Effect of Cold Application on Local Problems among Patients Receiving Subcutaneous Enoxaparin

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Abstract

Background: Subcutaneous enoxaparin administration often causes problems such as pain; bruise and hematoma at the injection sites. In terms of these problems, cold application has been found to have various therapeutic benefits as relieve pain by produce localized anesthetic effect and controls bleeding by causing vasoconstriction. **Aim of the study:** To investigate the effect of cold application on local problems among patients receiving subcutaneous enoxaparin. **Design:** Self-controlled trial design was utilized. **Setting:** The study was carried out in general surgery department, orthopedic surgery department, and chest Intensive Care Unit at Beni-seuf University Hospital. **Study subjects:** A purposive sample of 60 patients was included in the study. **Data collection tools:** Data were obtained through Patient assessment tool, Bruising Category Scale, Visual Analogue Scale for pain and Hematoma Formation Scale. **Results:** All studied patients had pain and more than half developed bruise at injection site when they received enoxaparin without cold application but more than three quarter of studied patients had pain and less than one quarter developed bruise when they received injection with cold application. Meanwhile, the majority of the studied patient did not develop hematoma whether cold applied at injection site or not. **Conclusion:** The pre-injection cold application at enoxaparin injection site was effective in reducing the occurrence of pain and bruising. Moreover, there was statistically significant relation between the patients' pain intensity, the size of bruising and their demographic characteristics; age and gender. **Recommendations:** Cold application should be included in standard protocol for the administration of SC enoxaparin and providing on-going and regular in-service educational programs about it for nurses.

Key words: Enoxaparin, Subcutaneous, Local problems, Cold application.

Introduction

Normal circulation requires blood to circulate freely through small and large blood vessels. Though, blood must also be able to form clots to prevent excessive blood loss from injuries. To perform both of these functions necessitates the body's ability to balance coagulation and anticoagulation. Blood is composed of various substances, each with a specific purpose that assists in maintaining a balance of coagulation and anticoagulation ***(Aschenbrenner & Venable, 2009).***

Anticoagulants are the cornerstone therapy for prevention and treatment of thrombosis as it can inhibit thrombogenesis by altering various pathways within the clotting cascade or by decreasing thrombin generation. It is prescribed for prophylaxis against or treatment of various medical conditions as venous thrombosis, pulmonary embolism and thromboembolic

complications associated with atrial fibrillation (AF) and heart valve replacement. Unfractionated heparin (UFH) and low molecular weight heparin (LMWH) are the anticoagulants of choice in acute thrombosis due to their rapid onset of antithrombotic activity ***(Alquwaizani, Buckley, Adams, & Fanikos, 2013).***

Enoxaparin which is low molecular weight heparin has a much more predictable anticoagulant effect, greater bioavailability and a longer half-life than unfractionated heparin. It's administered subcutaneously and don't need frequent lab monitoring. However, just like any other drugs, the use of LMWH does not come without possible adverse reactions. Enoxaparin often cause local problems such as bruising, pain and hematoma at the injection site, these local problems increase the patient's physical and psychological discomfort and thus result in patients' distrust in nurses' efficiency ***(Yi et al., 2016).***

These problems can threaten patient safety and result in the patient's avoidance of future injections so it is important that nurses use strategies to reduce the incidence of these adverse outcomes to improve the patients' satisfaction and also enhance their trust in health care providers ***(de Campos, da Silva, Beck, Secoli, & de Melo Lima, 2013).***

In terms of these adverse effects, the application of cold has been found to have various therapeutic benefits. Cold application at the site of subcutaneous injection controls bleeding by causing vasoconstriction in the arterioles, increases clotting by lowering the speed of blood flow, increasing viscosity, reducing capillary permeability and metabolic needs and this reduces the development of bruising and hematoma furthermore cold application relieve acute pain by produce localized anesthetic effect in the injection site ***(Kilic &Midilli, 2017).***

Aim of the study

This study was aiming to investigate the effect of cold application on local problems among patients receiving subcutaneous enoxaparin.

