Al-Rafidain J Med Sci. 2024;6(1):202-207.
DOI: https://doi.org/10.54133/ajms.v6i1.622

A J M S
Online ISSN (2789-3219)

Research Article

Effectiveness of Pharmacist-Led Nurse Education on Enoxaparin Injection Technique in Baghdad Teaching Hospital, Iraq

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Received: 24 January 2024; Revised: 28 February 2024; Accepted: 10 March 2024

Abstract

Background: Proper injecting technique ensures maximum effectiveness and minimizes the incidence of enoxaparin-related local side effects. ***Objective***: To develop a pharmacist-led educational program and evaluate its benefit in improving the nurses' enoxaparin injecting technique for hospitalized patients. ***Methods***: A pre-post study design was conducted from March to July 2023, involving nurses working the day shift at Baghdad Teaching Hospital. Nurses were given an interactive education through a brief lecture with open discussion and training on the correct enoxaparin injecting technique. A clinical pharmacist observed and recorded the enoxaparin injecting technique for each nurse twice: once at the start of the study and again after the nurse's enrollment in the educational program. ***Results***: At the baseline level, only 12.5% of the participating nurses had a good technique for injecting enoxaparin. The nurse's gender, level of education, work history, or workplace did not significantly affect her poor enoxaparin injection technique. After enrolling nurses in the pharmacist-led educational program, the number of nurses with a good enoxaparin injection technique significantly increased from 12.5% to 59%. ***Conclusions***: Effectiveness was improved considerably by the currently developed interactive pharmacist-led nurse education.

Keywords: Enoxaparin, Injection technique, Nurses, Nurse education.

فعالية تعليم الممرضات بقيادة الصيدلي على تقنية حقن إينوكساباريين في مستشفى بغداد التعليمي، العراق

الخلاصة

الخلفية: تضمن تقنية الحقن المناسبة أقصى قدر من الفعالية وتقلل من حدوث الآثار الجانبية الموضعية المرتبطة بالإينوكساباريين. **الهدف**: تطوير برنامج تعليمي بقيادة الصيدلي وتقييم فائدته في تحسين تقنية حقن إينوكساباريين للممرضات للمرضى في المستشفى. **الطريقة**: تم إجراء تصميم ما قبل وبعد الدراسة من مارس إلى يوليو 2023، بمشاركة ممرضات يعملن في نوبة نهارية في مستشفى بغداد التعليمي. تم إعطاء الممرضات تعليما تفاعليا من خلال محاضرة قصيرة مع مناقشة مفتوحة وتدريب على تقنية حقن الإينوكساباريين الصحيحة. لاحظ الصيدلي السريري وسجل تقنية حقن الإينوكساباريين لكل ممرضة مرتين: مرة في بداية الدراسة ومرة أخرى بعد تسجيل الممرضة في البرنامج التعليمي. **النتائج**: على مستوى خط الأساس، كان لدى 12.5٪ فقط من الممرضات المشاركات تقنية جيدة لحقن الإينوكساباريين. لم يؤثر جنس الممرضة أو مستوى تعليمها أو تاريخ عملها أو مكان عملها بشكل كبير على تقنية حقن الإينوكساباريين الضعيفة. بعد تسجيل الممرضات في البرنامج التعليمي الذي يقوده الصيدلي، ازداد عدد الممرضات اللواتي لديهن تقنية حقن إينوكساباريين جيدة بشكل كبير من 12.5٪ إلى 59٪. **الاستنتاجات**: تم تحسين الفعالية بشكل كبير من خلال تعليم التمريض التفاعلي الذي يقوده الصيدلي والذي تم تطويره حاليا.

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Article citation: Mikhael EM, Nassir KF, Alkhaqani AL, Jabbar ZR. Effectiveness of Pharmacist-Led Nurse Education on Enoxaparin Injection Technique in Baghdad Teaching Hospital, Iraq. *Al-Rafidain J Med Sci*. 2024;6(1):202-207. doi: https://doi.org/10.54133/ajms.v6i1.622

