Effect of Warm Application on Propofol Injection Pain among Patients Undergoing Surgical Interventions.

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Abstract

Propofol is an intravenous anesthetic used for procedural sedation, during monitored anesthesia care, or as an induction agent for general anesthesia. Propofol is almost an ideal IV anesthetic agent, but pain during its injection still remains a problem. The aim of this study was to evaluate the effect of warm application on propofol injection pain among patients undergoing surgeries. Quasi-experimental post-test only non-equivalent groups design was utilized in the current study. The current study was conducted in operating unit at a governmental hospital afflicted to Cairo university hospitals, Cairo, Egypt. A convenient sample of 60 adult male and female patients immediate before surgeries was recruited for the current study. ~~60~~ patients were divided to intervention and control group (30 patients in each group). Two tools were used I) personal and medical data tool, II) pain assessment tool. The current study found that; there was not statistically significance difference between study and control group in relation to level of pain, nerve pain and pain radiation. The current study concluded that; both of warm compresses and lidocine injection as a routine intervention are similar in improving level and characteristics of pain in the site of propofol injection.

Keyword: Warm Application, Propofol Injection Pain, Undergoing Surgical

Introduction

Propofol is an intravenous anesthetic agent used for sedation procedural, during monitored anesthesia care, or as an induction agent for general anesthesia. It may be administered as a bolus or an infusion, or some combination of the two. Propofol is prepared in a lipid emulsion which gives it the milky characteristic white appearance and the colloquial name "milk of amnesia." The formula contains soybean oil, glycerol, egg lecithin, and a small amount of the preservative EDTA. Strict aseptic technique must be used when drawing up propofol as the emulsion could support microbial growth **(Scott, Saunders & Norman 2022).**

There are many clinical uses for propofol which include induction of general anesthesia in patients ≥ three years old, though it may be used as an induction agent if a child less than three years of age has IV access, or as maintenance of anesthesia in patients > 2 months old, sedation during monitored anesthesia care for patients undergoing procedures and in edition among intubated patients on mechanical ventilator at ICU. Off-Label uses of Propofol including status of epilepticus, refractory (among children and adults) **(Kwak, Kim, & Jeon, 2019 and Wang, & Wang, 2022).**

Like most general anesthetic agents, the mechanism of action for propofol is poorly understood but thought to be related to the effects on GABA-mediated chloride channels in the brain. Propofol may work by decreasing the dissociation of GABA from GABA receptors in the brain and potentiating the inhibitory effects of the neurotransmitter. This, in turn, keeps the channel activated for a longer duration resulting in an increase in chloride conductance across the neuron, causing ahyper-polarization of the cell membrane, making it harder for a successful action potential to fire **(Jung, Kim & Cho, 2021).**

Propofol is almost an ideal IV anesthetic agent, but pain on its injection remains a problem. The pain may not be a serious complication, but most patients remember it as one of the unpleasant encounters with anesthetists. In one survey, pain on propofol injection stands as the seventh most important problem in the current practice of clinical anesthesia. Pain which produced in the site of propofol injection caused by vascular involvement. POPI is immediate or may be

delayed after 10–20 seconds. The immediate pain is due to irritation of the vein endothelium whereas delayed pain is due to the release of mediators such a kininogen from kinin cascade **(Jeon & Menna, 2020 and Doenicke, Roizen, Rau, & Kellermann, 2021).**

When the injection is carried out in a large vein, pain experienced becomes less probably due to that injection in the midstream leading to minimal contact of propofol with the endothelial wall of the vein. Furthermore, the injected propofol can be mixed with the blood freely and could have a buffering effect. Slow injection leading to more pain than the fast injection since slow injection may increase the concentration and duration of exposure of propofol to the vein wall while rapid injection may clear the drug quickly from vein and mixed it with blood **(Picard & Tramèr, 2020 and Sadler, Thompson & Maslowski, 2022).**