Research hypothesis:

- The pre-injection cold application at the injection site will have a positive effect in prevention and reduction of pain intensity among patients receiving subcutaneous Enoxaparin.

- The pre-injection cold application at the injection site will have a positive effect in prevention and reduction of bruising among patients receiving subcutaneous Enoxaparin.

- The pre-injection cold application at the injection site will have a positive effect in prevention and reduction of hematoma among patients receiving subcutaneous Enoxaparin.

Subject and Methods

The subject and methods of the current study were discussed under the following four designs:

Technical Design, Operational Design, Administrative Design and Statistical Design

Technical Design:

Technical design included the research design, setting, subjects, as well as tools for data collection.

Research Design:

Self-controlled trial design was utilized for the conduction of this study.

Research setting:

The study was conducted at general surgery department, orthopedic surgery department, and chest Intensive Care Units at Beni-Seuf University Hospital.

Subjects:

Purposive sample of 60 patients from the previously mentioned departments was included in the study.

- **Inclusion criteria:** Only newly admitted conscious patients who receive subcutaneous injections of 40 mg of low molecular weight heparin (Clexane) twice a day for prophylaxis or treatment and able rate the pain scale intensity were included in the study.

- **Exclusion criteria:** pregnancy, intake of any other anticoagulant drugs and patients with abnormal liver functions, with coagulation or hematological diseases and patients with cognitive impairments were excluded from the study.

Tools of data collection:

Data were collected using the following tools:

1.Patient assessment tool: This tool was developed and filled by the investigator based on ***(Kilic & Midilli, 2017)*** to suite the study aim. It included two parts: Demographic data and Medical data.

Part I: Demographic Data: It used to assess demographic characteristics of the studied patients as age and gender.

Part II: Medical Data: It used to collect data regarding patient care unit, medical diagnosis, past medical history, patient's weight and laboratory investigation as (Prothrombin time, prothrombin concentration and International normalized ratio (INR) for studied patients from patient's admission records. Meanwhile, height, body mass index and arm circumference were measured by the investigator.

2.**Bruising Category Scale**: This scale was used by the investigator for measurement of bruising which adopted from ***McGowan and Wood, (1990)***.

- **Scoring system:**

It was classified bruises into three categories according to surface area: No bruise (<2 mm^2), small bruise (2-5 mm^2), and large bruise (>5 mm^2).

3.Visual Analogue Scale for pain (VAS): This scale was used by the investigator to assess pain intensity which adopted from ***(Ohnhaus & Adler, 1975).***

- **Scoring system:**

It was classified pain intensity as none, mild, moderate, or severe: no pain (0), mild pain (1–4), moderate pain (5–7), and severe pain (8– 10).

4.**Hematoma Formation Scale tool:** This scale was used by the investigator for measurement of hematoma which adopted from ***(Andersen, Bregendahl, Kaestel, Skriver, & Ravkilde, 2005)***.

- **Scoring system:**

It was classified hematoma into four categories according to surface area: No hematoma (< 2cm in diameters), Small hematoma (2 < 5 cm in diameter), Large hematoma (5≤ 10 cm in diameter) and Significant hematoma (>10 cm in diameter).

Operational Design:

Preparatory phase:

It included reviewing of related literature, and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and journals to develop data collection tools.

Pilot study

A pilot study was carried out on 10% of total study subjects (6) to test the clarity, applicability, feasibility and relevance of the tools used and to determine the needed time for the application of the study tools. The patients who were included in the pilot study excluded from the sample because minor modification was done after conducting pilot study.

Field work:

- All newly admitted patients receiving SC enoxaparin assessed by the investigator for meeting the inclusion criteria. Patients who met the study criteria, obtaining explanatory information about the study and asked if agree to participate in the study. The actual work of this study started and completed within six months from **October (2017)** to the end of **March (2018).** Data were collected by the investigator five days per week, at night shifts in the previous mentioned settings.

