Original article

Effect of using different sizes of needle along with cryoanalgesia on pain associated with arterial blood gas sampling: A prospective study

Heera Lal Mahto, Neethu Somanathan, Deepak BK

Email: heerart2007@gmail.com

Abstract

Introduction: Arterial blood gas (ABG) testing requires puncture of an artery to obtain a blood sample for analysis. It is a common procedure in the hospital to allow assessment of pulmonary gas exchange. Compared with vein puncture, arterial puncture is more difficult, requires deeper needle insertion and is more painful for the patient. Cryoanalgesia would offer a noninvasive, nonpharmacologic, 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. **Methodology**: This was a prospective study with a convenience sample of intensive care unit patients on oxygen therapy with a physician order for an ABG test. The intervention group had a plastic bag of ice applied to their wrists for 3 min before drawing an ABG sample from the radial artery. The control group had an ABG sample drawn from the radial artery without the application of ice. Pain from the arterial puncture was measured with a pain rating scale. **Results:** 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). **Conclusions**: Use of cryoanalgesia (Ice bag) reduces the pain associated with arterial puncture.

Keywords: Arterial blood gas, Cryoanalgesia, Needle size, Pain,

Introduction

Arterial blood gas (ABG) testing is performed on a blood sample drawn from an artery.[1] It is commonly performed to assess adequacy of gas exchange and acid-base status, especially in the intensive care unit.[2] Compared with venepuncture, arterial puncture is more difficult and may require several attempts, requires a deeper needle insertion and is more painful for the patient. Use of intradermal local anaesthetic agents have shown reduced ABG related pain.[2,3] However, intradermal anaesthetics are often not used during ABG sampling unlike during insertion of large bore intravenous cannulae. This is probably because it is believed that the intradermal injection causes as much pain as the arterial puncture. Furthermore, the intradermal wheal thus raised may make palpation of the radial arterial pulse more difficult.[4-6] Respiratory therapists may not be permitted by their hospital or licensing board to administer intradermal anaesthetics. Use of anaesthetic creams have not been shown superior to placebo in reducing pain due to arterial puncture.[5,6]

Cryoanalgesia was first formally described by Hippocrates and was also used by ancient Egyptians, Persians and Romans to alleviate pain. Since that time, cryoanalgesia has been widely used to reduce pain associated with numerous injuries, illnesses and invasive procedures. Effective application of cryoanalgesia would offer a noninvasive,

Heera Lal Mahto, MSc RT
(Adult Cardiorespiratory Care), Assistant Professor, Department of Respiratory Therapy, School of Allied Health Sciences, Manipal University, Manipal

Neethu Somanathan
Department of Respiratory Therapy, School of Allied Health Sciences, Manipal University, Manipal

Deepak BK, MBBS, (MD)
Postgraduate in Anaesthesiology, Kasturba Medical College, Manipal University, Manipal

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nonpharmacologic, inexpensive and readily available tool to reduce pain associated with arterial puncture.[7,8] Moreover, cryoanalgesia could fill a void in settings that do not offer intradermal anesthesia before arterial puncture.

The pain associated with arterial puncture may also be related to the size of the needle used. Different sizes of the needle may be used by the respiratory therapist to obtain arterial blood sample. No study has compared the pain associated with the use of different sizes of needle for arterial puncture. The aim of this study was to determine whether cryoanalgesia in the form of ice application could be an effective analgesic when applied before arterial puncture and also to evaluate level of pain using different needle sizes for arterial sampling.

Methodology

This was a prospective randomized control trial (RCT) conducted in medical intensive care unit (ICU). This study was approved by the institutional review board of Kasturba Hospital. Written informed consent was taken from all study subjects before enrolment in the study. Eighty four patients who required arterial blood sample on oxygen therapy in medical Intensive care Unit of the Medical College Hospital between March 2015 and June 2015 were enrolled prospectively by convenient sampling *(Figure 1)*. Subjects were randomised to the interventional group or control group after physician order for arterial blood gas sampling. Randomisation was done by computer generated program. The use of pain rating scale was explained to all subjects.

