Effect of cold application versus local anesthetic ointment during intravenous cannulation among patients

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Abstract

Aims: To assess the effect of cold application versus local anesthetic ointment on pain, hemodynamic parameters, and local reaction among patients during intravenous cannulation.

Background: Insertion of the intravenous catheter during hospitalization causes pain and discomfort. Today many various methods are being made to reduce pain severity such as local anesthetic ointment (EMLA) and cold application.

Design: A pre-experimental two-group post-test design.

Methods: Data collected between January 2021 to March 2021. 60 samples (30 in each group) who underwent intravenous cannulation were taken as a sample size by purposive nonprobability sampling method. The local anesthetic ointment was given to experimental group 1 for 5 min and cold application to experimental group 2 for 3 min prior to intravenous cannulation. Hemodynamic parameters were monitored, and the pain was assessed using a Visual analog scale and local reaction by local reaction assessment scale during intravenous cannulation.

Results: There was a non-significant difference (p=0.812) in the mean post-test pain score of intravenous cannulations and in the mean score of hemodynamic parameters (p> 0.05) in both experimental groups. No local reaction was found.

Implication: The present study proves that both cold application and local anesthetic ointment application are effective and therefore these simple noninvasive modalities can be incorporated. This can be followed as routine care during intravenous cannulation. It has to establish as evidence-based nursing practice and should be incorporated in the nursing manual/SOP.

Conclusion: From the findings, the study interprets that both cold application and local anesthetic ointment application had an effect on reducing pain and had no change in the hemodynamic parameters of patients during intravenous cannulation.

Keywords: effect, cold application, local aesthetic ointment, intravenous cannulation

1. Introduction

In spite of best preventive and promotive health care, people become sick and they need hospitalization. More than 80% of patients in hospital receives some form of intravenous therapy and for that patient may need quick intravenous access [1]. Approximately more than 1 billion peripheral intravenous catheters are inserted across the world annually [2]. The need for insertion of an intravenous catheter invokes anxiety and fear in patients. It may trigger the vasovagal reaction and may even prevent them from seeking health care [1]. Peripheral intravenous (IV) cannulation is an invasive procedure performed in hospitalized patients where the patient's skin is punctured with a needle to allow insertion of a temporary plastic tube into a vein [3]. Vein puncture is one of the most commonly performed invasive procedures leading to pain and discomfort. It is a very painful and stressful procedure for the patient. The management of pain associated with intravenous cannulation must be a nursing priority. Today many efforts are being made to reduce pain severity. Various pharmacological and non-pharmacological methods are used to reduce pain during intravenous cannulation. In pharmacological methods various topical anesthetic agents such as eutectic mixture of local anesthetics, epinephrine, tetracaine, lidoderm, lidocaine is available and in non-pharmacological methods such as cold application, music therapy, touch therapy, and acupuncture.

Cold application is an effective non-pharmacological pain-relieving method. The local application of cold constricts peripheral blood vessels, reduces muscle spasm and promotes comfort. Cold reduces blood flow to tissues and decreases local release of pain producing substances such as histamine, serotonin and bradykinin [4].

A study was conducted to assess the pain response of children during intravenous procedures, the effectiveness of ice application for 3 min on pain response during intravenous procedures and association between pain score and selected demographic variables of children admitted in pediatric ward. The study was two groups post-test only control group design. 60 samples age between 6-12 years, 30 samples in experimental and 30 in control group were selected by Non probability purposive sampling technique. The study concluded that the ice application promote comfort and reduces pain in children during intravenous procedures [5].

A topical preparation of local anesthetics that can be applied to intact skin is one such option. These preparations can be applied without discomfort, and they alleviate pain associated with intravenous cannulation [1]. Topical anesthetic reversibly blocks nerve conduction near their site of administration by targeting free nerve endings in the dermis or mucosa, thereby producing temporary loss of sensation in a limited area. One of such topical anesthetic ointment is used to reduce pain during

intravenous cannulation is EMLA (Eutectic mixtures of local anesthetics). Eutectic mixtures are compounds, which melt at lower temperatures than any of their components, permitting higher concentrations of anesthetics for use. It is 5% oil in water emulsion cream with a melting point of 18°C and consists of 25 mg/mL of lignocaine, 25 mg/mL of prilocaine, a thickener, an emulsifier, and distilled water adjusted to a pH level of 9.4 [6].

