Effect of Precooling Puncture Site on Pain Associated with Arterial Puncture

Samia Ashraf Samy 1, Hanan Mohamed Badran 2,Wafaa Gameel Mohamed Ali 3

1B. Sc, Medical Surgical Nursing Department, Faculty of Nursing, Mansoura University, Egypt.
2 Assisst. Professor, Medical Surgical Nursing, Faculty of Nursing. Mansoura University, Egypt.
3Professor, Medical Surgical Nursing Department, Faculty of Nursing, Mansoura University, Egypt
Email: ssemsema50@gmail.com

1.ABSTRACT

Background: Arterial puncture is a daily routine care and a frequently ordered medical procedure for patients requiring blood gas analysis which associated with severe pain. Cold application is a simple, non-invasive, and inexpensive technique for reducing pain associated with arterial puncture. **Study aim:** Investigate the effect of precooling puncture site on pain associated with arterial puncture. **Methods:** A quasi experimental research design was used. Setting: The study was carried out at Chest and Medical Fourteen departments at Mansoura University Hospital. **Sample**: A purposive sample of 66 patients who had orders for arterial blood gases draws as a part of their routine clinical assessment. They were recruited and divided randomly into two equal groups**. Tool**: consisted of three parts, Part I: demographic and medical data, Part II: Wong Baker faces pain rating scale, and Part III: Numerical pain rating scale. Results: The study revealed that there was a highly statistically significant reduction in pain level as measured by Wong Baker face pain rating scale and Numerical pain rating scale after application of precooling puncture site among study group when compared by control group. **Conclusion**: The study revealed that cold application is a simple non pharmacological, convenience and cost-effective method in reducing pain associated with arterial puncture. **Recommendations**: Cardio-respiratory and metabolic departments should involve cold application for managing arterial puncture pain in the routine care for patients with arterial blood gases analysis. Educational programs about the application of ice and its effect on minimizing the pain should be conducted for nursing staff.

 Key words: Arterial puncture, Cold application, Pain

2.Introduction:

An arterial puncture is a diagnostic procedure in which a blood sample is obtained from an artery directly for mainly analysis of blood gases. It is utilized by many hospital services lines in different care settings and is used commonly for patients with cardio, respiratory diseases, and metabolic disorders. It is considered one of the most routine painful procedure. Moreover, it is the most accurate blood sampling technique for true arterial blood gases (ABG), acid-base determination and a gold standard for pulmonary function evaluation **(Jensen & Markewitz, 2018)**.

An arterial blood gases (ABG) sampling provides information about lung ventilation through the interpretation of partial pressure of carbon dioxide ($Paco_2$) and information about tissue oxygenation through the interpretation of partial pressure of oxygen (Pao_2) for patient with respiratory problems. It can show the body's ability to absorb oxygen (O_2) and remove carbon dioxide (CO_2). Dysfunction in this process can indicate problems within the respiratory, metabolic, and renal system **(Castro, Patil, Keenaghan, 2021)**.

Respiratory diseases oblige a tremendous worldwide health burden and about 544.9 million individuals worldwide suffer from a chronic respiratory disease. Inpatients with respiratory diseases spent between 5 days to 10 days with a total of 43.6 million days in hospital **(Soriano et al., 2020)**. Also, cardiovascular diseases (CVDs) are a major cause of mortality and morbidity worldwide and a major public health concern. Cardiovascular diseases are the first cause of death globally, taking an estimated 17.9 million lives each year. In 2017, CVD accounted for 46.2% of the overall mortality in Egypt with a frequent hospital admissions and prolonged length of hospital stay **(Hassanin et al., 2020)**. These patients require ABG analysis for diagnosis or treatment follow up or to monitor the health condition at least twice daily **(Soriano et al., 2020)**. According to monthly statistical report of Mansoura University Hospital the admission of patients in chest and medical departments account from 100-150 patient every month for each department **(Mansoura University Hospital statistical reports, 2020)**.

Minimizing the pain and discomfort throughout any invasive procedure is considered a most basic human right which is a pivotal role of nurses. Cold therapy is one of the nonpharmacological measures that provide benefits over other techniques because it can be easily integrated into clinical practice without additional cost or time. It is a safe technique with fewer or no systemic adverse effects and include less costs and additionally require little time to prepare **(Abd Elkader, Shahin, Bakr, 2020)**.

