The Role of Nonpharmacological Methods in Attenuation of Pain Due to Peripheral Venous Cannulation: A Randomized Controlled Study

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Abstract

Background: Establishing an intravenous access is indispensable for safe administration of anesthesia. Most of the times, it is executed without any analgesia although the pain associated with this procedure is quite agonizing to the patients. Aims: This study aims to evaluate the role of 3 different nonpharmacological measures such as Valsalva maneuver, flash of light, and distraction method in attenuation of pain during venous cannulation. Design: A clinical randomized controlled study. Materials and Methods: Two hundred patients of either sex, aged between 18 and 65 years, posted for elective surgery were enrolled in this study. Patients were randomly allocated into four groups, Group C-control, Group V (valsalva) - blew into sphygmomanometer raising the mercury column up to 30 mm of Hg, Group D (distraction) - pressed a rubber ball and Group L (light) - photographed with a flash of light before venous cannulation. During the process of cannulation, patients were observed and questioned, and pain was graded using a 4-point scale. After the cannulation, pain during the procedure was also assessed using visual analog scale (VAS) score. Data analysis was done using SPSS statistical package version 17. Results: A significant reduction in the incidence of pain was noted in distraction group 36% as compared to 44% in Group L, 46% in Group V, and 100% in the control group. The severity of pain as assessed by 4-point score was significantly lowest in Group D 0.26 ± 0.53 as compared to other three groups (Group V and L = 0.54 ± 0.16, Group C = 1.64 ± 0.6, P < 0.001). Mean VAS score was significantly low in Group D 0.6 ± 1.11 and Group L 0.54 ± 1.06 as compared to Group V 1.26 ± 1.76 and Group C 5.0 ± 1.21, P < 0.001. Conclusion: We conclude that distraction can be considered as a diligent, reasonable, and simple method to attenuate procedural pain during peripheral venous cannulation.

Keywords: Distraction, flash of light, intravenous cannulation, Valsalva

INTRODUCTION

Securing a peripheral venous cannulation (PVC) is imperative for safe administration of anesthesia. This procedure has been reported by adults to be painful and distressing. It is a normal practice to provide local anesthesia (EMLA cream, ethyl chloride spray) for children before PVC whereas in adults PVC is often executed without any analgesia. Fear of this procedure may trigger an autonomic response resulting in vasoconstriction and further difficulty in venous access. A clinical study by expert anesthesiologists showed that discomfort due to venous cannulation was ranked among the top five low morbidity clinical outcomes.

The pain experienced during venous cannulation has both somatic and psychological components. Pharmacological measures like the application of local anesthetics treat only the somatic component of pain, whereas nonpharmacological measures which cause attention diversion address the psychological component of pain. Venous cannulation is usually the first procedure that an anesthesiologist performs on patients presenting for procedures requiring sedation or anesthesia, and is probably the one that patients will remember the most. Hence, it is very essential to make venipuncture as painless and as less distressful to the patients as possible.
Methods such as distraction tactics and cough tricks have been used to minimize venipuncture pain. Distraction reduces attention by competing with alternative stimuli over the attention for sensory stimuli and this shift in attention may affect pain sensation more than anxiety.\(^{[6,5]}\) There were few clinical studies showing Valsalva maneuver performed during venous cannulation could be effective for reducing the incidence and severity of venipuncture pain in adults.\(^{[6]}\) This maneuver may cause activation of the baroreceptor reflex arc thus inducing antinociception.\(^{[7]}\)

In the recent literature, venous cannulation pain after a flash of light has been shown to reduce the pain.\(^{[8]}\) During pain conditions, thalamic stimulation causes modulation of nociceptive information, leading to a reduction in pain perception.\(^{[9]}\) Thalamus is an integral part of the light reflex; it was presumed that a flash of light, by initiating a light reflex, might cause thalamic stimulation and thus decrease venous cannulation pain.

Thus, we compared these three nonpharmacological methods for attenuation of pain during venous cannulation in adults.

### Materials and Methods

After obtaining institute ethics committee clearance, this study was undertaken in our institution. 200 patients of either sex, aged between 18 and 65 years, with the American Society of Anesthesiologists physical Status I–II having prominent veins on the dorsum of the hand, undergoing elective surgical procedures were recruited for the study. Patients having problems in communication, having abnormal skin conditions or infection at the site of proposed venous cannulation, patients on long-term consumption of analgesics and patients whose vein could not be cannulated in the first attempt were excluded. A written informed consent was taken from the included patients. Patients were randomized into four groups by a sealed envelope technique before cannulation.

- **Group C (control)** - patients were not allowed to do any maneuver.
- **Group V (Valsalva)** - Patients were asked to blow into a rubber tubing connected to a sphygmomanometer and raise the mercury column up to 30 mm of Hg for 20 s.
- **Group D (distraction)** - patients were given a rubber ball in the palm of the hand which will not be cannulated and were asked to press it as hard as they can.
- **Group L (light)** - patients were photographed with a flash of light from a distance of 2 meters just before cannulation.

