UTILIZATION OF INJECTION PAD SET TECHNOLOGY AND EDUCATIONAL VIDEOS IN OPTIMIZING INSULIN THERAPY IN TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

One of the pharmacologically controlled blood sugar levels in T2DM patients is by giving the correct insulin injection including the dose, method, time, and location, the success parameters of insulin injection include the injection location, injection procedure, and insulin management where everything will depend on glycemic control. Complications that appear at the injection site include bruising, pain, and swelling that indicate the occurrence of Lipohypertrophy (LH) Lipodystrophy is a form of lipohypertrophy (LH) which is a common complication that often occurs in T2DM patients with insulin injection therapy. This lipodystrophy will also be one of the factors that cause other T2DM complications. Method: the design in this study is One-Group Pre-test-Post-test Design, with a sampling of 14 DM patients who receive insulin injection therapy. The research period is from May to July 2024. Education using injection pad sets and educational videos on insulin injection techniques, observation of skills, and signs of lipodystrophy using questionnaires. Results: The results showed a decrease in the average blood sugar level before and after the educational intervention with a P-value of <0.001, the average patient's skill insulin injection showed an increase with a P-value of <0.001, the incidence of lipodystrophy showed that out of three areas of insulin injection, there was one location where lipodystrophy was found, namely in the arm area. With a p-value of 0.041. Conclusion: in this study, modifications are needed in the use of media or techniques in educating DM patients on insulin injection. Education can be repeated in both new and old patients on insulin. Patients need to be explained how to independently check for signs of lipodystrophy or changes in the injection site area.

Keywords: diabetes mellitus; education; insulin injection

INTRODUCTION

Diabetes Mellitus Type 2 (T2DM) is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body is unable to use the insulin produced effectively. T2DM is characterized by the appearance of hyperglycemia, a condition in which blood glucose increases.According to WHO, in 2019 there were 463 million people suffering from diabetes mellitus in the world, and the number is predicted to increase to around 578 million people by 2030 (International Diabetes Federation; 2019). Meanwhile, the number of DM sufferers in Indonesia reaches 10.7 million people. Diabetes mellitus ranks fourth as the cause of death due to NCDs. In addition, diabetes mellitus is also included in the top 10 leading causes of (Riskesdas 2018 in Numbers, Indonesia II, n.d.) Disability Adjusted Life years (DALYs). (General et al., 2022). T2DM management is generally aimed at improving the quality of life of people with T2DM. These efforts include controlling blood glucose, blood pressure, weight, and body fat values through independent patient management and behavior changes. T2DM treatment is grouped into 5 pillars, namely: education, meal planning, physical exercise, pharmacological

intervention and blood sugar checks. Effective management of T2DM is an important thing that must be maintained by patients with T2DM, this requires support for self-management. This support is interpreted as a resource that helps patients to maintain skills, knowledge, and behavior change (PERKENI, 2021)

One of the pharmacologically controlled blood sugar levels in T2DM patients is by giving the correct insulin injection including the dose, method, time, and location (Tahir, 2008). The success parameters of insulin injection include the injection site, injection procedure and insulin management all of which will be determined by glycemic control. Complications that appear at the injection site include bruising, pain, and swelling that indicate the occurrence of Lipohypertrophy (LH). (Patil et al., 2017) Lipodystrophy is a form of lipohypertrophy (LH) which is a common complication that often occurs in T2DM patients with insulin injection therapy. This lipodystrophy will also be one of the factors that cause other T2DM complications. Lipohypertrophy (LH) is a condition in which there is a buildup of fat cells under the surface of the skin that is injected continuously, this will cause impaired insulin absorption, and lead to failure of glycemic control (Arda Sürücü & OKurArslan, 2018). The prevalence of LH was reported to be 37.3% in T2DM patients in Saudi Arabia, 48.8% in T1DM & T2DM patients in Turkey, 64.5% in T1DM and T2DM patients in Spain, and 35.26% in <China (Arda Sürücü & OKurArslan, 2018). . In a joint study, the prevalence of LH in T1DM cases was 39.9% and T2DM was 45.9% (Wang et al., 2021). According to Rose, AN et al (2019) stated that 51.5% of patients who received insulin therapy experienced lipohypertrophy. LH will cause impaired insulin absorption so that there is a risk of hypoglycemia or hyperglycemia and other complications.Therapeutic adherence of patients with diabetes mellitus needs to be emphasized because this has a major impact on the success of glycemic control (Khardhori, 2013). According to Ejata et al. (2015), with this increase in insulin use, DM patients should know and understand how to use insulin properly and correctly so that the main goal of insulin therapy is achieved.

