

Original Research Article

Practice of insulin injection techniques among persons with diabetes in central India: an observational survey

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ABSTRACT

Background: Correct injection technique used by the patient can determine the outcomes with insulin therapy in type 2 diabetes mellitus, however most patients on insulin remain unaware of the proper insulin injection techniques. The purpose of this study was to assess the current practice of insulin administration among diabetes patients.

Methods: This cross-sectional study was conducted in 3 tertiary care centers delivering specialized diabetes care in central India from November 2019 to February 2020. The study included patients (n=150) using insulin for at least three months by either syringe or pen. All of them answered a survey questionnaire which focused on key insulin injection parameters.

Results: Abdomen was the most common (53.33%) site of insulin injection. About 95.33% of subjects were following the injection site rotation instructions. The practice of hand washing, and cleaning of the injection site was practiced by 120 (80%) and 112 (74.66%) respondents respectively. Needle reuse was a common practice, and 146 (97.33%) subjects were using the same needle more than once. Around 73.33% were storing insulin at proper temperature, while 54.66% reported having pain at the injection site and 14.66% had noticed persistent swelling at their injection sites.

Conclusions: There is a significant gap between the insulin administration guidelines and current insulin injection practice. Education and counseling about proper insulin injection techniques should be provided to all persons with diabetes to ensure optimal usage of the drug to achieve the desired glycemic control.

Keywords: Insulin injection techniques, Diabetes, Diabetes mellitus

INTRODUCTION

The prevalence of type 2 diabetes mellitus (T2DM) has increased significantly in India in the last few decades. The 2019 international diabetes federation atlas estimates that India has a burden of 77 million of 463 million adults with diabetes.¹ One of the major dilemmas faced by physicians in the management of T2DM is that at the time of diagnosis, about 50% of beta-cells are already exhausted. This is especially alarming in our country as the average HbA1c at diagnosis is >9.0% as per the DiabCare India

study.² Further, the progressive decline in beta cell function leads to glycemic deterioration leading to irreversible insufficiency. Hence, insulin therapy needs to be initiated to prevent glucose toxicity and protect pancreatic β cells in most diabetics in India.³

Apart from the challenges faced by physicians, several other factors such as incorrect choice of injection site, faulty delivery devices, and improper technique may modify insulin absorption parameters, contribute to the disconnect between maximum glucose load and peak

insulin effect. Consequently, glycemic variability or unexplained hypoglycemia result and adversely affect long-term outcomes.⁴ Clinical experience as well as anecdotal evidence indicates that poor injection technique is one of the important and modifiable reasons for inadequate glycemic control. Improving insulin injection technique at patient and caregiver level results in the better glycemic control.⁵ Additionally, the improper disposal of the sharp is a major concern as it can increase the risk of transmitting blood borne infections.⁶ Another major challenge is needle reuse, which can result in pain with bleeding and bruising, chances of breaking off and lodging under the skin, risk of contamination, dosage inaccuracy, and lipohypertrophy (LH).⁴ Hence, following recommended and proper injection technique is an important part of insulin therapy.

Efforts need to be made to ensure that patients have basic information such as the storage, injection site selection, and the correct method of injection. The first Indian guidelines for insulin administration were described in 2012 which were updated in 2015 and further refined as the Indian recommendations for best practice in insulin injection Technique, in 2017 to address these issues.^{4,7,8} Various studies across the globe have reported the significant gap between the recommendations and actual practice of injecting insulin.⁹⁻¹⁴ This study was conducted to assess the practice of storage, administration of insulin and disposal of sharp waste in persons with diabetes in central India.

METHODS

This observational cross-sectional study was conducted in 3 tertiary centers (Balco medical centre, Raipur, Sri Aurobindo institute of medical sciences, Indore and Diabesity centre, Bhopal) delivering specialized diabetes care in central India from November 2019 to February 2020. A total of 150 patients who were using insulin for at least three months by either syringe or pen were recruited. Inclusion criteria included T2DM patients using insulin over the last three months. Patients not using insulin were excluded from the study. A written informed consent was obtained from all the participants. The study was conducted according to good clinical practice and the declaration of Helsinki. Patient identity was always kept confidential and was approved by the human ethics committee. All patients underwent a questionnaire survey which focused on key insulin injection parameters. The questions were based on the recommendations of the forum of injection technique, India.²

The insulin injection parameters: A. Current insulin injection practice: type of insulin, storage of insulin, injection device, the choice of injection site, site rotation, the time the needle remains under the skin, practice of hand washing, disinfection of injection site, needle disposal practice and B. Complications at injection sites: pain, bruising, and swelling suggestive of lipohypertrophy (LH).