All patients were premedicated with Tablet Alprazolam 0.5 mg on the previous night and the morning of surgery. In the operating room, patients were placed in supine position. A vein on the dorsum of the nondominant hand was identified and depending on the group allocation; patients were asked to press the ball, perform Valsalva maneuver, photographed with white light or do nothing. 20 s later, a venous tourniquet was applied, and PVC was attempted. PVC was performed by the same senior resident in all the patients with an 18G cannula.

During the process of venous cannulation, patients were observed and questioned by an independent anesthesiologist. The pain was graded using a four-point scale.

- 0 – No pain
- 1 – Mild pain (pain reported only in response to questioning without any behavioral signs such as facial grimacing, arm withdrawal or tears)
- 2 – Moderate pain (pain reported in response to questioning and accompanied by behavioral signs/pain reported spontaneously without questioning)
- 3 – Severe pain (strong vocal response or response associated with behavioral signs).

After cannulation, pain during the procedure was assessed using visual analog scale (VAS) score.

The primary outcome was the incidence of pain and secondary outcome was the severity of pain due to PVC.

### Statistical analysis

A sample size of 46 each was calculated based on the studies carried out by Agarwal et al. which have indicated the incidence of pain with various interventions such as Valsalva maneuver, flash of light, distraction and control to be 75%, 50%, and 100%, respectively. Based on these findings, to demonstrate statistical significance with least difference of 25% and keeping the power of study at 90% and \( \alpha \) error of 2.5%, a sample size of 46 each was calculated. Hence, a total of 200 patients who were posted for elective surgery were enrolled in this study allowing for possible dropouts. Data analysis was done using SPSS Statistical Package-Version 17. Frequencies, percentages, means, standard deviations, Chi-square, and \( P \) values were calculated. ANOVA and unpaired ‘t’ tests were used to test the significance of difference between quantitative variables and Yates’s and Fisher’s Chi-square tests for qualitative variables. \( P < 0.05 \) was taken to denote statistically significant relationship.

### Results

Data from 200 patients (50 patients in each group) were analyzed. The demographic data were comparable among groups [Table 1]. The incidence of pain was lowest in Group D 36% as compared to 44% in Group L, 46% in Group V, and 100% in the control group [Table 2]. The severity of pain as assessed by 4-point score was significantly lower in D group as compared to the other three groups. Mean four-point score in Group D was 0.26 ± 0.53, as compared to 0.54 ± 0.61 in Group V and L \( (P < 0.001) \) [Table 2]. Similarly, VAS score was not distributed normally, the mean VAS score was 1.26 ± 1.76 in Group V, 0.6 ± 1.11 in Group D, 0.54 ± 1.06 in Group L, and 5.0 ± 1.21 in Group C [Table 2].

### Discussion

Pain attenuation before the first painful procedure like venous cannulation may reduce pain-related negative emotional
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### Table 1: Demographic characteristics of the patients

| Group | Age (years) mean±SD | Sex (male/female) | Weight (kg) mean±SD | Height (cm) mean±SD | BMI (kg/m²) mean±SD | P |
|-------|---------------------|-------------------|---------------------|---------------------|---------------------|---|
| C     | 47.2±9.6            | 22/28             | 65.9±9.9            | 160.8±8.4           | 25.4±2.8            |   |
| D     | 45.1±12.3           | 28/22             | 65.6±12             | 160.5±6.0           | 25.4±4.2            |   |
| V     | 46.0±12.9           | 23/27             | 65.1±11.0           | 159.7±7.3           | 25.5±3.6            |   |
| L     | 46.1±9.6            | 18/23             | 65.1±11.0           | 158.9±6.5           | 25.7±3.9            |   |
| P     | 0.832               |                   |                     |                     |                     |   |

Data represented as mean±SD or number of patients. SD=Standard deviation, BMI=Body mass index

### Table 2: Incidence and severity of venepuncture pain

| Group | No pain | Pain present | Four point score mean±SD | VAS mean±SD |
|-------|---------|--------------|--------------------------|-------------|
| C     | 0       | 50           | 1.64±0.6                 | 5.0±1.21    |
| D     | 32*     | 18           | 0.26±0.53                | 0.6±1.11*   |
| V     | 27      | 23           | 0.54±0.61                | 1.26±1.76*  |
| L     | 28      | 22           | 0.54±0.61                | 0.54±1.06   |

Data represented as mean±SD or number of patients. *P<0.001 intergroup comparison between control and other groups, †P<0.01 intergroup comparison between control and other groups, §P<0.05 intergroup comparison between distraction and Valsalva, and distraction and light groups, ‖P<0.01 intergroup comparison between control and other groups, ‡P<0.027 intergroup comparison between distraction and Valsalva. SD=Standard deviation, VAS=Visual analog scale

During Valsalva maneuver, there is an increase in intrathoracic pressure, due to contraction of thoracic cage, which results in compression of vessels within the chest and return results in activation of baroreceptor reflex. Laboratory experiments have shown that activation of baroreceptor reflex arc results in modulation of pain perception and induces antinoceception.