Significance of the study

Arterial puncture is described as the most painful laboratory procedure and is performed without the benefit of pain management. It is one of the main factors that caused distress in patients and is placed into a higher discomfort category compared to other types of procedures experienced on patients with cardio-respiratory problems. Furthermore, the pain associated with arterial puncture could be responsible for delayed hospital presentation in patients with chronic respiratory conditions such as asthma and associated pain may cause some patients to avoid the nursing care. Cold application is a simple, non-invasive, and

inexpensive technique for pain management **(Abd Elkader, Shahin, Bakr, 2020)**. Data generated from this study can lead to decrease in patients' pain and resulting in increased patients' satisfactions. It also ensures that consistency and quality of care, and decreases hospital stay as well as cost.

Aim of the study

Investigate the effect of precooling puncture site on pain associated with arterial puncture.

Research hypothesis

Precooling puncture site will reduce level of pain associated with arterial puncture among study group when compared with control group

3. Research Design

Quasi-experimental two groups research design was utilized in this study to establish the effect relationship between independent and dependent variable, evaluate the intervention without randomization **(Maciejewski, 2020)**.

Setting

This study was conducted in the chest and medical 14 departments at Mansoura University Hospital. The chest department located in 2nd and 3rd floor, divided into 3 rooms with capacity of 8-10 patients in each room and medical 14

departments presented in 4th floor with capacity of 23 patients.

Participants

A purposive sample of 66 patients who had orders for ABG draws as a part of their routine clinical assessment in the above-mentioned setting were recruited and divided randomly into two equal groups. Group I (Study group) consisted of 33 patients were received ice pack for 5 minutes before arterial puncture for pain management. Group II (Control group) consisted of 33 patients were received routine hospital care before arterial puncture for pain management. All patients in the study and control group were selected according to the following criteria. The inclusion criteria were adult male or female with age from 20 to 60 years, fully conscious who able to describe their pain with positive Allen's test and first radial arterial puncture. While patients with difficult palpation of radial pulse or with arterio-venous fistula for haemodialysis, have burn/ scar over the radial artery and who underwent muscle relaxant or sedative drugs were excluded.

Tool of data collection

One tool was used in this study in an English form for data collection based on reviewing related literatures. It divided into three parts as following:

Part I: Demographic and medical data: including age, gender, marital status, educational level, occupation and previous hospitalization and ABG sample.

Part II: Wong Baker faces pain rating scale: This part of the tool was adopted from **Wong DL (2005)** to assess the level of pain according the patients' facial expression. It consists of six figures ranging from no hurt, hurts little bit, hurts little more, hurts even more, hurts whole lot and hurts worst.

Scoring system:

- *Face 1: No hurt = score: 0*
- *Face 2: hurts little bit = score: 2*
- *Face 3: hurts little more = score: 4*
- *Face 4: hurts even more = score: 6*
- *Face 5: hurts whole lot = score: 8*
- *Face 6: hurts worst = score: 10*

Part III: Numerical pain rating scale: This part of tool was adopted from **Hawker et al (2011)**, to assess the level of pain based on patient sensation and perception. It was divided into four levels, no pain, mild, moderate pain and worst possible pain. A numerical rating scale (NRS) requires the patients to rate their pain on a defined

scale from (0–10) where 0 is no pain and 10 is the worst pain imaginable.

Scoring system:

- *No pain: have 0*
- *Mild pain: range 1:3*
- *Moderate pain: range 4:6*
- *Sever pain: range 7:10*

- **Validity of the tool:** revised by a panel of five experts in the field of medical- surgical nursing.

- **Reliability:** was tested by Cronbach alpha test and it was equal 0.92.

- **Pilot study:** was carried out on 10% of patient with ABG ordered (7 patients) who were randomly selected and excluded from the actual study.

- **Ethical considerations and Human Rights:** An ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing, Mansoura University to carry out the study. Participants will be informed that participation in the study is voluntary and they have the right to withdraw at any time freely without any responsibilities.

- **Data collected** from the beginning of September till November 2020 the investigator used to go to the chest and medical 14 departments 3hours/ day, 2 days/week.

Fieldwork:

The framework of this study was carried out according to three phases; **assessment, implementation, and evaluation phase.**

Assessment phase: The researcher explained the purposes of the study to the patients and verbal consent was taken if ready to participate in the study.

Each Patient was interviewed by the researcher individually to collect the demographic and medical data using **(part I)** of the tool. This tool took in duration about 5 minutes.

Implementation phase: After positive Allen test cold application was done with ice packs wrapped in a piece of gauze on the radial arterial site for 5 minutes before the blood sample was

obtained in the study group. The control group received routine hospital care.