- **Data Collection Instruments:** The equipment used in this study consist of: Refillable cold packs (size: 15×11 cm); a thermometer to determine the temperature of the packs; disposable towel to cover refillable cold packs; a watch with a second hand to measure the duration of an enoxaparin injection and the duration of the applications of cold packs; a waterproof pen to mark the injection site; a millimeter transparent ruler for measuring the diameter of a bruise and hematoma, and measuring tape to measure arm circumference and height .

- The study used self-controlled trial design in which each patient act as his/her own control, meaning that a one-group study (60 subjects) were used, in which each patient received two injections by the same investigator using two different techniques: injection without cold application as the control method (Technique A) and pre injection cold application for 5 minute as the experimental method (Technique B) at different sites in 24h interval.

- **Firstly,** subject's demographic characteristics such as age and gender and medical data were recorded in a data collection form.

Body mass index: It was calculated as body mass in Kg divided by the height in meters squared. Patient's body mass index was categorized into: Normal (18.5-24.9) Kg/m^2, overweight (25.0-29.9) Kg/m^2 and obese ($\geq$ 30.0 Kg/m^2) based on ***(Pi-Sunyer et al., 1998).***

Arm circumference: Mid upper arm circumference was measured by a flexible non-stretch tape. The measurement was taken at the midpoint of upper arm (between the acromion process and the tip of olecranon) based on ***(Gibson, 2005).***

- During the study, Refillable ice bags made of rubber with clamp is used. The investigator filled the bag to two-third full with ice and some water; the remaining air was expelled from the bag and the clamp was closed. Then ice bag warped in a towel or thin cloth as a barrier between ice pack and the patient's skin to prevent frostbite and damage to the tissue. The temperature range of these ice bags was below 15^0 C based on the instructions recommended by available nursing textbooks ***(Taylor & Evans-Smith, 2005; Berman, A., Snyder, S.,& Frandsen, G., 2015).***

- **In first day** night shift, the enoxaparin injection (clexane) was given by the investigator in the left arm (the back of upper arm) without cold application, according to SC injection technique, the site marked with water proof pen, a circle of approximately 5 cm^2 was drawn around the insertion point and recorded in data collection form. Pain assessment was performed immediately after injection. Hematoma and bruising assessed after 48 and 72 hours.

- **Later in the second day** night shift, pre injection ice bag applied for 5 minutes, and then SC enoxaparin injection (clexane) was administered by the investigator in the right arm (the back of upper arm) according to SC injection technique, the site marked with water proof pen, a circle of approximately 5 cm^2 was drawn around the insertion point and recorded in data collection form. Pain assessment was performed immediately after injection. Hematoma and bruising assessed after 48 and 72 hours.

Measurement of bruise and hematoma:

It was reported that the bruising or hematoma induced by the SC enoxaparin injection was most significant at 48 hours after injection, and the bruising decreased by 72 hours ***(Potter and Perry, 2007).*** Therefore, bruising and hematoma measurements were performed at 48 and 72 hours after injection. The assessment was made by the investigator. Any discoloration of the skin >2 mm^2 in diameter was measured by transparent millimetric ruler placed on the injection site and the bruise area was calculated in mm^2. The investigator measured hematoma size by millimeter transparent ruler placed on injection site and the widest dimension was measured to the nearest centimeter.

Measurement of pain intensity:

Pain assessment was carried out immediately after each injection using visual analog scale. Zero represented no pain and 10 represented extreme pain. Immediately following each injection, the subjects were asked to identify a number from 0 to 10 that represents their current level of perceived pain at the time of injection.

Subcutaneous injection protocol for all patients and in two techniques includes: Syringe type: Prefilled single dose (enoxaparin) with LMWH dose 4000 IU and volume 0.4 ml. Its needle size 27 gauge, **Air lock:** 0.2-ml air lock inserted. **Alcohol wipe:** Area cleanses with alcohol and allowed to air dry before needle insertion, **Raised skin fold:** Yes, **Aspiration:** No aspiration, **Insertion angle:** 45 or 90 degree, **Site:** Right and left arms, **Injection duration:** 10 seconds, **after injection:** Applying a light pressure at the injection site, not massaging the site and **site pressure duration:** 10 seconds.