Agarwal et al. in their study showed a significant reduction in the incidence of pain in the Valsalva group (72%) as compared to control and distraction group (100%), and a reduced median VAS in the Valsalva group when compared with other groups (P<0.001). Distraction is an approach to divert the patient’s attention away from the painful stimulus, it is difficult to maintain the same level of distraction in all the patients, and the type of distraction used will also affect the pain scores reported by the patients. Preprocedural anxiety scores will have an implication on the pain scores reported by the patients, experienced during the procedure. Pain rating is also influenced by demographic variables such as age, gender, and education levels of the patients. Although performing Valsalva maneuver before venous cannulation helps in attenuation of pain, patient’s ability to comprehend and execute the maneuver efficiently plays an important role in obtaining the desired result.

Gupta et al. in their study conducted on children to evaluate the efficacy of balloon inflation on venous cannulation pain, demonstrated a reduction in incidence and severity of pain in the balloon group as compared to distraction and control groups. It was suggested that balloon inflation may have a combined effect of Valsalva and distraction on decreasing the pain.

Agarwal et al. in their study on the role of flash of light for attenuation of venous cannulation pain, showed a significant reduction in incidence and severity of pain in the flash of light group compared to distraction and control groups. Somatosensory thalamic stimulation has been described to activate thermal pathways leading to modulation of nociceptive information. The type of distraction used in their study was the passive type which was different from the active type of distraction used in our study. Further, a study was conducted on the effects of a flash of light of different colors on venous cannulation by Rahimi et al. They found a lower median VAS in the blue light as compared to white and red groups. Distraction can be considered as a component during Valsalva maneuver and flash of light, thus contributing to the reduction of pain during venipuncture.

Distraction is defined as an approach, whether cognitive or behavioral, that diverts a person’s attention away from the painful stimuli. It is a widely used technique most commonly practiced in children to facilitate tolerance of painful medical procedures. Distraction techniques can be broadly classified into two types – active and passive. Active forms of distraction include interactive games, virtual reality, controlled breathing, guided imaginary, and relaxation. Passive forms involve those where the patients’ needs to remain calm and quiet during

and social experiences. This will reduce anxiety, fear, and distress thus facilitating less complications in further medical procedures.

Various pharmacological and nonpharmacological methods have been used for control of pain during PVC. Most commonly used pharmacological approaches include topical creams, gels, sprays which require waiting times of approximately 45–60 min for action. Nonpharmacological methods such as Valsalva maneuver, flash of light, distraction are simple and feasible, which are time and cost efficient requiring little or no training for use. Hence, they can be easily implemented for attenuation of pain during venipuncture. Hence, we compared these nonpharmacological methods for attenuation of pain during venipuncture.

In this study, it can be seen that the incidence of pain was least in the Group D with 36% whereas it was 44% in the flash of light group and 46% in the Valsalva group. Four-point score VAS was similar in Valsalva group and flash of light group but significantly lesser in the distraction group.

Distraction methods have been used to reduce procedural pain and anxiety, and it is a good analgesic maneuver. It has been postulated that distraction relieves procedural pain by actively drawing the patient’s attention away from pain. In our study, it was noted that both incidence and severity of pain was significantly lower in distraction group as compared to Valsalva group. Distraction is essentially a cognitive behavioral preparation that may be active or passive, for example, blowing, counting, looking through the kaleidoscope, and cough tricks. Distraction may decrease attention by competing with alternative stimuli over the restricted capacity of attention for sensory stimuli.
the procedure, listening to music and watching television are passive forms of distraction.[17]

In this study, we used one of the many types of distraction approaches commonly used to alleviate procedural pain. Canbulat et al., in their study described that distraction cards were the most effective method for alleviation of pain and anxiety in children during phlebotomy.[18] Rezai et al. in their review article disclosed that several techniques of distraction can be used to reduce the pain of venipuncture. As stated in the results of the cited studies, they observed that to reduce the pain of venipuncture in children more effectively it is important to execute these techniques according to age as well as mental and physical condition of the patient.[19]

This study has few limitations. First, it could not be performed as a double-blind study as it is not possible to blind the person cannulating the vein. Second, change in the hemodynamic parameters before and after cannulation was not recorded.

**CONCLUSION**

It is suggested that distraction can be considered as an effective, inexpensive and easy method to control procedural pain during PVC. Distraction interventions vary widely with respect to the degree of passive or active involvement of the patient. Despite significant variability in distraction methods, it is an efficient technique for attenuation of venous cannulation pain. As anaesthesiologists, we should realize the significance of pain alleviation during PVC, and should be acquainted with various techniques available for the same.

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**Conflicts of interest**

There are no conflicts of interest.

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