From the patients who were found that the location of insulin injection, either carried out by the patient or nurse, was carried out in the arm (deltoid) or in the abdomen, but rotation was rarely carried out. This happens because it is in accordance by the patient's understanding and familiarity with the arm area. In general, patients say they are hesitant to inject insulin in the other part. The insulin injection position in the arm is sometimes difficult to do in some cases, causing it to depend on other people. When inspection and palpation were carried out in the deltoid area of T2DM patients with insulin therapy, changes in skin contour in the form of thickening and elasticity were palpable. This is in line with research conducted by . said that the barriers to compliance in the use of insulin are fear of syringes and not knowing the correct way to inject. These barriers will make the patient non-compliant for the correct use of insulin. (Vazini & Barati, 2014) In Article 29 paragraph 1 of Law number 38 of 2014, it is said that in organizing Nursing Practice, one of the duties of nurses is as an extension worker or educator. This is also stated in the Decree of the Minister of Health of the Republic of Indonesia in 2020, which explains that the competency standards that nurses must master are educating about diet, hyperglycemia prevention, hypoglycemia prevention, and monitoring blood glucose levels. As an extension worker, nurses explain to patients concepts and data about health, demonstrate procedures such as insulin injections, assess whether patients understand the things being explained and evaluate progress in learning. In providing this teaching, nurses involve various resources such as the family and the patient itself as well as with various learning methods. (Ministry of Health, 2020) Education can

be provided when the patient is hospitalized or the patient is assigned to receive an insulin injection terrapin program as a form of discharge planning.
The study also stated that (Khalid et al., 2018) the teaching and guidance provided to patients by health professionals has a statistically significant influence ($p<0.001$) on the correct application of insulin injection techniques.Various educational techniques can be used to convey messages to patients, including lectures, demonstrations and the use of supporting media such as videos and posters. The results of the study stated that the use of video-based media can be an effective alternative in providing education about insulin use in patients with diabetes mellitus and can help improve overall insulin therapy outcomes. Similar research was also conducted by those who stated that the application of simulation tools coupled with video playback and guidelines as standard procedures in training patients about insulin injection, with the results all having a good understanding in applying insulin injection techniques. This method is considered safe, efficient and worthy of promotion (Putri et al., n.d. 202; Hole, et al., 2021).

METHOD

The design in this study is One-Group Pretest-Posttest Design. The research was conducted at PKU Muhammadiyah Gamping Hospital Yogyakarta. The research period was carried out in May – June 2024. The sample in this study is patients with type 2 diabetes mellitus with insulin injection therapy who are hospitalized. The sampling technique using non-probability sampling with the accidental sampling method was obtained by 14 people.The research subjects before the intervention were measured blood sugar levels, manifestations of lipodystrophy and understanding of insulin injection techniques. Then the subjects were carried out interventions in the form of insulin injection technique education using an injection pad set and insulin injection technique videos. The post-test was carried out 1 month later by evaluating blood sugar levels, manifestations of lipodystrophy, and understanding of insulin injection techniques. The data obtained were analyzed univariate and bivariate. Univariate analysis was carried out to find the mean blood sugar level and understanding of insulin injection techniques, while bivariate using the formula of one sample T-test.

RESULT AND DISCUSSION

Based on the data in table 1 above, the age of the majority of respondents was in the age range of 45-55 years (42.9%), with the majority gender being female (57.1%), the majority of high school education levels (71.4%), HBA1c levels >8% (78.6%), the duration of suffering 1-5 years (50.5%), the frequency of insulin administration 3 times per day (57.1%), the duration of insulin use <1 year (50%), and all respondents used insulin needles > 3 needle injections.

