


ORIGINAL RESEARCH REPORT

**Insulin Therapy in T2DM Patients in Diabetes Outpatient Clinic,
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ABSTRACT

Background: High mortality in type 2 diabetes mellitus (T2DM) has a strong correlation with the presence of macrovascular and microvascular complications. The risk of these complications can be reduced through good glycemic control. As the disease progresses, patients may need to add or switch to insulin therapy rather than oral antihyperglycemic drugs to achieve desirable glycemic control. **Objective:** To determine the pattern of insulin therapy and glycemic control in T2DM patients. **Material and Method:** Data for this study were obtained from the medical records of the Diabetes Outpatient Clinic at the Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. This study was an observational descriptive. In June-July 2016, total samples were collected from 124 patients who received insulin therapy between February 2015 and March 2015. **Result:** According to the data obtained, the most commonly used insulin was a combination of rapid-acting and long-acting insulin (75.8%). While basal bolus insulin (75.8%) accounts for the most common regimen used to administer insulin, only 27.4% and 45% of total patients achieved good glycemic control based on FPG and PPG testing, respectively. HbA_{1c} testing was done on 44 out of 124 people, with 9 people (20.5%) met the target of HbA_{1c} <7%. **Conclusion:** Glycemic control in T2DM patients who received insulin therapy was relatively low.

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Highlights

1. The occurrence of macrovascular and microvascular problems is strongly associated with high mortality in type 2 diabetes mellitus (T2DM).
2. Combinations of rapid-acting and long-acting insulin were the most frequent kind of insulin.

BACKGROUND

Type 2 Diabetes Mellitus (T2DM) is considered as a major health problem, that has a big effect on people's lives and health care costs, with a prevalence of 9% on all adults in the world (Alkaff, et al. 2021; Khan, et al., 2019). The high prevalence makes T2DM as the 7th most cause of death in the world. Deaths due to T2DM is mostly due to macrovascular and microvascular complications. The risk of these complications can be reduced through good glycemic control (Ahmad, et al, 2014; Chawla., et al, 2016).

Glycemic control is defined as patients' average blood glucose values (Shita & Iyasu, 2022). Glycemic control can be known through two ways; self monitoring of blood glucose (SMBG) and HbA_{1c} testing (Sia, et al., 2021). HbA_{1c} testing is recommended as the most reliable way in determining the glycemic control because of the properties it possesses (Schnell, et al., 2017). Aside from the fact that it is a long-term glycemic control parameter, it is also correlated with things causing macrovascular-related death in T2DM patients, such as TG, HDL, LDL, and TCH (Bodhe, et al., 2012; Kidwai, et al., 2020). In lowering the risk of complications, HbA_{1c} needs to be maintained at HbA_{1c} < 7%, though it can be individually adjusted based on each patient/diseases features (Inzucchi, et al., 2012; Davies, et al., 2018). Lowering HbA_{1c} until < 7% will need a constant fasting plasma glucose (FPG) of < 130 mg/dl and post-prandial glucose (PPG) of < 180 mg/dl (Hershon, et al., 2019).

In achieving HbA_{1c} < 7%, T2DM patients are advised to adopt a healthy lifestyle, receive oral antihyperglycemic drugs (OAD), and/or insulin therapy. Because of the progressivity of the disease, T2DM patients will have to switch from oral antihyperglycemic drugs which they are naturally prescribed when first diagnosed, to insulin therapy (Asif, 2014). Taking such decision is under so many considerations because it is not guaranteed for T2DM patients who receive insulin therapy to have their HbA_{1c} levels controlled (Silver, et al., 2018). Furthermore, decision to switch to insulin therapy is limited with the risk of hypoglycemia, weight-gain, and other patients' beliefs (Yavuz, et al., 2015). Because of so many barriers insulin therapy has in achieving the glycemic control target, it is necessary to further study the pattern of insulin used in T2DM patients and their glycemic control.