There are many modalities applied to decrease propofol injection pain which include using of pharmacological medications as a combination of nicardipine and lidocaine, iontophoretically as well with applying lidocaine, dexmedetomidine, ketamine, and dexamethasone. Non pharmacological interventions include the injection in the antecubital vein instead of the dorsal vein of the hand, using the central venous catheter, local cooling or heating application in the injection site of propofol **(Seki, Sekine, Aketa & Kobayashi, 2019).**

Warm application is a method of applying heat to the body. Heating sources could include warm water, microwaveable pads, wheat packs and electrical or chemical pads. Warm application are a common non-pharmacological therapy used in the treatment of things such as sports injuries, dental pain, post-operative wound healing, ophthalmic conditions and also in reliving local pain. Moist heat therapy had been believed to be more effective at warming tissues than dry heat because water transfers heat more quickly than air. Moist heat results in the perception that the tissue is heated more deeply. In fact, recent studies indicate that vasodilation, the expansion of the blood capillaries (vessels) to allow more blood flow, is improved with moist heat therapy. Expansion of the blood capillaries is the primary objective of heat therapy. Localized application of heat dilate the blood vessels in that area and enhancing perfusion to the targeted tissue area **(Parmar & Koay 2018).**

Significance of the Study

Propofol is the drug of choice for induction of anesthesia among millions of patients every year because of its rapid onset, short duration of action, easy titration, and favorable profile for side effects. Despite these positive attributes, about four out of five patients experience pain on injection of propofol, with one of these patients reporting severe or excruciating pain. Some patients recall the induction of anesthesia as the most painful part of the perioperative period according to the World Health Organization. (WHO) 2021 and Center of Disease Control **(CDC), 2021).**

Several interventions had been investigated to alleviate the pain associated with propofol injection. A systematic review in 2021 about “reduces incidence and severity of pain on propofol injection” suggested that; pretreatment using lidocaine (lignocaine) in conjunction with venous occlusion as the most effective intervention, other studies suggested that; use of a small dose of opioids to decrease pain intensity inside the propofol injection. Despite that recommendation the technique failed to gain widespread popularity, possibly because of the time needed to apply the tourniquet and negative pharmacological effect of lidocaine. As a result the pain associated with injection of propofol remains a challenge.

Undoubtedly, the use of natural methods is safer and reduces the patients' exposure to complications and side effects, and also reduces the financial burden on patients and hospitals. Few studies had demonstrated the contribution of hyperthermia associated vasodilation in reducing propofol injection pain such as randomized control trial done by **(Misun and Tzung, 2021)** entitled “heated carrier fluids in decreasing propofol injection pain” concluded that; thermal stimulus with temperature of 40oC with a low risk of causing burn is known to be an effective to increases both cutaneous blood flow and vasodilation for peripheral intravenous propofol injection.

Aim of the Study:

The aim of the current study was to evaluate the effect of warm application on propofol injection pain among patients undergoing surgeries.