Administrative Design:

To carry out this study, the necessary approval was obtained from the hospital director and the administrative authorities of the previously mentioned settings in Beni-Seuf University Hospital after explanation of the aim of the study. A letter was issued to them from the faculty of nursing, Ain Shams University explaining the purpose of the study to obtain the permission for conducting this study.

Ethical considerations

Approval of the study protocol was obtained from Ethical Committee in the Faculty of Nursing at Ain Shams University before starting the study. The investigator clarified the aim of the study to the patients included in the study and asked them if agree to participate in the study.

Patients were informed that they have the right to withdraw from the study at any time. The investigator assured maintaining anonymity and confidentiality of the subject data and patient safety assured during the study

The collected data were organized, categorized, tabulated and statistically analyzed using the statistical package for social science (SPSS) version (17). Data were presented in tables and graphs. The statistical analysis included; percentage (%), the arithmetic mean ($\overline{X}$), standard deviation (SD), chi-square (X^2) and t-Test.

Statistical Design:

Result

Table (1): Frequency and percentage distribution of the studied patients as regards to demographic characteristics (n=60).

Demographic characteristic		Frequency	Percent
Age	18 < 30	12	20.0
	30 < 40	14	23.3
	40 < 50	9	15.0
	≥ 50	25	41.7
	Mean ±SD 45.43±18.18		
Gender	Male	41	68.3
	Female	19	31.7

Table (1): Reveals that 41.7% of the studied patients their age ≥ 50 with a mean age of 45.43±18.18. As regard to gender, the results revealed that 68.3% of studied patients were male.

Table (2): Frequency and percentage distribution of the studied patients as regards to medical history (n=60).

Medical history	No.	%
Medical Diagnosis		
Fracture	41	68.3
Interstitial lung disease	6	10.0
Postoperative	3	5.0
Pneumonia	3	5.0
Lower limb ischemia	3	5.0
Deep vein thrombosis	2	3.3
Chronic obstructive pulmonary disease	2	3.3
Past medical history		
Diabetes Mellitus	11	18.3
Hypertension	9	15.0
Cardiac diseases	1	1.7
Renal diseases	1	1.7

Table (2): displays that the studied patients current medical diagnosis were fractures, interstitial lung disease, postoperative, pneumonia, lower limb ischemia, deep vein thrombosis and chronic obstructive pulmonary disease (68.3%, 10.0%, 5.0%, 5.0%, 5.0%, 3.3%, 3.3%)

respectively. This table also reveals the past medical history as patients had diabetes Mellitus, hypertension, cardiac diseases and renal diseases (18.3%, 15.0%, 1.7%, 1.7%) respectively.

Fig (1): Frequency and percentage distribution of the studied patients as regards to their patient care setting (n =60).

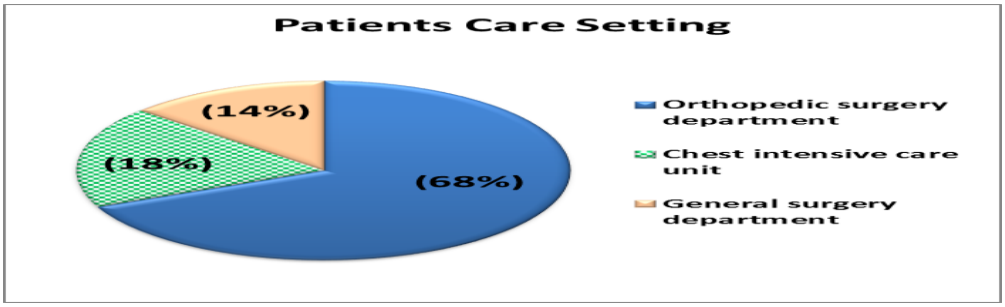

Fig (1): Illustrates that, 68% of the studied patients were from orthopaedic surgery department, while 18% of them from chest intensive care unit and 14% from general surgery department.

