

Effects of subcutaneous injection after coolant spray on pain, hematoma, and ecchymosis in three different regions

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Abstract

Aims: This study determined the effect of subcutaneous (SC) low molecular weight heparin (LMWH) injection in three different areas (abdomen, leg, and upper arm) after coolant spray application on pain, hematoma, and ecchymosis formation. **Methods:** The sample of this randomized controlled study consisted of 50 patients that were administered SC LMWH once a day. The SC injection occurred after applying coolant spray to the arm, leg, or abdominal region. The sample of this randomized controlled study consisted of 50 patients that were administered SC LMWH once a day. The SC injection occurred after applying coolant spray to the arm, leg, or abdominal region. **Results:** The study determined that there was no statistically significant difference in pain severity, hematoma, and ecchymoses between the regions of SC injection after coolant spray was applied ($p>0.05$). However, the highest average pain intensity directly and 15 minutes after the SC injection was in the leg region. **Conclusion:** SC injection after coolant spray application in three different regions led to the biggest hematoma in the abdominal region, the biggest ecchymosis in the arm region, and the lowest pain severity in the abdominal and arm regions. **Key words:** Coolant spray, ecchymosis, hematoma, pain, subcutaneous injection (SC).

1 INTRODUCTION

One of the most important tasks and responsibilities of nurses is drug administration. During drug administration, the nurse uses proper application techniques and ensures patient safety by knowing the drugs and their side effects.^{1,2} In subcutaneous (SC) injections, the drug is applied to loose connective tissue under the skin that is not rich in blood vessels.^{2,3} The abdominal region has thicker subcutaneous tissue than other parts of the body, which is why it is preferred for SC heparin injections.^{4,5}

Previous studies show that a SC injection to the arm, abdominal, or leg areas does not differ in ecchymosis formation and they can be used interchangeably^{4,6} (However, using the same region for SC injections can cause physical factors such as pain in the skin, hematoma, ecchymosis, and a decrease in the rate of absorption of the drug in addition to psychological health problems.^{4,5,7} Therefore, it is important that nurses use different regions for subsequent SC injections to avoid possible complications.^{1,4,8}

Low molecular weight heparin (LMWH), which is generally administered by SC injection, is an anticoagulant drug used for preventive or therapeutic purposes in clinical situations with a risk of venous thromboembolism or when thromboembolic events occur^{9,10,11} (Carrying out a cooling application or not before heparin administration by SC injection, needle diameter size, use of aspiration, drug application rate, and massage after the injection may cause complications such as ecchymosis, hematoma, and pain under the influence of factors such as platelet value.^{5,9}

The pain reducing effect of cold application is explained by the Melzack theory as follows: the mechanical receptors in the skin stimulated by local cold application help to prevent pain from passing into T cells

and stimulate gelatinosa cells to prevent pain sensations.^{12,13} Cold application causes vasoconstriction and lowering of muscle temperature. Cold application creates a reflex effect in heat receptors and reduces skin sensitivity by lowering the temperature of muscle spasm and nerve fiber receptors.²

There are only a few studies in the literature that analyze the pain, hematoma, and ecchymosis formation in different areas due to SC injection with or without coolant spray application.

Kücükgülü and Okümüs (2010) reported that cold application applied to the injection area for 2 minutes before and after the injection reduced ecchymosis and hematoma formation.¹⁴ Avşar and Kaşıkçı (2013) reported that a 2-minute cold application to the area with SC LMWH injection reduced ecchymosis and pain.⁴ Sendir, Büyükyılmaz, Celik, and Taskopru (2015) specified that the SC LMWH injection duration should be 30 seconds and that a 5-minute local ice application before and after the injection may be effective in the prevention of ecchymosis formation by reducing the severity of ecchymosis and pain in the application areas.¹⁵ Kilic and Midilli (2017) reported that a 2-minute cold application before and after SC heparin injection reduced the pain score and the ecchymosis size after 48 and 72 hours.¹⁶ Unal, Tosun, Aslan, & Tunay (2019) evaluated the effect of coolant spray and a placebo (water spray) on pain, ecchymosis, and hematoma in SC LMWH injection in the arm area and found that the pain intensity was lower with the vaporizer spray method but there was no significant effect on ecchymosis size.¹⁷

Uzelli-Yılmaz et al. observed the pain and ecchymosis in the arm and abdominal region after SC LMWH injection and determined that an injection into the abdominal area causes less pain and ecchymosis.⁸ Cengiz and Ozkan reported that the pain rate in the arm region was higher than other regions in patients that received a SC heparin injection into the abdominal region and the arm. However, they did not find a significant difference in pain severity and duration or ecchymosis and hematoma size in the injected regions.¹⁸

Inangil and Şendir (2020) reduced pain in the application of SC heparin injection in mechanical-analgesia and cold applications.¹⁹ The difference between ecchymoses and techniques resulting from the lowest and smallest ecchymosis cold application was not statistically significant. As a result, mechanical-analgesia and cold applications reduced pain in SC heparin injection.

