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Identifying Methods Used to Avoid Insulin Injection Pain

Pınar TUNÇ TUNA¹, Enes GÜNHAN², Halil İbrahim TUNA¹,
Birsal MOLU¹, Alev YILDIRIM KESKİN¹

¹ Selcuk University, School of Health, Nursing Department
² Akşehir State Hospital, Internal Medicine

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ABSTRACT

Objective: The aim of the study is to determine the knowledge levels of diabetes mellitus patients about the disease and insulin use and their practices to prevent insulin injection pain. **Material and Methods:** Data were collected from 399 patients who administered insulin injections in the study. Patient Identification Form, Disease and Treatment Compliance Form, Morisky-8 Treatment Adherence Scale (MMAS-8), and Visual Analog Scale were used for data collection. **Results:** According to the findings of the study, it was determined that 16.6% of the patients made correct rotation while administering insulin injection. It was determined that 46.4% of the patients preferred the painless area while injecting. However, it was determined that patients who applied insulin injection correctly had higher pain scores. It has been determined that patients with complications related to DM have higher adherence to treatment. **Conclusion:** Although the vast majority of patients reported that they came to regular check-ups; it was found that they did not rotate correctly while injecting insulin, nearly half of the patients preferred to inject into the painless area as a way of avoiding pain, and patients who did not rotate experienced low pain associated with the injection. In addition, patients were found to have low adherence to treatment. **Keywords:** Pain, Insulin, Injections, Nursing Care.

İnsülin Enjeksiyonu Ağrısından Kaçınmak İçin Kullanılan Yöntemlerin Belirlenmesi

ÖZ

Amaç: Bu çalışma diyabet hastalarının hastalık ve insülin kullanımı ile ilgili bilgi düzeylerini ve insülin enjeksiyon ağrısından korunmak için yaptıkları uygulamaları belirlemek amacıyla yapıldı. **Gereç ve Yöntem:** Çalışmada insülin enjeksiyonu yapan 399 hastadan veri toplandı. Veri toplama aracı olarak Hasta Tanıtım Formu, Hastalık ve Tedavi Uyum Formu, Morisky-8 Tedavi Uyum Ölçeği (MMAS-8) ve Görsel Analog Skalası kullanıldı. **Bulgular:** Çalışmanın bulgularına göre hastaların %16,6'sının insülin enjeksiyonu uygularken doğru rotasyon yaptığı saptandı. Hastaların %46,4'ünün enjeksiyon yaparken ağrısız alanı tercih ettiği belirlendi. Bununla birlikte insülin enjeksiyonunu doğru uygulayan hastaların ağrı skorlarının daha yüksek olduğu belirlendi. DM'ye bağlı komplikasyonları olan hastaların tedaviye uyumunun daha yüksek olduğu saptandı. **Sonuç:** Hastaların büyük çoğunluğunun düzenli kontrollere geldiğini bildirmesine rağmen; insülin enjeksiyonu yaparken doğru rotasyon yapmadıkları, hastaların yarısına yakınının ağrıdan kaçınma yolu olarak ağrısız alana enjeksiyon yapmayı tercih ettikleri, rotasyon yapmayan hastaların enjeksiyona bağlı düşük ağrı yaşadıkları bulundu. Ek olarak hastaların tedaviye uyumlarının düşük olduğu bulundu.

Anahtar Kelimeler: Ağrı, İnsülin, Enjeksiyon, Hemşirelik Bakımı.

