The Necessity of Teaching Diabetic Patients the Correct way of Insulin Administration: A Clinical Trial to Improve Glycemic Control

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Abstract

Background: It is important to achieve good glycemic control to avoid long-term diabetic complications. It has been largely debated about the role of correct way of insulin administration to get the desired glycemic control.

Objective: To evaluate the effect of teaching diabetic patients who are on insulin therapy the correct way of injecting insulin and its effect on glycemic control.

Methods: A non randomized clinical trial with 820 diabetic patients on insulin therapy on whom A_1 c estimation was performed before and after three months of teaching them the right injection technique.

Results : Sixty seven patients (8.17%) had A_1 c $\leq$ 6.5% before they were enrolled in the study while the majority (753 patents, 91.82%) had A_1 c $>$ 6.5% and the last group showed the best benefit of teaching them the correct way of injection when compared with first group (P= 0.0001). Also patient with age 20-40years showed the best results (P=0.0001), while the poorest results were observed in those aged 40 years and above.

Conclusion: Teaching patients the right injection technique is important to achieve good glycemic control in those who already had poor one.

Keywords: glycemic control, A_1 c, injection technique.

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Introduction

There are two important reasons for optimizing diabetes control: the first is to eliminate symptoms, and the second is the longer-term aim of aborting the development of diabetic complications[1]. Recent studies have now demonstrated that insulin injection technique can affect to a very significant degree the glycemic control, but this intervention would have its greatest impact if instituted in an appropriate method[2].

Achieving and maintaining tight glycemic control has been the aim of modern diabetologists in order to prevent long – term complications of diabetes , but in spite of advancement in insulin therapy and devices for its administration (syringes, pens , and needles), there still remains a few setbacks to treatment efficacy [3]. Many variables may affect the pharmacokinetics and pharmacodynamics of insulin and these include ages of patients, gender, body mass index (BMI), dose volume, insulin formulation and injection technique, the last covers injection site, needle length, angle of needle insertion in order to have the least painful insulin delivery [3]. One of the most important barriers to insulin therapy is the use of conventional delivery process , which remains time- consuming , cumbersome , inconvenient , and to some extent , associated with a high risk of dosage errors, with as many as 80 % of patients carrying out some aspect of insulin administration via syringe incorrectly [4].

A number of studies indicate that correct technique of insulin administration may be as important to good glucose control as the type and dose of insulin delivered [5-6]. While classic syringes and needles are still in use in a number of countries, in some other countries, 70 % to 90 % of all insulin is delivered by pen devices [7].

Fear of injection and pain remain an obstacle to insulin therapy in a number of patients. Many factors can contribute to pain perception, including needle length and diameter, injection technique and inadvertent intramuscular injection [8]. Short and narrow- gauge (4 to 5 mm x 32 G) insulin pen needles have been reported to reduce pain in children and adults. [9-10]

Iraq is experiencing an increase burden of chronic Non Communicable Diseases, mainly cardiovascular diseases and diabetes mellitus. The prevalence of diabetes reached 10% in

population 25-65 years of age (9, 875, 373 or 34.4 % of total population) in 2006 [11].

Few studies about the effect of the way of insulin injection on glycemic control in Arab countries have been published and no such study exists in Iraq.The aims of the study were:

1- Finding out the glycemic control among diabetic patients attending the specialized center for Endocrinology and Diabetes in Baghdad.

2- Assessing any association between proper injection technique and achieving good glycemic control.

Methods

Participants:

Following the approval of ethical and scientific committee in Al Kindy College of Medicine and the scientific committee in the Specialized Center for Endocrinology and Diabetes – Baghdad, one thousand twenty four (1024) diabetic patients who were on insulin therapy were recruited in this study. The study was performed in the Specialized Center for Endocrinology and Diabetes form April 2010 till February 2012. All study samples were assessed for inclusion criteria after giving informed consent from the patient or their family. The study included both type 1 and type 2 diabetics (on insulin therapy) who have defects in the way of insulin injection with age ranged from two years up to 80 years.

Of these, only eight hundred and twenty (80.08%) met the inclusion criteria and adhered to the program instructions in completing the three months period of the follow up in this study.

