NORTHERN JOURNAL of HEALTH SCIENCES

Review Article

Review of Diabetes on A Case of Type 2 Diabetes With Polycystic Syndrome*

Gökşen Polat[1], Yağmur Yeytunç [2], Elif Ünsal Avdal[3]

[1] İzmir Tınaztepe University, Vocational School of Health Services, Department of First and Emergency Aid, İzmir, Türkiye.
[2] İzmir City Hospital, İzmir, Türkiye.
[3] İzmir Katip Çelebi University, Faculty of Health Sciences, Department of Nursing, İzmir, Türkiye.

Corresponding Author:
Gökşen Polat
E-mail:
goksen.polat@tinaztepe.edu.tr

ORCID IDs of the authors:
G.P. 0000-0001-9575-2325
Y.Y. 0009-0001-2169-7674
E.Ü.A. 0000-0001-6888-0882

Abstract

Diabetes is a chronic disease characterized by hyperglycemia that develops as a result of insulin deficiency or insufficiency. Diabetes classification includes Type 1 diabetes, Type 2 diabetes, gestational diabetes and other specific types of diabetes. In the pathophysiological process of Type 2 diabetes, in addition to the decrease in β-cell mass, hyperglucagonemia exacerbates the hyperglycemia caused by hypoinsulinemia, suggesting that glucagon plays a role in the pathophysiology of Type 2 diabetes. However, Type 2 diabetes is affected by genetic and environmental factors. This study was needed because the majority of diabetes patients are individuals with Type 2 diabetes and environmental factors such as aging, obesity and lack of physical activity are becoming widespread in developing societies. In this study, Type 2 diabetes was reviewed through a case and nursing interventions were included.

Keywords: Nursing, Obesity, Type 2 Diabetes.

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (American Diabetes Association [ADA], 2014) Metabolic abnormalities in carbohydrates, lipids and proteins result from the importance of insulin as an anabolic hormone (Kharroubi & Darwish, 2015). The Turkish Society of Endocrinology and Metabolism (TEMD) defines diabetes as "a chronic, broad-spectrum metabolic disorder requiring continuous medical care in which the organism cannot adequately utilize carbohydrates, fats and proteins due to insulin deficiency or defects in insulin action" (Turkish Endocrinology and Metabolism Association [TEMD], 2020).

Various pathogenic processes play a role in the development of diabetes. These range from autoimmune destruction of pancreatic β-cells, resulting in insulin deficiency, to abnormalities resulting in resistance to insulin action. The basis of abnormalities in carbohydrate, fat and protein metabolism in diabetes is insufficient insulin action in the tissues it targets. Deficient insulin action results from inadequate insulin secretion and/or a reduced tissue response to insulin at one or more points in the complex pathways of hormone action. Defects in insulin secretion and defects in insulin action often coexist in the same patient, and it is often unclear which abnormality alone is the primary cause of hyperglycemia (ADA, 2014).

Diabetes is categorized under 4 main headings according to etiologic classification: Type 1 DM, Type 2 DM, Other Specific Types of Diabetes and Gestational Diabetes. Latent autoimmune diabetes in adults (LADA) is classified under Type 1 DM, while rare forms of autoimmune-mediated diabetes, genetic defects of β cell function Maturity-Onset Diabetes of Young (MODY forms), endocrinopathies are listed under Other Specific Diabetes Types. Pathophysiologic processes vary according to the title under which they are classified (Kerner et al.,2014; Canivell & Gomis, 2014).

When the pathophysiological process of Type 2 Diabetes Mellitus (T2DM) is examined, it is seen that it is a disease characterized by high blood sugar levels, often characterized by hypoinsulinemia and hyperglucagonemia. Hypoinsulinemia is caused by insufficient insulin secretion and is associated with a 25-50% reduction in β-cell mass. In contrast to the effects on insulin levels, patients with T2DM often have persistent fasting hyperglucagonemia and suppressed glucagon levels in the fed state. This hyperglucagonemia exacerbates the hyperglycemia caused by hypoinsulinemia, because hyperglucagonemia increases hepatic glucose production. These data suggest a causal role for glucagon in the pathophysiology of T2DM. In particular, blockade of glucagon receptors is associated with α-cell hyperplasia, abnormal lipid metabolism, hepatic steatosis and elevated plasma levels of liver enzymes. It is still unclear whether α-cell mass is unchanged or increased in patients with T2DM. Importantly, even in the setting of unchanged α-cell number, the ratio of α-cells to β-cells has been found to be higher in patients with T2DM due to reduced β-cell mass compared to people without T2DM. Evidence from the last few years in mouse and non-human primate models of diabetes and in humans with T2DM suggests that β-cells differentiate and adopt α-cell characteristics. This finding is confirmed by the detection of insulin and glucagon bihormonal cells in islets from T2DM patients (Gromada et al., 2018). In addition, it is thought that incretin hormone deficiency and intestinal microbiome may play a role in the pathophysiologic process. Incretins are

hormones secreted from special cells of the gastrointestinal tract in response to food intake and stimulate insulin release (TEMD, 2020). Gestational Diabetes (GDM) is one of the risk factors of T2DM and is thought to have an effect on the pathophysiologic process (Öztürk & Altuntaş, 2015).