A study was conducted to determine the effect of 5-minute application of EMLA cream on a patient's pain perception of cannulation. This study compared the pain perception between an experimental group who received EMLA cream and a control group who received a placebo. There were 20 subjects in each group. The subjects in the experimental group were 14 years older. The study concluded that there was a significant difference between the two groups (p = .002) and the findings suggested that the 5-minute application of EMLA cream is adequate to decrease pain associated with intravenous cannulation [1].

The conceptual framework for the study was developed on the basis of Modified Wiedenbach's helping art of clinical nursing theory. The theory has two parts: Helping art of clinical nursing theory and Nursing practice. Helping art of clinical theory consists of three factors: central purpose, prescription and realities and nursing practice process consists of identification, ministration and validation. (See figure no. 1)

Conceptual framework

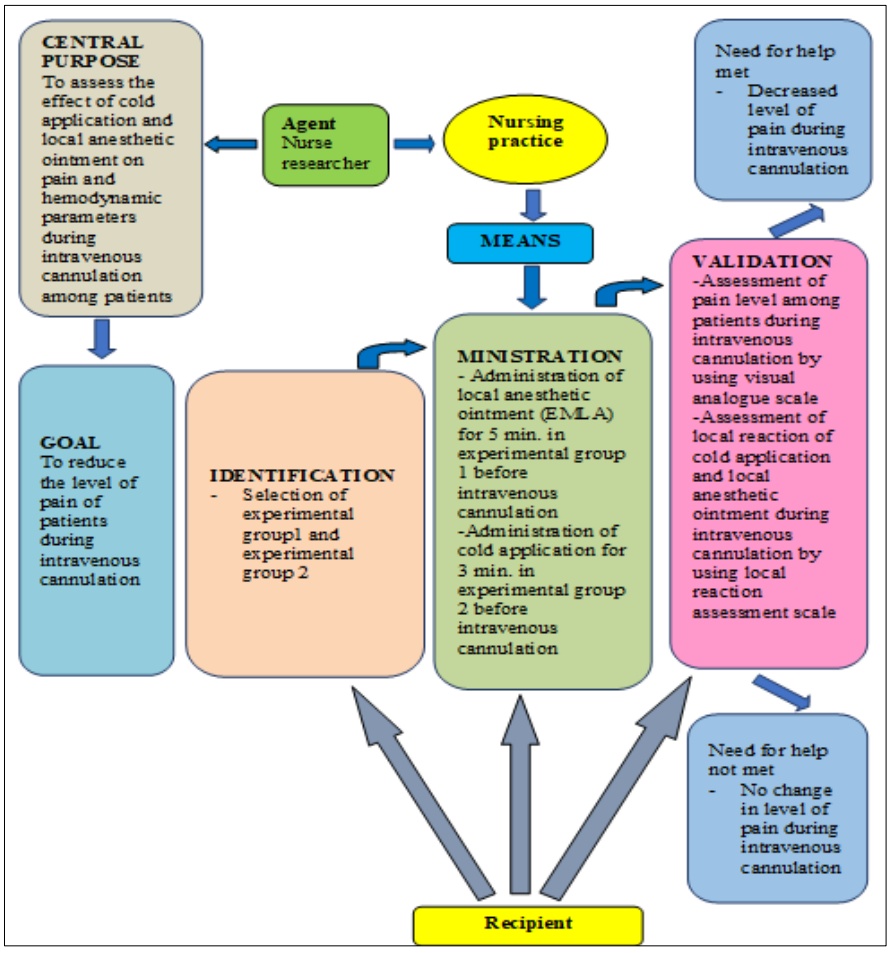

Fig 1: Conceptual framework for the study based on modified weidenbach's helping art of clinical nursing theory (1964)

Hypothesis

H1: There will be a significant difference in mean post-test pain score of intravenous cannulations in experimental group 1 and experimental group 2.

H2: There will be a significant difference in mean of hemodynamic parameters of experimental group 1 and experimental group 2.

2. Methods

2.1 Aim

The aim of the study was to assess the effect of cold application versus local anesthetic ointment on pain, hemodynamic parameters, local reaction among patients during intravenous cannulation.

2.2 Design

The study was quantitative evaluative comparative approach with pre-experimental two group post-test only design.

2.3 Sample

A non-probability purposive sampling was used for this study. Patient who are undergoing intravenous cannulation during the data collection period, are the sample for the study. The sample size for this study is based on the study conducted by Svensson, P., Petersen, J. K., & Svensson, H. to assess the efficacy of a topical anesthetic on pain and unpleasantness provoked by scaling of gingival pockets in 20 patients with mild chronic periodontitis.[7] The sample size was calculated by use of power

analysis with 80% of statistical power and 5% level of significance.