INTRODUCTION

Heparins are anticoagulants used mainly in treating and preventing venous thromboembolism [1]. Low molecular weight heparins (LMWH) are preferred over unfractionated heparin (UFH) because of their ease of use [2], more predictable dose response, and fewer systemic side effects [1]. The commercially available LMWH include Bemiparin, Certoparin, Dalteparin, Enoxaparin, Nadroparin, Parnaparin, Reviparin, and Tinzaparin [1]. However, enoxaparin is the most commonly used LMWH [3]. Enoxaparin is usually given subcutaneously [3]. Nurses play an important role in injecting enoxaparin. Proper

injecting technique ensures maximum effectiveness and minimizes the incidence of enoxaparin-related local side effects such as bruising and injection site pain [4,5]. Only a limited number of studies have assessed the accuracy of subcutaneous (SC) drug-injecting techniques [6]. Only one of these studies assessed the nurses' injecting technique for enoxaparin and found a non-optimum injecting technique. The small sample size of this study, which involved only 33 nurses, limited its scope [7]. Other studies reported nurses' very poor injecting techniques in developing countries such as Iraq, Jordan, and Nepal [8–10]; however, all these studies focused on insulin therapy and none on enoxaparin. Therefore, educating and training nurses on injecting techniques for SC drugs is essential [8,10]. However, such educational programs were lacking in Iraq [9]. Researchers observed that some nurses at Baghdad Teaching Hospital had a poor experience with enoxaparin injecting techniques, which was to develop interactive pharmacist-led nurse education. Therefore, this study aimed to develop a pharmacist-led educational program and evaluate its benefit in improving the nurses' enoxaparin injecting technique for hospitalized patients.

METHODS

Study design

A pre-post study design was conducted at Baghdad Teaching Hospital from March to July 2023 to assess the effect of pharmacist-led educational programs on the enoxaparin injecting technique by nurses. The local institutional ethical committee at Baghdad Teaching Hospital, Iraq, ethically approved this study.

Sample selection

The study sample consisted of 128 nurses who had worked in an all-hospital context. Furthermore, participants must have been in charge for at least six months and be considered for data collection from those with minimal expertise in patient care. A non-probability, convenience sampling technique was used to select 128 nurses (male and female) from internal medicine wards, surgical wards, internal medicine departments, orthopedic clinics, dermatology clinics, neurology clinics, private care departments, children's hematology wards, gynecology wards, and other settings. The study's participants are nursing professionals who work at Baghdad Teaching Hospital.

Educational program

To maximize effectiveness, the instructional program was interactive [11], consisting of a brief lecture (delivered using Microsoft PowerPoint) followed by open debate and training (practical ward-based teaching sessions) on the proper enoxaparin injection technique. Previous literature [12-15] was used to provide educational material on the enoxaparin injection procedure. Lecture sessions consist of the following: Before delivering medication, it is critical to take particular precautions to ensure patient safety and minimize discomfort. Begin by properly cleaning your hands to prevent infection spread. Next, examine the patient's skin, avoiding regions with scars or bruising. Check the prefilled syringe for discoloration or particle matter, and discard it if required. Inject enoxaparin sodium into the abdominal wall, keeping injection sites 5cm away from the umbilicus. Prepare the injection without removing air bubbles from the syringe. Clean the injection site with an antiseptic swab and let it dry before carefully pinching the skin and injecting at a 90° angle, only releasing the skin fold after the needle is removed. To reduce pain, inject gently over 30 seconds. Avoid massaging the spot to prevent bruising. To prevent tissue damage, rotate injection sites between the left and right anterolateral and posterolateral abdominal walls. These stages ensure that medication is administered properly and that the patient is comfortable during the process. Appendix A illustrates the details of the instructional program.

Data collection and study sample

The target sample consisted of nurses working the day shift at Baghdad Teaching Hospital. All eligible nurses were invited to participate in the study. Only participants who provided informed consent were included in the study. At the start of the study, each nurse was interviewed to learn about his or her age, qualifications, and work history. A clinical pharmacist witnessed and documented each nurse's preparation and delivery of an enoxaparin SC injection to the patient. Because it was impossible to judge the nurse's role in rotating the enoxaparin injecting sites through observation, and there were no records on the site of injection in the previous days, this point was decided by asking the nurse directly whether or not to perform this procedure. A pharmacist documented the enoxaparin injection procedure using a custom devised checklist based on previously published material (Table 1) [12-14]. To eliminate any gaps in information, the documentation process was completed immediately after the nurse administered each patient's enoxaparin injection. All of the aforementioned factors were evaluated twice: once at the beginning of the study and again after the nurse engaged in the educational program. The researchers created a semi-structured survey questionnaire for the purpose of this investigation. The questionnaire was tested for content and face validity to ensure that all of the items were relevant and that the information was clear. The validity of an instrument refers to its capacity to collect the data that it is designed to collect. The face validity of the nursing intervention program and the study instrument is determined by having a panel of ten experts with more than ten years of experience in their scientific field review the intervention program's content and instrument, as well as investigate the clarity, relevancy, and adequacy of the questionnaire to measure the concepts of interest. Some demographics were removed following a face-to-face or email conversation with each expert. After