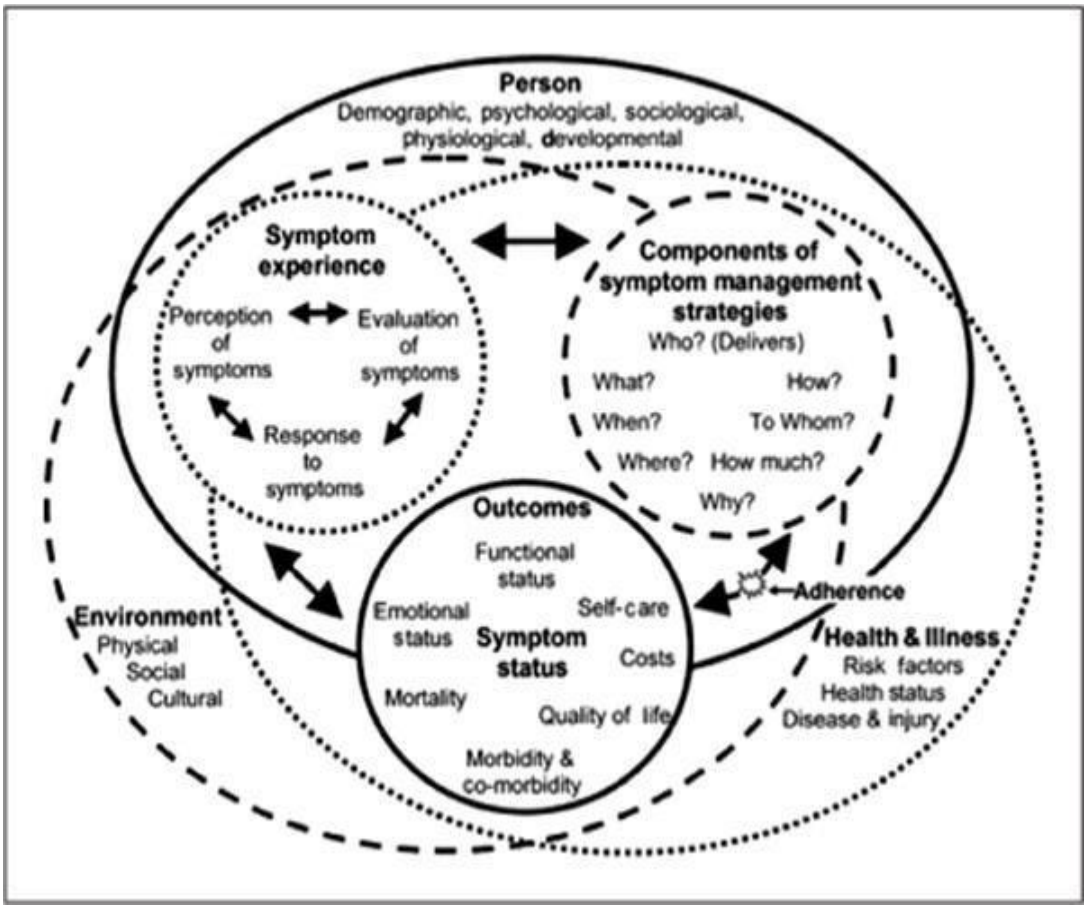
Research Hypothesis:

To achieve the aim of the current study, the following hypothesis was formulated to be tested:

H1: There will be statistically significance difference in total mean pain score between the study and control group in relation to warm application among patients undergoing surgeries.

Conceptual Framework

This study was conducting through the theoretical framework of symptom management nursing theory. The symptom Management Theory (SMT) is a deductive, middle range theory depicting symptom management as a multidimensional process occurring in the domains of nursing science. This model is based on programs of research working with adult patients in different health problems **(Dodd, Janson, Facione, 2016).**



