.89	0.01 S
		Tense	8	16.0	24	48		
		Grimacing	2	4.0	4	8.0		
Body movements	Immediately the puncture	Absence of movements	22	44.0	13	26.0	3.71	0.15 NS
		Cautious movements/Protection	20	40.0	28	56.0		
		Restlessness	8	16.0	9	18.0		
	5 minutes after the puncture	Absence of movements	40	80.0	25	50.0	10.93	0.04 S
		Cautious movements/Protection	8	16.0	15	30.0		
		Restlessness	2	4.0	10	20.0		
Muscle tension	Immediately the puncture	Relaxed	21	42.0	11	22.0	7.67	0.02 S
		Tense, rigid	23	46.0	23	46.0		
		Very tense or rigid	6	12.0	16	32.0		
	5 minutes after the puncture	Relaxed	42	84.0	18	36.0	26.3	0.01 S
		Tense, rigid	8	16.0	30	60.0		
		Very tense or rigid	0	0.00	2	4.0		
Vocalization	Immediately the puncture	Talking in normal tone or no sound	19	38.0	10	20.0	3.92	0.14 NS
		Sighing/ moaning	26	52.0	33	66.0		
		Crying out/ sobbing	10	20.0	7	14.0		
	5 minutes after the puncture	Talking in normal tone or no sound	45	90.0	30	60.0	12.78	0.01 S
		Sighing/ moaning	5	10.0	20	40.0		
		Crying out/ sobbing	0	0.0	0	0.00		

NS: Not Significant, S: Significant

Table (IV) shows that observational characteristics of pain as perceived by both Study and Control group immediately and 5 minutes after puncture. Concerning facial expression, it reveals that the highest percentage in study group had relaxed, neutral facial expression in immediately and 5 minutes after puncture (40% & 80% respectively). Although in control group the highest percentage was tense facial expression in immediately and 5 minutes after puncture (46% & 48% respectively).

Regarding to, body movements to pain, the majority of study group had absence of body movements in immediately and 5 minutes after puncture (44% & 80% respectively). Although 56% of control group had cautiously /protected movements in immediately the puncture and 50% of control group had absence of body movements in 5 minutes after puncture.

Concerning to muscle tension, the highest percentage in both study and control group had rigid and tensed muscle (46% & 46% respectively) in immediately the puncture but in 5 minutes after puncture, 84% of study group had relaxed muscle although 60% of control group still had rigid and tensed muscle.

Regarding vocalization of pain, the majority of study and control group had sighing/moaning in immediately after puncture (52% & 66% respectively). But the majority of both study and control group had talking in normal tone or no sound (90% & 60% respectively). Finally, there were statistically significant differences regarding observational characteristics of pain as perceived by both study and control groups immediately and 5 minutes after puncture except in body movements, and vocalization immediately the puncture.

Table 5: Mean and Standard Deviation regarding physiological measures in three times interval (before, immediately and 5 minutes after) arterial puncture

Physiological Measures		The studied groups		t-test	P-value
		Study group (n=50)	Control group (n=50)		
Systolic BP	Before Puncture	155.3±10.8	156.8±11.8	0.66	0.50 NS
	Immediately the puncture	155.12±11.4	156.22±9.6	0.52	0.60 NS
	5 minutes after the puncture	155.8±10.4	156.18±10.6	0.18	0.85 NS
Diastolic BP	Before Puncture	99.3±9.2	100.3±4.1	0.70	0.48 NS
	Immediately the puncture	99.15±7.2	100.11±8.1	0.63	0.53 NS
	5 minutes after the puncture	99.12±10.2	100.13±5.1	0.63	0.53 NS
Heart rate	Before Puncture	80.19 ± 8.8	81.6±10.2	0.74	0.46NS
	Immediately the puncture	80.22± 9.2	81.8± 7.1	0.96	0.33 NS

	5 minutes after the puncture	80.11± 7.2	81.7± 6.1	1.19	0.23 NS
Respiratory rate	Before Puncture	16.2± 2.1	16.3± 4.3	0.15	0.88 NS
	Immediately the puncture	16.4± 4.2	16.7± 2.1	0.45	0.65 NS
	5 minutes after the puncture	16.3± 3.1	16.5± 3.3	0.31	0.75 NS

NS: Not Significant

Table (V) shows that mean and standard deviation regarding physiological measures in three times interval before arterial puncture, immediately and 5 minutes after arterial puncture. It was observed that there were no a statistically significant differences between study and control group related to mean and standard deviation regarding to systolic and diastolic blood pressure, heart and respiratory rate in previous mentioned times intervals.

5. Discussion

Cutaneous stimulation in the form of cryoanalgesia was first formally described by Hippocrates and was also used by ancient Egyptians, Persians and Romans to alleviate pain. Since that time, cry analgesia has been widely used to reduce pain associated with numerous injuries, illnesses and invasive procedures. Effective application of cry analgesia would offer a noninvasive, non-pharmacologic, inexpensive and readily available tool to reduce pain associated with arterial puncture [21-22].

General profile of the study and control group

The findings of the present study revealed that there were no statistical significant differences in the basic data between the study and control groups regarding to age, sex, residence, marital status, education level and occupation.