Sorumlu Yazar / Corresponding Author: Pınar TUNÇ TUNA, Selcuk University, School of Health, Nursing Department, Konya, Türkiye

E-mail: pinartunctuna@gmail.com

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder requiring exogenous insulin therapy for approximately one-third of patients (Yoo & Kim, 2023). Insulin is a vital hormone that plays a crucial role in regulating blood glucose levels. It is produced by the pancreas, acts as an anabolic hormone, and has many effects on lipid, protein, and carbohydrate metabolism. Insulin helps move glucose from the bloodstream into cells where it can be used for energy production or stored as glycogen in the liver and muscles. Without enough insulin, glucose cannot enter cells effectively, leading to high blood sugar levels that are characteristic of diabetes mellitus. This chronic autoimmune disease results from the destruction of insulin-producing beta cells within the pancreatic islets of Langerhans (Aslan et al., 2023). As a result, individuals with diabetes have to be on insulin therapy. However, inappropriate use of this treatment method often leads to various complications such as pain, lipoatrophy, and lipohypertrophy (Gentile, Guarino, & Strollo, 2020). However, the administration of insulin injections is often accompanied by discomfort and pain, which leads to various difficulties in compliance with treatment. In particular, the experience of pain during insulin injections can significantly affect patients' adherence to treatment, leading to suboptimal disease management and reduced quality of life. Therefore, understanding the methods used by diabetic patients to alleviate injection pain and their subsequent adherence to treatment is crucial for optimizing patient care and outcomes (Lee, Ma, Lee, & Jung, 2018). Pain experienced during insulin injections is often a deterrent for patients, leading to a decrease in adherence to treatment and an increased risk of complications. Needle configuration (length, diameter, wall thickness, bevel type), injection technique (angle, pressure, velocity), drug formulation (pH, viscosity, drug concentration), drug dose (volume), injection site (abdomen, thigh, upper arm) and previous injection experiences contribute to pain intensity during injection (Zijlstra, Jahnke, Fischer, Kapitza, & Forst, 2018). These factors affect perceived pain intensity and may differ between individuals. As a result, patients may adopt a variety of strategies to relieve injection pain, as avoiding or reducing pain is their primary concern. Patients who are afraid of experiencing this pain can avoid pain pharmacologically and non-pharmacologically. Pharmacological methods may include the use of topical anesthetics such as lidocaine-based creams or patches to numb the injection site before insulin administration (Puthrl et al., 2022). Additionally, new needle technologies such as ultra-thin or shorter needles could be explored as potential options for reducing pain during injections.

Non-pharmacological methods cover a wider range of techniques and applications. Patients can use psychological interventions such as distraction techniques and deep breathing exercises to distract their attention from the pain associated with injections

(Khan & Baig, 2022). Appropriate injection site selection, rotation, and preparation can also minimize discomfort (Zijlstra, Jahnke, Fischer, Kapitza, & Forst, 2018). In addition, patients can benefit from education and training in injection techniques, including appropriate needle insertion angles, speed, and depth, which can contribute to pain reduction. Cold application or heat therapy to the injection site before or after the injection may provide additional relief (El-Mahdi et al, 2023). Complementary and alternative therapies such as acupuncture or transcutaneous electrical nerve stimulation (TENS) may also be explored as potential adjunctive options (Ramadan Esmail Magor et al., 2023).

Among the current treatment options for diabetes management, insulin therapy plays a critical role, especially in patients with type 1 diabetes and advanced type 2 diabetes. However, successful management of diabetes through insulin therapy requires not only insulin administration but also consistent adherence to treatment regimens and lifestyle changes. An important factor that can significantly affect adherence to treatment in patients with diabetes using insulin is the experience of pain associated with insulin injections. Insulin administration, typically by subcutaneous injections, may be accompanied by pain, discomfort, and localized tissue reactions. This unpleasant sensory experience can lead to adverse psychological and physiological effects, potentially compromising patients' adherence to treatment and overall glycemic control. In a study, it was found that pain was the main difficulty in self-administration and compliance (da Costa AKG et al., 2023). In another study, insulin pain ranks first among the reasons for non-compliance with treatment (Kim, Shah, Buettner, 2022).