Table (3): Frequency and percentage distribution of the studied patients as regards to medical data (n=60).

Medical data	No.	%	Mean± SD
Lab investigations			
International Normalized Ratio			
Normal	50	83.3	1.11± 0.11
High	10	16.6	
Low	0	0	
Prothrombin time			
Normal	42	70.0	13.07±1.35
High	18	30.0	
Prothrombin concentration			
Normal	52	86.6	88.77±10.48
Low	8	13.3	
Body measurements			
Body mass index			
Normal	24	40.0	28.14±6.44
Overweight	18	30.0	
Obese	18	30.0	

Based on the ranges indicated by the laboratory unit of the hospital involved.

Table (3): Shows that 83.3% of the studied patients had normal INR and 70% of them had normal PT value. This table also reveals that mean score of INR, PT and PC in studied patients were 1.11, 13.07 and 88.77 respectively. Also this table displays that 30% of the studied patients were obese and patient's body mass index mean score was 28.14±6.44.

Table (4): Comparison between pain intensity levels in technique A and B (n= 60).

Pain intensity	Mean±SD	T	P Value
Technique A (without cold application)	5.27± 1.89	5.77	0.00000*
Technique B (with cold application)	3.12± 2.19		

*≤ 0.001 highly significant

Table (4): Displays that the mean score of pain intensity after technique A was 5.27± 1.89, while it was 3.12± 2.19 in patients received technique B. This table also shows that pain intensity level reported by patients when technique B was used was statistically highly significantly lower than technique A at p value 0.00000.

Table (5): Comparison between two injection technique regarding bruising categories after 48 and 72 hours (n= 60).

Bruising categories	Technique A		Technique B		Chi squared	P Value
	No.	%	No.	%		
After 48 Hours						
No bruise (<2 mm^2)	28	46.7	47	78.3	14.61	0.000671*
Small bruise (2-5 mm^2)	12	20	8	13.3		
large bruise (>5 mm^2)	20	33.3	5	8.3		
After 72 Hours						
No bruise (<2 mm^2)	30	50.0	47	78.3	12.98	0.001522*
Small bruise (2-5 mm^2)	10	16.7	8	13.3		
large bruise (>5 mm^2)	20	33.3	5	8.3		

*≤ 0.001 highly significant

Table (5): Shows that patient's developed bruise at injection site when technique B used was statistically highly significant lower than technique A at p value ≤ 0.001 and the difference between the two techniques after 48 & 72 hours was statistically highly significant at p-value 0.000671 and 0.001522 respectively.

Table (6): Comparison between two injection technique regarding hematoma categories after 48 and 72 hours (n= 60).

Hematoma categories	After 48 and 72 Hours				Chi squared	P Value
	Technique A		Technique B			
	No.	%	No.	%		
No hematoma (< 2cm in diameters)	52	86.7	57	95.0	3.23	0.19895
Small hematoma (2< 5 cm in diameter)	6	10.0	3	5.0		
Large hematoma (5≤ 10 cm in diameter)	2	3.3	0	0.0		
Significant hematoma (>10 cm in diameter)	0	0.0	0	0.0		

Both techniques (A, B) were the same after 48hrs and 72hrs. > 0.05 insignificant

Table (6): Displays that there was no statistically significant difference can be detected between the two techniques regarding hematoma categories at p value 0.19895.

Discussion

Cold application at the site of SC injection controls bleeding by causing vasoconstriction in the arterioles, increases clotting by lowering the speed of blood flow, increasing viscosity, reducing capillary permeability and metabolic needs and this reduces the development of bruising and hematoma furthermore cold application relieve acute pain by produce localized anesthetic effect in the injection site ***(Kilic & Midilli, 2017).***

So, the aim of the current study was to investigate the effect of cold application on local problems among patients receiving subcutaneous enoxaparin.

The discussion of the findings covered four main parts:

(1) The first part concerned with demographic characteristics of the patients under the study.

(2) The second part discussed studied patient's medical data.