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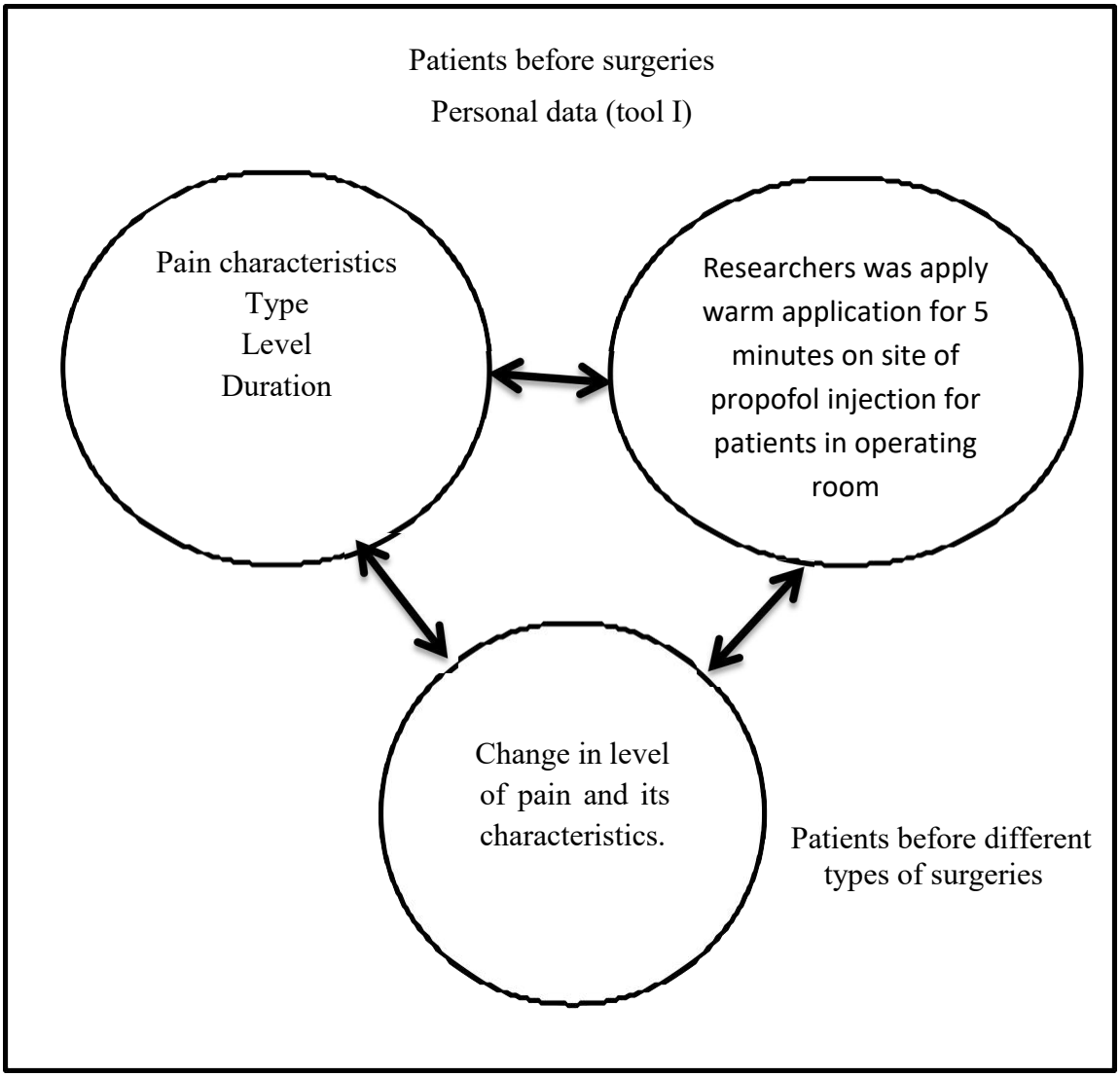
Application of symptom management theory



Operational Definitions

Pain

In the current study pain defined as characteristics of pain including pain intensity, nerve pain, duration of pain, type of pain such as electrical pain or pressure pain. It was measured immediate after applying the warm application (for intervention group) and immediate after lidocaine injection (for the control group) and during propofol injection for the both groups using pain assessment questionnaire (tool II).

Warm application

In the current study warm application defined as an application of rubber gloves containing 200cc warm water with temperature of 40 o. It applied on site of propofol injection for 5 minutes immediately before injection. The warm temperature was maintained (40oC) for 5 minutes.

Routine hospital care

Intravenous injection of lidocaine in conjunction with venous occlusion two minutes before propofol injection.

Methods

Research design:

Quasi-experimental post-test only non-equivalent groups design was utilized in the current study. In this design, study sample in one group are exposed to a treatment or intervention, a nonequivalent group is not exposed to the same treatment or intervention, and then the two groups are compared (APA dictionary of psychology, 2022).

Setting:

The current study was conducted in the operating unit at a governmental hospital afflicted to Cairo university hospitals, Cairo, Egypt. The hospital contains an operating unit in second floor, consisting of 3 operating rooms, one big recovery room containing of 6 beds to receive patients immediate before and after surgery, scrub area, nursing rooms and secretary room. It equipped to receive different types of general surgeries for adult patients.

