



INSULIN TREATED PATIENTS; INAPPROPRIATE INJECTION TECHNIQUE CONTRIBUTES TO COMPLICATIONS AND GLYCEMIC VARIABILITY

Dr. Rizwana Kitchlew¹, Dr. Inayat Thaver², Dr. Shehryar Pervez³, Dr. Ikram ul Haq⁴

1. Associate Prof. Medicine
FMH College of Medicine &
Dentistry,
Shadman Lahore
2. Prof. and Chair,
Al-Shifa School of Public Health,
Al-Shifa Trust Eye Hospital,
Jehlum Road, Rawalpindi.
3. Post Graduate Trainee Registrar
Medicine
FMH Hospital, Shadman Lahore
4. Post Graduate Trainee Registrar
Medicine
FMH Hospital, Shadman Lahore

Correspondence Address:
Dr. Rizwana Kitchlew
Associate Prof. Medicine
FMH College of Medicine & Dentistry,
Shadman Lahore
riz102403@yahoo.com

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ABSTRACT... Objective: To determine the trends in insulin injection technique and associated complications in the local diabetic patients. **Study Design:** Cross-Sectional Descriptive study. **Place and Duration of Study:** This study was conducted in Department of Medicine at Fatima Memorial College & Hospital Lahore from 25th May 2015 to 25th October 2015. **Patients and Method:** Three hundred patients above 18 years of age who presented in outdoor and indoor department of the hospital, gave consent were enrolled. The data was collected through interview and relevant physical examination; data was analyzed by using SPSS 20.0 version. **Results:** 300 diabetics were enrolled; 108 (36%) male and 192 (64%) female. Mean age in males was 52.8 ± 13.7 and in females was 52.2 ± 11.8 . Duration of insulin use was less than 5 years in 175 (58%) and 5 years or more in 125 (42%). Insulin syringe of 8 mm gauge was being used by 263 (87%). Abdomen was the injection site in 202 (67%); however, 279 (93%) rotated the injection site. The angle of injection was kept at 90 degrees by 254 (85%). The needle was reused for five or more times by 187 (52%) and 216 (72%) were self-injecting. Local complications were seen in 105 (35%); out of those pain was most commonly (35 %) reported. Among age groups significant association ($p < 0.05$) was seen in site of insulin delivery, in age more than 60 years more injected in abdomen. In gender groups more males (83%) were self-injecting. Significant association ($p < 0.05$) was seen in duration of insulin use and local complications. Majority, 126(72%) of those who were on insulin for less than 5 years did not have complications. **Conclusion:** Majority of our patients had adopted reasonable technique however repeated reinforcement can further improve appropriate insulin delivery, less wastage of insulin and better glycemetic control with less chance of complications.

Key words: Insulin, injection, technique, complications

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INTRODUCTION

Diabetes Mellitus is one of the commonest non-communicable disease prevalent in both developed and developing countries. There are 387 million people with diabetes worldwide and it will go upto 592 million by 2035.¹ In 2013, around 10% of the total health expenditure globally was on diabetes.² Diabetes contributed US\$ 612 billion as health expenditure in 2014; 11% of total spending on adults. Currently 15% of American and British diabetics use insulin.³ In the United States 29% of adults with diabetes are using insulin.⁴ Between 30 to 40% of people with type 2 diabetes take insulin.⁵ In fact, there are more people with type 2 diabetes who take insulin than type 1 because of the much larger number of people with type 2. The American Diabetes

Association recommends and experts believe in early addition of insulin therapy in people with diabetes who do not meet target goals. This has led to an increase in the number of people with type 2 diabetes using insulin therapy. Similarly increase in number of people developing type 2 diabetes at a younger age and living longer, will likely lead to more people taking insulin.

One of the major causes of unexplained glycemetic variability appears to be suboptimal injection practice. Injection technique can affect the onset, degree and duration of insulin activity. It is vital that appropriate injection technique is adopted so as to achieve the desired effect without wasting the medicine. Incorrect technique causes local complications and disfigurement which may

compromise compliance plus insulin absorption tends to be erratic from intradermal and fat hypertrophy sites. This leads to ineffective diabetic control. Therefore international recommendations have been made in injection technique workshops the latest held in 2009 in Athens.⁶

MATERIALS & METHODS

This descriptive study was done in a tertiary care teaching hospital, in the Department of Medicine from 25th May 2015 till 15th October 2015. All diabetics aged 18 years or above using injectable insulin giving informed written consent were included. In addition, a formal approval was also sought from the Institutional Ethical Review Board. A simple random sampling was done after including the study population (through Epi-Info7 CDC), keeping an expected frequency of complications at 25%, with 95% confidence Interval. The size calculated was 287; considering non-refusal and lost to study, 5% extra were studied.