considering all of the expert opinions and recommendations, the instrument was determined to be legitimate. Cronbach's alpha was then calculated to assess internal consistency

Table 1: Checklist for enoxaparin injecting technique

Parameter	Checklist of Variables	Correct	Incorrect
Preparation	Washing hands		
	Inspect the prefilled syringe before use to ensure it is not discolored and does not contain visible particulate matter.		
	Clean the injection area.		
	Not removing air bubbles from the prefilled syringe.		
Administration	Inspecting the skin at the site of injection for any bruising, redness, or scars		
	Inject into the abdomen.		
	Choosing a correct location within the injecting area (i.e., 5.0 cm away from the umbilicus; e.g., the lateral aspects of the upper arm and thighs)		
	Pinching the skin		
	Injecting at a 90 angle		
Reducing risks of side effects	Don't massage or rub		
	Inject slowly over 30 seconds.		
	Rotate the site of the injection.		

Statistical analysis

Data input was done using Microsoft Excel 2007. Categorical variables were presented as numbers and percentages. Continuous variables were presented as mean±standard deviation. For calculation purposes, a technique was considered optimal for 100% scores and good for scores ≥80% of the maximum possible score [16]. The chi-square test was used to test the significance of differences among categorical variables. The chi-square test was calculated using an online calculator: http://www.quantpsy.org/chisq/chisq.htm. *p*-values less than 0.05 were considered significant.

RESULTS

This study included one hundred forty-four nurses. The majority of nurses who participated were female (68%) and held a nursing diploma (56.25%) with 5-10 years of experience (43%). In terms of employment location, 26.4% of participating nurses worked in internal medicine wards, 19.4% in surgical wards, 18.1% in gynecological wards, 17.4% in hematology wards, and 18.8% in other specialist wards. Table 2 provides more details. At baseline, only 8.3% of nurses who participated completed all of the necessary preparatory procedures before injecting enoxaparin, with examining the prefilled syringe being the least done activity (47.2%) and washing hands being the most commonly performed action (57.6%). Furthermore, only 13.2% of participating nurses correctly administered enoxaparin, with choosing the abdomen as the least performed action (53.4%) and pinching the skin while injecting enoxaparin being the most common (75%). Furthermore, only 20.1% of participating nurses took all of the necessary steps to reduce the pain of injecting enoxaparin, while injecting enoxaparin slowly over 30 seconds was the least performed action (49.3%), and rotating the injection site with enoxaparin was the most commonly performed action (62.5%). Meanwhile, only 12.5% of the participating nurses identified a good injecting technique. Furthermore, the most effective enoxaparin injection technique was dramatically improved (from 0.7% to 16%; p=0.000) (Table 3). Table 4 reveals that gender, working experience, educational level, or work did not have a significant effect on the participating nurses' bad enoxaparin injection technique. Regarding the impact of pharmacist-led nurse education, all preparation stages and approaches for reducing injection discomfort were greatly improved. Meanwhile, all phases of enoxaparin administration, except for pinching the skin, were dramatically better after nurses completed the teaching session. Furthermore, the proportion of nurses who correctly conducted the enoxaparin injection technique jumped from 12.5% to 59%.

Table 2: General demographic data of enrolled nurses

Variables	Values
Gender	
Male	48(33.3)
Female	96(66.7)
Academic degree	
Secondary school	33(22.9)
Diploma	81(56.3)
Bachelor of Science	29(20.1)
Master	1(0.7)
Years of experience	9.34±8.51
Less than 5 years	43(29.9)
5- 10 years	62(43.1)
10 years or more	39(27.1)
Working place	
Surgical ward	28(19.4)
Working place	38(26.4)
Hematology ward	25(17.4)
Gynecology ward	26(18.1)
Other wards (Rheumatology, pediatric, renal dialysis, CCU)	27(18.8)

Values were expressed as mean±SD, frequencies and percentage.