In table 2 above are the results of the analysis using the one sample T test formula. Based on the above data, the average decrease in blood sugar levels before and after the educational intervention with a P-value of <0.001 can be concluded that insulin injection education can reduce blood sugar levels in T2DM patients. In the second data, the average skill of patients about insulin injection showed an increase with a P value of <0.001. The third data on the incidence of lipodystrophy shows that out of three insulin injection areas, there is one location where lipodystrophy is found, namely in the arm area, with a p-value of 0.041. Two other locations, including the abdominal and thigh areas, were not found to be signs of lipodystrophy either before or after the intervention.

Table 1.
Characteristics of Respondents (n=14)

Characteristic	f	%
Age		
35-45	0	0
46-55	6	42,9
56-65	5	35,7
>65	3	21,4
Gender		
Man	6	42,9
Woman	8	57,1
Education		
Primary school	1	7,1
JUNIOR	1	7,1
SMA	10	71,4
Bachelor	2	14,3
HBA1C		
4-6	0	0
< 7	1	7,1
7-8	2	14,3
>8	11	78,6
Length of Suffering (Years)		
<1	3	21,4
1-5	7	50,5
6 – 10	2	14,3
11 – 15	1	7,1
>15	1	7,1
Frequency of Insulin Administration (times)		
1 time	4	28,6
2 times	0	0
3 times	8	57,1
4 times	2	14,3
Duration of Insulin Use (Years)		
<1	7	50
1-5	5	35,7
6 – 10	1	7,1
11 – 15	0	0
>15	1	7,1
Frequency of Use of Insulin Needles		
>3 times	14	100

Table 2.
Results of blood sugar level analysis, patient skills in performing insulin injections, and the incidence of lipodystrophy

	N	t	Mean	Std. Deviation	P Value	Cohen's d
Blood Sugar Levels					<0.001	29.96
Pre	14	14,88	225,43	56,68		
Post	14	21,83	174,79	29,96		
Patient Skills in insulin injection					<0.001	1,490
Pre						
	14	30,44	16,71	2,054		
Post	14	48,43	19,29	1,490		
Lipodystrophy						
Abdominal area					1	
Pre	14		0			
Post	14		0			
Thigh Area					1	
Pre	14		0			
Post	14		0			
Arm Area					0.041	0.426
Pre	14	1,883	0.21	0.426		
Post	14	1,883	0.21	4.26		

A person over the age of 40 is more at risk of developing type 2 DM. This is because the aging process in the age group of more than 40 years causes changes in body components that result in damage to cells β pancreas, target tissue cells, nervous system and other hormones that can affect glucose levels (Fahrudini, 2015). Research by et al. in 2020 stated that there was a significant relationship between age and the incidence of type 2 DM with a p value of 0.017, people aged 45 years and older were 4.3 times at risk of developing type 2 DM (Rofikoh, Handayani and Suraya, 2020). Increasing age causes a decline in body function and results in unstable blood sugar. So that the older you get, the greater the incidence of type two DM (Isnaini and Ratnasari, 2018). Although there are several studies that state that there is no relationship between age and the incidence of type 2 diabetes mellitus, type 2 DM is more commonly found in patients over 40 years old. (Handayani et al., n.d.; Ratri et al., 2020)

This study shows that type 2 DM is more often found in women than men, this is in accordance with previous research, among others, women also have more fat cells than men and tend to be easily obese. The reduction in the number of insulin-responsive receptors is caused by the accumulation of a large number of fat cells, resulting in a merger between the insulin receptor complex and the abnormal glucose delivery system. As a result, the action of insulin is disrupted and causes insulin resistance to be inadequate to maintain normal glucose levels in the blood (Sherwood, 2014). In Indonesia in 2020, women have a life expectancy of 73.5 years while men have a life expectancy of 69.6 years (Central Statistics Agency, 2021). The research of Fathurohman & Fadhilah (2016) shows that there is a relationship between sex and type 2 DM as evidenced by the results of statistical analysis of the p-value of 0.027 (). In line with the research of Prasetyani & Sodikin (2017) which proved that sex was significantly related to the incidence of type 2 DM (value p=0.018 OR=0.153). The high number of DM cases in women is caused by insulin resistance which occurs due to women who are menopausal experiencing a decrease in estrogen hormone concentration which causes an increase in body fat reserves and an increase in

the production of free fatty acids (Prasetyani and Sodikin, 2017). (Fathurohman & Fadhilah, 2016)