Evaluation phase: During puncture, the investigator used Wong-Baker faces pain scale **(part II of the tool)** to observe patient's facial expression and determine pain level according to it in both groups.

After the puncture, the investigator asked the patients to describe pain sensation by using Numerical pain rating scale **(part III of the tool)** in both groups.

Statistical analysis

Upon completion of data collection, the data were coded, tabulated, and analyzed by computer using the "Statistical Package for Social Sciences" (SPSS 22). Qualitative data were expressed as count and percent. Quantitative data were initially tested for normality using student t- test and Chi-Square with data being normally distributed if $p>0.050$. Quantitative data were expressed as mean ± standard deviation (SD) if normally distributed or median and interquartile range (IQR) if not. Statistically significant was considered at p-value <0.05.

4. Results

Table (2) illustrated that two third of study group (66.7%) had mild pain while slightly more than two thirds of the control group (72.7%) had severe pain. It was clear from the table that there is a highly statistically significant reduction in level of pain reported by patient after application of ice (P <0.001).

Figure (1) represented that near half of the study group (48.5%) had hurts little bit while slightly more than one third (36.4%) of the control group had hurts even more and (36.4%) hurts whole lot pain. The minority (12.1%) of the study group had no hurt compared to the minority (12.1%) of the control group had hurts worst so there is highly statistically significant reduction in objective pain score after application of ice P<0.001.

Table (3) displayed that there was a highly significant correlation between Numerical Pain rating scale and Wong Baker face pain rating scale in both study and control group. This mean that the two scales measures the same level of pain to the same patient.

Table (1): Demographic characteristics and medical data of the participants (n=33 in each group).

Items	Study group (n=33)		Control group (n=33)		Significance
	No	%	No	%	
Gender					
▪ Male	15	45.5	14	42.4	X²=0.062
▪ Female	18	54.5	19	57.6	*p*=0.804
Age group					
▪ 20-30 years	4	12.1	4	12.1	
▪ 31-40 years	8	24.3	7	21.3	X²=4.619
▪ 41-50 years	4	12.1	11	33.3	*p*=0.202
▪ 51-60 years	17	51.5	11	33.3	
Education					
• Illiterate	6	18.2	4	12.1	
• Read and write	6	18.2	3	9.1	
• Primary	5	15.1	7	21.2	X²=2.093
• Secondary	11	33.3	14	42.4	*p*=0.719
• University	5	15.2	5	15.2	
Marital status					
• Single	2	6.1	4	12.1	
• Married	25	75.7	22	66.6	X²=0.969
• Widow	4	12.1	5	15.2	*p*=0.809
• Divorced	2	6.1	2	6.1	
Occupation					
• Working	19	57.6	18	54.5	X²=0.062
• Not working	14	42.4	15	45.5	*p*=0.804
History of hospitalization					
• Yes	21	63.6	18	54.5	X²=0.564
• No	12	36.4	15	45.5	*p*=0.453
History of arterial puncture (n=21 &18)					
• Yes	17	81	6	33.3	X²=9.582
• No	4	19	12	66.7	*p*=0.002*

Table (2): Comparison between study and control group in relation to pain level as measured by Numerical Pain rating scale (N=33 in each group).

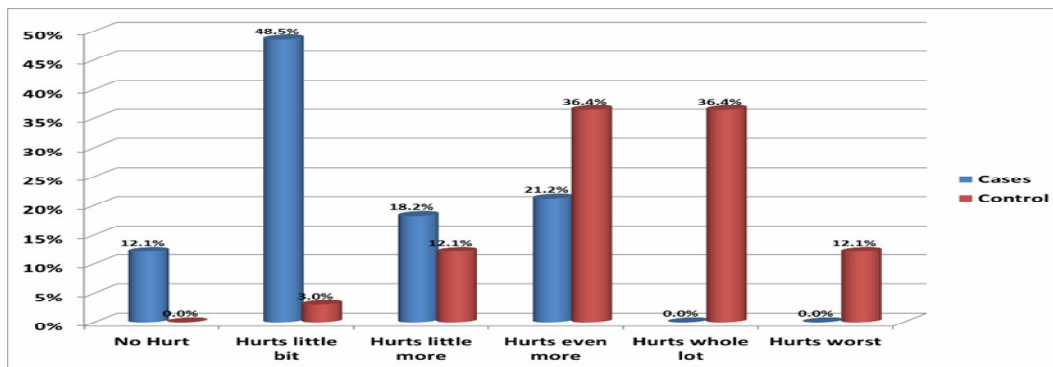| Pain levels	study group (n= 33)		Control group (n=33)		Significance
	No	%	No	%	
• Mild pain	22	66.7	0	0	χ2=43.213
• Moderate pain	10	30.3	9	27.3	*p*=0.000**
• Severe pain	1	3	24	72.7	
Mean ± SD	2.939 ± 1.344		7.606 ± 1.801		t=-11.924 *p*=0.000**

Figure 1: Comparison between study and control group in relation to objective pain score as measured by Wong Baker faces pain rating scale (n=33 in each group).