Despite the existence of guidelines and adherence programs for patients on insulin, non-compliance remains common. Doctors and diabetes nurses play an important role in educating patients about their condition and insulin administration techniques. However, patients often do not comply with these programs because of their desire to avoid injection-related pain (Lee et al., 2018). The desire to avoid injection pain is one of the main causes of non-compliance. Patients may hesitate to inject their insulin for fear of pain, which can lead to missed doses or irregular dosing schedules. This mismatch creates significant challenges in achieving optimal glycemic control and preventing diabetes-related complications. As a result, individuals resort to alternative practices, such as repeatedly injecting into areas that cause the least or no pain, as a way to reduce the discomfort associated with insulin injections (Kalra, Kumar, & Gupta, 2016; Spollett, Edelman, Mehner, Walter, & Penformis, 2016). For a comprehensive understanding of this phenomenon, it is imperative to evaluate the knowledge level of diabetic patients regarding their disease and insulin therapy. In addition, investigating the specific methods that patients use to relieve

injection pain, such as site rotation or selective injection, can provide information about coping strategies. In addition, assessment of patient adherence, including regular insulin administration and adherence to recommended injection techniques, will shed light on overall adherence rates and potential barriers.

This study aims to investigate the methods used by diabetes patients using insulin to reduce injection pain and their compliance with their treatment regimens. By clarifying patients' knowledge levels, pain reduction strategies, and treatment adherence patterns, healthcare providers can develop tailored interventions and educational programs to address patients' concerns and improve treatment outcomes. Increasing patient engagement and satisfaction with insulin therapy can ultimately lead to better disease management and improved overall well-being for individuals with diabetes mellitus.

Research questions;

- Do diabetic patients using insulin rotate correctly when applying insulin?
- What are the methods used by diabetic patients using insulin to avoid the pain of insulin injections?
- Does the correct rotation status of diabetic patients using insulin and whether they experience complications related to their disease affect their pain and treatment compliance scores?

MATERIALS AND METHODS

Type of research

In this descriptive study.

Place and time of research

The study was carried out with patients who were followed up in the internal medicine outpatient clinic of a secondary level state hospital between October 15, 2021 and April 15, 2022.

Population/sample of the research

The sample population of the study was calculated according to the known sample calculation method. It was determined that there were 755 diabetes patients followed up from the outpatient clinic at the beginning and at least 255 people should be reached after the calculation made with a 95% confidence interval and a 5% margin of error. The research was completed with 399 participants.

Inclusion criteria of research

Patients aged 18-65, diagnosed with diabetes mellitus at least 1 year ago, using insulin for at least one month, and having no communication problems, and no mental illnesses were included.

Data collection tools

Patient identification form: This form was prepared by the researchers in line with the literature (Famulla et al., 2016; Hernar, Haltbakk, & Broström, 2017, Usach, Martinez, Festini, & Peris, 2019). It consists of two parts. First episode; consisted of 7 questions containing the descriptive characteristics of the participants, such as the patient's age, marital status, gender, and

educational status. (Famulla et al., 2016; Usach, Martinez, Festini, & Peris, 2019). Second part; consists of 12 questions regarding the disease and treatment of the participants' disease, such as duration of illness, duration of insulin use, frequency of insulin use, insulin dose, HbA1C, insulin injection rotation status and frequency, presence of diabetes-related complications. (Hernar, Haltbakk, & Broström, 2017). *Morisky-8 Treatment Adherence Scale (MMAS-8):* The scale used to determine the drug compliance of patients was developed by Donald Morisky et al. (1986) (Cronbach alpha: 0.61) (Morisky, Green, & Levine, 1986). It is an 8-item scale that evaluates patients' adherence to drug therapy based on their statements. The first 7 items in the scale are binary yes-no, and the last item is a 5-point Likert-type scale as 'never', 'seldom', 'sometimes', 'often', 'always'. The 5th item in the scale is reverse coded. For the first 7 items (after the 5th item is reverse coded), each 'no' answer is scored as 1 point and a 'yes' answer as 0 points. In question 8, 1 point is assigned for the 'always' answer and 0 for the 'never' answer. The highest 8 and the lowest 0 points can be obtained from the scale. The higher the score, the higher the fit. A score of 0-6 is considered low compliance, 6-8 points as moderate, and 8 points as full compliance (Aşilar, Gözüm, Çapık, & Morisky, 2014).