The injection technique parameters studied were needle size, injection site and its rotation, angle of injection, raising skin fold, needle cleaning, frequency of needle reuse, air bubble removal, needle stay in skin post-delivery, site cleaning with alcohol and complications at injection site (including pain, redness, bruising or lipodystrophy). Standard statistical techniques were used for analyzing the data using SPSS version 20.

Comparisons were made in the injection technique among various groups such as a) BMI kg/m² (<25, 25-30, >30); b) self -injecting and help group; c) duration of insulin use (less than 5 years, 5 or more years); d) gender; e) age (<40, 41-60, >60 years) and f) presence or absence of complications.

RESULTS

A total of 300 diabetics were enrolled; two-thirds (66%) were between 41-60 years, and almost two-thirds females. Table I illustrates basic characteristics of study population. Local complications were noted in one-third 35% of study population; among them pain was the

commonest (53%). See, Figure 1 for frequency of various complications. The injection techniques varied according to age groups; except site of Insulin delivery, where either older or younger age groups preferred using 'alternate sites' ($P < 0.05$). Similarly, among the sex, relatively more females (68%) were not cleaning the injection site with alcohol and more (72%) were not removing the air bubble as compared to males ($P < 0.05$). No significant findings were noted within various BMI categories (as identified in Table I), with the exception of having higher BMI ($P < 0.05$), when study population were removing the bubble before insulin use.

The use of Insulin Injection either by oneself or through others had some interesting significant association with various characteristics (as identified in Table I). Table II illustrates that there were relatively more males (83%); duration of Insulin was > 5 years (78%); air bubble was removed (78%); vial was rolled (78%); needle stayed in skin post-delivery (81%) and needle was reused for > 5 times (78%) when study population was self-injecting.

Similarly, associations were analyzed between injection techniques and development of complications. Table III illustrates that the patients who had been using the Insulin since < 5 years, who cleaned site with Alcohol, kept on rotating the sites of injection, and reused the Injection for 1-4 times were relatively reporting the lesser development of complications than their respective counterparts.

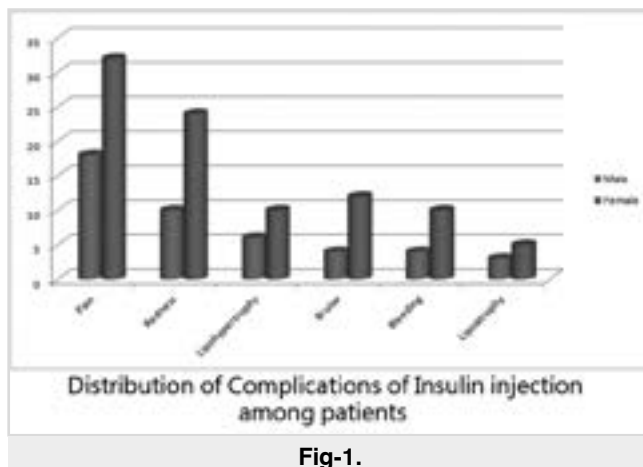


Fig-1.

Characteristics N= 300	Categories-frequency	%
Age:	< = 40 years (42)	14
	41-60 years (198)	66
	61 + (60)	20
Sex	Male (n=108)	36.0
	Female (n=192)	64.0
Duration of Insulin use	<5 Years n=(175)	58.3
	≥5 Years n=(125)	41.7
Needle length delivery	8mm gauge (n=263)	87.7
	Others (n=37)	12.3
Site cleaned with alcohol	Yes (n=93)	31.0
	No (n=207)	69.0
Site of Insulin Delivery	Abdomen n=(202)	67.3
	Alternate n=(98)	32.7
Site Rotation	Yes (n=279)	93.0
	No (n=21)	7.0
Injecting angle	45 Degree (n=46)	15.3
	90 Degree (n=254)	84.7
Air bubble removal before insulin delivery	Yes (n=169)	56.3
	No (n=131)	43.7
Vial Roll (n=294)	Yes (n=183)	62.2
	No (n=111)	37.8
Needle stay in skin post-delivery	Yes (n=84)	28.0
	No (n=216)	72.0
Local Complications	Yes (n=105)	35.0
	No (n=195)	65.0
Reuse	1-4 times n=(113)	37.7
	≥5 times n=(187)	62.3
Needle Cleaning	Yes (n=45)	15.0
	No (n=255)	85.0

Table-I. Basic characteristics of study population

DISCUSSION

Inappropriate insulin injecting technique is one of the well-known exogenous factors that contribute to glycemic variability. From 1997 various international recommendations have been made in the injection technique workshops, first held in Strausboro. Later at Barcelona (in 2000) and latest at Athens (2009; injection technique workshop in Athens -TITAN). This study was conducted to assess to what extent the latest recommendations were being followed in our local population and what was the impact.

