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An efficacy of cryoanalgesia on arterial blood gas puncture-related pain

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Abstract---Context: Arterial blood gas analysis requires puncture of an artery to obtain a blood specimen. Arterial punctures are quite painful among many patients and are the major source of morbidity in clinically ill patients. Aim: We aimed to evaluate the efficacy of cryoanalgesia among patients undergoing arterial puncture. Settings and Design: The one group pre-test post-test design included 40 samples undergoing arterial puncture in Krishna Hospital and MRC, Karad. Materials and Methods: Purposive sampling technique was used and collected data were analysed using Instat software. Statistical analysis: Statistical analysis was performed using Instat software. Results: The pre-test results depict that out of 40 patients, no patient 0(0%) had mild pain during arterial puncture, 4 (10%) patients had moderate pain and 36(90%) patients had severe pain whereas in the post-test results, out of 40 patients, 1(2.5%) patient had mild pain during arterial puncture, 39 (97.5%) patients had moderate pain and no 0(0%) patients had severe pain. Conclusion: On the whole, conducting this study was a learning experience for the investigator. The result of the study showed that, the cryoanalgesia was effective on reduction in pain among patients undergoing arterial puncture and it is useful in the areas of nursing practice and nursing research.

Keywords---Cryoanalgesia, Arterial blood gas, Pain.

Introduction

Arterial blood gas (ABG) testing requires puncture of an artery to obtain a blood specimen for analysis. Arterial punctures can be quite painful for many patients and are a major source of morbidity in critically ill patients.[1] Randomized controlled trials (RCTs) of intradermal anesthetics have been shown to be effective in reducing ABG-related pain;[2] however, intradermal anesthetics are not widely used. The underutilization of intradermal anesthetics was explained by the unsubstantiated belief that the intradermal injection causes as much pain as the arterial puncture and that the volume of fluid infused into the dermal layer may make it more difficult to palpate the radial artery.[3,4,5,] Furthermore, clinicians underutilize non-pharmacologic/noninvasive techniques such as cold application for relief of pain caused by procedural interventions.[6,7] Cold application had been used for decades as an effective non-pharmacologic method for pain management.[8,9] Ice application decreases nerve conduction velocity, increases the pain threshold and provides analgesia. If effective, cryoanalgesia would offer a noninvasive, non-pharmacologic, inexpensive, and readily available tool to reduce pain associated with arterial puncture. This study sought to determine whether cryoanalgesia in the form of ice application could be an effective analgesic when applied before arterial puncture.[10] This study indicated that ice application was an effective tool to reduce pain associated with arterial puncture. Moreover, cryoanalgesia with an ice bag is an attractive analgesic option since it is noninvasive, non-pharmacologic, inexpensive, and readily available. However, cryoanalgesia may not be an acceptable technique for patients with Raynaud's or scleroderma/CREST syndrome. One potential hazard of this technique is tissue injury if ice is inadvertently applied for prolonged periods of time (e.g., ice is applied, and the phlebotomist leaves the room and does not return in a timely manner).[11]

Need for the study

Patients in critical care unit undergo arterial puncture are repeatedly exposed to pain for approximately 1-2 radial punctures per day. Ice massage reduces sensation, including pain sensation, by slowing the transmission of sensory message from local nerve fibers to the brain. It reduces the inflammation. It slows the transmission, motor message to the local nerve fibers known as cryostretch.[12] Studies have thrown light on the fact that cryoanalgesia is equally effective in alleviating pain as a cutaneous stimulation technique. This study is therefore under taken to look at the effect of cryoanalgesia on level of pain during arterial puncture among patients undergoing arterial blood gas analysis. [13] Nurses are care giver for patients are obligated to minimize the emotional and physical effects of painful procedures. The investigator felt that nurses in these departments can make major contribution to the patients by reducing pain at the arterial site. Hence the researcher was interested in evaluating the simple, cost effect, easy to administer intervention that is cryoanalgesia.

Problem statement

To assess an efficacy of cryoanalgesia on arterial blood gas puncture-related pain among patients admitted in Krishna hospital, Karad.