Formula used

$$N = \frac{2 \times (Z_\alpha + Z_\beta)^2 \, CSD^2}{(X_1 - X_2)^2}$$

Z_α = 1.96 at 5% level of significance
Z_β = 0.841 at 80% power
CSD = Combined Standard deviation
CSD = $\sqrt{sd^2_1 + sd^2_2 / 2}$
N= 15.691 x 1.79^2 / $(1-0)^2$ = 50. Expected attrition rate 20%. So, N=50+10=60.
The sample size for the present study was estimated to be 60. In this study 60 patients (30 patients in each experimental group) were selected who underwent intravenous cannulation and fulfil the criteria.
The inclusion criteria were the patients who would be;

1. age of 18 years and above.
2. admitted with order for intravenous therapy.
3. willing to participate in the study.

The exclusion criteria were the patients who will be;

1. unconscious patients
2. emergency patient

2.4 Data Collection

After obtaining ethical approvals, the study was conducted in the hospital and data was collected between January 2021 to March 2021. The tool prepared by the investigator was pre-tested, validity and reliability were established. The tool developed for data collection was divided into 4 sections. Section-A consists of demographic data, Section-B consists of hemodynamic parameters, Section-C consists of visual analogue scale and Section-D consists of local reaction assessment scale. The reliability of the tool was 0.866 which was established by test-retest method by using Karl Pearson's correlation coefficient formula stating the tool is reliable.
The demographic data was collected from the patients who underwent intravenous cannulation. Then intervention of local anesthetic ointment was given to experimental group 1 for 5 minutes prior to intravenous cannulation and cold application was given to experimental group 2 for 3 minutes prior to intravenous cannulation. The baseline data of respiration rate is checked manually, heart rate, SpO_2 was checked through a cardiac monitor and blood pressure was checked using a sphygmomanometer during intravenous cannulation. The pain was assessed using visual analogue scale and any local reaction during intravenous cannulation were assessed by local reaction assessment scale.

2.5 Ethical Considerations

Prior to data collection, ethical approval was obtained from the ethical committee and hospital. The informed consent was obtained from each participant.

2.6 Data Analysis

The data gathered from the patients were analyzed based on objectives and hypotheses using descriptive and inferential statistics i.e., unpaired 't' test. All the hypotheses were tested at 0.05 level of significance.

3. Results

Section I: Findings related to the description of demographic data of patients (See table no.1)

- Majority of patients 41.7% were in the age group of 68 years and above.
- In total 61.7% of the patients were male and 38.3% were female.
- Majority (43.3%) of the total sample were graduate.
- In total 23.3% of the patients had no pre-existing illness.
- In experimental group 1 (76.7%) and in experimental group 2 (83.3%) of patients had previous experience of intravenous cannulation. (See figure no. 2)
- Majority of (90%) patients in experimental group 1 and 2 had not taken any pain medication in past 24 hours. (See figure no. 3)
- Majority (81.7%) of total patients had undergone cannulation with 20G.

Table 1: Frequency and percentage distribution of patients according to demographic data N = (30+30=60)

S. No.	Demographic data	Experimental Group 1		Experimental Group 2		Total	
		f	%	f	%	f	%
1	Age of the patient						
	18-27	00	00	00	00	00	00
	28-37	01	3.3	00	00	1	1.7
	38-47	01	3.3	2	6.7	3	5.0
	48-57	06	20.0	7	23.3	13	21.7
	58-67	10	33.3	8	26.7	18	30.0
	68 yrs. and above	12	40.0	13	43.3	25	41.7
2	Gender						
	Male	19	63.3	18	60.0	37	61.7
	Female	11	36.6	12	40.0	23	38.3
	Other	00	00	00	00	00	00
3	Educational Status						
	Illiterate	6	20.0	6	20.0	12	20.0
	Secondary to Higher secondary	7	23.3	6	20.0	13	21.7
	Graduate	11	36.7	15	50.0	26	43.3
	Post-graduate	6	20.0	3	10.0	9	15.0
4	Pre-existing illness						
	Diabetes	01	3.3	02	6.7	03	5.0