(3) The third part discussed assessment of local problems associated with enoxaparin injection.

(4) The fourth part discussed the relations between different variables.

Part I. Concerned with demographic characteristics of the patients under the study:-

Regarding the demographic characteristics of the patients under the present study, the results revealed that, more than half of the studied patients' age was less than 50 years with mean age of 45.43±18.18 years.

This finding was in agreement with ***Alabdalhai, Mokabel & Al-Ghuneimy, (2017)*** mentioned in study titled "The Impact of Cold Therapy on the Pain and Hematoma on the site of Injection of Enoxaparin in Kingdom of Saudia Arabia" and found that, the patients mean age was 47.5 ± 20.7 years.

This finding was contradicted with ***Ahmadi, Ahmadi, Saadati & Mehrpour, (2016)*** who conducts a study titled "The Effect of Extended Injection of Subcutaneous Heparin on Pain Intensity and Bruising Incidence" and

stated that, more than two third of the studied patients were in the age group 50-69 years.

Related to gender, the present study results showed that, more than two third of the studied patients were males. This finding was consistent with ***Avsar & Kasikci, (2013)*** who carried a study entitled "Assessment of four different methods in subcutaneous heparin applications with regard to causing bruise and pain in Turkey" and found that, the majority of studied patients were males.

This finding was incongruent with ***Sendir, Buyukyilmaz Celik & Taskopru, (2015)*** who mentioned in study titled "Comparison of 3 Methods to Prevent Pain and Bruising after Subcutaneous Heparin Administration in Turkey" and stated that, more than half of the studied patients were females.

Part II: concerned with studied patient's medical data:

Regarding patient care unit, the results of the current study found that, more than half of the studied patients were taken from orthopaedic surgery department and had fractures as their medical diagnosis, while less than one quarter of the studied patients from chest intensive care unit and only eight patients from general surgery department. This might be due to the majority of orthopedic patients receive enoxaparin pre and post-surgery to prevent complications of immobility.

This finding agreed with ***Dadaeen et al. (2015)*** who conduct a study titled" The Effect of Duration of Subcutaneous Injection on the Extent of Bruising and Pain Intensity at Injection Sites among Patients Receiving Enoxaparin Sodium in Iran" and reported that, more than half of the study sample was orthopedic patients.

Concerning patients past medical history, the present study findings showed that, only one third of the studied patients had chronic diseases as diabetes mellitus, hypertension, renal and cardiac diseases. This might be due to more than half of the studied patients were young orthopedic patients.

This finding was contradicted with ***Kilic & Midilli, (2017)*** who mentioned in the study entitled "Effects of Cold Application on Pain and Bruising Complications Associated with Subcutaneous Heparin in Intensive Care Patients" and reported that all patients had chronic diseases and half of them had cardiovascular diseases as a chronic illness.

Regarding patient's lab investigation on admission, the results of the current study revealed that, the mean score of prothrombin time in the studied patients was 13.07± 1.3. This finding was in accordance with ***Alabdalhai et al. (2017)*** who reported that, the mean score of prothrombin time in the studied patients was 12.8 ± 1.3.

Related to INR, the present study results showed that, more than three quarter of the studied patients had normal INR and only one quarter of patients had high INR. This finding was in the same line with ***Palese, Aidone, Dante, & Pea, (2013)*** who mentioned in the study entitled" Occurrence and Extent of Bruising According to Duration of Administration of Subcutaneous Low-Molecular-Weight Heparin in Italy" and found that, the majority of the patients had normal INR.

Based on the results of the current study, it was found that, more than one quarter of the studied patients were obese. This finding was in the same line with ***Jareno-Collado et al. (2018)*** who carried a study entitled "Ecchymosis and/or hematoma formation after prophylactic administration of subcutaneous enoxaparin in the abdomen or arm of the critically ill patient in Spain" and stated that, more than one quarter of the studied patients were obese. This finding was incongruent with ***Palese et al. (2013)*** who found that, less than one quarter of patients were obese.

Part III: concerned with assessment of local problems associated with enoxaparin injection.