Objectives of the study

1. To assess the level of pain during arterial puncture among patients admitted in Krishna Hospital, Karad.
2. To evaluate the efficacy of cryoanalgesia on arterial blood gas puncture related pain among patients admitted in Krishna Hospital, Karad
3. To determine the association between pretest level of arterial blood gas puncture related pain among patients with their selected demographic variables.

Subjects and Methods

In this study Quantitative research approach was used for analyzing the effectiveness of cryoanalgesia on level of pain during arterial puncture among patients undergoing arterial blood gas analysis. In this study Quasi experimental one group pretest post-test design was adapted without randomization. This study included a total of 40 patients from Krishna hospital Karad.

The study included only those patients undergoing arterial puncture for arterial blood gas analysis at Krishna hospital Karad, willing to participate in the study, and present during data collection period. Those were not willing to participate were excluded from the study.

Data were collected using numerical pain scale during pre and post-test.

A structured questionnaire was prepared by investigator to be used as an instrument in the study. The instrument comprised two parts:

Section I consisted of sociodemographic variables of the sample. The following socio-demographic variables were considered: age, sex, education, occupation, marital status, type of family, family's monthly income.

Section II consisted of numerical pain scale to assess the pain during pre and post-test.

All the data were collected by the investigator. Prior to the data collection, the study was approved by institution ethics committee. A letter from chairman of institutional ethics committee KIMSDU Karad was obtained after presentation and approval. The researcher obtained permission from the present institution to conduct the research study. Written consent was obtained from the subjects before the data collection. The subjects confirmed to keep the data confidential.

Statistical analysis

All the data were computed, and the answers were coded in a Microsoft Excel spread sheet. The data were analyzed by various tools in the Microsoft Excel; statistical analysis was performed using Instat software.

Results

Section A: Frequency and Percentage distribution of demographic variables of patients undergoing arterial puncture in Krishna Hospital, Karad.

Table 1: Frequency and Percentage distribution of demographic variables of patients undergoing arterial puncture in Krishna Hospital, Karad.

Demographic variables	Frequency	Percent
Age (in years)		
<40	4	10
41-50	10	25
51-60	16	40
>60	10	25
Gender		
Males	20	50
Females	20	50
Education		
Illiterate	19	47.5
Primary school	5	12.5
High school	9	22.5
Graduate	7	17.5
Occupation		
Unemployed	15	37.5
Unskilled worker	12	30
Semi professional	8	20
Professional	5	12.5
Marital status		
Unmarried	3	7.5
Married	37	92.5
Type of family		
Rural	20	50
Urban	20	50
Monthly income		
Less than Rs. 10,001/-	2	5
Rs. 10,002/- to Rs. 29,972/-	14	35
Rs. 29,973/- to Rs. 49,961/-	20	50
Rs.49,962/- to Rs. 74,755/-	4	10
Total	40	100

Table 1: Frequency and Percentage distribution of patients according to demographic variables.

Section B: Findings related to the level of pain during pre-test arterial puncture among patients undergoing arterial blood gas analysis in Krishna Hospital, Karad.

Table 2: Level of pain during arterial puncture among patients.

Level of pain (Pretest)	Frequency	Percent
No pain (0)	0	0
Mild pain (1-3)	0	0
Moderate pain (4-6)	4	10
Severe pain (7-10)	36	90
Total	40	100

Table 2 revealed that, out of 40 patients, no one 0(0%) had pain and mild pain during arterial puncture whereas 4 (10%) patients had moderate pain and 36(90%) patients had severe pain.

Section C: Findings related to the efficacy of cryoanalgesia on arterial blood gas puncture related pain among patients admitted in Krishna Hospital, Karad.