Program intervention:

Our intervention in this study was training the patients (or their families) about the correct way of insulin injection. They were given a 2 hour-course about the best way of injection in small group teaching method. Theoretical and practical informations were given about rotations of the sites of administration at the well known areas in the body that include the outer upper part of both arms, the lateral aspects of both thighs and around the umbilicus. They were shown the right way of subcutaneous (and not intradermal or intramuscular) administration of insulin. Also, they were taught that insulin injection should be perpendicular with pens and syringes harboring short needles (less than 10mm) and at 45 degree angle with long needles(10mm or more), and also they were given instructions about how to clear the air bubbles before injection, and how to aspirate insulin into the syringe from a vial in those who are on split doses and how to aspirate neutral then intermediate or long-acting insulin in the same syringe if both are produced by the same manufacturer or in different syringes with different manufacturers, and how to shake the vial containing pre-mixed insulin or intermediate (or long-acting) insulin gently by rolling it between both palms and to avoid vigorous shaking.

These instructions were given by well-trained nurses, under the supervision of a consultant physician.

Measurements: Estimation of Hb_{A1c} was performed at the same day of giving the instructions (baseline) and 3 months later to see if any change had occurred on glycemic control. Other data as age, gender, duration of disease, type of insulin injection were also obtained.

Follow up: All patients were followed in a monthly visit to the center to assure their adherence to the instructions and only those who adhered to the instructions at the end of the study (820 patients) period were included in the analysis.

Statistical analysis: Data were entered and analyzed by MINI TAB soft ware version 14. Statistical analysis was done by descriptive statistical: frequency, percentages, minimum, maximum, mean and standard deviation were calculated and inferential statistical: percent reduction was calculated to assess the difference in HbA1c reduction. Paired t test was used to find the difference between means. P-value <0.05 was considered statistically significant.

Results

The results of this study showed a significant HbA1c reduction in the total study sample as well as in male-female categories with higher

percent reduction (%R) in females than males (12.03 versus 11.77) as shown in table 1.

Table 1: The before-after intervention change in HbA_1c according to gender in the total diabetic patients

Gender	No (%)	Hb1c% level								%R	P value
		Before				After					
		Min	Max	Mean	SD	Min	Max	Mean	SD		
Male	420 (51.2)	4.40	11.74	9.09	2.07	3.30	14.60	8.02	2.72	11.77	0.0001
Female	400 (48.8)	4.50	13.83	9.23	2.13	2.50	18.90	8.12	2.59	12.03	0.0001
Total	820 (100)	4.40	12.79	9.16	2.09	2.50	18.90	8.07	2.66	11.90	0.0001

After categorization of the disease duration into five categories, the HbA1c reduction was statistically significant in all periods except for categories 4 and 5, as shown in table 2.

Table 2: The before-after intervention change in HbA_1c according to diabetes duration.

Disease Duration Categories (years)	No (%)	Hb1c% level								%R	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
1(<1)	164 (20.0)	4.50	14.60	9.26	2.16	3.30	13.90	8.00	2.48	13.61	0.0001
2(1-5)	304 (37.)	4.40	16.10	9.13	2.17	3.10	14.60	8.07	2.73	11.61	0.0001
3(6-10)	241 (29.3)	4.50	14.60	9.14	2.11	2.50	18.90	7.85	2.69	14.11	0.0001
4(11-15)	49 (5.97)	5.90	13.30	9.31	1.74	4.00	13.80	8.61	2.71	7.52	0.1261
5(>15)	62 (7.56)	4.90	14.00	9.00	1.87	3.90	14.10	8.31	2.58	7.66	0.6900
Total	820 (100%)	4.40	16.10	9.16	2.09	2.50	18.90	8.07	2.66	11.90	0.0001

There is significant HbA1c reduction whatever the type of administration with higher percent reduction(R%) in those using pens than those using syringes, as shown in table 3

Table (3): The before-after intervention change in HbA_{1c} regarding type of administration

Injection types	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Usual syringe	422 (51.46%)	4.40	16.10	9.13	2.07	3.30	16.30	8.05	2.61	11.83	0.0001
Pens	250 (30.48)	4.50	15.00	9.22	2.19	2.50	14.60	8.02	2.63	13.05	0.0001
Non specified	148 (18.04)	4.90	13.90	9.14	2.01	3.90	18.90	8.21	2.82	10.17	0.0075
Total	820 (100%)	4.40	16.10	9.16	2.09	2.50	18.90	8.07	2.66	11.90	0.0001

In those aged < 20 there is a significant A1c reduction in both genders, with slightly higher percent reduction(R %) in females than males, as shown in table 4.