A- Pain intensity regarding two injection techniques (Hypothesis I):

As regards to pain assessments, It was showed that all studied patients expressed that they had pain during technique A (without cold application) used, while more than three quarter of them reported that they had pain during technique B (with cold application) used. The results of the present study showed that, the pain intensity of injecting enoxaparin with cold application was significantly lower compared to inject it without cold application at $P < 0.001$.

This might be due to the physiological effects of the cold application and according to these findings, it could be said that pre-injection cold application had both an analgesic effect and was effective in decreasing the pain perception at injection site.

The hypothesis formulated by the investigator in this study was that the pre-injection cold application at the injection site will have a positive effect in prevention and reduction of pain intensity among patients receiving subcutaneous enoxaparin. Thus the hypothesis was accepted.

This result was consistent with many studies as ***Avsar & Kasikci, (2013)*** who showed that, adding cold applications to injection procedures had a significant influence in the reduction of pain and ***Kilic & Midilli, (2017)*** who stated that the pain scores in the intervention with cold application were lower than those in the intervention without cold application.

B- Bruising category regarding two injection techniques(Hypothesis II):

The present study findings showed that, more than half of the studied patients developed bruise at injection site during technique A (without cold application) used, while less than one quarter of them developed bruise during technique B (with cold application) used. This reflected that, the difference between the two techniques after 48 & 72 hours was statistically highly significant at $P < 0.001$ and the proportion of cases with no bruise in Technique B was higher than technique A.

According to these findings, it could be said that the cold application at the injection sites was prevented and reduced bruises. The hypothesis formulated by the investigator in this study was that the pre-injection cold application at the injection site will have a positive effect in prevention and reduction of bruising among patients receiving subcutaneous enoxaparin. Thus the hypothesis was accepted.

This result has been confirmed in many studies as ***Avsar & Kasikci, (2013)*** who said that, injection of subcutaneous enoxaparin with 2-min cold application can be effective in preventing and reducing the occurrence of bruising and ***Varghese, Walia, Sharma, & Kaur, (2006)*** who conduct a study titled "Prevention and reduction of pain, bruise and hematoma by 'Moist Ice Pack' application on the site of subcutaneous heparin injection "and reported that, application of moist ice pack at the injection sites have prevented and reduced the number and size of bruises.

However, result was contradicted with ***Kuzu & Ucar, (2001)*** who carried a study entitled "The effect of cold on the occurrence of bruising, hematoma and pain at the injection site in subcutaneous low molecular weight heparin" and stated that, there was no statistically significant difference between incidence of bruising and applying of local cold packs on the injection site.

As regards to comparing between bruising at 48h and bruising at 72 h, the current study was found that, with or without the cold application intervention, the bruising was seen to be the same at 48hours and at 72 hours and there was no significant difference.

This finding was contradicted with ***Amaniyan, Varaei, Vaismoradi, Haghani, & Sieloff, (2016)*** who carried a study entitled "Effect of local cold and hot pack on the bruising of Enoxaparin Sodium Injection Site: A Randomized Controlled Trial" and stated that, for both intervention groups the peak of bruising was at 48 hours after injections, and the beginning of the disappearing process was within 24 hours after this peak.

C- Hematoma formation regarding two injection techniques (Hypothesis III):

The present study findings revealed that, less than one quarter of patients developed hematoma at injection site during technique A (without cold application) used. While only three patients developed hematoma during technique B (with cold application) used. This reflected that the majority of the studied patient did not develop hematoma in two techniques and there was no statistically significant difference between the two techniques regarding the hematoma formation at p value > 0.05.

This finding might be due to the standard injection technique, which was applied to prevent haematoma and was effective whether used the application or not used at injection sites. The fact that there was no difference between two techniques also indicates that the injection technique is more effective in the prevention of hematoma than cold application.

As well, it could be said that the pre-injection cold application at the injection site is not effective in reducing or preventing hematoma. The hypothesis formulated by the investigator in this study was that the pre-injection cold application at the injection site will have a positive effect in prevention and reduction of hematoma among patients receiving subcutaneous enoxaparin. Thus the hypothesis was rejected.