VAS: This scale was used to determine the patient's pain during insulin injections. Patients were asked to rate the pain they experienced while injecting insulin between 0 and 10. 0 points on a 10 cm ruler were defined as no pain and 10 points as the most severe pain. It has been reported that the VAS is more sensitive and reliable than other unidimensional scales in the measurement of pain severity (Delgado et al., 2018).

Data collecting

Data were obtained from the patients who met the inclusion criteria and agreed to participate in the study in the waiting area of the internal medicine outpatient clinic. Data were collected by the same researcher. Data collection time for each patient is 10-15 minutes.

Data analysis

Analyzes were performed in SPSS (IBM SPSS Statistics 23). In descriptive statistics, n, % was used. "Mann-Whitney U" test (Z-table value) and "Kruskal-Wallis H Test" test were used. The data were evaluated based on 0.05 significance levels.

Ethical consideration

Permissions were obtained from the Local Ethics Committee (2021/22) and the institution where the research would be conducted (No. 16.12.2021/194210). In addition, verbal and written consent was obtained from the participants in the study.

RESULTS

72.4 % of the participants were women, 92.2% were married, 76.2% were primary school graduates, and 44.1% used novarapid as insulin. It was determined that the mean age of the researchers was 54.04, the

duration of the disease was 9.44 years, and the average insulin dose used was 14.49 (Table 1).

Table 1. Sociodemographic characteristics of patients using insulin and data on insulin use.

	n	%	
Gender	Woman	289	72.4
	Male	110	27.6
Marital status	Married	368	92.2
	Single	31	7.8
Income status	Income equals expense	168	42.1
	Income more than expenses	92	23.1
	Income less than expenses	139	34.8
Educational status	Primary education	304	76.2
	Secondary education	93	23.3
	Bachelor and above	2	0.5
Family structure	Lives alone	59	14.8
	Nuclear family	315	78.9
	Extended family	25	6.3
Where they lives	Town center	127	31.8
	Other	272	68.2
Age	54.04 ± 8.20 (min: 26, max: 64)		
Disease duration (years)	9.44 ± 7.49 (min: 1, max:30)		
Insulin use (months)	6.49 ± 5.71 (min: 1, max:30)		
Frequency of insulin use (days)	2.51 ± 2.15 (min: 1, max: 20)		
Insulin dose	14.49 ± 4.99 (min: 1, max: 34)		
HbA1C	9.52 ± 1.96 (min: 5.90, max: 13.90)		

In Table 2, it was found that 83.7% of the patients participating in the study rotated during insulin injection, but 16.3% rotated during each injection. It was determined that 57.1% of the patients participating in the study experienced complications related to DM, 18% had a severe hypoglycemic period in the last year, and 90% of them regularly came to physician controls.

It was determined that 46.4% of the patients injected into the painless area to avoid insulin pain, a small number of patients knew HemoglobinA1C (HbA1C) and its value, whereas 62.4% of them knew the organs affected by hyperglycemia. It was found that the patients experienced low pain due to insulin injection and their adherence to treatment was low (Table 2).

Table 2. Sociodemographic characteristics and data on insulin uses.

	n	%	
Rotation status	Continuous rotation	65	16.3
	Day rotation	164	41.1
	Rare rotation	170	42.6
DM complication status	Yes	228	57.1
	No	171	42.9
Regular attendance to physician check-ups	Yes	359	90.0
	No	40	10.0
Insulin methods used to avoid injection pain	Injection into the painless area	185	46.4
	Cold application	14	3.5
	Hot application	16	4.0
	Using cream	43	10.8
	Do not rub the injection site	24	6.0
	Dose skipping	37	9.3
	Disrupting sugar tracking	70	17.5
	Using a short needle	10	2.5