OBJECTIVE

This study was intended to determine the proper application of insulin administration, it is necessary to further study insulin therapy in Indonesia, therefore this research needs to be done. The purpose of this study was to determine the pattern of insulin therapy and glycemic control in T2DM patients.

MATERIAL AND METHOD

Data for this study was obtained from the medical records of the Diabetes Outpatient Clinic at the Dr. Soetomo General Academic Hospital, Surabaya, Indonesia. This study was an observational descriptive. In June-July 2016, total samples were collected from 124 patients who received insulin therapy between February 2015 and March 2015. We collected the data from patients' medical records including basic data (sex and age), pharmacological therapy used, types of insulin used, regimen of therapy used, and glycemic control through FPG, PPG, and HbA_{1c} levels.

RESULT

Data in this research had a mean age of 57.4 years. The distribution of sample according to sex and age is shown in Table 1.

Table 1. Distribution of subject according to sex and age

		n = 124	Mean
Sex	Male	47 (37.9%)	57.4 years
	Female	77 (62.1%)	
Age	< 45 years	8 (6.4 %)	
	45 - 60 years	74 (59.7 %)	
	60 - 75 years	40 (32.2 %)	
	>75 years	2 (1.7%)	

Patients who received insulin therapy were then grouped based on their pharmacological therapy, whether it was insulin only or combination therapy with OAD, as shown in Table 2.

Table 2. Pharmacological therapy used in T2DM patients

Pharmacological therapy	n	%
Insulin only	56	45%
Insulin and OAD	68	55%

The distribution of insulin therapy used in T2DM patients based on its characteristics such as; onset of action, peak, and duration of action is shown in [Figure 1](#).

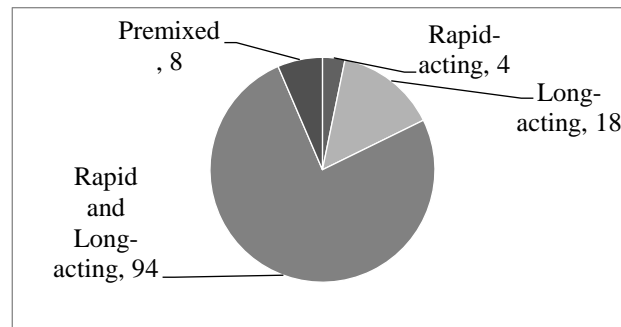


Figure 1. Distribution of subjects according to type of insulin used

Regimen of insulin therapy used in T2DM patients is shown in [Figure 2](#).

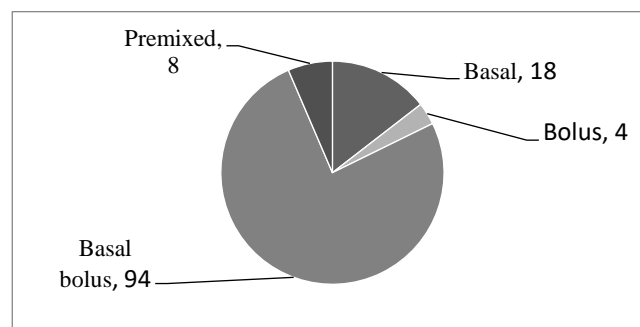


Figure 2. Distribution of subjects according to regimen therapy used

Glycemic control monitoring in T2DM patients who received insulin therapy was done by conducting FPG, PPG, and HbA_{1c} tests. Based on American Diabetes Association's 2016 recommendation, the target of each test is as follows: FPG <130 mg/dl, PPG <180 mg/dl, and HbA_{1c} <7%. The results of each test conducted are shown in [Table 3](#) and [Figure 3](#).