Studies have shown that cold administration during SC LMWH injection effectively reduces pain severity, hematoma, and ecchymosis. However, there is no study evaluating pain intensity, hematoma, and ecchymosis together with the use of a coolant spray applied with SC LMWH injections in three different regions (arm, leg, and abdominal region). Due to the lack of time for the nurse to apply a coolant agent, it is not standard clinical practice, but considering that it makes the injection easier for the nurse, the effect of coolant spray should be determined.

Only one study evaluated the effect of coolant spray in the arm region, which reveals the need to carry out new studies on the effect of coolant spray on pain, hematoma, and ecchymosis after subcutaneous injections in different regions.

The main purpose of the current study is to determine the effect of coolant spray on pain due to SC LMWH injection in three different regions. The secondary aim is to determine the effect of coolant spray on hematoma and ecchymosis formation due to SC LMWH injection in three different regions.

2 METHODS

2.1 Design and sample: The design of this study is prospective randomized self-control. The study population consisted of 80 patients, who were hospitalized and received a SC LMWH injection in the university health research and application center, internal sciences services from May 2018 to May 2019.

The decrease of pain due to cold spray application was recorded with a minimum standard deviation of 0.5 on the numerical pain scale and this value was accepted as statistical significance. The study of Uzelli-Yılmaz et al. (2016),⁸ which evaluated the pain intensity difference between two regions, was calculated as a reference.

In order to reveal the statistical difference between pain intensity in the current study, the sample size was calculated to be at least 46 patients with 80% power and a type 1 error of 0.05 (e-picos.com).²⁰

The study population consisted of 50 patients, who gave their written and oral consent and were administered SC LMWH (6000 units) treatment once a day in the X University Health Research and Application center, Internal Medicine Services. Criteria were platelet count within normal limits (150-400 thousand microliters), tissue integrity in the outer side of the upper arm, abdominal region, anterior or lateral part of the thigh, clear consciousness, being orientated and cooperative, no psychiatric illnesses, no sensitivity to ethyl chloride, being able to speak and understand Turkish, being 18 years or older, and receiving a Visual Analog Scale (VAS) score of 0 before application.

Thirty patients that were hospitalized within this date range were not included. Patients, whose SC LMWH (6000 units) treatment was interrupted ($n=8$), who had a language barrier ($n=2$), with whom no communication could be established due to psychiatric problems ($n=4$), who had no tissue integrity in the abdominal region ($n=3$), who received a VAS score over 1 before the application ($n=5$), whose platelet count was not within normal limits (150-400 thousand microliters) ($n=5$), and who did not want to participate in the study ($n=3$) were excluded.

2.2 Data collection

The data were collected with the Introductory and Clinical Features Form prepared by the researchers, the VAS, and ecchymosis and hematoma follow-up chart.

Descriptive and Clinical Features Form: The Descriptive and Clinical Features Form prepared by the researchers consisted of nine questions about the patients' age, gender, educational status, marital status, chronic diseases, diagnosis, height and weight, and use of pain killers.

Visual Analog Scale: VAS is a commonly used pain assessment scale in which the severity of pain is determined by marking the patient's own pain on a ruler between 0 cm and 10 cm. VAS is more sensitive and reliable in the assessment of pain severity than other one-dimensional scales.²¹

Application of the Data Collection Form: The Descriptive and Clinical Features Form was filled out with information obtained from the patient/relatives of the patient, patient file, and health workers of the department. The patients were divided into three different regions according to the randomization table created by a computer (e-picos.com).²⁰

All SC LMWH injections were given by the same nurse working in the clinic in which the study was carried out. In line with the randomization table created for patients who received SC LMWH treatment for the first time, SC LMWH injection was performed with an interval of one day in all three regions (arm, abdomen, and leg), starting from the arm (16 patients), the leg (17 patients), and the abdomen (17 patients). A cooling effect was provided a short time before SC injection by applying coolant spray to each region.

SC LMWH injection steps

- The injection region was cleaned with 70% alcohol and dried.¹
- The coolant spray was applied from 30 cm for 2 seconds.
- After it dried, the injections were done with a 25-gauge, 1.26 cm long needle and standard ready-made injectors filled with LMWH (enoxaparin sodium or nadroparin calcium) and air (0.6 ml heparin volume and 6000 IU dose).
- The skin was entered at a 90° angle and the drug was administered slowly over 20 seconds.^{1,5,22}
- A slight pressure was applied to the injection area after the injection.
- The patient was shown the VAS directly after application and 15 minutes later and asked to mark their pain due to the SC LMWH injection.
- The 5 cm diameter region in which hematoma and ecchymosis could form after SC LMWH injection was determined on the skin because the hematoma and ecchymosis size are biggest in the first 48

hours.²³ The nurse who administered the injection marked the hematoma and ecchymosis on a film at 24 and 48 hours.

