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Original Article

The Effect of 3 Different Local Cold Applications on Pain and Ecchymosis in Subcutaneous Heparin Injections

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ABSTRACT

Objective: The study aimed to examine the effect of 3 different local cold application methods on pain intensity and ecchymosis in subcutaneous low-molecular-weight heparin.

Methods: A randomized controlled experimental study. Participants consisted of patients who were hospitalized and administered subcutaneous low-molecular-weight heparin. The sample consisted of 54 patients who applied 3 cold applications (thermomechanical analgesia, local coolant spray, and cool-pack). Pain intensity was measured with the visual analog scale and the ecchymosis sizes were measured with the Opsite-Flexigrid Measurement Tool. This study was created in accordance with CONSORT Statement Checklist.

Results: The rate of the pain experience (11%) and the mean of pain intensity had the lowest rate/level in the "local cool-pack" application ($P < .05$). Similarly, the rate of ecchymosis (24.1%) and the mean of ecchymosis had the lowest rate/level in the "local cool-pack" application ($P < .05$). In the control application, the rate of ecchymosis development at the 24th, 48th, and 72nd hours after subcutaneous low-molecular-weight heparin injection was found to be significantly higher than in other cold application methods ($P < .05$).

Conclusion: This study provides the information that cool-pack application is the most effective method among the different cold applications used in reducing the complications related to subcutaneous low-molecular-weight heparin applications.

Keywords: Subcutaneous injection, pain, ecchymosis, cold application

Introduction

The abdominal region, which is stated as the most reliable injection site in subcutaneous (SC) low-molecular-weight heparin (LMWH) applications, is the first region to be preferred for SC heparin injections due to its low muscle activity, being rich in adipose tissue and being wide enough to allow rotation.[1-4]

Systemic and local complications may occur due to SC-LMWH injections. The most important complications that occur locally are pain at the injection site, ecchymosis, and hematoma.[1,3,5] While the pain complication occurring during the injection affects the patient's compliance with the treatment, the pain complication occurring after the injection can significantly affect the comfort of the patient and the way they perform their vital activities by limiting the use of the extremity.[2,3] The treatment-induced ecchymosis complicates the use of the damaged area in subsequent injections, adversely affecting medication absorption and leading to physical trauma and changes in body image.[1,3] In studies related to SC-LMWH applications, the frequency of ecchymosis occurrence was reported by Kuzu and Uçar as 11.4%, by Yıldırım and Atalay as 57%, by Varghese et al as 36%, by Zaybak and Khorshid as 64%, by Küçükgüçlü and Okumuş as 31%, by Palese as 38%, and by Dursun and Balcı Akpınar as 28.7%.[6-12] One of the preferred nonpharmacological methods to prevent these negative complications is local cold applications.

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Local cold application methods not only help to reduce the pain intensity by delaying the transmission of pain signals to the central nervous system but also reduce blood flow by creating vasoconstriction in the vessels, preventing ecchymosis formation.[1,3,13,14] In studies on local cold application methods, Avşar and Kaşıkçı have determined that the application of SC heparin without aspiration with the airlock technique and local cold application to the injection site for 2 minutes reduced the size of the ecchymosis and the pain intensity.[15] Şendir et al[1] have reported that a 30-second duration of injection and the local application of ice for 5 minutes both before and after the injection is effective in reducing the pain intensity, preventing the formation of ecchymosis, and alleviating the development of ecchymosis in SC-LMWH applications. İnangil and Şendir have determined that the use of mechano-analgesia in SC-LMWH applications reduces pain formation, and the 2-minute cold application before and after injection reduces both pain and ecchymosis formation.[2] Mohammady and Sadeghi have reported that applying cold to the injection site for 3-5 minutes before or after SC heparin injection reduces the pain intensity.[16] Wang et al[13] have reported that applying cold between 2 and 20 minutes before and after SC-LMWH injections will reduce the pain level of the patients and significantly reduce the ecchymosis areas 72 hours after the injection. Ünal et al[14] have recommended the use of local cooling spray to prevent ecchymosis and pain formation. Reviewing the studies, it was seen that different local cold application methods were very effective in reducing/preventing the formation of pain and ecchymosis.[1,2,14,17,18] However, no study has been encountered in which these methods are used together, their effects are compared, and the determinations on which method is the most effective were reported. In this context, the study was planned in a randomized controlled experimental design type to examine the effects of 3 different local cold application methods on the injection site in SC-LMWH applications on pain intensity and ecchymosis.