Regarding to the age, the results of the present study illustrated that more than half of both groups were in age group of 50 years or more, where the subjects‟ age ranged from 20 to ≤ 60 years, with mean 48.33± 9.47 for study group and 49.80±7.94 for control group. In this context, the finding was in consistent with the study of *Weheida, et al.,* [23] who mentioned that the results of the current study illustrated that more than half of both groups were in age groups of 50 years or more as well as *Abdulrahman, et al.,* [24] who reported that the most common age of ICU patients was about 50 years old. Also *Sallam, et al.,* [25] mentioned that the age of the patients in their study ranged from 40 years to less than 60 years.

According to gender, the results of the present study revealed that more than half of both group were male. In this regard, this was consistent with the study of *Weheida, et al.* [23] who mentioned that about three fourth of the both groups were male. In addition to, *Galal and Gomaa* [26] who reported that the majority of their patients were male.

In relation to marital status of the present study, more than three quarter of both study and control group were married. This was consistent with *Zaheer, et al.* [27] who found that more than half of patients were married.

Concerning educational level and occupation, the results of the present study revealed that the majority of the both study and control group had secondary education and workers. These results were supported by *Weheida, et al.* [23] who reported that the results of the present study revealed that more than three fourth of the both groups had secondary education and workers as well as, these results were consistent with the study of *Abdulrahman et al.* [24] and *EL Minshawy et al.* [28] who reported that the patients in their studies were highly educated and worker.

In relation to residence, the majority of patients were from rural regions that affiliate and receive medical treatment in Menoufia University hospital, this finding was agreement with *Weheida, et al.* [23] who reported that the majority of studied groups were from rural region.

Concerning to, the worry from the arterial puncture, the findings of the present study, the majority of both study and control group became worry from the arterial puncture. This result was consistent with the study of *Turner, et al.* [29] reported that in a study of 100 intensive care patients, punctures to obtain samples for arterial blood analysis were the number one factor “that moderately or severely worried patients,” and 48% of these patients’ unpleasant experiences were associated with arterial blood sampling.

Effect of cutaneous stimulation on arterial puncture pain

The present study findings showed that there was a statistically significant difference between study and control group related to pain score immediately the puncture and 5 min after the puncture.

In this context the study of *Turner, et al.* [29] reported that in a study of 100 intensive care patients, obtaining samples for arterial blood analysis was ranked higher than endotracheal suctioning as an unpleasant experience and was identified separately from regular “pain,” which was ranked third. It is noteworthy that the pain related to arterial puncture is of such intensity that patients place it in a separate and higher category of discomfort than other types of pain in the intensive care unit.

As well as, The present study findings were consistent with *Bastami et al.* [19] mentioned that the study finding showed patients had moderate to high levels of pain during the arterial puncture as well as the mean of pain score immediately the arterial puncture were 3.12 (1.68) and 4.6 (1.56) for treatment and control group, respectively. The mean pain score 5 minute after the punctures were 1.9 (1.51) for treatment group and 2.53 (1.85) for control group.

Moreover, studies have thrown light on the fact that cold therapy (cryotherapy) ice cubes is one of the effective cutaneous stimulation techniques in alleviating pain. Cryotherapy is defined as the use of a substance that applied to the body to decrease tissue temperature. It was clarified that cryotherapy is used for treatment of pain by slowing nerve conduction rate and blocking nerve impulses through lowering the temperature over the affected area. It also relaxes muscles, decrease capillary permeability by vasoconstriction and slow cellular metabolism. The cold application can be delivered by cold packs, ice massage or spray [30].

Yoon [31] also reported that pretreatment use of ice cubes was effective in reducing pain and discomfort related to intra-dermal skin injection. In addition to, *Goel,* [32] said that in a study of 22 patients underwent local lid anaesthetic infiltration, local ice application prior to local anaesthetic

injection significantly reduced the pain and discomfort of the injection.

This is also supported by *Watkins* [33] who examined the effect of ice packs on postoperative middle incision pain and found narcotic use and pain was decreased significantly in cryotherapy patients.

As well as, *Jeffrey* [33] who reported that In this study, cryoanalgesia in the form of ice application for 3 min before arterial puncture significantly reduced procedure-related pain compared with a control group (no ice). As well as cryoanalgesia reduced pain scores compared with the control.

The findings of the present study revealed that there were no statistical significant difference in heart rates as a physiological measure between the study and control. This was supported with

Bastami, et al. [19] mentioned that contrary to the researcher's expectations, there did not found any significant differences in the heart rates during the procedure between the two groups.

Finally, application cutaneous stimulation in the form of ice cubes as a simple, available, inexpensive and non-invasive nursing intervention has been less explored. The present study provides a foundation for future research with the potential to change pain management techniques for the arterial puncture.

6. Conclusion

Cutaneous stimulation is effective in reducing pain at arterial puncture among critically ill patients.

7. Recommendations

1. Cutaneous stimulation should be carried out routinely for managing arterial puncture related pain among critically ill patients.
2. Replication of the study with respect to compare the effect of cutaneous stimulation with other nonpharmacological pain relieve measures.
3. Replication of the study using a large probability sample from different geographical areas must be considered in the development of future research to allow greater generalization of the results.

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