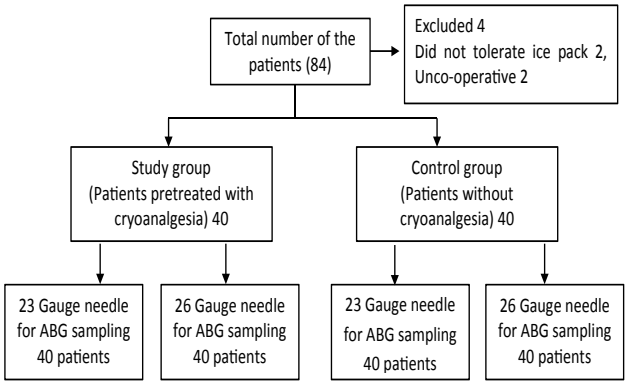

Figure 1: Flow chart of patients

The demographic data and diagnosis of the study subjects were noted for both groups along with needle size used for arterial sampling. Both wrists of all subjects were examined to determine the side with the stronger radial pulse (most suitable for puncture). All arterial punctures were performed using one cc syringe with the subjects in sitting position. The arterial puncture in the Control group was performed conventionally without any analgesia whereas the patients in the intervention group had a small plastic bag filled with crushed ice applied on the radial artery puncture site for 3 min (timed with stopwatch) without external compression or massage. If any of the subjects felt cold-related discomfort, they were told that they were allowed to remove the ice before the 3-min period. Subjects were also permitted to briefly lift the ice bag off their wrists and then reapply.

One ml of arterial blood sample was obtained using a 23 G needle after the elapse of 3 min of ice-application in the Study group whereas it was drawn immediately after group assignment in the Control group. All arterial punctures were performed by the respiratory therapist according to ICU protocol. Following arterial puncture, subjects were asked to rate the pain associated with the arterial puncture using a visual analog pain rating scale *(Figure 1)*. One end of the scale represented no pain (0) whereas the other end represented worst pain (10). All subjects were instructed to complete the pain rating scale immediately after the procedure *(Figure 2)*. To avoid bias, the pain score was assessed by the attending nurse after the principal investigator had left the ICU with the ABG sample for analysis. The score was written and stored in a sealed envelope before the investigator returned to the ICU. A similar sample was drawn again on the next day using a 26 G needle in both groups. We used SPSS software (Version 17.0, SPSS, Chicago, Illinois) for statistical analysis. Differences in continuous data were analysed with the Mann-Whitney test for unpaired medians. Data are expressed as mean ± SD or median and interquartile range (IQR). A 2-tailed P value of $< .05$ was considered statistically significant.

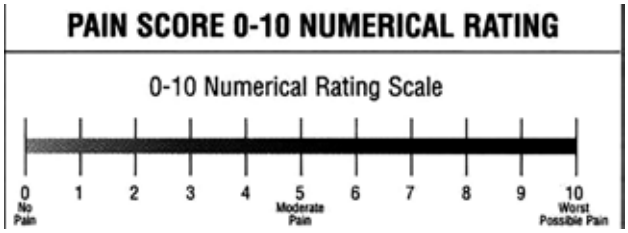

Figure 2: Pain rating scale

Results

A total number of 84 subjects were enrolled in the study. Four subjects were excluded from the study, two of whom did not tolerate the ice pack and two did not cooperate with the study. A total of 80 subjects were included in the study. The demographics of patients were similar between both groups (Table 1). The visual analogue pain rating score was lowest in subjects pretreated with ice and when 26 gauge needle was used. The pain was greater in patients when 23 gauge needle was used (median pain rating scale 0 (IQR 0 – 1) vs 2.00, (IQR 1 – 2, P = 0.001). In control group where cryoanalgesia was not provided, the pain of arterial puncture was less painful when 26 gauge needle was used as compared with 23 G (median pain rating scale 1.50 (IQR 1 – 2) vs 4.00, IQR 3 – 5, P = 0.001) (Table 2).

Table 1: Demographic data

	Interventional Group	Control Group
Age in years (Mean ± SD)	52.6 ± 16	54.2 ± 18
Female %	28.3	34.5

Table 2: *Pain rating score during arterial blood sampling with and without cryoanalgesia using 23 G and 26 G needle*

	Arterial Sampling using 23 G needle	Arterial sampling using 26 G needle	
With Cryoanalgesia (Study group) Pain in Median (IQR)	2 (1 - 2)	0 (0 - 1)	P = 0.001
Without Cryoanalgesia (Control group) Pain in Median (IQR)	4 (3.25 - 5)	1.5 (1 - 2)	

Discussion

Arterial puncture can be painful and many patients, especially in the intensive care units require repeated sampling. Insertion of arterial lines for the purpose of repeated sampling is not practiced in many places for lack of monitoring devices or lack of expertise. Arterial blood gas analysis is essential for the assessment of acid-base status in particular and accurate assessment of oxygenation and ventilation status. Thus, arterial blood sampling is inevitable in these patients. In this study, pain associated with arterial puncture has been compared with and without prior analgesia and with the use of either 23 or 26 G needles. There is significant reduction in the pain associated with arterial puncture with cryoanalgesia and the use of 26 G needle.

Giner J et al found that arterial puncture with prior infiltration of local anaesthetic is least painful.3 In a randomised controlled trial, Jeffrey et al found that use of cryoanalgesia (ice bag) reduces pain associated with arterial puncture.9 Our findings are similar to the previous study, use of cryoanalgesia in form of ice bag reduce pain during arterial puncture. However, use of ice pack might be difficult in patients with cold related discomfort. Cryoanalgesia may not be an acceptable technique for patients with Raynaud's or scleroderma syndrome. One potential hazard of this technique is tissue injury if ice is inadvertently applied for prolonged periods of time.