Methods

Aims

The study was carried out in a randomized controlled experimental design to examine the effects of 3 different local cold application methods on the injection site in SC-LMWH applications on pain intensity and ecchymosis.

Hypotheses of Research

H1: Local cool-pack application to the injection site is effective in reducing the pain intensity in patients who are SC-LMWH administered.

H2: Local cool-pack application to the injection site is effective in reducing the size of the ecchymosis in patients who are SC-LMWH administered.

H3: Local thermomechanical analgesia application to the injection site is effective in reducing the pain intensity in patients who are SC-LMWH administered.

H4: Local thermomechanical analgesia application to the injection site is effective in reducing the size of the ecchymosis in patients who are SC-LMWH administered.

H5: Local cooling spray application to the injection site is effective in reducing the pain intensity in patients who are SC-LMWH administered.

H6: Local cooling spray application to the injection site is effective in reducing the size of the ecchymosis in patients who are SC-LMWH administered.

Place and Time of Research

The study was carried out in the Internal Medicine, Cardiology, and Neurology Services of a State Hospital affiliated with the Ministry of Health in the Turkish Republic of Northern Cyprus between June 1 and July 30, 2020.

Participants

The participants of the study consisted of patients who applied SC-LMWH in the Internal Medicine, Cardiology, and Neurology Services of a State Hospital affiliated with the Ministry of Health in the Turkish Republic of Northern Cyprus. The sample of the study consisted of 54 patients who met the inclusion criteria and agreed to participate in the study.

Inclusion Criteria

It was planned to evaluate the effects of 3 different local cold application methods on pain intensity and ecchymosis in SC-LMWH injection in the same patient group (single-group experimental design). In this direction, the inclusion criteria in the sample of research are (a) the patient being 18 years or older, (b) having the physical and mental ability to correctly evaluate the visual analog scale (VAS), (c) platelet value being 100 000/mm³ and ↑, (d) does not use the oral anticoagulant Coumadin, (e) having no scar tissue in the skin in the abdominal area where the injection will be made, (f) having no incision, lipodystrophy, or any signs of infection, (g) having no history of cold allergy, and (h) having consent to participate in the study.

According to the sample size G-Power analysis, the effect size ($d = 0.80$) was found with[10] references in similar study results; for $d = 0.80$ effect size and $\alpha = 0.05$, and for $1 - \beta = 0.95$ (power), the required sample size was determined as n = 38. The sample of the study consisted of 54 patients who met the inclusion criteria and agreed to participate in the study. According to the post hoc G-Power analysis performed at the end of the study, it was determined that the current sample number had an effect size of $d = 29.45$, at $\alpha = 0.05$ and $1 - \beta = 0.95$ and that the power of the study was 100%.

Implementation of Research

In the study, the abdominal region on which 3 different local cold application methods would be applied was determined by the method of drawing lots and by an individual independent of the study, for once. Accordingly, the umbilicus was centered, the abdominal region was divided into 4 (lower right, upper right, lower left, and upper left) with an imaginary horizontal and vertical line, and the cold application method to be applied was standardized throughout the entire research process (NCT04235244). Starting from the control group, the application sequence was followed in a clockwise direction.

According to the randomization result, the right upper abdominal region was determined as the thermomechanical analgesia (Buzzy) region, the right lower abdominal region was determined as the control region, the left upper abdominal region was determined as the local cooling spray region, and the left lower abdominal region was determined as local cold application package (ice pack) region.

- In the application of thermomechanical analgesia (Buzzy): The device was operated by placing it on the right upper abdomen to be applied 30 seconds before the injection, and it was moved to the side of the selected area during the injection. Abdominal tissue was grasped, and the relevant procedure steps were followed.14,19,20
- In local coolant spray application: The local coolant spray was sprayed on the left upper abdomen to be injected from a distance of 15 cm 5 seconds before the injection. Abdominal tissue was grasped, and the relevant procedure steps were followed.1,10,14
- In the local cold application package (ice pack) application: The ice pack, which was covered with a protective cloth sheath 5 minutes before the injection, was placed on the left lower abdomen. It was applied, for 5 minutes, and the abdominal tissue was grasped and the relevant procedure steps were followed. In addition, after the injection, ice was applied again for 5 minutes without applying massage.[1,19-21]

- In the control application, SC injection steps were applied without any intervention.