Diagnostic Criteria for Diabetes

According to the American Diabetes Association (ADA) guidelines, diabetes is diagnosed according to plasma glucose criteria. These methods are admission plasma glucose (APG), 75 g oral glucose tolerance test (OGTT) and 2-hour plasma glucose (PG) value or A1C value. In general, APG, 2-hour PG during a 75 g OGTT, and A1C are equivalent in terms of diagnostic testing and any of them can be used (ADA, 2018). It should be noted that the tests do not necessarily detect diabetes in the same individuals. The effectiveness of interventions for primary prevention of T2DM has been demonstrated mainly among individuals with impaired glucose tolerance (IGT) with or without elevated fasting blood glucose not among individuals with isolated diabetes. The same tests can be used to screen and diagnose diabetes and detect individuals with prediabetes Prediabetes is a preliminary stage of diabetes mellitus in which all the symptoms necessary for the diagnosis of diabetes are absent but blood sugar is abnormally high. Compared with APG and A1C cutpoints, the 2-hour PG value diagnoses more people with diabetes (ADA, 2018).

The aim of this case report is that the majority of diabetic patients are Type 2 diabetic individuals and environmental factors such as aging, obesity and lack of physical activity are becoming widespread in developing societies.

Case Report

The case was a female patient, Y.B., 55 years old and married. She graduated from secondary school and was a housewife. She was diagnosed with polycystic ovary syndrome (PCOS) at the age of 33. She was diagnosed with gestational diabetes 15 years ago during her second pregnancy. She is checked by the gynecology outpatient clinic once a year. The blood test she gave to the family health center 7 years ago revealed that her HbA1C was 7.1%. She told the doctor that she was very thirsty, urinated even at night and had fatigue. Blood pressure was measured and it was 150/96 mmHg. The patient was asked to follow and record her blood pressure for one week. Metformin Hydrochloride 2 grams was started in our patient whose body mass index was 29.1 kg/m2 at diagnosis. She was also advised to get support from a dietician. One week later, Hypertension was diagnosed and Ramipril 5 mg (1x1) peroral (PO) was started. However, the patient did not comply with her diet and went to the doctor's control two years later, during which she continued to use Metformin Hydrochloride and HbA1C was 9%. The patient was referred to the endocrinologist and insulin was started in addition to Metformin Hydrochloride. Insulin Glargine 10 units was prescribed. Patient received diabetes education by the diabetes nurse, insulin education and nutrition education from the dietitian in the endocrine outpatient clinic. Laboratory findings of the patient were Table 1. After taking hypertensive agents, blood pressure is 129/73 mmHg. The patient is currently using 4 units of Insulin Aspart in the morning, noon and evening and 12 units of Insulin Glargine insulin at night.

Table 1. Laboratory findings of a case with type 2 diabetes

Lab reference	Laboratory results
Glukose	320 mg/dl
Sodium	142 mmol/L
Potassium	3.7 mmol/L
Triglyceride	261 mg/dl
Total cholesterol	272 mg/dl
HDL	30 mg/dl
LDL	187 mg/dl
Glucose (urine)	++++
Ketone (urine)	+
Urine density	1028

Analysis of Case Risk Factors

Age: Individuals over the age of 40 years is one of the risk factors for T2DM (Olgun, 2021). Although T2DM mostly occurs after the age of 30 years, it can also be observed in childhood or adolescence with the recent increase in obesity (TEMD, 2020). We can consider the fact that our patient was 55 years old and over 40 years of age as a risk factor.

Family history of diabetes: A diagnosis of diabetes in parents or close blood relatives is a risk factor for diabetes (Olgun, 2021). A strong genetic predisposition can be mentioned. It has been found that first-degree relatives of individuals with T2DM have less insulin sensitivity and are more likely to develop diabetes in the future. There is no single gene identified for T2DM (except MODY). T2DM, which is polygenic, varies from person to person and occurs as a result of the interaction of different types of gene variants (Arıkoğlu & Erkoç, 2015). As the genetic predisposition increases in family members, the risk of diabetes increases in subsequent generations (TEMD, 2020). We can consider our patient's mother having diabetes as a risk factor.