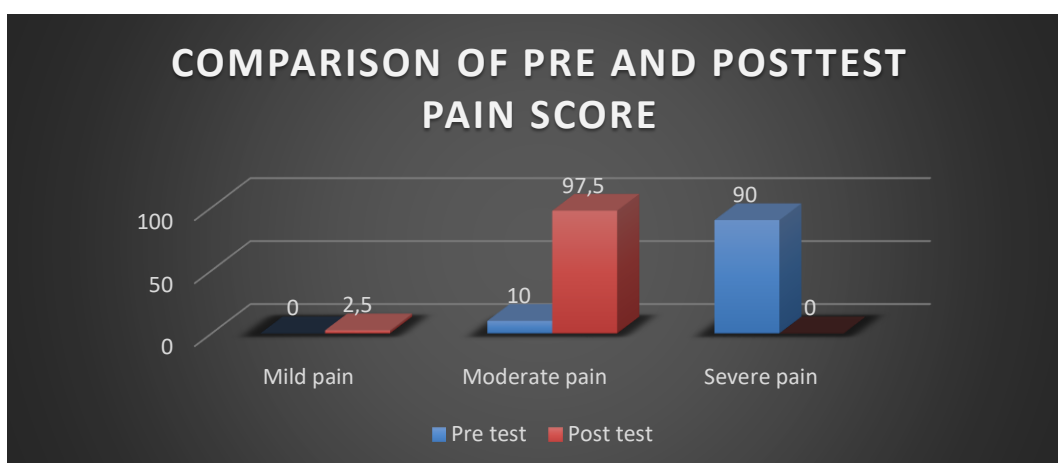


Figure 1: Bar diagram representing comparison of pretest and posttest pain among patients undergoing arterial puncture

The above figure no.1 shows the comparison of pretest and post-test pain patients during arterial puncture. The pre-test results depict that out of 40 patients, no patient 0(0%) had mild pain during arterial blood gas puncture, 4 (10%) patients had moderate pain and 36(90%) patients had severe pain. The post-test results depict that, out of 40 patients, 1(2.5%) patient had mild pain during arterial puncture, 39 (97.5%) patients had moderate pain and no 0(0%) patient had severe pain.

Table 4: Evaluation of efficacy of cryoanalgesia on arterial blood gas puncture related pain among patients admitted in Krishna Hospital, Karad.

Pre test			Post test			Mean gain percentage	W statistic	p-value
Mean	Mean Percentage	SD	Mean	Mean Percentage	SD			
7.43	74.3	0.87	4.83	48.3	0.78	26	780	<0.0001

The above table no.4 depicts that mean and standard deviation of pain score obtained before and after the administration of the cryoanalgesia among patients. The Wilcoxon matched pairs signed rank test was used to test the hypothesis and significant difference in the level of pain between pre-test and post-test by patients during arterial puncture ($p < 0.0001$). The pretest mean is 7.43 with the standard deviation of 0.87 and posttest mean is 4.83 with the standard deviation of 0.78. The p value was < 0.0001 which was considered statistically significant. Hence it shows that there is efficacy of cryoanalgesia on arterial puncture related pain among patients admitted in Krishna Hospital, Karad.

Section D: Findings related to the association between level of pain related to arterial blood gas puncture among patients with their selected demographic variables.

Table-5: Association between demographic variables and pre-test level of pain among patients during arterial blood gas puncture

Demographic variables	Pain scale				Total		Chi square statistic	p value
	Moderate		Severe					
	F	%	F	%	F	%		
Age (in years)								
≤ 40	0	0.0	4	100.0	4	10.0	6.25	0.1
41-50	0	0.0	10	100.0	10	25.0		
51-60	1	6.3	15	93.8	16	40.0		
>60	3	30.0	7	70.0	10	25.0		
Gender								
Males	2	10.0	18	90.0	20	50.0	0	1
Females	2	10.0	18	90.0	20	50.0		
Education								
Illiterate	2	10.5	17	89.5	19	47.5	6.78	0.07
Primary school	2	40.0	3	60.0	5	12.5		
High school	0	0.0	9	100.0	9	22.5		
Graduate	0	0.0	7	100.0	7	17.5		
Occupation								
Unemployed	3	20.0	12	80.0	15	37.5	3.6	0.31
Unskilled worker	0	0.0	12	100.0	12	30.0		
Semi professional	1	12.5	7	87.5	8	20.0		
Professional	0	0.0	5	100.0	5	12.5		
Marital status								
Unmarried	0	0.0	3	100.0	3	7.5	0.36	0.55
Married	4	10.8	33	89.2	37	92.5		