Sample:

A convenient sample of 60 adult male and female patients immediately before surgeries was recruited for the current study. 60 patients were divided into two groups, intervention and control group (30 patients in each group).

Inclusion criteria

Age over 18 years old, able to communicate and receive propofol as pre anesthetic medication in one of upper extremities,

Exclusion criteria

Patients had disturbance in conscious level or any problems that interfere with pain sensation in the injection site such as paralysis or any neurological problems. Patients with skin problems, skin damage, erythema, burn or edema. Patients who were on low dose of aspirin or other antiplatelet or anticoagulant drugs were also excluded.

Tools of Data Collection and Scoring System

Data for the current study was collected using the following two tools:

Tool 1: Personal and medical data form, It developed by the researchers and consisted of two parts.

Part one; questions regarding gender, age, place of residence, marital status, level of education, occupation, type of surgery … etc..

Part two; pain assessment questions**,** It developed by the researchers and include questions to assess pain characteristics as pain intensity, nerve pain, duration of pain, type of pain such as electrical pain, pressure pain, pain or radiation….etc.

Tool (II) Pain assessment questionnaire, It is consisting of four main questions the first two questions are rating scale type and the last two are open ended questions.

For the first question, it is scored from 0 to 10 scores, 0 means no pain. From 1 to 3 mains the patient has mild pain and from 4 to 7 means that the patient has moderate level of pain while scores from 8 to 10 means the patient has severe level of pain.

The second question has 4 sub questions; each one has 6 answers with 6 scores as follow (0) never, (1) hardly notice (2) slightly (3) moderately (4) strongly (5) very strong. The last two questions about presence of pain radiation and site of radiation if present.

Validity and Reliability

Face and content validity were established for the study tools by a panel of five experts in the field of medical surgical nursing from-faculty of nursing Cairo University. The experts will ask to examine the tools for content coverage, clarity, wording, length, format, and overall appearance. Modifications will be done accordingly. On the other hand, reliability of the second study tool was statistically established using Cronbach's alpha to examine the internal consistency. It was 0.89.

Ethical consideration:

A primary approval was obtained from the Research Ethical Committee at Faculty of Medicine, Kafrelsheikh University to conduct the study with the approval code (MKSU 50-11-21), also an official permission from the operating unit administrators was obtained to conduct the study, the purpose, nature and the importance of the study were explained to each patient who met the inclusion criteria. Also, anonymity and confidentiality of the data collected were assured through coding the data. Patients were assured that participation in this study are voluntarily, and they have the right to withdraw from the study at any time without penalty.

Procedure

Upon receiving the formal approval from Research Ethical Committee at Faculty of Medicine, Kafr El-Sheikh University to conduct this study, as well as an official permission was obtained from the operating unit and hospital

administrators for conducting the study. The current study was preceded in four phases including assessment, planning, implementation, and evaluation.

Assessment phase: In this phase the researchers reviewing the recent relevant literature, checking the feasibility of the study and accessibility of the sample were also assessed. In addition face and content validity of the study tools were established. There were no modifications in the study tools; also reliability of tools was tested statistically using Cronbach's alpha which indicating (0.89).

Planning phase: Based on the outcome of the previous phase the researchers started to randomly select the studied patients from the operating unit to ensure homogeneity between the study groups. The selected patients were assessed for the inclusion and exclusion criteria to make the final design about their involvement in this study. Selected patients were allocating randomly to two groups (intervention and control group).

Implementation phase: Each patient was approached individually one hour before surgery by the researcher to explain the purpose, nature of the study, benefits of adherence to intervention and all the previous mentioned ethical considerations. Each patient was asked to sign the consent form then; the researcher conducted structural interview with each patient to fill up the first research tool which including the initial research assessment. The researcher prepared warm application device by using rubber gloves containing 200cc warm water with temperature of 40 o C (it was measured using the digital temperature probe) and apply it for each patient among the study group 5 minutes before propofol injection.