Obesity: Especially the fact that the body shape of the individual has an android fat distribution, that is, being an apple-type individual, is a risk factor for T2DM (Olgun, 2021). T2DM patients are mostly obese or overweight and have a body mass index (BMI) >25 kg/m2 (TEMD, 2020). The relationship between T2DM and obesity stems from insulin resistance. Severe hyperinsulinemia and insulin resistance are present in central obesity. In obese individuals, the onset of insulin hormone action is delayed and rapid deactivation of insulin reduces the effect of insulin during oral glucose loading or at meals. This leads to dysfunction in insulin action despite hyperinsulinemia. Lipolytic activity and antilipolytic activity of insulin are greater in abdominal fat cells. The increase in free fatty acids increases glucose production in the liver and decreases insulin release from the β cell of the pancreas. First, insulin resistance starts and then insulin secretion increases against this resistance. Finally, insulin secretion decreases. As triglyceride stores increase in adipose tissue, obesity develops. This results in decreased response to insulin and insulin-mediated glucose

transport in muscle and adipose tissues. Another condition is lipotoxicity. Excess storage of triglyceride in the islet cells of Langerhans in muscle, liver and pancreas causes dysfunction in the cells. This condition is called lipotoxicity. TNF-α level is also high in obesity (Karslıoğlu, 2019). The fact that our patient was obese with a BMI of 32.1 kg/m2 can be considered as a risk factor for T2DM.

Dyslipidemia: Blood lipid values of HDL-cholesterol ≤35 mg/dl or triglycerides ≥250 mg/dl indicate that the individual is in the risk group in terms of diabetes (Olgun et al., 2011). Our patient's total cholesterol: 272 mg/dl, HDL: 30 mg/dl, LDL: 187 mg/dl.

History of gestational diabetes: Giving birth to a large baby or having a diagnosis of GDM in any of the pregnancies is risky in terms of type 2 diabetes (Olgun et al., 2011). Our patient had a history of gestational diabetes in her pregnancy history, which we can consider as a risk factor.

Hypertension: In order to talk about a hypertensive individual, the blood pressure of the individual should be ≥140/90 mmHg and when combined with other factors, it shows that the individual is in the risk group, in the group that should be screened (Olgun et al., 2011). The fact that your patient has a diagnosis of hypertension indicates that she is in the risk group.

Polycystic ovary syndrome: PCOS, is caused by receptor-induced signal transduction of insulin resistance (IR) or by a postreceptor defect. In addition, insulin signaling defect occurs in PCOS as a result of impaired insulin receptor tyrosine kinase activity in skin fibroblasts. Peripheral IR and consequently compensatory hyperinsulinemia occurs. All these conditions are risk factors for T2DM (Yıldızhan, 2016).

Analysis of Symptoms and Signs Related to the Case

Signs and symptoms of diabetes mainly include polyuria, polydipsia, weight loss, sometimes polyphagia and visual impairment, which are symptoms of hyperglycemia. Polyuria and polydipsia are caused by excessive fluid loss due to osmotic diuresis (TEMD, 2020). Polyphagia occurs as a result of inability to take glucose into the cell despite adequate or even excessive insulin secretion. In insulin insufficiency, loss of appetite, weakness due to burning of proteins and fats, and rapid fatigue are observed. Our patient stated that he was very thirsty, urinated even at night, and had fatigue.

Analysis of Laboratory Findings of the Case

The high blood laboratory values are PG, HbA1C, triglycerides, total cholesterol and LDL. The lower blood laboratory value is HDL. Glucose, ketone and density values in urine test are high.

Analysis of Medications Used by the Subject

Metformin Hydrochloride: It is an oral antidiabetic agent in the biguanide class. Its main mechanism is to reduce hepatic glucose production by inhibiting gluconeogenesis, thus lowering blood glucose. It also increases glucose uptake and utilization in peripheral tissues and improves insulin sensitivity, especially in the muscle layer. The only biguanide drug is Metformin Hydrochloride, which has been used in the treatment of T2DM for many years, but its mechanism of action is still not fully understood. The dose is increased starting from 500 mg PO once a day (TEMD, 2020; Turan & Kulaksızoğlu, 2015). In addition to its effect on blood glucose, Metformin Hydrochloride can also be used in conditions such as PCOS and non-alcoholic fatty liver disease due to its pleiotropic effects. Common side effects include gastrointestinal system problems, vitamin B12 deficiency, acidosis and acute kidney injury (Aydar et al., 2022). Since our patient had PCOS and T2DM,

Metformin Hydrochloride was used as the first oral antidiabetic drugs.