	Diabetes and other comorbidities diseases	01	3.3	01	20.0	02	3.3
	Hypertension	04	13.3	06	20.0	10	16.7
	Hypertension and Diabetes	01	3.3	00	00	01	1.7
	Hypertension, Diabetes and other comorbidities	06	20.0	05	16.7	11	18.3
	Hypertension and other comorbidities disease	05	16.7	05	16.7	10	16.7
	Other comorbidities	05	16.7	04	13.3	09	15.0
	None	07	23.3	07	23.3	14	23.3
5	Size of Cannula (Gauge)						
	14	00	00	00	00	00	00
	16	00	00	00	00	00	00
	18	01	3.3	01	3.3	2	3.3
	20	24	80.0	25	83.3	49	81.7
	22	05	16.7	04	13.3	9	15.0

Section II: Findings related to comparison of the effect of cold application and local anesthetic ointment on pain among patients during intravenous cannulation

- Majority of patients 53.3% in experimental group 1 and 46.7% of patients in experimental group 2 scores '0' with 'no hurt' severity of pain during intravenous cannulation. (See figure no. 4)
- The overall experimental group 1 (local anesthetic ointment) mean score (1.00±1.14) was 10% whereas in experimental group 2 (cold application) mean score (1.06±1.01) was 10.67%.

Section III: Findings related to comparison of the effect of cold application and local anesthetic ointment on hemodynamic parameters (blood pressure, heart rate, respiratory rate, SpO_2).

- Majority of patients i.e., 66.7% in experimental group 1 and 56.7% in experimental group 2 had heart rate within the range of 73-91beats/min.
- Majority of patients i.e., 53.3% in experimental group 1 and 46.7% in experimental group 2 had SBP within the range of 120-139 mmHg.
- 36.7% of patients in experimental group 1 had DBP within the range of 70-79mmHg and 80-89 mmHg and in experimental group 2 (43.3%) of patients had DBP within the range of 80-89 mm Hg.
- Majority (70%) of patients in experimental group 1 and 73.3% in experimental group 2 had SpO_2 within the range of 96-100% on RA whereas in experimental group 1 (3.3%) of patients had SpO_2 within the range of 82% on 2L, 98% on 2L and 8L and in experimental group 2 (3.3 %) of patients had SpO_2 within the range of 94% on 2L.
- Majority of the patients i.e., 56.7% in experimental group 1 and 63.3% in experimental group 2 had respiratory rate within the range of 15-20 per min.
- The mean and SD of SBP in experimental group 1 was (134.23±1.85) and (126.93±1.65) in experimental group 2. The mean and SD of DBP in experimental group 1 was (74.13±9.96) and (75.53±9.302) in experimental group 2.
- The mean and SD of heart rate in experimental group 1 was (81.46±1.30) and (81.13±1.58) in experimental group 2. With regards to respiratory rate the mean and SD in experimental group 1 was (20.93±2.33) and (20.73±1.70) in experimental group 2. In terms of SpO_2, the mean and SD in experimental group 1 was (96.37±3.65) and (97.03±2.12) in experimental group 2.

Section IV: Findings related to comparison of the local reaction of cold application and local anesthetic ointment during IV cannulation.

- Majority of patients i.e., 100% in experimental group1 and 2 had no local reaction during intravenous cannulation.

Section V: Findings related to testing of hypotheses significant difference in mean post-test pain score of intravenous cannulations in experimental group 1 and 2.

- To test the significance of post-test pain score of intravenous cannulations in both experimental groups, t test was used. There was non-significant difference, t=0.239 at p>0.05 between the experimental group 1 and 2. (See table no. 2)

Significant difference in mean of hemodynamic parameters of experimental group 1 and 2.

- To test the significance of hemodynamic parameters of experimental group 1 and 2, t test was used. There was non- significant difference at p> 0.05 between experimental group 1 and 2. (See table no. 3)

Table 2: Comparison of the effect of experimental group1 and 2 on pain among patients during intravenous cannulation by using 't' test on pain score

Variable	Group	Mean	Mean difference	SEM	t	df	*p* value
Pain	Exp. Group 1	1.00	0.067	0.209	0.239	58	0.812*
	Exp. Group 2	1.067		0.185			

Level of significance: 0.05, df=58, *non-significant

Table 3: Comparison of the effect of experimental group1 and 2 on hemodynamic parameters among patients during intravenous cannulation by using 't' test on hemodynamic parameters

Variables	Group	Mean	SEM	Mean difference	df	t	*p* value
SBP	Exp. Group1	134.23	3.387	7.3	58	1.611	0.113*
	Exp. Group 2	126.93	3.014				
DBP	Exp. Group1	74.13	1.819	1.4		0.563	0.576*
	Exp. Group 2	75.533	1.698				