Table 3. Distribution of subjects according to FPG and PPG levels

		n
FPG	< 130 mg/dL	34 (27.4%)
	≥ 130 mg/dL	90 (72.6%)
PPG	< 180 mg/dL	56 (45.0%)
	≥ 180 mg/dL	68 (55.0%)

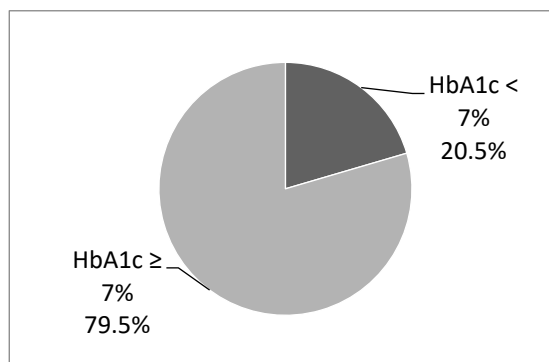


Figure 3. Distribution of subjects according to HbA_{1c} levels

DISCUSSION

T2DM is a chronic, progressive illness that consequently lead to a condition known as secondary pancreatic failure. As a result of this study, moving from OAD to insulin treatment may help patients better regulate their blood glucose levels (Galicia-Garcia, et al., 2020). Thus, the research about daily practices of insulin therapy in T2DM patients has become a particular interest for researchers.

According to this research, the most type of insulin used was combination of rapid-acting and long-acting insulin (75.8%). Similar result was obtained from a research conducted in Bali by Kartika, et al., (2013), that combination of rapid-acting and long-acting insulin was the most used, by 53% of the total samples of the research. ADA 2016 explained that those combinations are more preferred than any other type of insulin available for now because of the pharmacokinetic features they have. A rapid-acting insulin with the fastest onset of action and duration of action will have its concentration peak in blood in a matter of minutes. Because of this feature, the efficacy of rapid-acting insulin in lowering the blood glucose will be higher than those with slower onset of action. Not only having the fastest onset of action, a rapid-acting insulin also has the fastest duration of action which makes the insulin cleared from the blood faster than any other type of insulin. This feature will lower the risk of hypoglycemia after meal (American Diabetes Association, 2016).

This study also found the most regimen of therapy used in T2DM patients. Basal bolus regimen was the most used (75.8%). It was the most popular because theoretically, it has the most characteristic endogen insulin has. It was also more preferred than premixed regimen probably because of the lower risk of hypoglycemia occurrence, though they have similar levels of efficacy (Hamaty, 2011). FPG, PPG, and HbA_{1c} tests were conducted to evaluate T2DM patients' glycemic control. This study found that through FPG and PPG tests, patients' glycemic control was relatively low in most patients. Although they were only short-term parameters of glycemic control, they have strong correlation in showing whether the proper dose of insulin has been achieved or not (Ketema & Kibret, 2015). It was reported that only 32.1% succeeded in achieving the said target. Similar results were also found in other countries through the DiabCare Project. In Australia, it is only 30% of the total samples who met the target of controlled HbA_{1c} (Quigley, et al., 2022). While there could be numerous factors causing the poor glycemic control, most probable cause in Diabetes Outpatient Clinic in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia was the highly complicated cases the place received, as it is the referral hospital for east part of Indonesia. Blood glucose levels in cases with advanced complications will still be difficult to be controlled, even with the help of insulin therapy (Ahmad, et al., 2014).

Strength and limitations

Further research on the relationship between insulin usage patterns and glycemic control in type 2 diabetes patients is warranted due to the multiple obstacles insulin treatment faces in reaching the glycemic control aim.

CONCLUSION

Glycemic control in T2DM patients who received insulin therapy in Diabetes Outpatient Clinic in Dr. Soetomo General Academic Hospital, Surabaya, Indonesia was still relatively low.

Acknowledgment

None

Conflict of Interest

All authors have no conflict of interest.

Ethic Consideration

The research protocol was approved by the Committee on Medical Research Ethics in the Faculty of Medicine, Universitas Airlangga (327/Panke.KKE/IV/2016).

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This research was self-funded.

Author Contribution

All authors have contributed to all processes in this research, including preparation, data gathering, analysis, drafting, and approval for publication of this manuscript.

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