Insulin Aspart: It is a fast-acting insulin. It is a prandial analog. Onset of action is 15 minutes. Peak level is 30-90 minutes. Duration of action is 3-5 hours (TEMD, 2020). The average daily insulin requirement in T2DM is 0.2-2 U/kg (Atmaca, 2012).

Insulin Glargine: It is a long-acting insulin. It is a basal analog. Onset of action is one hour. It has no peak effect. Duration of action is 20-26 hours (TEMD, 2020). In patients who will receive intensive insulin treatment, half of the total calculated dose is divided into equal doses as basal insulin and half as bolus insulin (Atmaca, 2012).

Ramipril: It is an antihypertensive agent. It can be used alone or in combination with other antihypertensive agents. The dose can be determined according to the individual. In general, 1/2 glass of water should be taken as a single dose in the morning, independent of food (TİTCK, 2024).

Case-Oriented Non-Pharmacologic Methods

Individuals with diabetes should be monitored by health professionals and at the same time should continue self-monitoring at home. The individual should receive diabetes education in order to provide self-monitoring and self-care. In the trainings, the disease process, medical nutrition therapy, physical activity and exercise, insulin injection techniques, oral antidiabetics, their application methods, self-monitoring of glucose, foot care, and protection from acute and chronic complications are explained (Karaca Sivrikaya & Ergün, 2019).

Medical Nutrition Therapy

- Energy, saturated and trans fats, cholesterol and sodium intake should be reduced and physical activity should be increased in T2DM, especially in glycemia, dyslipidemia and blood pressure (TEMD, 2020).

- Plasma glucose monitoring is used to determine the adequacy of meal adjustments in terms of target blood glucose or whether the drug treatment should be combined with medical nutrition therapy (TEMD, 2020).

- In order to reduce the risk of weight gain, fatty liver and cardiovascular system diseases, consumption of sugar-sweetened beverages such as sucrose, glucose, high fructose corn syrup should be reduced or prevented (REF).

- Patients using insulin secretagogues should not change their carbohydrate intake in main and intermediate meals, should definitely add it to meals to reduce the risk of hypoglycemia, should not skip meals, and should supplement food containing carbohydrate (sugar cubes, fiber-free fruit juice) to prevent hypoglycemia during or after exercise (REF).

- In nutrition education, individuals are taught how to plan their meals. Considering the situations that may affect the individual's lifestyle, the dietitian should make suggestions. These suggestions can be methods such as plate model, change lists, nutrition pyramid, carbohydrate counting. One of the frequently used methods is the plate method. First, healthy nutrition is explained and then a visual is used to limit T2DM. It is preferred in individuals with newly diagnosed diabetes who take their meals outside the home, have difficulty with other methods, have a low level of education, and are known to have high protein and glucose (TEMD, 2020).

Physical Activity

Aerobic exercises such as brisk walking, running, swimming and resistance exercises to increase muscle strength are recommended. Moderate intensity exercise is recommended for adults with

diabetes for at least 3 days a week for a total of 150 minutes, with no more than two days off (REF). The intensity should be increased gradually. If there are no contraindications, resistance exercise should be recommended for individuals with diabetes 2-3 days a week. Flexibility and balance exercises increase joint mobility, especially in older patients. These exercises are recommended 2-3 days a week in addition to the others (REFs).

Case-Oriented Nursing Interventions

It was stated that our patient was given training by a diabetes nurse. These training topics include the definition of diabetes, diabetes treatment methods, diet therapy in diabetes, physical activity, diabetes medications and their use, information about blood glucose and other parameters, how to monitor blood glucose by oneself, methods of preventing and pre-detecting acute-chronic complications and treatment methods, psychological problems that the individual may encounter, individual strategies for correct health. In diabetes education, it should be emphasized that patients should especially continue blood glucose monitoring at home (Ernawati et al., 2021).

T2DM nursing care that should be given is given below (Muslu & Aradan, 2018);

-Patient-specific training should be planned. Individuals' knowledge about diabetes should be evaluated at the end of the training. It should be ensured that they have sufficient knowledge.

-It should be ensured that individuals and their relatives learn the signs and symptoms of hypoglycemia and hyperglycemia. What to do in these situations should be conveyed to patients and their relatives.

-Individuals should be made aware of the risks and complications of diabetes.

-Their ability to self-monitor blood glucose should be improved.