Table 3: Effect of pharmacist-led nurse education on enoxaparin injecting technique

Variables		Performance n(%)		*p*- value
		Before education	After education	
Preparations	Washing hands	83(57.6)	123(85.4)	0.000
	Inspect the prefilled syringe before use to ensure it is not discolored and does not contain visible particulate matter.	68(47.2)	121(84)	0.000
	Clean the injection area	80(55.6)	128(88.9)	0.000
	Not removing air bubble from the prefilled syringe	69(47.9)	103(71.5)	0.000
	Optimum preparation	12(8.3)	71(49.3)	0.000
Administration	Inspecting the skin at the site of injection for any bruising, redness, or scars	86(59.7)	129(89.6)	0.000
	Inject into the abdomen	77(53.4)	104(72.2)	0.001
	Choosing a correct location within the injecting area	92(63.9)	113(78.5)	0.006
	Pinching the skin	108(75)	116(80.6)	0.257
	Injecting at a 90 angle	86(59.7)	120(83.3)	0.000
	Optimum administration	19(13.2)	59(41)	0.000
Reducing pain techniques	Don't massage or rub	89(61.8)	118(81.9)	0.000
	Inject slowly over 30 seconds	71(49.3)	99(68.8)	0.001
	Rotate site of injection	90(62.5)	121(84)	0.000
	Optimum reducing pain techniques	29(20.1)	69(47.9)	0.000
Overall injecting technique	Good	18(12.5)	85(59)	0.000
	Poor	126(87.5)	59(41)	
	Optimum	1(0.7)	23(16)	0.000
	Not optimum	143(99.3)	121(84)	

DISCUSSION

The majority of participants in this study were female nurses with nursing diplomas. The current study's demographic findings were consistent with those of previous studies conducted in several Iraqi governorates [17,18]. Meanwhile, this conclusion was partly predicted given that females generally prefer nursing occupations [19]. In terms of work experience, the majority of the included nurses had at least 5 years of experience, which is longer than that discovered in research conducted in other Iraqi governorates [17,18]. This discrepancy could be attributable to the fact that the nurses in the current study worked in Baghdad Teaching Hospital (Iraq's largest hospital) and were mostly invested in experienced staff. The study's findings revealed that the most common preparatory actions performed by participating nurses before to enoxaparin injection were hand washing (57%), followed by cleaning the injection site (55%).

Table 4: Factors affecting the appropriateness of the enoxaparin injecting technique

Variables		Good	Poor	*p*-value
Gender	Male	8(16.7)	40(83.3)	0.134
	Female	8(8.3)	88(91.7)	
	< 5 years	4(9.3)	39(90.7)	
Experience	5-10 years	4(6.5)	58(93.5)	0.082
	> 10 years	8(20.5)	31(79.5)	
	Secondary school	2(6.1)	31(93.9)	
Academic degree	Diploma	10(12.3)	71(87.7)	0.569
	College and above	4(13.3)	26(86.7)	
	Surgical ward	6(21.4)	22(78.6)	
	Internal medicine ward	3(7.9)	35 (92.1)	
	Hematology ward	5(20)	20(80)	0.081
Working place	Gynecology ward	1(3.8)	25(96.2)	
	Other wards	1(3.7)	26(96.3)	

Values were expressed as frequencies and percentages.

A similar finding was discovered among Iraqi nurses in the Kurdistan region, where over half did not wash their hands before administering intravenous medications [20]. The current finding differed significantly from that of a study conducted among American nurses in which more than 90% of them washed their hands and cleaned the injection site before administering anticoagulant medications [7]. The poor preparatory techniques for injecting enoxaparin by the participating nurses in the current study may be attributed to their work overload due to a staff shortage [21], as well as their limited competence and skills [21,22] due to the scarcity of continuous medical and educational programs and training sessions for nurses in Iraq and other developing countries [22, 23]. The recent study found that the optimal way for nurses to deliver enoxaparin is to pinch and check the skin before injecting it. On the other hand, the current study participants conducted the least amount of enoxaparin injections in the abdomen. These findings were comparable to those obtained in a study of Turkish nurses [24]. In contrast to the current findings, all American nurses administer low-molecular-weight heparins into the abdomen [7]. This disparity may be due to the desire of most Iraqi patients for subcutaneous injections in

