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Impact Of Insulin Injection Methods On Glycemic Control In Diabetic Patients

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Abstract

Introduction: Insulin therapy, a cornerstone of diabetes management, requires precise administration techniques to ensure optimal absorption and efficacy.

Objectives: So, the basic aim of the study is to find the impact of insulin injection methods on glycemic control in diabetic patients.

Methodology of the study: This retrospective observational study was conducted at Medicine Department, Kutyana Memon Hospital, Karachi from 2021 to 2023. A total of 310 patients suffering from diabetes were included for data collection. Patient data, including demographic information, medical history, insulin therapy regimen, and glycemic control parameters, were collected from electronic medical records. Glycemic control parameters included, HbA1c levels, fasting blood glucose and postprandial glucose levels. Insulin injection techniques were assessed through patient self-reporting, healthcare provider documentation, and visual inspection of injection sites.

Results: Adherence to recommended practices was significantly associated with lower HbA1c levels ($p < 0.01$), indicating better long-term glycemic control among those who followed proper techniques. Conversely, rotation of injection sites showed no significant correlation with glycemic control parameters ($p > 0.05$). Additionally, there was a positive correlation between proper injection depth and fasting blood glucose levels ($p = 0.03$). **Conclusion:** Proper insulin injection techniques are essential for achieving optimal glycemic control in diabetic patients.

Keywords: Insulin, Patients, DM, Therapy, Injecting

Introduction

Effective glycemic control is crucial in managing diabetes and preventing its long-term complications. Despite advances in insulin formulations and delivery devices, variations in injection methods can significantly impact blood glucose levels [1]. The management of T1DM involves the administration of insulin as the only medication to regulate blood glucose levels. It can be given in combination with oral antidiabetic agents for patients with T2DM who have not met their glycemic goals. Since the discovery of insulin in 1921, insulin has remained the most suitable treatment approach to managing hyperglycemia in diabetic patients [2]. It is injected subcutaneously and can be delivered through insulin pump or through multidose insulin injection techniques. For this reason, the right procedures for insulin administration should be meticulously followed in order to get the expected results from insulin therapy [3].

Some researchers have established that the best results of insulin therapy are obtained from the adjustment of insulin injection methods. Diabetes self-management education (DSME) is a critical element of diabetes care and could potentially result in significant reduction of blood glucose level [4]. A previous systematic review of the effectiveness of self-management programs has not examined the glycemic effects of the training for insulin injection which is an important component of DSME. There are many guidelines and recommendations which are available on the international and national level regarding the correct way of insulin injection; nonetheless, it is well documented that majority of patients receiving routine care have limited injection training and are not injecting insulin in the right way [5]. Research has established that the right insulin injection technique is essential in enhancing the effectiveness of the treatment [6].

Most of the recommendations made by different diabetes associations are based on Injection Technique Questionnaire (ITQ) which is the largest multinational study of this kind. Although it can be easily understood that taking insulin injections correctly is necessary for keeping blood sugar level in check and thereby minimizing the complications of diabetes, recent research has indicated that a large number of patients are not aware of this fact [7]. In addition, it is a fact that using better devices with many modern solutions in the therapy of diabetes helps in increasing the effectiveness of insulin therapy [8]. Proper insulin injection techniques encompass several factors, including the choice of injection site, needle length, injection depth, and rotation of injection sites [9]. Inadequate or improper techniques can lead to erratic insulin absorption, resulting in suboptimal glycemic control. Additionally, improper techniques can cause complications such as lipohypertrophy, which further impair insulin absorption and contribute to glycemic variability. Lipohypertrophy (LH) is a condition characterized by the formation of nodules of adipose tissue in the subcutaneous tissue and is particularly associated with multiple and frequent injection therapy [10]. The constant administration of insulin in the same area leads to fat deposition as well as the formation of scar tissue. Factors which cause LH are frequency of needle change, frequency of change of site and duration of insulin therapy which are normally taught during insulin injection techniques. These areas may cause injection site variation in the rate of absorption, hematoma, hematomas, as well as inconsistent glycemic levels [11].

Objectives

So, the basic aim of the study is to find the impact of insulin injection methods on glycemic control in diabetic patients.

Methodology of the study

This retrospective observational study was conducted at Medicine Department, Kutayana Memon Hospital, Karachi from 2021 to 2023.

A total of 310 patients suffering from diabetes were included for data collection. Patients age >18 years and suffering from diabetes were included in the study. Patients suffering from DM but do not use insulin injection methods were excluded from the study. Patient data, including demographic information, medical history, insulin therapy regimen, and glycemic control parameters, were collected from electronic medical records. Glycemic control parameters included, HbA1c levels, fasting blood glucose and postprandial glucose levels. Insulin injection techniques were assessed through patient self-reporting, healthcare provider documentation, and visual inspection of injection sites. Factors evaluated included injection site rotation, needle length, injection depth, and adherence to recommended injection practices. Statistical analysis was conducted using SPSS v27. The relationship between insulin injection methods and glycemic control parameters was assessed using Pearson correlation. A p-value < 0.05 was considered statistically significant.