Table 2. (Continue) Sociodemographic characteristics and data on insulin uses.

		n	%
The state of knowing HgA1C	Yes	76	19.0
	No	323	81.0
The state of knowing the HgA1C value	Yes	46	11.5
	No	353	88.5
state of knowing the organs affected in hyperglycemia	Yes	249	62.4
	No	150	37.6
VAS [(Mean \pm SD)- Min – Max]		[(2.20 \pm 1.64) 0-7]	
Morisky -8 Treatment Compliance [(Mean -SD) Min - Max)		[(3.39 \pm 1.68) 1-8]	

In Table 3, it was determined that there was a difference between the way of rotation of the participants and their pain scores, and the pain scores

of the patients who made each injection to a different region were higher. It was determined that patients with complications related to DM had higher adherence to treatment.

Table 3. The relationship between some findings of patients using insulin and pain scores and treatment compliance scores.

		Pain	Compliance with treatment
		median [IQR]	median [IQR]
How to rotate	Each injection is to a different body area ^a	3 [2-4]	3 [3-4]
	Every other day rotation ^b	2 [1-4]	3 [2-4]
	Rare rotation ^c	2 [1-3]	3 [2-4]
Test * and p value		p<0.001 a=b>c	p = 0.47
Presence of DM complications	Yes	2 [0.25-3]	4 [2-5]
	No	2 [1-3]	3 [2-3]
Test ** and p value		p = 0.73	p <0.001

*Kruskal Wallis test, Bonferroni-corrected pairwise comparisons were made to determine which group caused the difference.,

**Mann Whitney U tests

DISCUSSION

It was determined that almost half of the patients used rare rotations. In a study conducted in Turkey, it was reported that more than half of the patients did not rotate while injecting insulin (Aslan and Korkmaz, 2015). Similarly, in a multicenter study in Italy, it was found that most of the patients did not rotate while injecting insulin (Gentile et al., 2020). Current guidelines in the literature recommend continuous injection site rotation as part of the insulin injection technique (Danne et al., 2018). A recent study has similarly reported that continuous care and optimization of insulin injection techniques can help patients achieve better diabetes-related outcomes (Zhang, Shen, & Sun, 2022). The result of the research is similar to the literature. This suggests that there is a lack of information about the complications that may be caused by patients not rotating while administering the insulin injection. This shows that patients have difficulty managing their diabetes. It is thought that patients need nursing care.

In this study, it was found that more than half of the patients who participated in the study experienced complications related to diabetes. If proper rotation is not performed while injecting insulin, cutaneous problems, allergic reactions, lipoatrophy, lipohypertrophy, and subcutaneous amyloid deposits occur (Ansari et al., 2017). It has been reported that this may be one of the causes of unexplained blood glucose fluctuations by affecting the adequate absorption of insulin (Nagase et al., 2014; Famulla et al., 2016). It is thought that the reason why more than half of the patients participating in the study experience complications related to DM is the lack of proper rotation and low adherence to treatment.

When the methods used by the patients to avoid pain due to insulin injections were examined, it was found that the majority of the patients resorted to inaccurate methods to avoid pain. It was found that the most common method among these methods was to inject into the painless area. Conditions such as subcutaneous injection, needle characteristics, injection site, injected

drug volume, injection speed, drug osmolality, drug viscosity, and pH affect injection pain (Usach et al., 2019). It has been reported that continuous injection into the same area in patients using insulin causes lipohypertrophy. In the skin that thickens due to lipohypertrophy, the feeling of pain is further reduced (Gentile et al., 2020). In this study, the fact that most of the patients did not do the ratio correctly and injected into the painless area to avoid pain suggests that complications may have developed in the skin tissue due to the insulin injection in the patients.