Evaluation phase: All patients in the study group were verbally asked about level of pain using second study tool immediate after propofol injection (post-test). After finishing the intervention group, patients in the control group after receiving the routine hospital care were verbally asked about level of pain using second study tool immediate after propofol injection (post-test).

Data analysis:

Collected data was tabulated, computed, and analyzed using statistical package for social sciences (SPSS) version 20. A descriptive statistics including frequency distribution, percentage, means and standard deviations were used as well as correlations and t-tests, were used to examine the relationships between variables. The alpha level of .05 was used for all tests of significance.

Results

Table (1) summarized the personal characteristics of the study and control group and showed that; 60% of patients in the study group were female while 46.7% of the control group were male. While 63.4% of patients in the study group were between 38 – to less than 48 years old, but 43.3 of patients in the control group were between 28 – to less than 38 years old. While 63.3% of patients among the study group and 53.3 % of the control group were live in urban area, Also, 43.3 of the study group and 46.3 of the control group were intermittent learning. While 93.3 % of study group and 86.7% of control group were married. In relation to type of work 46.7 % of the study group were housewives, while 36.7 % of the control group were housewives and employees.

Table (2) illustrated the medical details of patients as follow; In relation to type of surgery, (26.6% and 23.3%) among the study group were (thyroidectomy and anal fissure) respectively while, (16.8% and 13.5%) of the control group were (thyroidectomy and ileostomy) respectively. In relation to the question about did patients take this medication before, 56.6% of the study group and 70% of the control group their answers were no. while 99.4% among the study group and 77.8% among the control group had pain and burning sensation in site of injection.

Table (3) showed that; 63.3% of the study group and 36.7% of the control group had mild level of pain. While 63.3% among the study group and 36.6% among the control group had slight burning sensation. Also, 23.3% and 23.3% of study group had (hardly noted and slight pricking sensation respectively) wile 53.3% of the control group had slight pricking sensation. Around 60% among the two groups never had Pain like electrical shock. As well as 46.7% of the study group never had numbness sensation and 60% of the control group slightly had numbness sensation. Also, 33.3% among the study group and 43.4% among the control group had slight pressure sensation. Both groups had no pain radiation.

Table (1): Frequency and percentage distribution of personal characteristics among study and control group (n = 60).

Item	Study group		Control group	
	No.	%	No.	%
Gender				
- Male	12	40	14	46.7
- Female	18	60	16	53.3
Age				
- 18 – < 28 years	2	6.6	5	16.7
- 28 – < 38years	9	30	13	43.3
- 38 – < 48 years	19	63.4	12	40
	39 ± 8		33 ± 10	
Place of residence				
- Rural	11	36.7	14	46.7
- Urban	19	63.3	16	53.3
Level of education				
- Highly educated.	8	26.7	6	11
- Intermediate education	13	43.3	14	46.3
- Can-not read or write.	9	30	10	33.3
Marital status				
- Married	28	93.3	26	86.7
- Single	2	6.7	4	13.3
Type of work				
- Employee	6	20	11	36.7
- Student	2	6.6	4	13.3
- Worker	8	26.7	3	10
- House wife	14	46.7	11	36.7

Table (2): Frequency and percentage distribution of medical data among study and control group (n = 60).

Item	Study group		Control group	
	No.	%	No.	%
Type of surgery				
- Perianal fistula	4	13.4	1	3.3
- Right superficial parotidectomy	2	6.7	2	6.6
- Thyroidectomy	4	13.4	2	6.6
- Inguinal hernia	8	26.6	5	16.8
- Ileostomy	0	0	2	6.6
- Anal fissure	3	10	4	13.5
- Laparoscopic cholecystectomy	7	23.3	9	30
- Hernioplasty	1	3.3	0	0
- Sleeve gastrostomy	0	0	2	6.6
- Umbilical hernia	1	3.3	3	10
Have you ever taken this medicine?				
- Yes	13	43.4	9	30
- No	17	56.6	21	70
If yes, have there been any complications at site?				
- Yes	12	92.3	9	100
- No	1	7.7	0	0
Mention				
- Pain				
- Pain and itching sensation	4	33.3	2	22.2
	8	66.7	7	77.8

Table (3.1): Frequency and percentage distribution of pain level among study and control group (n = 60).