Table (3): Correlation between Wong Baker face pain scale & Numerical Pain rating scale.

Group	Variables	r	P
Study	Wong Baker face pain scale & Numerical Pain rating scale	0.764	0.000**
Control	Wong Baker face pain scale & Numerical Pain rating scale	0.671	0.000**

5. Discussion

Firstly, regarding the pain level as measured by Wong-Baker faces pain rating scale, the results represented that nearly half of the study group had hurt a little bit while slightly more than one-third of the control group had hurt even more and one-third hurt a whole lot of pain. The minority of the study group had no hurt compared to the minority of the control group had hurt worst so there is a highly statistically significant reduction in objective pain score after application of ice. This was in agreement with a study by **Attia and Hassan, (2017)** who used the Wong-Baker faces pain score and determined that almost all observed pain behaviours significantly decreased after cryotherapy.

Then, concerning the Numerical pain rating scale, this study illustrated that there is a highly statistically significant reduction in the level of pain reported by patients after the application of ice, as two-thirds of the study group had mild pain while slightly more than two-thirds of the control group had severe pain. Similar to this result, statistically significant differences were found between the control and cryotherapy groups in the study by **Badr, Gaafer, and Ahmed, (2020)**.

In this study, concerning the correlation between Wong-Baker faces pain scale and numerical pain rating scale, it was illustrated that there was a highly significant correlation between numerical pain rating scale and Wong-Baker faces pain rating scale in both study and control group. This means that the two scales measure the same level of pain to the same patient. Supporting to our finding, **Charak et al., (2021)** stated that these two scales work in a similar method.

6. Conclusion

There was highly significant reduction of pain associated with arterial puncture after application of ice packs so cold application is a simple non pharmacological, convenience and cost-effective method in reducing pain associated with arterial puncture.

7. Recommendations

-Cardio-respiratory and metabolic departments should involve cold application for managing arterial puncture pain in the routine care for patients with ABG analysis.

 -Educational programs about the application of precooling puncture site using ice packs and its effect on minimizing the pain should be conducted for nursing staff.

8.Acknowledgments

9.References

- Attia, A. A. M., & Hassan, A. M. (2017). Effect of cryotherapy on pain management at the puncture site of arteriovenous fistula among children undergoing hemodialysis. *International journal of nursing sciences*, *4*(1), 46-51.

- Badr, E. A., Gaafer, Y. A. E. S., & Ahmed, A. A. E. (2020). Effect of foot reflexology versus cryotherapy on pain associated with arterial puncture among critically ill children. *International Journal of Novel Research in Healthcare and Nursing, 7*(1), 1050-1070.

- Castro, D., Patil, S. M., & Keenaghan, M. (2021). Arterial blood gas. *StatPearls [Internet]*.

- Charak, S., Thattil, R. G., Srivastava, C. M., Das, P. P., & Shandilya, M. (2021). Assessment and Management of Pain in Palliative Care.

- Hassanin, A., Hassanein, M., Bendary, A., & Maksoud, M. A. (2020). Demographics, clinical characteristics, and outcomes among hospitalized heart failure patients across different regions of Egypt. *The Egyptian Heart Journal*, *72*(1), 1-9.

- Jensen, P. R., & Markewitz, B. A. (2018). Improved Success Rate of Arterial Puncture for Blood Gas Analysis through Standardization. *Laboratory medicine*, *49*(2), 175-178.

- Maciejewski, M. L. (2020). Quasi-experimental design. *Biostatistics & Epidemiology*, *4*(1), 38-47

- Mohamed Abd Elkader, H., & Shahin, S. M. E., & Bakr Abo El-Ata, A. (2020). Effect of applying program based learning on nurse's performance and self-efficacy regarding arterial blood puncture. *American Journal of Nursing Research*, *8*(2), 10-12691.

- Soriano, J. B., Kendrick, P. J., Paulson, K. R., Gupta, V., Abrams, E. M., Adedoyin, R. A., & Moradi, M. (2020). Prevalence and attributable health burden of chronic respiratory diseases, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet Respiratory Medicine*, *8*(6), 585-596.