In SC-LMWH applications, safe injection application steps were determined by considering the stated results of the studies in the literature.[1,2,10,15] The determined injection method was applied bedside in the same way by the principal investigator (15 years of clinical experience, with a doctorate in Fundamentals of Nursing) in both the experimental and control groups. In this way, factors that may arise from different applications were eliminated. The application of 2 × 0.6cc standard ready-to-use injectable Enoxiparin, which was requested by the physician according to the SC injection application steps, was applied together with the cold application method determined by randomization.

Data Collection

Patient Information Form
This form, which was developed by the researcher in line with the relevant literature,[1,2] consists of information about the patients' age, gender, medical diagnosis, presence of chronic disease, type, and the medication they use constantly.

Subcutaneous Injection Follow-up Chart
The chart prepared by the investigator was used to follow-up on the pain intensity, ecchymosis formation, and the size of the ecchymosis at the 24th, 48th, and 72nd hours immediately after the injection.

Visual Analogue Scale
It was used to evaluate the pain intensity of the patients during and after SC injection. The pain intensity of the patient was evaluated on a scale at the hours determined as a result of the literature review (right after the injection and at the 24th, 48th, and 72nd hours after the injection).[1,3,18,22]

Opsite-Flexigrid Measurement Tool
It is a transparent measurement tool designed to measure the size of the ecchymosis formed in the SC injection site, in millimeters. Ecchymosis sizes that occurred at the hours determined as a result of the literature review (24, 48, and 72 hours after the injection) were measured with the "Opsite-Flexigrid Measurement tool."[3,14,17,23]

"Thermomechanical analgesia device (Buzzy)," "local coolant spray," and "local cold application package (Cool-Pack)" were used to collect research data.

Thermomechanical Analgesia Device (Buzzy)
Dr. The Buzzy device, developed by Amy Baxter, is used to reduce pain by applying local cold and vibration. It is produced to control interventional pain with local cold application in adults and children and to direct the attention of the individual in a different direction with vibration.[24,25]

Local Coolant Spray
These are medical treatment agents that are obtained from liquefied gases with high pressure and act by rapidly reducing the skin temperature in the area where it is applied. It acts on the applied area by preventing the activation of ion channels involved in pain transmission or desensitizing pain receptors.[14]

Local Cold Application Package (Cool-Pack)
Before using the ice pack, it should be kept in the freezer or deep freezer for at least 24 hours and frozen. The application should be limited to 15-20 minutes.[26]

Ethical Consideration
Institutional Approval (YTK1.01-629-20/E.408) and Ethics Committee approvals (YTK.1.01-EK006/20) were obtained from the Chief Physician of the hospital where the research was conducted. In addition, participation was voluntary, and the participants were informed of the research objectives, voluntary participation, anonymous responses, and confidentiality terms regarding their personal information.

Data Analysis
Statistical Package for Social Sciences (SPSS) 24.0 (IBM SPSS Corp.; Armonk, NY, USA) software was used for the statistical analysis of the research data. The Kruskal–Wallis *H*-test was used to compare the pain intensity and ecchymosis size of the patients by 3 different cold application methods for each measurement. The Friedman test was used to compare the pain intensity and ecchymosis size over time for each injection method of the patients. The significance level was accepted as $P < .05$.

Results

Table 1 shows the distribution of patients' individual-, disease-, and treatment-related characteristics.

Research Hypotheses 1-3-5: Effect on Pain Intensity
In Table 2, the effect of different cold application methods on pain is examined, and according to the results of the first measurement performed immediately after the SC-LMWH injection, self-reports regarding the presence of pain were determined in 80.0% of the patients in the control application, 54.0% in the thermomechanical analgesia application, 39.0% in the local coolant spray application, and 11.0% in the local dry cold application. By the cold application method of the patients, the difference between the rates of presence of pain was found to be statistically very significant ($P < .05$).