In this intervention, patients were assessed for their ability to perform insulin injections using a format adapted from a reference article consisting of 21 items, including preparation, hand washing, cartridge storage, installation, needle removal, selection of injection locations including rotation, air removal, dose adjustment according to the program, injection angle, how to hold the pen, and how to dispose of the needle that has been used. The education was carried out with a demonstration technique using an injection set pad that can be installed in the patient's abdomen equipped with a picture of the direction of rotation of the injection. Then the patient was also given a YouTube link to see a video about the insulin injection technique. Two educational methods are applied by practitioners with the hope that if the patient forgets, the patient can see it on YouTube. Education using demonstration methods and using audiovisuals (videos) can improve patients' understanding of insulin injection. The results of the study obtained an average pre-test score of 16.71 to 19.29 with a p-value of 0.001 which shows that the method significantly improves patient understanding. Improved patient understanding occurs in the steps of disinfection during preparation, washing hands before injection, ensuring that insulin can be removed after changing the needle, and disposal of used needles. Research conducted by Nur Muji Astuti (2023) regarding the use of the self-insulin injection stimulation tool (SSIT) application which was carried out in 2 meetings within 7 days was able to improve the skills of DM patients who received self-insulin injection therapy with a p-value of 0.001, this is also supported by research from Hadeci Lovenda Putri (2023) which states that video-based education can improve patients' skills to insulin pen injection. According to research, Chu et al (2021) provided video-based education for one month accompanied by demonstrations to improve patients' skills in injecting insulin pens independently.

The average score of pre-test blood sugar levels was 225.43 and the post-test was 174.79, and also the standard deviation of pre and post-blood sugar levels, while the p-value was 0.001 so showed the significance of the decrease in blood sugar with the intervention carried out. Although there were respondents who experienced an increase in blood sugar levels during control, the patient had other diseases that could cause an increase in blood sugar levels. Education on insulin injection techniques is expected to keep patients' glycemic levels within the normal range. Insulin injection plays an important role in keeping the patient's blood sugar in the well-controlled category. Providing education about injection techniques can control glycemic levels in DM patients who use insulin therapy, where the provision of injection technique education, intensive education, injection technique training, insulin injection technique education, and re-education can reduce HbA1c glycemic levels. The same was revealed that the respondents used insulin and also assessed the effects of the insulin injection practice. Therefore, regular education on the proper use of insulin and in particular on proper injection techniques should be provided at every hospital visit. Correct insulin injection techniques are just as important to achieve glycemic control. Healthcare facilities should pay more attention to insulin education and re-evaluate injection practices from time to time.

The number of respondents who experienced lipodystrophy between the pre-test and the post-test did not change. The three respondents who experienced lipodystrophy both in number and personally were the same. Lipodystrophy that occurs in respondents is found in the arm area. The commonly used injection areas are the arms, abdomen, and thighs. This is in line with research conducted by Abdul Khalida, et al. (2018) that the majority of respondents injected insulin in the

arm (27%). Forty-six percent (46%) of patients who did not undergo insulin injection rotation increased the risk of LH and decreased insulin absorption. The ongoing problem with insulin injections requires special attention and strategies for patient education. The area of insulin injection in the abdomen does not contribute to the incidence of lipodystrophy. (Khalid et al., 2018) There was no change in the condition of respondents who experienced lipodystrophy, whether it improved or not, and this change in number could also be caused by the short intervention time span with evaluation. This was supported by research that resulted in study respondents who had LH with stage 2 before the intervention and experienced no change in the evaluation conducted 6 months later (Chen et al., 2021).

CONCLUSION

The conclusion of this study is that modifications are needed in the use of media or techniques in educating DM patients on insulin injection. Education can be repeated in both new and old patients on the use of insulin. Patients need to be explained how to check for signs of lipodystrophy or changes in the injection site area independently.

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