RESULTS

One hundred and fifty participants completed study. The mean age of the participants was 48.32 ± 12.21 (Table 1). 92 (61.33%) study participants were male. There were 140 (93.33%) patients with type 2 DM, and 10 (6.66%) patients with type 1 DM. The median duration of diabetes was 5.32 ± 6.54 . The median duration of insulin uses 5.3 years. The premixed insulin was the most common type of insulin used in this study 110 (73.33%) compared to basal insulins 40 (26.66%).

Table 1: Baseline characteristics, (n=110).

Baseline characteristics	All participants
Age (mean±SD) (years)	48.32±12.21
Sex	N (%)
Male	92 (61.33)
Female	58 (38.66)
Type of diabetes	
T2DM	140 (93.33)
T1DM	10 (6.66)
Duration of diabetes (mean±SD)	5.32±6.54
Insulin use (mean±SD)	3.5±4.03
Responsible for injection	
Self	103 (68.66)
Care giver	37 (24.66)
Paramedic	10 (6.66)
Insulin type	
Premix insulin	110 (73.33)
Basal insulin	40 (26.66)
Frequency of insulins per day	
1	25 (16.66)
2	92 (61.33)
3	21 (14)
4	12 (8)

110 (73.33%) patients were storing insulin vials at proper temperature either in refrigerator or earthen pot. 32 (23.33%) subjects were keeping the insulin vials at room temperature, and 8 (5.33%) in a deep freezer. 142 (94.66%) patients were transporting insulin without maintaining cold chain during travel.

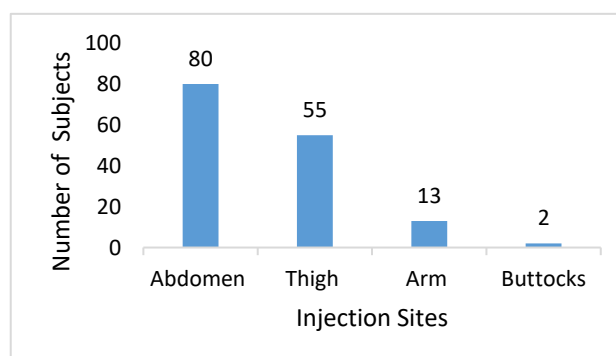


Figure 1: Insulin injection sites preferred by the patients.

Majority of the patients (135/150) were using needle and syringe for administration of insulin. The number of subjects using various insulin injection sites were- abdomen 80 (53.33%), thigh 55 (36.66%), arm 13 (8.66%), and buttock 2 (1.33%) (Figure 1). One hundred and forty-three (95.33%) study participants were rotating injection sites as recommended by their physicians.

Table 2: Injection site complications.

Parameter	Number of subjects	Frequency
Painful injections	82/150	54.66
Bleeding and/or bruising	53/150	35.33
Prevalence of lipohypertrophy	22/150	14.66

The practice of hand washing was followed by 120 (80%) patients. The cleaning of the injection site before insulin administration was practiced by 112 (74.66%) subjects. Needle reuse was a common practice, and 146 (97.33%) patients were using the needle more than once. Each needle was reused for average 8 times. Eighty-two (54.66%) subjects reported having pain at the injection site, 53 (35.33%) subjects reported bleeding and or bruising at the injection site (Table 2). Twenty-two (14.66%) subjects had noticed persistent swelling at their injection sites suggestive of the LH. Majority of the patients 146 (97.33%) were throwing the needle and syringes directly

into the garbage and public drainage system.