When the pain scores of the patients participating in the study were compared, it was found that there was no difference between the pain scores of the patients who rotated in each injection and the patients who rotated every other day. However, patients who rarely rotate when injecting insulin have been found to experience the least pain. In this study, it was determined that the average injection pain intensity of our patients was low. In addition, to reduce the pain of patients; It was determined that they took incompatible actions such as injecting into the painless area, skipping insulin doses in order not to experience the pain of insulin injection, and delaying sugar monitoring. Gentile et al. (2020) reported that many diabetic patients with lipohypertrophy do not want to rotate to different areas because it is painless (Gentile et al., 2020). Frid et al. (2016) also had similar results (Frid, Hirsch, Menchior, Morel, & Strauss, 2016). This shows that patients constantly inject into the same area to avoid pain. The application will increase the risk of developing lipohypertrophia. Our research results show that more than half of the patients injecting into the painless area do not apply the rotation. Patients will likely face more complications due to this wrong application to avoid pain. This may be an indication that patients have problems in follow-up and care.

It was determined that there was no difference between the rotation status of the patients and their compliance with the treatment. This result shows that rotation does not affect treatment adherence. In this study, no difference was found between the injection pain severities of patients with DM complications, but it can be said that patients with DM complications were more likely to comply with treatment. The presence of DM complications reduces the quality of life of patients, and therefore, the comfort of patients is impaired due to reasons such as decreased vision, foot wounds, and increased blood pressure (Khunkaew, Fernandez, & Sim, 2019). It can be said that these complications increase the compliance of the patients to the treatment.

In this study, it was determined that the patients participating in the study had a low level of treatment adherence. In eastern Nigeria, it was reported that patients with type 2 diabetes had good drug compliance (Pascal et al., 2012). In a study conducted with adult patients with diabetes in the United Arab Emirates, it was found that most of the patients had a low level of treatment adherence (Al-Haj Mohd et al.,

2015). The high level of HbA1C values of the patients also supports this finding. Our results support the literature (Fernandez-Lazaro et al., 2019). In another study conducted in Bangladesh, it was reported that patients with type 2 DM had low drug compliance (Islam et al., 2021). In a study in India, it was reported that the drug compliance of type 2 dm patients was high (Usman et al., 2023). In the literature, a common consensus could not be reached among studies investigating the level of adherence to treatment in patients with diabetes. This study is similar to the studies in the literature reporting that patients with diabetes have low drug compliance levels. In the unit where the study is carried out, patients come to regular doctor check-ups. However, regular check-ups are not made with diabetes nurses. This suggests that patients may reduce their treatment adherence.

Limitations

This research can only be generalized to the sample studied. The limitations of the study are that the injection site, which is defined as the least painful area by the patients, cannot be evaluated in terms of lipohypertrophy, and the study was conducted only in one center.

CONCLUSION

In this study, it was determined that the patients did not rotate correctly while injecting insulin, and they performed inappropriate behaviors such as injecting into the painless area to avoid insulin pain, skipping the drug dose, and using the needle tip short.

The patients participating in the study stated that although they knew the HgA1C level, they did not know what it was for. On the other hand, they stated that they knew the organs were affected due to hyperglycemia.

It was found that more than half of the patients who participated in the study had complications related to DM, despite regular visits to their doctors.

It was determined that the pain levels of the patients who rotated regularly during insulin injection were higher than the others. Compliance with treatment was higher in patients who experienced complications related to DM.

It was found that the patients in the study had low adherence to treatment.

The fact that patients come to regular check-ups may suggest that they accept the DM disease. It can be concluded that patients are inadequate in receiving nursing care. It is recommended to inform the patients about the importance of the drugs used in DM disease and the application of insulin injection and to conduct regular interviews with the patients about how they inject insulin.

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Conflict of Interest

The author declares no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Author Contributions

Plan, design: PTT, HIT, BM, AYK; **Material, methods and data collection:** PTT, EG, HIT, BM, AYK; **Data analysis and comments:** PTT, HIT, BM, AYK; **Writing and corrections:** PTT, HIT, BM, AYK.

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