Table (4): The before-after intervention change in HbA_{1c} regarding gender in those aged < 20 years.

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	183 (50.84)	4.50	14.30	9.18	2.17	3.30	14.60	7.76	2.77	15.47	0.0001
Female	177 (49.16)	4.90	16.10	9.23	2.06	3.80	13.90	7.69	2.33	16.68	0.0001
Total	360(100)	4.50	16.10	9.20	2.12	3.30	14.6	7.73	2.56	15.98	0.0001

Also, there is a significant HbA1c reduction in those aged <20 regarding disease duration, except for categories 4 and 5 with higher percent reduction(R%) in 1 , as shown in table 5.

Table (5): The before-after intervention change in HbA_{1c} regarding DM duration in those aged < 20 years

Disease Duration Categories (years)	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
1(<1)	73 (20.27)	4.50	14.60	9.31	3.20	3.30	13.90	7.13	2.29	23.41	0.0001
2(1-5)	133 (36.94)	4.60	16.10	9.18	2.21	3.80	14.60	7.34	2.70	20.04	0.0001
3(6-10)	106 (12.92)	4.50	13.70	9.21	2.03	4.10	14.60	7.29	2.44	20.85	0.001
4(11-15)	21 (5.833)	5.90	11.90	9.33	1.56	4.40	13.80	8.85	2.87	5.14	0.332
5(>15)	27 (7.5)	4.90	14.00	8.92	1.99	3.90	14.10	8.25	2.59	7.51	0.110
Total	360(100)	4.50	16.10	9.20	2.12	3.30	14.6	7.73	2.56	15.98	0.0001

As shown in table 6, there is also a significant reduction in HbA1c, whatever the type of administration in those aged <20 with higher percent reduction(R%) in pens users.

Table (6): The before-after intervention change in HbA_{1c} regarding type of insulin injection in those aged < 20 years

Injection type	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Usual syringe	185 (51.38)	4.50	16.10	9.17	2.08	3.30	14.10	7.89	2.58	13.96	0.001
Pens	109 (20.27)	4.50	15.00	9.21	2.25	4.10	14.60	7.50	2.57	18.57	0.0001
Non specified	66 (18.33)	4.90	13.70	9.29	2.03	3.90	14.60	7.63	2.45	17.87	0.0001
Total	360(100)	4.50	16.10	9.20	2.12	3.30	14.6	7.73	2.56	15.98	0.0001

In age group 20-40 years, there is also a significant HbA1c reduction with higher percent reduction (R%) in females than males, as shown in table 7.

Table (7): The before-after intervention change in HbA_{1c} regarding gender in those aged 20-40 years

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	84 (52.5)	6.10	13.90	9.31	1.66	4.30	14.30	7.68	2.35	17.51	0.0001
Female	76 (47.5)	5.50	13.90	9.59	2.13	2.50	13.90	7.50	2.33	21.79	0.0001
Total	160(100)	5.50	13.90	9.45	1.89	2.50	14.30	7.59	2.34	19.68	0.0001

Regarding disease duration in age group 20-40 years, there is a significant HbA1c reduction with higher percent reduction (R%) in categories 2 and 3, as shown in table ٨

Table (8): The before-after intervention change in HbA_{1c} regarding DM duration in those aged 20-40 years

Disease Duration Categories (years)	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
1(<1)	31 (19.37)	6.60	13.90	9.42	1.71	4.00	13.50	7.58	2.05	19.53	0.0001
2(1-5)	61 (38.12)	6.10	13.70	9.36	1.93	3.10	13.90	7.43	2.30	20.62	0.0001
3(6-10)	46 (28.75)	5.50	13.90	9.38	2.24	2.50	14.30	7.44	2.15	20.68	0.0001
4(11-15)	10 (6.25)	7.20	13.30	10.18	2.34	6.20	12.80	8.84	2.72	13.16	0.001
5(>15)	12 (7.5)	6.00	12.20	9.58	1.88	5.00	11.10	8.03	2.16	16.18	0.0001
Total	160(100)	5.50	13.90	9.45	1.89	2.50	14.30	7.59	2.34	19.68	0.0001

Also, there is a significant Hb A1c reduction in those aged 20-40 whatever the type of administration But, the higher percent reduction (R%) was in those with non- specified methods of administration , as shown in table 9.