- Opsite-Flexigrid Measurement Tool: Although this tool was developed for measurement of the wound environment, it is a polyethylene transparent film that is frequently used to measure hematoma and ecchymosis size in millimeters. It consists of squares of centimeters divided into 10 pieces of 0.1 mm.¹⁸ The transparent film was adhered to the injection area and the ecchymosis and hematoma sizes that developed after injection were recorded in mm².

2.3 Ethical considerations

In order to carry out the study, approval was obtained from a university medical school non-interventional clinical research ethics committee (Number: 77, Date: 4.05.2018) and Mersin University Health Research and Application Center (Number: 41993462-774.01.06, Date: 22.05.2018) and written consent was obtained from patients who agreed to participate in the study.

2.4 Data Analysis

The data obtained from the study were analyzed via computer. Descriptive statistics were expressed as frequency, percentage, mean, standard deviation, and minimum-maximum. The t test was used to compare two independent groups. One-way analysis of variance (ANOVA) was used to compare more than two independent groups. Significance was evaluated as $p < 0.05$ (95% confidence interval).

3 RESULTS

The mean age of the patients was 62.8 ± 15.4 years. Of them, 68% were male, 78% were primary school graduates, 86% were not working, 90% had at least one chronic disease, of which the most common were hypertension and diabetes mellitus (46%), 88% did not receive pain killers during their treatment, and 44% were overweight (Table1).

There was no significant difference in pain severity between the regions directly after the SC injection and 15 minutes after the injection ($p > 0.05$, Table 2). However, it was observed that the pain severity in the arm and leg region significantly decreased 15 minutes after the injection.

There was no significant difference between the three regions in hematoma and ecchymosis size 24 and 48 hours after subcutaneous LMWH injection ($p > 0.05$, Table 3). There was no significant difference in the size of hematoma and ecchymosis that occurred in the application areas after SC LMWH injection ($p > 0.05$, Table 3). Although not statistically significant, it was determined that after 24 and 48 hours, the hematoma size was more likely to increase in the abdominal region and ecchymosis in the arm region (Table 3).

4 DISCUSSION

Pain, hematoma, and ecchymosis are the major complications after subcutaneous LMWH injection. In the literature, cold application is recommended against pain, ecchymosis, and hematoma that may occur during SC injections.^{4,14,15,17,19} Cold application helps to physically reduce pain sensation.²

The current study did not reveal a statistical difference between the three tested regions (arm, abdomen, and leg) in pain severity right after and 15 minutes after SC LMWH injection carried out after coolant spray application. The highest pain severity occurred in the leg region and the lowest in the arm and abdominal regions. Cengiz and Ozkan (2018) reported in their study, in which they compared pain severity of SC LMWH injection between the arm (1.59 ± 1.51) and abdominal (1.52 ± 1.69) region, that the pain was lower in the abdominal region.⁸ Similarly, Uzelli-Yılmaz et al. (2016) also reported in their study about pain severity of SC LMWH injection in the arm (4.32 ± 1.27) and abdominal region (3.45 ± 1.68) that the pain was lower in the abdominal region.⁸ Avsar and Kasıkcı (2013)⁴, Sendir, and Buyukyilmaz, Celik & Taskopru (2015)¹⁵, Inangil and Sendir (2020)¹⁹, Kucukguclu and Okumus (2010)¹⁴, and Kilic & Midilli (2017)¹⁶ reported in their studies on the use of locally applied coolant spray for SC LMWH injection that coolant application does reduce the pain. Unal, Tosun, Aslan, & Tunay (2019) reported that coolant spray is effective in reducing pain severity.¹⁷ These study results parallel the results of the current study, which

determined that less pain was experienced in the abdominal and arm region. Unlike other studies in which the severity of pain was evaluated,^{8,18} the result of the severity of pain in the current study was lower. It is possible that the severity of pain result in the current study was lower due to the effect of the coolant spray that was used. As a result of the study, it may be suggested that the nurse choose the leg as the injection site, in terms of pain severity.

There was no difference in hematoma and ecchymosis formation in the three regions (arm, abdomen, and leg) after coolant spray and injection after 24 and 48 hours. Similar studies in the literature examined hematoma and ecchymosis formation after SC LMWH injection performed in two (abdomen and arm) regions and reported no difference between the regions.^{8,18} Unal, Tosun, Aslan, & Tunay (2019) show that coolant spray application on the arm region did not affect the size of the ecchymosis formation.¹⁷ The current study parallels existing studies. The coolant spray had no effect on the formation of hematoma and ecchymosis in all three regions and nurses can use all three areas as needed.

5 CONCLUSIONS

This study, which determined the effect of coolant spray applied to three different regions prior to SC LMWH injection on pain, hematoma, and ecchymosis formation, showed that of the three regions (arm, abdomen, and leg), pain was experienced most in the leg region and it should not be chosen, if possible. After SC LMWH injection, pain was least experienced in the arm and abdominal regions, which should be preferred locations for pain management. The three regions (abdomen, arm, and leg) have similar hematoma and ecchymosis formation after SC injection and nurses could use all regions equally.

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Declaration of Conflicting Interests

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