their arm rather than their belly [25], as well as the preference of most nurses for injections in the lateral portions of the arm over the abdomen [24]. In terms of approaches for reducing the discomfort of injecting enoxaparin, the current study found that around half of the participating nurses inject enoxaparin gently over 30 seconds, and two-thirds rotate the injection site. This finding was comparable to that of Turkish nurses [24]. Furthermore, the current study discovered that only 20% of participating nurses used all of the necessary procedures to lessen the pain of injecting enoxaparin. In line with the current study, Engstrom and colleagues discovered that most nurses did not employ appropriate strategies to prevent pain when delivering reproductive medications intramuscularly [26]. Although nurses must be knowledgeable about the enoxaparin injection technique to achieve optimum efficacy and safety from this drug [27], the current study found that only 12.5% of the participating nurses had a decent technique for injecting enoxaparin. Unfortunately, the participating nurse's gender, degree of experience, educational background, or place of employment had no noticeable influence on good injecting technique. Similarly, inadequate injecting technique was widespread in other developing countries [28,29]. In Pakistan, only 14.7% of nurses had appropriate knowledge of insulin injecting technique, but 28.2% of Indian nurses had adequate understanding of intramuscular injection technique [28, 29]. Regarding the efficacy of pharmacist-led nurse education, the findings of this study revealed that the number of nurses who completed the enoxaparin injection technique correctly and optimally increased dramatically. Two more investigations discovered that nurse education can marginally enhance drug delivery procedures [30, 31]. The primary distinction between the preceding research and the current investigation was the form of education, which was didactic [30,31] and not driven by a pharmacist in prior studies [30], whereas it was pharmacist-led interactive face-to-face education in the current study. In this regard, research has demonstrated that interactive face-to-face education is the most effective strategy to develop nurses' competence and skills [32,33]. This discrepancy could explain why nurses' performance improved significantly in the current trial but not in the previous studies.

Study limitations

The sample size of enrolled participants may be insufficient to extrapolate the findings to a larger population. Also, it was probable that some of the participants lacked the essential experience. Further research should be conducted with a bigger population sample and potentially more specific questions to measure nurses' understanding of the enoxaparin injection technique. Further research should be performed to obtain a broader spectrum of the nursing community in order to understand whether these issues are unique to the hospital or are common across the nursing spectrum.

Conclusion

The enoxaparin injection technique used by nurses at Baghdad Teaching Hospital was quite insufficient, and it was greatly improved by the newly devised interactive pharmacist-led nurse education.

Conflict of interests

No conflict of interests was declared by the authors.

Funding source

The authors did not receive any source of fund.

Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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1. Wash hands to minimize the risk of infection to the patient.
2. Assess the skin and the patient's condition. Any area with scars or bruising should also be avoided.
3. Inspecting the prefilled syringe before use to ensure it is not discolored and does not contain visible particulate matter. Discard the prefilled syringe if it is discolored and/or it contains visible particulate matter.
4. **Administration site: Enoxaparin sodium is only licensed for administration into the abdominal wall. The recommended site for injection is on the right or left side of the abdomen, 5cm away from the umbilicus. Some references allow the injection of enoxaparin to sites other than the abdomen, such as lateral aspects of the arm and thigh. Anyhow, injecting enoxaparin into the abdomen is associated with less pain than the thigh. On the other hand, injecting enoxaparin into the abdomen is associated with non-significantly less pain than injecting it into the arm.**
5. **Preparing the injection: To ensure optimum drug dose, the air bubble should not be expelled from pre-filled syringes.**
6. **Gently clean the site with an antiseptic swab and let it dry.**
7. Rotating site of the injection: Consider rotation of injection sites and assess those that are repeatedly used for injection. Administration should be alternated between the left and right anterolateral and left and right posterolateral abdominal walls
8. Pinching the skin: Ensure the fold of skin is injected into and released only when the needle is removed.
9. Injection angle: Inject at a 90° angle. (Hold the syringe like a pencil or a dart and fully insert the needle at an angle of 90° (a right angle).
10. Inject slowly over 30 seconds. This will reduce injection pain.
11. Do not massage or rub the site afterward. As this increases bruising.

Appendix A: Educational information about enoxaparin injecting technique