In Table 3, pain intensity was compared by different cold application methods and measurement time. In the first measurement immediately after the injection of the patients participating in the study, the highest mean of pain intensity was in the control application, and the lowest value was in the local dry cold application; it was determined that in the measurement performed at the 24th hour, the pain intensity decreased to a similar level in all applications, and the pain intensity remained at a horizontal level in the measurements performed at the 48th and 72nd hours. Accordingly, when the mean pain intensity of the patients was compared by the different cold application methods (intergroup), there was a statistically very significant difference between the pain intensity in the first measurement performed immediately after the injection and the other measurement times ($P < .001$). In the analysis, it was seen that this difference was between the mean pain intensity in the control application and other cold application methods. In the control group, the mean pain intensity immediately after the injection was found to be higher than the other cold application methods. These findings obtained from the study indicate that the first, third, and fifth hypotheses of the study were confirmed.

Research Hypotheses 2-4-6: Effect on Ecchymosis
When the findings in Table 4 regarding the effect of different cold application methods on ecchymosis are examined, according to the measurement results made at the 24th hour of SC-LMWH injection, ecchymosis was observed to develop in 44.4% of the patients in the control application, in 27.8% in the thermomechanical analgesia application, in 29.6% in the application of local coolant spray, and in 24.1% in the local dry cold application. It was observed that 3 different cold application methods did not affect ecchymosis development rates at the 24th hour ($P > .05$). According to the measurement results performed at the 48th hour of SC-LMWH injection, ecchymosis

Table 1. Distribution of Patients' Individual and Disease- and Treatment-Related Characteristics

Individual and Disease- and Treatment-Related Characteristics	n	%
Age		
65 years and younger	28	**51.9**
66 years and older	26	48.1
Mean age (years) (minimum–maximum ± SD)	62.31 ± 1.99	
Gender		
Female	22	40.7
Male	32	**59.3**
BMI (kg/m^2)		
≤24.99 kg/m^2	18	33.3
25-29.9 kg/m^2	19	**35.2**
≥30 kg/m^2	17	31.5
BMI mean (minimum–maximum ± SD)	27.33 ± 0.64	
Smoking condition		
Yes	14	25.9
No	40	**74.1**
Alcohol use condition		
Yes	9	16.7
No	45	**83.3**
Presence of chronic disease		
Yes	47	**87.0**
No	7	13.0
Type of chronic disease*		
Hypertension	31	57.4
Diabetes	24	44.4
Cardiac diseases	33	**61.1**
Other	19	35.2
Regular medication use conditions		
Yes	45	**83.3**
No	9	16.7
Medications used other than SC anticoagulant*		
Hypertension	31	57.4
Heart	32	**59.3**
Diabetes	24	44.4
Antiaggregant	28	51.9
Other	28	51.9
Hospitalization service		
Cardiology	20	**37.0**
Neurology	14	26.0
Internal medicine	20	**37.0**
Mean platelet value (minimum–maximum ± SD)	241.17 ± 0.09	

*More than 1 option has been selected and the line percentage has been taken.
BMI, body mass index.

was observed to develop in 55.6% of the patients in the control application, in 42.6% in the thermomechanical analgesia application, in 38.9% in the local coolant spray application, and in 25.9% in the cool-pack application. According to the measurement results performed at the 72nd hour of SC-LMWH injection, ecchymosis was observed to develop in 66.7% of the patients in the control application, in 50.0% in the thermomechanical application, in 50.0% in the local coolant spray application, and 33.3% in the cool-pack application. It was determined that the difference between the rates of ecchymosis development by 3 different cold application methods of the patients at the 48th and 72nd hours was statistically very significant ($P < .001$). Accordingly, the rate of ecchymosis development in the control application was found to be significantly higher than in the cool-pack application ($P < .001$).

In Table 5, ecchymosis sizes were compared by different cold application methods and measurement times. In the measurement of the patients participating in the study at the 24th, 48th, and 72nd hours after the injection, it was observed that the mean ecchymosis size was highest in the control application, and the lowest value was in the local dry cold application. The mean ecchymosis size in all measurements was determined to increase compared to the measurement at the 24th hour in all cold application methods. There was a statistically very significant difference between the mean size of ecchymosis and the measurement times by different cold application methods (intergroup) ($P < .001$). In the analysis, it was seen that this difference was between the mean ecchymosis size in the control application and other cold application methods for all measurement methods. These findings obtained from the study indicate that the second, fourth, and sixth hypotheses of the study were confirmed.