Results

Data were collected from 310 patients. Mean age of the participants was 55 ± 8.2 years. Out of 310 there were 55% male and 45% female participants. Almost 25% of the participants suffering from type I DM and 75% were suffering from type II DM. 45% patients used basal-bolus insulin therapy.

Table 01: Demographic data of participants

Characteristic	Value
Total Participants	310
Mean Age (years)	55 ± 8.2
Gender (Male/Female)	55% / 45%
Type of Diabetes	
- Type 1	25%
- Type 2	75%
Insulin Therapy Regimen	
- Basal-Bolus	45%
- Basal Only	30%
- Premixed	25%
Glycemic Parameter	
HbA1c (%)	7.8 ± 1.2
Fasting Blood Glucose (mg/dL)	145 ± 30

70% practiced regular rotation of injection sites, while 25% had inconsistent rotation, and 5% did not rotate sites. Regarding needle length, 60% used appropriate needles (4-6 mm), whereas 40% used needles that were too short (< 4 mm). For injection depth, 80% administered insulin at the recommended depth, and 20% injected at a shallow depth. Adherence to recommended practices varied, with 50% of patients strictly adhering, 30% partially adhering, and 20% not adhering to the recommended techniques.

Table 02: Use of insulin injection technique

Injection Technique Characteristic	Number of Subjects	Percentage (%)
Rotation of injection site		
- Regular Rotation	217	70%
- Inconsistent Rotation	78	25%
- No Rotation	15	5%
Length of needle		
- Appropriate (4-6 mm)	186	60%
- Too Short (< 4 mm)	124	40%
Depth of injection		
- Recommended Depth	248	80%
- Shallow Depth	62	20%
Adherence		
- Strict Adherence	155	50%
- Partial Adherence	93	30%
- Non-Adherence	62	20%

Adherence to recommended practices was significantly associated with lower HbA1c levels ($p < 0.01$), indicating better long-term glycemic control among those who followed proper techniques. Conversely, rotation of injection sites showed no significant correlation with glycemic control parameters ($p > 0.05$). Additionally, there was a positive correlation between proper injection depth and fasting blood glucose levels ($p = 0.03$).

Table 03: Relation between injection technique and glycemic control

Injection Technique	Correlation with Glycemic Control Parameters	p-value
Adherence to Practices	Lower HbA1c levels	< 0.01
Rotation of Injection Sites	No significant correlation	> 0.05
Injection Depth	Positive correlation with fasting blood glucose levels	0.03

Discussion

The results of this study also support that appropriate insulin injection techniques are essential for the management of diabetes to reach good glycemic control. This further supports the notion that adherence to recommended injection practices is an effective way of managing their diabetes especially when it comes to insulin therapy since it lowers HbA1c levels [12]. Better fasting blood glucose level was correlated with proper injection depth to subcutaneous tissue rather than intradermal injection, which highlights the importance of correct technique to avoid complications and achieve optimal glucose regulation [13]. Although 70% of patients stated they practiced regular rotation of injection sites there was no strong relationship between site rotation and glycemic control indicators; this could be attributed to the fact that the majority did practice proper rotation, hence reducing on the variability in the results [14]. Nonetheless, inability to follow the right rotation can cause lipohypertrophy, which is a condition that affects the absorption of insulin and shows why rotation should be done properly. Also, it was found that 40% of the participants used needles with an insufficient length, which can influence the insulin injection into the subcutaneous layer, thus underlining the importance of selecting adequate needle length based on the patient's characteristics [15]. It is interesting to note that the incidence of lipohypertrophy is quite different among countries. This study confirms that 48.8% of the Jordanian DM patients had lipohypertrophy. A meta-analysis of 26 studies on lipohypertrophy gave an overall estimated prevalence of 49% among T2DM patients and 34% among T1DM patients [16]. The lack of adequate health information on injection techniques in Jordan may be the reason for the high lipohypertrophy rates among the current study subjects. These findings underscore the importance of patient education concerning insulin injection procedures [17]. The current article suggests that healthcare providers should periodically remind patients about the proper needling techniques and conduct assessment of each patient in order to provide

recommendations regarding needle length and rotation frequency. It is also a best practice to assess and inspect the injection sites on a frequent basis to ensure that there are no complications such as lipohypertrophy [18].

Conclusion

Proper insulin injection techniques are essential for achieving optimal glycemic control in diabetic patients. Adherence to recommended practices, appropriate needle length, and correct injection depth significantly improve blood glucose levels. Ongoing patient education and personalized guidance are crucial for optimizing insulin therapy and enhancing clinical outcomes.

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