Achieving deep levels of cryoanalgesia can be time-consuming. Algafly and George found that the mean time to reduce ankle skin temperature to 10°C with ice packs was 26 min.[10] This level of cryoanalgesia would likely not be practical, not well tolerated, or probably not even necessary for arterial puncture. Clinicians should be aware that some forms of cryoanalgesia are more effective than others. For example, France *et al* showed that pain from arterial puncture was not affected by the use ethyl chloride coolant vapour.[4] Moreover, crushed ice packs provide more effective cryoanalgesia than cold gel packs or cold water immersion.[11-13] In addition, the quantity of ice used and the practice of compressing

or massaging the ice against the body surface has a positive impact on skin and tissue cooling.[14]

This study has a number of limitations. Although subjects reported less pain with cryoanalgesia, it is difficult to know if this finding represents a meaningful improvement in procedure-related morbidity. This study used a standard ice exposure time (3 min) for all subjects, whereas targeting a specific skin temperature might better tailor cryoanalgesia to individuals. Future studies should examine the use of ice bags to reduce arterial puncture in different patient populations.

We also evaluated the pain associated with use of different sizes of needle. The use of 23 gauge needle was associated with less pain in both groups. One may argue that the smaller needle (26 G) may actually make aspiration of blood more difficult and may take longer than a 23 G needle. The backflow is likely to be less obvious with a thinner needle, especially if the syringes do not have plungers that slide smoothly. If the arterial puncture is done only for the purposes of blood gas analysis, a volume of even 0.5 cc is sufficient. If a larger volume of blood must be drawn at the same time to include other investigations from the same sample, the time delay and reduced ease of aspiration can be significant.

Conclusions

Use of cryoanalgesia (Ice bag) and a 26 G needle reduces the pain associated with arterial puncture.

References

1. Turner JS, Briggs SJ, Springhorn HE, Potgieter PD. Patients' recollection of intensive care unit experience. *Crit Care Med* 1990;**18**: 966-8.
2. Lightowler JV, Elliott MW. Local anaesthetic infiltration prior to arterial puncture for blood gas analysis: a survey of current practice and a randomised double blind placebo controlled trial. *J R Coll Physicians Lond* 1997;**31**:645-6.
3. Giner J, Casan P, Belda J, Gaonza´lez M, Miralda RM, Sanchis J. Pain during arterial puncture. *Chest* 1996;**110**:1443-5.
4. France JE, Beech FJ, Jakeman N, Benger JR. Anaesthesia for arterial puncture in the emergency department: a randomized trial of subcutaneous lidocaine, ethyl chloride or nothing. *Eur J Emerg Med* 2008; **15**:218-20.
5. Hudson TL, Dukes SF, Reilly K. Use of local anesthesia for arterial punctures. *Am J Crit Care* 2006;**15**:595-9.
6. Tran NQ, Pretto JJ, Worsnop CJ. A randomized controlled trial of the effectiveness of topical amethocaine in reducing pain during arterial puncture. *Chest* 2002;**122**:1357-60.
7. Trescot AM. Cryoanalgesia in interventional pain management. *Pain Physician* 2003;**6**:345-60.
8. Aaron SD, Vandemheen KL, Naftel SA, Lewis MJ, Rodger MA. Topical tetracaine prior to arterial puncture: a randomized, placebocontrolled clinical trial. *Respir Med* 2003;**97**:1195-9.
9. Jeffrey M Haynes RRT RPFT. Randomized controlled trial of cryoanalgesia (ice bag) to reduce pain associated with arterial blood gas puncture. *Respir Care* 2015;**60**:1–5.
10. Algafly AA, George KP. The effect of cryotherapy on nerve conduction velocity, pain threshold, and pain tolerance. *Br J Sports Med* 2007;**41**:365-9.
11. Herrera E, Sandoval MC, Camargo DM, Salvini TF. Motor and sensory nerve conduction are affected differently by ice pack, ice massage, and cold water immersion. *Phys Ther* 2010;90:581-91.
12. Kanlayanaphotporn R, Janwantanakul P. Comparison of skin surface temperature during the application of various cryotherapy modalities. *Arch Phys Med Rehabil* 2005;**86**:1411-5.
13. Chesterton LS, Foster NE, Ross L. Skin temperature response to cryotherapy. *Arch Phys Med Rehabil* 2002;**83**:543-9.
14. Janwantanakul P. The effect of quantity of ice and size of contact area on ice pack/skin interface temperature. *Physiotherapy* 2009;**95**:120-5.2009;95:120-5.