Table (9): The before-after intervention change in HbA_{1c} regarding type of insulin injection in those aged 20-40 years

Injection	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Usual syringe	82 (51.25)	5.70	13.50	9.48	1.81	4.00	14.30	7.71	2.48	18.67	0.0001
Pens	49 (30.62)	5.50	13.90	9.60	2.10	2.50	13.50	7.74	2.35	19.38	0.0001
Non specified	29 (18.12)	6.60	13.90	9.08	1.74	4.00	11.70	7.03	1.83	22.58	0.0001
Total	160(100)	5.50	13.90	9.45	1.89	2.50	14.30	7.59	2.34	19.68	0.0001

In diabetic patients with age range 41-60 years, there is a non- significant HbA1c reduction in both genders, as shown in table 10.

Table (10): The before-after intervention change in HbA_{1c} regarding gender in those aged 41-60 years

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	122(50.83)	4.40	13.9	8.99	2.27	4.00	14.60	9.08	2.86	-1.01	0.331
Female	118(49.16)	4.90	14.60	9.20	2.35	3.80	18.90	8.83	2.92	4.02	0.284
Total	240(100)	4.40	14.60	9.09	2.31	3.80	18.90	8.96	2.89	1.43	0.426

Regarding disease duration, and type of insulin administration, in those patients aged 41-60 years, there was also a non-significant HbA1c reduction in all groups, as shown in table 11 and 12.

Table (11): The before-after intervention change in HbA_{1c} regarding DM duration in those aged 41-60 years

Disease Duration Categories (years)	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
1(<1)	50 (20.83)	5.60	13.90	9.08	2.17	4.30	13.90	8.84	2.83	2.64	0.426
2(1-5)	89 (27.08)	4.40	13.90	9.12	2.43	3.80	14.60	8.93	3.01	2.08	0.485
3(6-10)	68 (28.33)	4.90	14.60	9.18	2.51	4.00	18.90	9.22	2.98	-0.44	0.258
4(11-15)	15 (6.25)	6.30	11.20	8.92	1.61	4.00	13.00	8.23	2.71	7.74	0.083
5(>15)	18 (7.5)	6.00	12.30	8.86	1.94	5.00	13.20	9.01	2.38	-1.69	0.324
Total	240(100)	4.40	14.60	9.09	2.31	3.80	18.90	8.96	2.89	1.43	0.426

Table (12): The before-after intervention change in HbA_{1c} regarding type of insulin injection in those aged 41-60 years

Injection	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Usual syringe	122(50.83)	4.40	14.10	9.03	2.33	3.80	16.30	8.65	2.84	4.21	0.156
Pens	74(30.83)	4.90	14.60	9.20	2.35	4.40	14.00	9.08	2.65	1.30	0.354
Non specified	44 (18.33)	5.60	13.40	9.09	2.25	4.00	18.90	9.59	3.33	-5.50	0.246
Total	240(100)	4.40	14.60	9.09	2.31	3.80	18.90	8.96	2.89	1.43	0.426

There is also a non-significant HbA1c reduction regarding gender, DM duration and type of insulin administration in those aged >60, as shown in tables 13, 14 and 15.

Table (13): The before-after intervention change in HbA_{1c} regarding gender in those aged >60 years

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	29(48.33)	6.00	11.40	8.35	1.18	4.30	11.80	7.70	1.86	7.78	0.085
Female	31(51.66)	4.50	10.10	8.42	1.38	3.80	13.90	8.01	2.59	4.87	0.324
Total	60(100)	4.50	11.40	8.38	1.28	3.80	13.90	7.85	2.23	6.32	0.075

Table (14): The before-after intervention change in HbA_{1c} regarding DM duration in those aged >60 years