According to the recommendation made in the third injection technique workshop in Athens (TITAN), syringes meeting the concentration of insulin U-100 should be used. This was the

practice in our patients.⁶

Injection procedures

In this study group all patients were lifting a skin fold to inject. Most of the patients (88%) were using 8 mm needle and 85% were injecting at 90 degrees. It is recommended that Injections with 6 or 8 mm needles should be used either with a skin fold or a 45-degree angle.^{7,8} Latest recommendation is that 4, 5 and 6 mm needles may be used by any adult patient including obese ones and do not generally require the lifting of a skin fold and should be given in adults at 90 degrees to the skin surface.⁹ Furthermore, a 4 mm pen needle was shown to be safe and effective in adult patients and pain scores were improved as compared with longer wider-diameter needles.^{10,11,12}

This study showed that only 28% were observing the practice of needle stay post-delivery, which is not in line with standard recommendations of embedding within the skin for 5 seconds after complete depression of the plunger to ensure complete delivery of the insulin dose particularly with insulin pen. However majority of our patients were not using pen they were injecting with syringe with 8 mm needle.

Injection site

Disinfection is usually not required outside the institutional setting¹³⁻¹⁵ In this study group only 93(31%) were cleaning site prior to injecting.

Abdomen was the commonest injection site (67%) in this study, followed by thigh & arm. The former has the fastest and most consistent rate of absorption followed by the arms, thighs and buttocks.¹⁶

Rotating the injection site within one area is recommended rather than to a different area so that initially used area can remain insulin free. This prevents lipohypertrophy and may decrease variability in absorption from day to day.^{17,18} This practice was seen in most (93%) of this study group.

		Insulin Use						P-value
		Self-Injecting		Help Group		Total		
		n	%	n	%	n	%	
Gender (n=300)	Male (n=108)	90	83.3	18	16.7	108	36.0	0.001
	Female (n=192)	126	65.6	66	34.4	192	64.0	
Duration of Insulin use (n=300)	<5 Years n=(175)	118	67.4	57	32.6	175	58.3	0.037
	≥5 Years n=(125)	98	78.4	27	21.6	125	41.7	
Needle length (n=300)	8mm gauge (n=263)	188	71.5	75	28.5	263	87.7	0.595
	Others (n=37)	28	75.7	9	24.3	37	12.3	
Site cleaned with alcohol (n=300)	Yes (n=93)	73	78.5	20	21.5	93	31.0	0.093
	No (n=207)	143	69.1	64	30.9	207	69.0	
Site of Insulin Delivery (n=300)	Abdomen n=(202)	142	70.3	60	29.7	202	67.3	0.346
	Alternate n=(98)	74	75.5	24	24.5	98	32.7	
Site Rotation (n=300)	Yes (n=279)	201	72	78	28	279	93.0	0.952
	No (n=21)	15	71.4	6	28.6	21	7.0	
Injecting angle (n=300)	45 Degree (n=46)	30	65.2	16	34.8	46	15.3	0.266
	90 Degree (n=254)	186	73.2	68	26.8	254	84.7	
Air bubble removal before insulin delivery (n=300)	Yes (n=169)	131	77.5	38	22.5	169	56.3	0.016
	No (n=131)	85	64.9	46	35.1	131	43.7	
Vial Roll (n=294)	Yes (n=183)	142	77.6	41	22.4	183	62.2	0.011
	No (n=111)	71	64	40	36	111	37.8	
Needle stay in skin post-delivery (n=300)	Yes (n=84)	68	81	16	19	84	28.0	0.031
	No (n=216)	148	68.5	68	31.5	216	72.0	
Local Complications (n=300)	Yes (n=105)	78	74.3	27	25.7	105	35.0	0.518
	No (n=195)	138	70.8	57	29.2	195	65.0	
Reuse (n=300)	1-4 times n=(113)	71	62.8	42	37.2	113	37.7	0.006
	≥5 times n=(187)	145	77.5	42	22.5	187	62.3	
Needle Cleaning (n=300)	Yes (n=45)	34	75.6	11	24.4	45	15.0	0.564
	No (n=255)	182	71.4	73	28.6	255	85.0	

Table-II. Association of factors with the Injection use as regards self or help groups.