Discussion

The research is the first study to reveal the effect of 3 different local cold application methods (cool-pack, coolant spray, and thermomechanical analgesia) applied to the injection site on pain intensity and ecchymosis formation in SC-LMWH applications.

One of the methods preferred by nurses to prevent pain formation is cold applications. In this study, according to the first measurement results made immediately after the SC-LMWH injection, pain experience/patients' self-report rate was the lowest in local dry cold application compared to other applications; in the control application, it was found to be the highest value (Figure 1). In other words, it was proven that the application of SC-LMWH without using any cold application method causes more pain than other methods in patients; however, the least presence and intensity of pain is observed in the local cool-pack application. This study is thought to be the first study to examine the effect of different cold application methods in SC-LMWH applications. Injection pain occurs as a result of the stimulation of the nerve endings called nociceptors, which are free in the SC tissues as a result of the mechanical trauma created by the needle in the tissue and the transmission of these impulses to the brain via the central nervous system.[2,3,27] Reviewing the literature on the subject, the frequently preferred cold application methods to prevent injection-related pain were observed to be the local cold application packages, local coolant sprays, and the Buzzy, a thermo-mechanical device.[2,14,28-30] These cold application methods reduce tissue temperature, blood flow, and cell metabolism. They also reduce catecholamine levels, increase endorphin levels, and delay the transmission of pain signals to the central nervous system, helping to reduce pain intensity.[13] Due to this physiological process, cold applications not only reduce the side effects that occur in SC-LMWH applications but also increase the quality of clinical applications and patient safety.[17] In the literature, there are many studies examining the efficacy of cold application methods for reducing pain associated with SC injections in adult patients. When we examine these studies, local dry and wet cold applications have been reported to significantly reduce the SC-LMWH injection-induced pain perception defined by patients.[1,14,15,17,19,23,31] However, these studies contain limited information on which cold application method is more effective in reducing the intensity of injection-induced pain in SC-LMWH applications by different measurement times. In line with these results, it is thought that the application of local ice packs before and after the injection to the patients who do not want to have an injection due to the fear of experiencing pain will be effective in both reducing fear and increasing comfort.

In this study, similar to pain experience/intensity, according to the first measurement results performed immediately after the (SC-LMWH) injection, ecchymosis development rate and size were the lowest in

Table 2. Comparison of the Presence of Pain By Different Cold Application Methods

		Pain					
		Yes		No			
Cold Application Method	**Measurement Time**	**n**	**%**	**n**	**%**	χ^2	***P***
Control	First measurement	43	80	11	20	53.464	<0.001*
Thermomechanical analgesia		29	54	25	46		
Local coolant spray		21	39	33	61		
Cool-pack		6	11	48	89		
Control	24 hours	2	3.7	52	96	—	—
Thermomechanical analgesia		2	3.7	52	94		
Local coolant spray		0	0	54	100		
Cool-pack		0	0	54	100		
Control	48 hours	2	3.7	52	96	—	—
Thermomechanical analgesia		1	1.9	53	98		
Local coolant spray		0	0	54	100		
Cool-pack		0	0	54	100		
Control	72 hours	2	3.7	52	96	—	—
Thermomechanical analgesia		0	0	54	100		
Local coolant spray		0	0	54	100		
Cool-pack		0	0	54	100		

—, the assumptions of the chi-square analysis could not be provided.
*$P < .001$.

Table 3. Comparison of Pain Intensity By Different Cold Application Methods and Measurement Time