Disease Duration Categories (years)	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
1(<1)	10 (16.66)	7.50	10.50	9.33	0.91	5.40	12.00	8.51	2.24	8.79	0.325
2(1-5)	21 (35.0)	4.50	11.40	8.20	1.65	5.10	11.90	8.34	1.98	-1.71	0654
3(6-10)	21 (35.0)	6.20	10.10	8.11	0.97	3.80	11.10	6.90	2.07	14.92	0.001
4(11-15)	3 (5.0)	7.10	9.10	8.23	1.03	6.50	11.10	8.10	2.60	1.58	0.456
5(>15)	5 (8.33)	7.70	9.30	8.50	0.64	6.10	13.90	8.28	3.22	2.59	0.486
Total	60(100)	4.50	11.40	8.38	1.28	3.80	13.90	7.85	2.23	6.32	0.075

Table (15): The before-after intervention change in HbA_{1c} regarding type of insulin injection in those aged >60 years

Injection	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Usual syringe	33 (55)	4.50	11.40	8.41	1.40	3.80	11.80	7.56	1.88	10.11	0.684
Pens	18 (30)	6.20	10.10	8.33	1.06	4.60	13.90	7.55	2.59	9.36	0.158
Non specified	9 (15)	6.70	10.50	8.39	1.33	4.60	11.90	9.49	2.20	-13.11	0.065
Total	60(100)	4.50	11.40	8.38	1.28	3.80	13.90	7.85	2.23	6.32	0.075

When we classified the patients according to their glycemic control, those patients who had optimal HbA1c (≤ 6.5%) before enrollment showed no significant HbA1c reduction after 3 months. While those who had a non-optimal HbA1c (> 6.5%) before enrollment, showed the most significant HbA1c reduction, with higher percent reduction(R%) in females than males, as shown in tables 16 and 17.

Table (16): The before-after intervention change in HbA_{1c} in patients with optimal glycemic control (A1c ≤ 6.5%) regarding gender

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	41(61.19)	4.40	6.50	5.79	0.58	3.30	13.60	6.10	2.19	-5.35	0.384
Female	26(38.8)	4.50	6.50	5.75	0.55	2.50	10.00	6.01	2.19	-4.52	0.325
Total	67(100)	4.40	6.50	5.78	0.56	2.50	13.60	6.07	2.07	-5.02	0.232

Table (17): The before-after intervention change in HbA_{1c} in patients with non- optimal glycemic control (A1c > 6.5%) regarding gender

Gender	No (%)	Hb1c% level								R%	P value
		Before				After					
		Min	Max	mean	SD	Min	Max	mean	SD		
Male	379(50.33)	6.60	14.30	9.45	1.84	4.00	14.60	8.34	2.69	11.74	0.001
Female	374 (49.66)	6.60	16.10	9.47	1.98	3.10	18.90	8.16	2.57	13.83	0.0001
Total	753(100)	6.60	16.10	9.46	1.91	3.10	18.90	8.25	2.63	12.79	0.0001

Discussion

The revised recommendations from the World Health Organization (WHO), the American Diabetes Association (ADA)and the European epidemiological study on the technique of insulin injection had all emphasized the appropriate technique in insulin administration. Common mistakes regarding insulin injection among patients include repeated injection at the same site, wrong angle, intradermal or intramuscular injection [12,13].

The focus of this study was to analyze whether knowing the proper methods of insulin injection are associated with good glycemic control among diabetics in different age groups. To our knowledge, this is the first study, in its design and sample size, that covers this important issue in Iraq and surrounding countries.

In this trail, we used Glycated haemoglobin (HbA1c), which is a useful measure of the efficacy of glucose-lowering treatment. It is an integrated summary of circadian blood glucose during the preceding 2to 3 months, equivalent to the lifespan of erythrocytes. So, the follow- up period for the study group was determined to be three months to assess the effectiveness of our intervention [14-16].

It is well known that diabetic patients are either injecting themselves or depending on others (e.g. one of the family members). In both situations , common mistakes regarding insulin injection occur among those patients, including repeated injection at the same site, wrong angle, intradermal or intramuscular injection. One serious violation of correct injection technique is the repeated use of the same needle which can be bent, and according to the European epidemiological study on the technique of insulin injection, the risk of lipo-dystrophy in patients reusing needles is 31 % higher than in non-reuse patients. It had been also noticed that repeated use of needles increases the risk of infection[17.]