Self-administration

Self-administration is preferred, unless someone has visual or arithmetical skill problems.¹⁹ In the study group 72% were self-injecting. However, 62% were actually reusing the needle for 5 or more times. This is not a desired practice, repeated use of needles increase the risk of needle contamination and bending of needle tip which can injure skin.^{20,21}

The fact that 85% of this study population did not clean the needle with alcohol is another good practice as cleaning reverses silicon coating that actually makes for less painful skin puncture.

Complications

It was noted that only one-thirds (35%) of study

population reported any complication. However various other studies reported a higher rate of complications such as by Munib and Alzubaidi (57%)²² and by Seyoum B, Abdulkadir J (53%).²³

Among 35% reporting complication in this study group, pain was the most frequent complication seen in 18%, whereas lipohypertrophy was reported by 6% only. Reporting of complications was strongly associated with the longer duration of insulin use, non-rotation of injection site and more frequent reuse of injections. Where as in China 59%²⁴ of patients had bleeding and bruising and 35% had lipohypertrophy, which was significantly associated with injection reuse. Similarly, Cunningham and McKenna²⁵ demonstrated significant relationship between the frequency of

		Local Complications						P-value
		Yes		No		Total		
		n	%	n	%	n	%	
Gender (n=300)	Male (n=108)	39	36.1	69	63.9	108	36.0	0.762
	Female (n=192)	66	34.4	126	65.6	192	64.0	
Duration of Insulin use (n=300)	<5 Years n=(175)	49	28	126	72	175	58.3	0.003
	≥5 Years n=(125)	56	44.8	69	55.2	125	41.7	
Needle length (n=300)	8 mm gauge (n=263)	94	35.7	169	64.3	263	87.7	0.473
	Others (n=37)	11	29.7	26	70.3	37	12.3	
Site cleaned with alcohol (n=300)	Yes (n=93)	43	46.2	50	53.8	93	31.0	0.006
	No (n=207)	62	30	145	70	207	69.0	
Site of Insulin Delivery (n=300)	Abdomen n=(202)	68	33.7	134	66.3	202	67.3	0.486
	Alternate n=(98)	37	37.8	61	62.2	98	32.7	
Site Rotation (n=300)	Yes (n=279)	93	33.3	186	66.7	279	93.0	0.027
	No (n=21)	12	57.1	9	42.9	21	7.0	
Injecting angle (n=300)	45 Degree (n=46)	19	41.3	27	58.7	46	15.3	0.330
	90 Degree (n=254)	86	33.9	168	66.1	254	84.7	
Air bubble removal before insulin delivery (n=300)	Yes (n=169)	59	34.9	110	65.1	169	56.3	0.971
	No (n=131)	46	35.1	85	64.9	131	43.7	
Vial Roll (n=294)	Yes (n=183)	60	32.8	123	67.2	183	62.2	0.179
	No (n=111)	45	40.5	66	59.5	111	37.8	
Needle stay in skin post-delivery (n=300)	Yes (n=84)	36	42.9	48	57.1	84	28.0	0.075
	No (n=216)	69	31.9	147	68.1	216	72.0	
Reuse (n=300)	1-4 times n=(113)	26	23	87	77	113	37.7	0.001
	≥5 times n=(187)	79	42.2	108	57.8	187	62.3	
Needle Cleaning (n=300)	Yes (n=45)	16	35.6	29	64.4	45	15.0	0.932
	No (n=255)	89	34.9	166	65.1	255	85.0	

Table-III. Association of complications with various factors related to injection technique

daily insulin injection and lipohypertrophy.

The study center is following many of the latest recommendations. We emphasize that correct injection technique is vital in diabetic patients on insulin. It is recommended that further larger studies should be conducted to identify trend of injection technique in our country. The patient's injection technique should be reviewed periodically with the diabetes care team and injecting sites examined and palpated, if possible at each visit but at least every year. A quality management method should be adopted to ensure that appropriate injection technique is regularly practiced by the patient and is documented.

CONCLUSION

Majority of our patients had adopted reasonable

technique however repeated reinforcement can further improve appropriate insulin delivery with less chance of complications.

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PREVIOUS RELATED STUDY

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*“Never get so busy making a living
that you forget to make a life.”*

Unknown

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. Rizwana Kitchlew	Principal investigator, Study design cinception, Data collection, Review of literature, Paper writing with data analysis	
2	Dr. Inayat Thaver	Drafting the weak, Final approval of the critical review	
3	Dr. Shehryar Pervez	Co-investigator, Data collection literature review & final data & work approval	
4	Dr. Ikram ul Haq	Co-investigator, Data collection literature review & final data review & work approval	