	Control		Thermomechanical Analgesia		Local Coolant Spray		Cool-pack				
Measurement Time	$\bar{x} \pm S$	**Minimum–Maximum**	$\bar{x} \pm S$	**Minimum–Maximum**	$\bar{x} \pm S$	**Minimum–Maximum**	$\bar{x} \pm S$	**Minimum–Maximum**	χ^2	P^2	**Difference**
First measurement	2.33 ± 1.63	0-8	1.11 ± 1.26	0-5	0.91 ± 1.32	0-6	0.19 ± 0.59	0-3	79.488	.000**	*x – y, x – z, x – t, y – t*
24 hours	0.13 ± 0.67	0-4	0.04 ± 0.19	0-1	0.00 ± 0.00	0-0	0.00 ± 0.00	0-0	4.714	.194	
48 hours	0.09 ± 0.49	0-3	0.02 ± 0.13	0-1	0.00 ± 0.00	0-0	0.00 ± 0.00	0-0	5.400	.145	
72 hours	0.06 ± 0.30	0-2	0.00 ± 0.00	0-0	0.00 ± 0.00	0-0	0.00 ± 0.00	0-0	6.000	.112	
χ^2	115.539		81.847		63.000		18.000				
P^1	<0.001**		<0.001**		<0.001**		<0.001**				
Difference	*a* – b, *a – c*, *a – d*		*a* – b, *a – c*, *a – d*		*a* – b, *a – c*, *a – d*		*a* – b, *a – c*, *a – d*				

**$P < .001$
P^1: In-group comparisons by measurement time (Friedman test).
P^2: Intergroup comparisons (Kruskal–Wallis *H*-test).
a, first measurement; *b*, 24 hours; *c*, 48 hours; *d*, 72 hours.
t, cool-pack application; *x*, control application; *y*, thermomechanical analgesia; *z*, local coolant spray.

Table 4. Comparison of Ecchymosis Presence By Different Cold Application Methods

		Ecchymosis					
		No		Yes			
Cold Application Method	**Measurement Time**	**n**	**%**	**n**	**%**	χ^2	***P***
Control	24 hours	30	55.6	24	44.4	6.010	.111
Thermomechanical analgesia		39	72.2	15	27.8		
Local coolant spray		38	70.4	16	29.6		
Cool-pack		41	75.9	13	24.1		
Control	48 hours	24	44.4	30	55.6	9.972	.019*
Thermomechanical analgesia		31	57.4	23	42.6		
Local coolant spray		33	61.1	21	38.9		
Cool-pack		40	74.1	14	25.9		
Control	72 hours	18	33.3	36	66.7	12.00	.001*
Thermomechanical analgesia		27	50.0	27	50.0		
Local coolant spray		27	50.0	27	50.0		
Cool-pack		36	66.7	18	33.3		

*$P < .05$.

Table 5. Comparison of Ecchymosis Size By Different Cold Application Methods and Measurement Times

Measurement Time	Control		Thermomechanical Analgesia		Local Coolant Spray		Cool-pack				
	$\bar{x} \pm S$	Minimum–Maximum	$\bar{x} \pm S$	Minimum–Maximum	$\bar{x} \pm S$	Minimum–Maximum	$\bar{x} \pm S$	Minimum–Maximum	χ^2	P^2	Difference
24 hours	28.65 ± 17.54	0-750	7.61 ± 4.28	0-225	8.59 ± 5.54	0-300	4.83 ± 1.90	0-80	16.452	.000**	$x-y, x-z, x-t$
48 hours	54.69 ± 31.74	0-1500	11.52 ± 5.65	0-300	13.85 ± 7.47	0-400	8.72 ± 3.37	0-150	24.709	.000**	$x-y, x-z, x-t$
72 hours	82.67 ± 41.82	0-2000	14.37 ± 5.89	0-300	17.72 ± 7.75	0-400	12.30 ± 4.55	0-200	25.032	.000**	$x-y, x-z, x-t$
χ^2	76.039		53.544		55.155		33.308				
P^1	0.000**		0.000**		0.000**		0.000**				
Difference	$a-b, a-c, b-c$		$a-b, a-c, b-c$		$a-b, a-c, b-c$		$a-b, a-c, b-c$				

**$P < .01$.
P^1: In-group comparisons by measurement time (Friedman test).
P^2: Intergroup comparisons (Kruskal–Wallis *H*-test).
a, 24 hours; *b*, 48 hours; *c*, 72 hours.
t, cool-pack application; *x*, control application; *y*, thermomechanical analgesia; *z*, local coolant spray.