Type of family								
Rural	4	20.0	16	80.0	20	50.0	4.44	0.03
Urban	0	0.0	20	100.0	20	50.0		
Monthly income								
≤ Rs. 10,001/-	1	50.0	1	50.0	2	5.0	4.84	0.18
Rs. 10,002/- to Rs. 29,972/-	2	14.3	12	85.7	14	35.0		
Rs. 29,973/- to Rs. 49,961/-	1	5.0	19	95.0	20	50.0		
Rs.49,962/- to Rs. 74,755/-	0	0.0	4	100.0	4	10.0		
Total	4	10.0	36	90.0	40	100.0		

Table-5 shows the association of level of pain related to arterial puncture before cryoanalgesia with their selected demographical variables, using Chi –square test. The analysis revealed that there was association between type of family with pretest pain of patients.

Table-6: Association between demographic variables and post-test level of pain among patients during arterial blood gas puncture

Demographic variables	Pain scale				Total		Chi square statistic	p value
	Mild		Moderate					
	F	%	F	%	F	%		
Age (in years)								
≤ 40	0	0.0	4	100.0	4	10.0	1.54	0.67
41-50	0	0.0	10	100.0	10	25.0		
51-60	1	6.3	15	93.8	16	40.0		
>60	0	0.0	10	100.0	10	25.0		
Gender								
Males	0	0.0	20	100.0	20	50.0	1.03	0.3
Females	1	5.0	19	95.0	20	50.0		
Education								
Illiterate	1	5.3	18	94.7	19	47.5	1.13	0.77
Primary school	0	0.0	5	100.0	5	12.5		
High school	0	0.0	9	100.0	9	22.5		
Graduate	0	0.0	7	100.0	7	17.5		
Occupation								
Unemployed	1	6.7	14	93.3	15	37.5	1.71	0.64
Unskilled worker	0	0.0	12	100.0	12	30.0		
Semi professional	0	0.0	8	100.0	8	20.0		
Professional	0	0.0	5	100.0	5	12.5		
Marital status								
Unmarried	0	0.0	3	100.0	3	7.5	0.083	0.77
Married	1	2.7	36	97.3	37	92.5		
Type of family								
Rural	1	5.0	19	95.0	20	50.0	1.03	0.3

Urban	0	0.0	20	100.0	20	50.0		
Monthly income								
≤ Rs. 10,001/-	0	0.0	2	100.0	2	5.0	1.91	0.59
Rs. 10,002/- to Rs. 29,972/-	1	7.1	13	92.9	14	35.0		
Rs. 29,973/- to Rs. 49,961/-	0	0.0	20	100.0	20	50.0		
Rs.49,962/- to Rs. 74,755/-	0	0.0	4	100.0	4	10.0		
Total	1	2.5	39	97.5	40	100.0		

Table-6 shows the association of level of pain related to arterial blood gas puncture after cryoanalgesia with their selected demographical variables, using Chi –square test. The analysis revealed that no association could be found with any of demographic variables of patients with post-test pain.

Discussion

Findings of the study:

The findings of the study were analyzed by using frequency, percentage distribution.

Major findings were as follows:

Distribution of demographic variables of patients admitted in Krishna Hospital, Karad:

Among 40 patients,

- 4(10%) were ≤ 40 years, 10(25%) were between age group 41-50 years, 16(40%) were between age group 51-60 years while 10(25%) were >60 years.
- 20 (50%) were males while 20 (50%) were females.
- 19(47.5%) patients were illiterate, 5(12.5%) patients had completed primary education, 9(22.5%) had completed high school and 7(17.5%) completed graduation
- 15(37.5%) patients were unemployed. 12(30%) patients were unskilled workers and 8(20%) were semiprofessional and 5 (12.5%) patients were professional workers
- 3(7.5%) patients were unmarried and 37(92.5%) patients were married
- 20(50%) patients were from urban and rural families each
- 2(5%) patients were having monthly family income <Rs.10,001/-, 14(35%) were having monthly family income Rs. 10,002/- to Rs. 29,972/-, 20(50%) were having monthly family income Rs. 29,973/- to Rs. 49,961/-, 4(10%) were having monthly family income Rs.49,962/- to Rs. 74,755/-.