This finding was consistent with ***Ross and Soltes, (1995)*** who conduct a study titled "Heparin and hematoma: does ice make a difference" and reported that, when ice was applied, there was no significant difference in the incidence or hematoma size.

This finding was incongruent with ***Alabdalhai et al. (2017)*** who stated that, the cold application can reduce occurrence of hematoma in patient who receives enoxaparin injection.

As regards to comparing between hematoma at 48h and hematoma at 72 h, the current study was found that with or without the cold application intervention, the hematoma was seen to be the same at 48hours and at 72 hours and there was no significant difference.

Part VI: Relations between patient's different variables:

Regarding patient's age, the results of the current study revealed that there was a significant relation between the bruising and age, Meanwhile there was no significant relation between pain intensity, hematoma and age.

In the same line ***Ebersole & Hess, (2001)*** believed that collagen tissue decreases by about 1% with age. This could affect the fragility of blood vessels and, consequently, decrease the resistance of the skin and capillary against pressure, easily tearing them. Thus, increased vascular fragility and decreased skin resistance against pressure in the elderly cause larger bruising due to the damages induced by SC injection of enoxaparin.

This finding was incongruent with many studies as ***Amaniyan et al. (2016)*** **and** ***Sendir et al. (2015)*** who stated that, no significant difference was found between the size of the bruise and age of studied patients.

Concerning patient's gender, the results of the present study found that the pain intensity

was significantly more in women than in men. However, no significant difference was found between male and female patients regarding bruising and hematoma formation. This might be due to women's greater susceptibility to nerve transmission of pain and their anatomical and hormonal differences.

This finding was in the same line with ***Asl, Kheradmand & Jafarian, (2008)*** who conduct a study on "Effect of duration of subcutaneous heparin injection on its subsequent pain "and reported that, pain intensity was significantly higher in women compared to men.

This finding was incongruent with ***Dadaeen et al. (2015)*** who found that the extent of bruising was significantly higher in women than in men and Regarding medical data as PT, INR, BMI and medical diagnosis of studied patients, the current study revealed that no significant differences were found between medical data and pain, bruising and hematoma formation. This finding was in the same line with ***Kuzu &Ucar, (2001)*** who stated that, the sample was tested to determine whether body mass index, patients' current medications, latest platelet and APTT values had an effect on the incidence of bruise formation, pain intensity and duration and no significant differences were observed.

Concerning arm circumference, the current study showed that, there was a relation between arm circumference and bruising, statistically highly significant at $P < 0.05$ but no previous study pointed to measurement of arm circumference and its relations.

Conclusion

Based on findings of the current study, it can be concluded that: When studied patients received enoxaparin without cold application, all of them had pain and more than half developed bruise at injection site but when they received injection with cold application only three quarter of them had pain and less than one quarter developed bruise. Meanwhile, the majority of the studied patient did not develop hematoma whether cold applied at injection site or not. Thus it could be said that the pre-injection cold application at the injection site was effective in reducing or preventing the occurrence of pain and bruising. Moreover, there was statistically significant relation between the patients' pain intensity, bruising and their demographic characteristics; age and gender.

Recommendation

- **Recommendations regarding clinical practice**:

It is recommended that the cold application should be included in the subcutaneous injection protocol of enoxaparin.

- **Recommendations regarding education:**

Providing on-going and regular in-service educational programs on standard protocol for the administration of subcutaneous LMWH.

- **Recommendations regarding administration:**

Hospital protocols regarding SC injection administration especially enoxaparin should be developed and reviewed regularly as updates and new evidence for best practice are constantly emerging and nurses should be educated on updated protocols.

- **Recommendations regarding research:**

Research should be conducted about current educational requirements that include subcutaneous LMWH to identify reasoning as why nurses are not administering this medication according to standard protocol. Results would indicate needed interventions in the educational

curriculum that would promote the use of the standard techniques.

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