DISCUSSION

Our study represents the practice of insulin injection techniques among diabetic patients in Central India. The comparison of the findings from our study with results gathered from international and national surveys is shown in Table 3.⁹⁻¹⁴

The guidelines recommend storing insulin vial in a refrigerator or earthen pot filled with water and insulin vial must be kept at room temperature for 30 min prior to injection after taking out from refrigerator. The vials in use can be stored at room temperature (15-20⁰ C) for 30 days. However, in many parts of India the room temperature exceeds 20⁰ C especially during summer season. In our study 73.33% patients were storing insulin vials at proper temperature either in refrigerator or earthen pot. The median time gap between taking out insulin vials from refrigerator and insulin injection was only 5.6 min in this study. This might be responsible for pain at the injection sites in a significant number of our patients.

The most common injection site in our study was abdomen which was similar across other national and international surveys but Patil et al reported thigh to be most used injection site. Rotation of injection sites was practiced by majority of our patients at a rate comparable with the most recent international surveys (Table 3).

Table 3: Comparisons of injection technique surveys between different studies.

Parameters	Strauss et al ⁹	De Coninck et al ¹⁰	Berard et al ¹¹	Ji et al ¹²	Patil et al ¹³	Kalra et al ¹⁴	Our study
No. of patients	1002	4352	503	380	225	1008	150
Age (years)	47	48.4	53.3	54.56	50	51.1	48.32
Duration of insulin therapy (years)	14.7	13.9	14.7	3.62	3	5.5	3.5
Insulin injection sites (%)							
abdomen	85	88	91.6	92.89	26.22	51.4	53.33
Thigh	69	59	36.3	24.21	71.55	32.5	36.66
Buttock	24	16	8.1	5	4	1.7	1.33
Arm	34	29	24.2	22.89	53.33	14.1	8.66
No. of patients practicing rotation of injection sites (%)	38	91	88.5	92.11	92.89	-	95.33
Prevalence of lipohypertrophy (%)	29	48	24.6	15.79	11.11	-	14.66
Average no of times single needle used	3.33	3.6	2.34	9.19	6	4	8
No of patients disposed needles directly into garbage (%)	47	38	12.5	13.42	91	60.9	97.33

Ninety-seven percent of the subjects were disposing the sharps in hazardous ways in our study. The lack of awareness among the patients, caregivers, proper advice by doctors, guidelines and no access to sharp disposal devices could be the possible factors.⁶ LH characterized by hard swelling or a lump under the skin is one of the most

common complications of insulin injection. LH is associated with inconsistent or decreased insulin absorption. The prevalence of LH reported in our study was lower than earlier surveys, while comparable to the study by Ji et al and Patil et al.⁹⁻¹³ The exact pathogenesis is not known, but factors associated with LH include

inadequate rotation of injection sites, duration of insulin therapy, length of the needle used and reuse of needles.¹⁵ The low prevalence of LH in study might be due to regular rotation of sites. However, needle reuse was a common practice in our survey. Each needle was used for average eight times. Patients need to be educated on seven golden rules for proper insulin injection techniques (Table 4).

Table 4: The seven golden rules developed for proper injection techniques.

S. no.	Golden rules for insulin injection technique
1.	The injection site should be clean, as should one's hands
2.	4 mm pen needles, and 6 mm syringe needles are recommended for all adults, children, and adolescents. Children <6 years of age, and very thin adults may inject perpendicularly into raised skin folds.
3.	Recommended sites are the abdomen, upper thighs, upper arms, and upper buttock
4.	Persons using insulin should self-inspect their injection sites and screen for LH.
5.	Injection sites should be inspected and palpated by diabetes care professionals at least once a year, and more frequently if LH is detected.
6.	Needles should not be reused. Insulin pens, cartridges and vials should not be shared
7.	Safe disposal of insulin needles and ancillaries should be ensured

Limitations

The limitations of the study include small sample size as well as the restricted geographical boundary, which means these practices may not give an accurate Pan-India picture.

CONCLUSION

Our study identified a significant gap between the insulin administration guidelines and current insulin injection practices among T2DM patients in central India. Initiatives to enhance diabetes education in patients and caregivers can improve self-care behaviours, knowledge, and attitude domains profoundly. Hence, education and counselling about proper insulin injection techniques should be provided to all diabetic subjects to ensure optimal usage of the drug to achieve the desired glycaemic control.

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