Findings related to the level of pain during pre-test arterial puncture among patients admitted in Krishna Hospital, Karad.

It was found that, out of 40 patients, no client 0(0%) had mild pain during arterial puncture, 4 (10%) patients had moderate pain and 36(90%) patients had severe

pain where as in the post test It was found that; mean pretest pain of patients was 74.3 which decreased after posttest 48.3. There was significant difference between level of pain before and after administration of cryoanalgesia on arterial puncture. The results were supported by many of the studies. Among those one of the studies conducted by **Jeffrey Hynes (2015)** that was randomized controlled trial of cryoanalgesia (ice bag) to reduce pain associated with arterial puncture. The result showed that subjects pretreated with ice reported less pain from arterial puncture compared with subjects in the control group.[1]

Another study by Bastami M et al (2015) stated that the mean of pain score immediately after the arterial puncture were 3.12 (1.68) and 4.6 (1.56) for treatment and control group, respectively ($p < 0.001$). Cold pack is a simple, non-invasive and inexpensive technique for pain management before the arterial puncture.[14]

3rd study conducted by Mahto et al. (2016) reported ice less from within the control group (median pain rating scale 2.00 Inter Quartile Range (IQR) 2.00-1.00 Vs 4.00 IQR 5.00-3.25, $P = 0.01$). Conclusions: Use of cryoanalgesia (Ice bag) reduces the pain associated with arterial subjects pretreated with ice reported less pain from arterial puncture compared with subjects in the control group (median pain rating scale 2.00 Inter Quartile Range (IQR) 2.00-1.00 Vs 4.00 IQR 5.00-3.25, $P = 0.01$). Use of cryoanalgesia (Ice bag) reduces the pain associated with arterial puncture.[10] **and one more study conducted by, Nahla Shaaban Khalil (2017)** revealed that the immediate mean pain score after the arterial puncture were 7.36+1.34 and 7.88+0.79 for the study and control group, ($p < 0.05$). The research results showed that cold pack could be effective for relieving pain during arterial puncture.[11]

Findings related to the association between level of pain related to arterial puncture among patients with their selected demographic variables.

It was found that there was association between type of family with pretest pain of patients ($p < 0.05$). The analysis also revealed that no association was found with any of demographic variables of patients with posttest pain ($p > 0.05$)

Conclusion

Objective 1: To assess the level of pain during arterial puncture among patients admitted in Krishna Hospital, Karad. It was found that, out of 40 patients, no client 0(0%) was having mild pain during arterial puncture, 4 (10%) patients were having moderate pain and 36(90%) patients were having severe pain.

Objective 2: To the efficacy of cryoanalgesia on arterial blood gas puncture related pain among patients admitted in Krishna Hospital, Karad. It was found that; mean pretest pain of patients was 74.3 which decreased after posttest 48.3. There was significant difference between level of pain before and after administration of cryoanalgesia on arterial puncture

Objective 3: To determine the association between pretest level of arterial blood gas puncture related pain among patients with their selected demographic

variables. It was found that there was association between type of family with pretest pain of patients ($p < 0.05$)

Nursing Implications:

The findings of the study have implications for nursing practice, nursing education, nursing administration and nursing research.

Nursing Research:

Investigator can use the methodology as reference material. It provides guidelines for the researcher to carry out other similar studies in different settings and on different population on larger scale for better generalization. It shows the area which needs further exploration. It provides avenue for further studies in this area.

Nursing Practice:

Several implications can be drawn from the present study for nursing practices. The extended and expanded roles of staff nurses emphasize more knowledge and practice to administer and encourage the utilization of the study findings to update the knowledge and practices of cryoanalgesia and adopt cryoanalgesia on arterial puncture to reduce pain of patients during the process.

Recommendations:

Since this study only touched pain level and controlled sample size the results can be only considered as reference study, recommendations can be as follows:

1. Same study can be carried out on larger population of patients.
2. The same study can be repeated in different regions of the state and nation so as to compare the results.
3. Similar study can be conducted among different population such as patients other age groups and on adult patient using same or different tool.

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