Item	Study group		Control group		P value
	No.	%	No.	%	
1- Intensity of pain					
- No	4	13.3	9	30	
- Mild	19	63.3	11	36.7	0.076
- Moderate	7	23.4	10	33.3	
- Sever	0	0	0	0	
2- Nerve pain					
a- Burning sensation.					
- Never	5	16.7	9	30	
- Hardly noted	2	6.7	5	16.7	0.082
- Slight	19	63.3	11	36.6	
- Moderate	4	13.3	5	16.7	
- Strong	0	0	0	0	
- Very strong	0	0	0	0	
b- Pricking sensation.					
- Never	14	46.7	3	10	
- Hardly noted	7	23.3	5	16.6	
- Slight	7	23.3	16	53.4	0.032*
- Moderate	2	6.7	6	20	
- Strong	0	0	0	0	
- Very strong	0	0	0	0	

Table (3.2): Frequency and percentage distribution of pain level among study and control group (n = 60).

Item	Study group		Control group		P value
	No.	%	No.	%	
c- Pain like electrical shock					
- Never	20	60.7	18	60	
- Hardly noted	8	26.7	10	33.3	
- Slight	2	6.6	2	6.7	0.182
- Moderate	0	0	0	0	
- Strong	0	0	0	0	
- Very strong	0		0	0	
d- Numbness sensation					
- Never	14	46.7	4	13.3	
- Hardly noted	4	13.3	4	13.3	
- Slight	7	23.4	18	60	0.041*
- Moderate	5	16.6	4	13.4	
- Strong	0	0	0	0	
- Very strong	0	0	0	0	
e- Presence of slight pressure					
- Never	8	26.7	5	16.6	
- Hardly noted.	6	20	10	33.3	
- Slight	10	33.3	13	43.4	0.64
- Moderate	6	20	2	6.7	
- Strong	0	0	0	0	
- Very strong	0	0	0	0	
3- Pain radiation					
- Yes	0	0	0	0	0.297
- No	30	100	30	100	

Summary of result

Based on the previous data There is no statistically significance difference regarding pain level among the study and control group in relation to warm application therefore, the study hypothesis was rejected.

Discussion

This present study compared the effects of warm compresses and lidocaine injection regarding decreasing the propofol injection pain. The results are similar with those of other studies in which local warm compresses and lidocaine injection at the intravenous site reduced propofol injection pain. The similar study done by (Yamakage, Iwasaki, Satoh & Namiki, 2020) in which they concluded that; both sole injection of heated carrier fluids and the combination of 0.5 mg/kg 1% lidocaine pretreatment were not effectively reduced propofol injection pain. So, the assumed mechanism of warm compresses which indicted that, the thermal stimulus increases blood flow and allows vasodilation of the blood vessels, thus diluting the propofol concentration, letting it flow in the mainstream of the vascular lumen and minimize the contact with the vascular epithelial cells. Although both warm compresses and lidocaine injection are similar in reducing level of pain in the site of propofol injection, also the warm compresses as a natural method are more safe than lidocaine injection in relation to the pharmacological effect and negative consequences inside the body.

Conclusion and recommendation

Both warm compresses and lidocaine injection as a routine hospital intervention are similar in improving level and characteristics of pain in the site of propofol injection. Although both interventions are effective. While from the researcher's point of view applying warm compresses in the site of propofol injection had no negative consequences comparing with lidocaine injection which considered unsafe as it is one of the pharmacological agent.

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