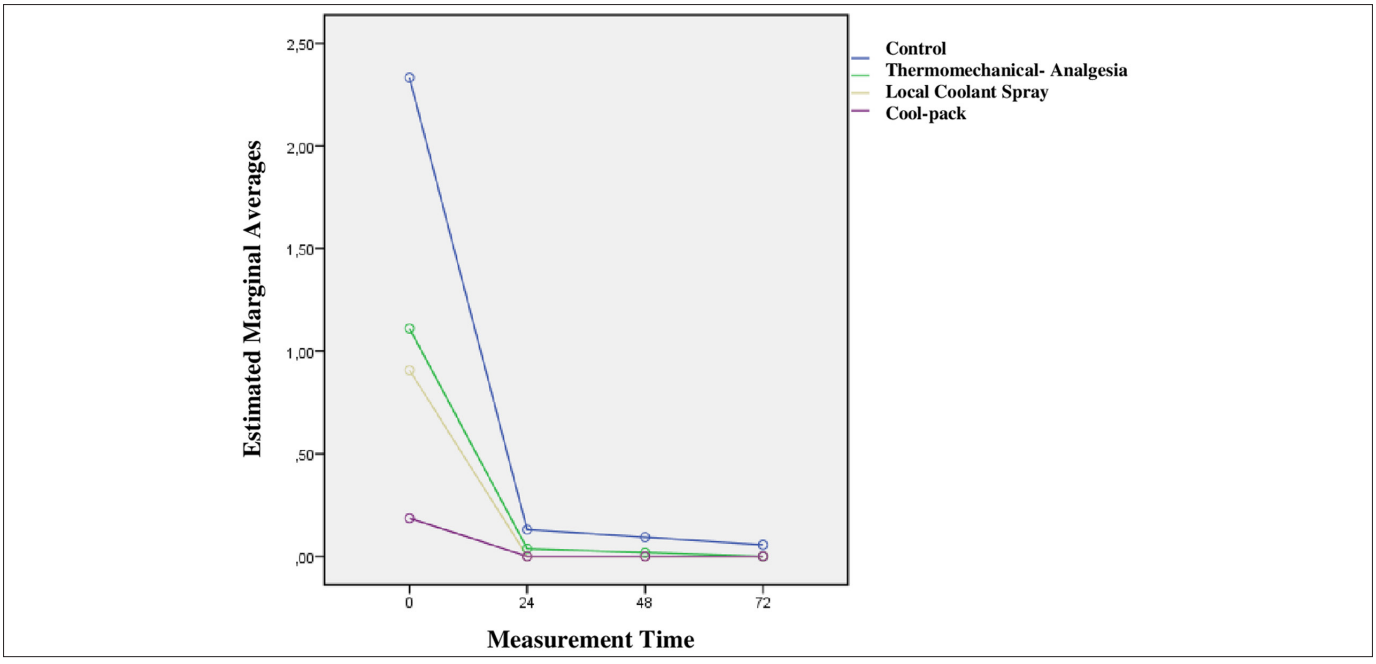

Figure 1. The effect of different cold application methods on pain intensity.

the local dry cold application compared to other applications and the highest in the control application. In other words, it was proven that SC-LMWH application without using any cold application method causes ecchymosis at a higher rate and size in patients compared to other methods; however, the least ecchymosis is in the local cool-pack application. In all measurements, it was observed that the mean ecchymosis size increased in all cold application methods compared to the measurement at the 24th hour (Figure 2).

Another local side effect that occurs in SC-LMWH applications is ecchymosis.[3,15] Occurring as a result of bleeding in the skin or under the skin, ecchymosis causes deterioration in the body image of the patients, narrowing of the injection region as a result of damage to the injection site, and more complications and pain in repeated injection applications. For these reasons, the effectiveness of the applied treatment may decrease and the patient may refuse treatment due to complications.[9,10,15] At this point, nurses can independently use many nonpharmacological alternative methods to prevent or minimize the formation of ecchymosis. One of these nonpharmacological methods is local cold applications, similar to those in preventing pain formation. Local cold applications can prevent the formation of ecchymosis by creating vasoconstriction in the vessels and reducing blood flow. At the same time, it increases blood viscosity, ensures blood coagulation, and reduces bleeding by narrowing the capillary surface.[1,3,14] Reviewing the literature, it has been seen that local cold application packages and local coolant sprays are frequently used to prevent or minimize the formation of ecchymosis. When these studies are examined, it has been reported that local cold application is effective in preventing the development of ecchymosis due to SC-LMWH injection and reducing/alleviating the ecchymosis that occurs.[5,8,10,14,15,23] However, there is limited information in the literature on which cold application method is effective in reducing the development/size of injection-induced ecchymosis in SC-LMWH applications by different measurement times. In this context, it is thought that this study is the first study to examine the effect of different cold application methods on the development and size of ecchymosis in SC-LMWH applications. According to the results of the study, it was observed that the application of SC-LMWH without using any cold application method caused more ecchymosis formation in patients compared to other methods; however, the lowest ecchymosis size was observed in the local dry cold (cool-pack) application. According to these results, it is thought that applying a local ice pack to the patients before and after the injection