HR	Exp. Group1	81.467	2.389	0.333		0.89	0.931*
	Exp. Group 2	81.133	2.899				
RR	Exp. Group1	20.93	0.425	0.2		0.379	0.706*
	Exp. Group 2	20.73	0.311				
SpO_2	Exp. Group1	96.37	0.667	0.668		0.854	0.397*
	Exp. Group 2	97.035	0.395				

Level of significance: 0.05, df=58, *non-significant

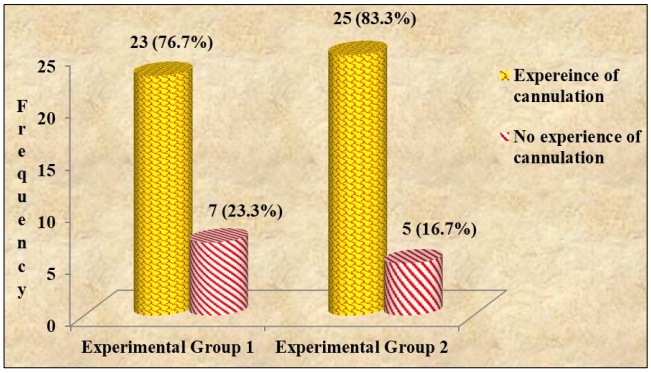

Fig 2: Bar diagram showing frequency distribution of patients according to previous experience of intravenous cannulation in experimental group 1 and 2.

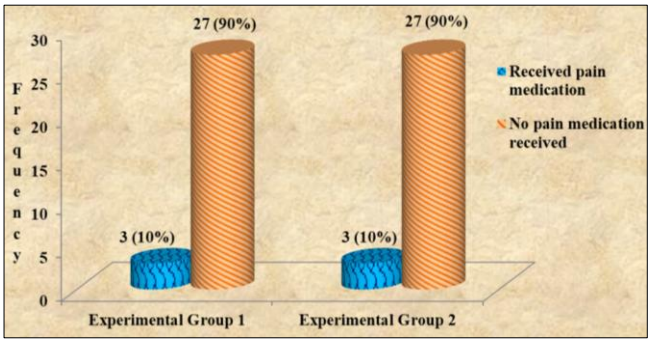

Fig 3: Bar diagram showing frequency distribution of patients according to any pain medication taken in past 24 hours in experimental group 1 and 2.

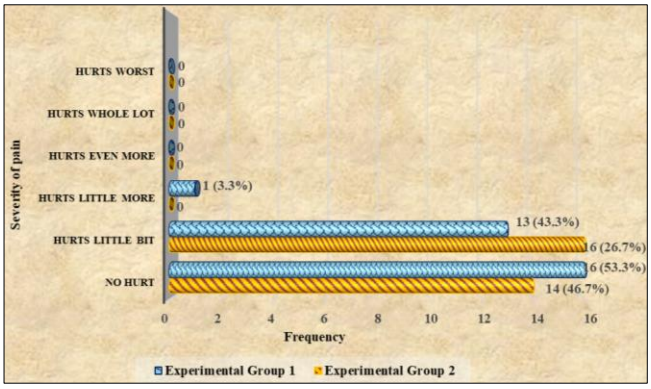

Fig 4: Bar diagram showing frequency distribution of patients according to severity of pain in experimental group 1 and 2.

4. Discussion

It is seen that intravenous cannulation is most commonly performed procedure within the hospitalized patients which causes pain, anxiety and physical discomfort. Thus, it is the responsibility of the nurse to reduce physical discomfort and pain of the patient by using different pharmacological and non-pharmacological pain-relieving methods during intravenous cannulation. Therefore, this study is taken to assess the effect of cold application versus local anesthetic ointment during intravenous cannulation among patients.

Comparison of the effect of cold application versus local anesthetic ointment on pain among patients during intravenous cannulation.

The findings of the present study reveal that there was non-significant difference (p=0.812) in mean post-test pain score of intravenous cannulations in experimental group 1 and 2. Hence, it was established that both applications had effect on reducing pain during intravenous cannulation.

The findings are consistent with the previous study which shows that ice application for 3 minute is a practical modality of choice and means of reducing pain in children during intravenous cannulation [9]. Yet another study suggests that 5-minute application of EMLA cream is adequate to decrease pain associated with intravenous cannulation [1].