In a study in Europe, 74% of patients preferred flex pen as compaired to 20% preferring vials and syringes[18-19]. In another study in Europe, 92% of adult patients, on insulin therapy, were using pens with disposable needles, and 63% were using an 8-mm needle or longer [20].

In this study, and as it is evident in table (1), both male and female patients got a significant improvement in HbA1 c% after teaching them the correct way of insulin injection (P=0.0001). Those patients with disease duration ≥ 11 years showed a non- significant change in A1c after 3 months of teaching as evident in table 2 (P>0.05) . This is probably due to that patients got bored with the disease as its duration becomes longer or they failed to adapt to their current situation.

This study showed that 54.46% of patients use syringes while 30.48 % use pens. This might be related to cost and availability as pens are expensive and not always available. But as it is evident in table 6, the percent reduction in HbA1c (R%) is higher with pens than usual syringes in those aged < 20 compared with those aged >40 (tables 12 & 15), this is probably because in the 1st group, mostly mothers are taking care of their diabetic kids and are more keen in following the instructions, as compared to those aged >40. In a study, 74% of patients preferred flex pen as compared to 20% preferring vials & syringes [18, 19]. In another study in Europe, 92 % of adult patients, on insulin therapy, were using pens with disposable needles, and 63 % were using 8-mm needles or longer [20.]

The results also showed significant improvements in HbA_1 c in those blow 20 years of age (P= 0.0001) except for disease duration ≥ 11years (Tables 4&6) probably for the same reason mentioned above or because their families who take care of them got frustrated with the chronic disease. The best results were seen in those aged 20-40years, where in all parameters HbA1c% was reduced significantly (P=0.0001) as evident in tables 7 and 9. The poorest results were seen in those aged above 40 years, as shown in tables 10-15, and we can see that there was a non- significant change in HbA1c% (P>0.05) in all parameters except for a disease duration of 6-10 years (group3) in those aged >60 years (P=0.001, table 14).

These poor results can be explained in that those with age >40 years (tables 10-15) had probably

not followed the right instructions because most of them are engaged fully in their jobs and not taking care about themselves, or because of diabetic complications as poor vision leading to poor injection technique , and , hence, poor glycemic control[21]. Needle length could affect glycemic control also (no comparison was done in this study between short and long needle effects) and this had been shown in other studies [22, 23-25] The reason behind that is that our patients usually use different needle lengths and it was difficult to instruct them to only one needle measurement .

Form table 16 we can see that those patients who already have good glycemic control (HbA1 c $\leq$ 6.5%) before they were enrolled in the study (67 patients) did not show a significant change in A_1 c (P >0.05 %) and these patients constitute only 8.17% of the total of 820 patients, while the majority (753 patients, 91.83%) who have A_1 c > 6.5% showed a better benefit after 3 months of intervention (P= 0.0001) as shown in table 17. This might be due to that, patients in the 1st group have already known the proper technique of injection. The American Association of Clinical Endocrinologist (AACE) and the American College of Endocrinology recommend an (A_1 c $\leq$ 6.5 %) for good glycmic control [26] .

It is clear in this study that our interventions in teaching diabetic patients the appropriate methods of insulin injection have a positive effect on glycemic control, and the null effect of this approach in some patients, especially in patients aged above 40 might be attributed to the wrong understanding of instruction's about the technique of injection , so , giving diabetic patients the correct instructions regarding insulin injection should form the basis in the treatment of all patients on insulin therapy. We can also notice in this study that, generally speaking, female patients showed higher percent reduction(R%) in HbA1c than males, , as shown in tables 1,4, 7, 10, and 17 and this probably can be explained on that female patients are more keen in following the instructions than male patients.

Although important, giving instructions is necessary for adequate blood glycemic control, most patients also need strict follow up to assure the continuity of adherence.

But this factor was not studied in this study and no comparison was done between short and long needle effects.

Conclusion:

We can conclude that correct way of insulin administration in diabetic patients has a positive effect on glycemic control, especially in those aged <40 years. Pens are better than usual syringes, and those with poor gycemic control (HbA1 c > 6.5%) get more benefit.

It is recommended that a well trained nursing staff is accessible in any diabetic center for teaching the patients the best way in injection technique.

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