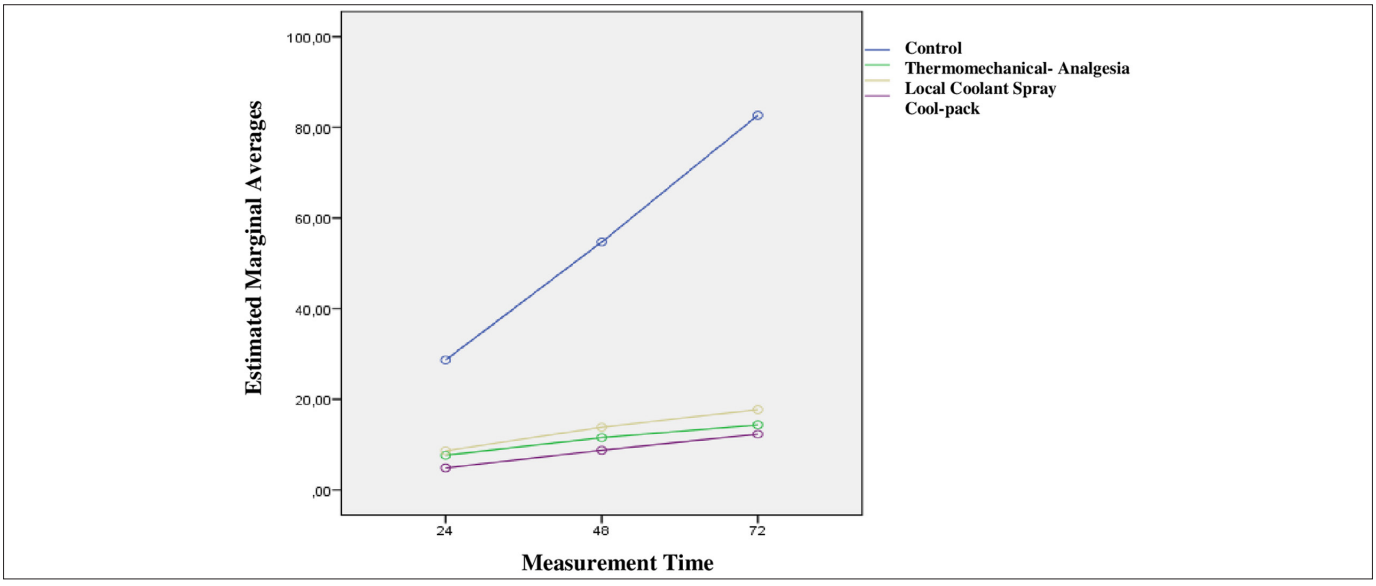

Figure 2. The effect of different cold application methods on ecchymosis size.

will be effective in order to both protect the body image and find space for subsequent injections in recurrent SC injections. In addition to applying an ice pack, it can be recommended to use local cooling spray to prevent pain development and thermomechanical analgesia (Buzzy) method to prevent ecchymosis formation as a second option.

Limitations

It was determined as the assessment of pain intensity due to SC injection based on the verbal reports of the patients.

Conclusion

In line with these results obtained from the study, it is recommended that local dry cold application should be preferred first to reduce the pain intensity and prevent ecchymosis in SC-LMWH injection applications. In addition to applying cool-packs before and after the injection, the nurses who are responsible for LMWH injections can also be advised to use a local coolant spray to prevent pain development and the thermomechanical analgesia (Buzzy) method to prevent ecchymosis formation as a second option.

Registration Number: Clinicaltrials.gov id/ NCT04235244.

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Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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