Effect of cold application and local anesthetic ointment on hemodynamic parameters

The findings of the present study reveal that there was non-significant difference (p>0.05) in mean of hemodynamic parameters of experimental group 1 and 2. Hence, there was no change in hemodynamic parameters of patient while applying cold application or local anesthetic ointment during intravenous cannulation.

The findings are consistent with the previous study which showed no differences on hemodynamic response among the groups and EMLA as acceptable alternate method for topical anaesthesia in venous cannulation in adults [8].

Comparison of the local reaction of cold application and local anesthetic ointment during intravenous cannulation

The findings of the present study reveal that there was no local reaction of cold application and local anesthetic ointment found among patients during intravenous cannulation in experimental group 1 and 2.

The findings are supported by another study which concluded that local anesthetic ointment was found to be highly effective and local side effects of EMLA cream were negligible [9].

The limitations of the study were:

- The study was confined to a small number of experimental group of patients in one hospital.
- The difference in pain bearing capacity of patients were likely to influence the result of the study.

5. Conclusion

The present study assesses the effect of cold application versus local anesthetic ointment during intravenous cannulation among patients. The major findings of the study revealed that there was non-significant difference in mean post-test pain score of intravenous cannulations and in mean of hemodynamic parameters of experimental group 1 and 2. No

local reaction was found with these applications during intravenous cannulation among patients. Therefore, it was concluded that both cold application and local anesthetic ointment application was able to reduce the intensity of pain and had no change in hemodynamic parameters of patients during intravenous cannulation. Both interventions are recommended as a pain relief technique during intravenous cannulation among patients irrespective of age and gender.

5.1 Implications

The message extracted from this study is of vital concern to all members of the health team, including nursing practitioners, nursing administrator, nursing educators and nursing researchers, and must be integrated into both theory and practice. Implication also guides members of the health team toward the preventive aspect of health.

Nursing practice

- Findings of the study point out the need for improving the practices of nursing personnel with regard to measures taken for pain reduction during intravenous cannulation.
- The present study proves that both cold application and local anesthetic ointment application are effective and therefore these simple noninvasive modalities can be incorporated. This can be followed as a routine care during intravenous cannulation. It has to establish as evidence-based nursing practice and should be encorporated in the nursing manual/SOP.
- The study will improve the nurse's knowledge and competence in care of patients who undergo intravenous cannulation.

Nursing education

- The syllabus of nursing education should emphasis on procedure of intravenous cannulation and pain management techniques.
- This study leaves the responsibilities to the nurse educators to conduct in-service education programs for nursing staff working in the hospital regarding cold application and local anesthetic ointment application during intravenous cannulation.
- Nursing education consists of theoretically and practical training which should be provided to nursing personal with a purpose to prepare them for their duties as nursing care professional. As nursing educator, we must strengthen the evidence-based nursing practices among the undergraduate and post graduate nursing students.
- As the students learn from what they observe in clinical area therefore clinical nurses should inculcate these simple and non-invasive pain reduction techniques during intravenous cannulation among patients
- A short-term course can be started on "use of simple nursing measure to improve quality of nursing care".

Nursing administration

- Nursing administration is a broad term that encompasses nursing professional who are knowledgeable of leadership practice as they related to nursing profession. The nursing administrator should take initiative in organizing the continuing nursing education programme and in-service education programme on newly devised strategies such as cold application and local anesthetic ointment.
- Patient and family awareness and training sessions can be conducted.
- The nursing administrator should supervise the intervention done for the patients by nurses and also monitor the standards of practice to promote excellence in nursing care.
- Nursing administrators can take up initiatives in planning and implementation of non-pharmacological and pharmacological therapies along with the routine therapy.

Nursing research

- Nursing research is used to provide evidence-based care that promotes quality health outcome for individual, family communities and health care system. Nursing researcher should encourage clinical nurses to apply the research findings in their daily nursing care activities and can bring out new innovative procedures to reduce pain during intravenous cannulation.
- The findings of the study serve as a basis for professionals and the student to conduct further studies to make cold application and local anesthetic ointment a generalize practice.
- Findings of the research study if communicated through a journal or other media encourage the nursing personnel to follow the practice of cold application and local anesthetic ointment in pain reduction.

5.2 Recommendations

On the basis of the study the following recommendations were made:

- A study can be replicated with larger samples for better generalization.
- Study can be conducted in different hospitals with similar facilities.
- A comparative study can be done to assess the effect of topical local anesthetic ointment versus injectable local anesthesia.
- A comparative study can be done to assess the effect of local anesthetic ointment application within 5 min and 60 min.
- The same study can be conducted by including a placebo and control group.

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