-In order to reach the individualized blood glucose target, the individual should be advised to receive support from a dietician in nutrition and physical activity should be recommended.

-Individuals should be informed about when blood glucose monitoring should be performed and how it should be measured.

-It should be emphasized that the patient should follow up to be aware of how food and exercise affect blood glucose.

-Carbohydrate counting is recommended.

-Adequate information about insulin and oral antidiabetic treatment should be provided and patients should be supported to maintain their own treatment.

-Trainings should be repeated so that they can apply insulin trainings correctly.

-Patients should be made aware that 70 mg/dL is a warning for hypoglycemia and <55 mg/dL in more severe hypoglycemia and the patient should be informed about what to do immediately and insulin dose adjustment should be informed.

As a result, the care provided by nurses plays an important role in the care of individuals diagnosed with Type 2 diabetes.

References

American Diabetes Association (ADA), (2014). Standards of medical care in diabetes care. *Diabetes Care*, 41(1), 1-155.

American Diabetes Association (ADA), (2018). Standards of medical care in diabetes care. *Diabetes Care,* 41(1), 1-155.

Arıkoğlu, H., & Erkoç Kaya, D. (2015). Tip 2 diyabetin moleküler genetik temeli; son gelişmeler. *Genel Tıp Derg,* 25, 147-159.

Atmaca, H. (2012). Tip 2 diabetes mellitusta insülin tedavisi. *J. Exp. Clin. Med*, 29, 44-48.

Aydar, H., Tezcan, N., & Mutluay, R. (2022). Acute renal failure and lactic acidosis seconder to metformin intoxication. *Pam Med J,*15:379-382.

Canivell, S., & Gomis, R. (2014). Diagnosis and classification of autoimmune diabetes mellitus. *Autoimmunity Reviews*, 13: 403-407.

Ernawati, U., Wihastuti, T.A., & Utami, Y.W. (2021). Effectiveness of diabetes self-management education (DSME) in type 2 diabetes mellitus (T2DM) patients: Systematic literature review. *Journal of Public Health Research,* 10(2).

Gromada, J., Chabosseau, P., Rutter, G.A. (2018). The α-cell in diabetes mellitus. *Nature Reviews Endocrinology*, 14, 694-704.

Karaca Sivrikaya, S. & Ergün, S. (2019). Diyabet eğitimi ve hemşirenin rolü. *Ahi Evran Üniversitesi Sağlık Yüksek Okulu Sağlık Bilimleri Dergisi,* 2(3), 25-36.

Karslıoğlu, H. (2019). Obezite, tip 2 diyabet ve beslenme. *Klinik Tıp Bilimleri Dergisi*, 7(3), 36-43.

Kerner, W., Brückel, J. (2014). Definition, classification and diagnosis of diabetes mellitus. *Exp Clin Endocrinol Diabetes,* 122, 384-386.

Kharroubi, A.T. & Darwish, H.M. (2015). Diabetes mellitus: The epidemic of the century. *World J Diabetes*, 6(6), 850-867.

Muslu, L., & Ardahan, M. (2018). Kan şekeri regülasyonunda hemşirelik bakımının önemi. *ACU Sağlık Bil Derg,* 9(4), 344-348.

Olgun, N., Yalın, H., & Demir, H.G. (2011). Diyabetle mücadelede diyabet risklerinin belirlenmesi ve tanılama. The Journal of Tuskish Family Physıcıan, 2(2), 41-49.

Olgun, N. (2021). Diabetes mellitus tanı ve sınıflandırılması. Ünsal Avdal E (ed.) Endokrin Hemşireliği içinde. 1.Baskı. Ankara: Hipokrat Yayınevi.

Öztürk, F.Y., & Altuntaş, Y. (2015). Gestasyonel diabetes mellitus. Şişli Etfal Hastanesi Tıp Bülteni, 49(1), 1-10.

TİTCK. Kısa ürün bilgisi. (08/12/2024) https://titck.gov.tr/storage/Archive/2019/kubKtAttachmen ts/TİTCK-KÜB-%20DELİX%2010MG-12,5MG.pdf_b6bd70d4-0194-4266-90f7-2377e406b93b.pdf

Turan, E., & Kulaksızoğlu, M. (2015). Tip 2 diyabet tedavisinde güncel yaklaşımlar. *Okmeydanı Tıp Dergisi,* 31(Ek sayı), 86-94.

Türkiye Endokrinoloji ve Metabolizma Derneği Diyabet Eğitim ve Çalışma Grubu (TEMD). (2020). Diabetes Mellitus ve Komplikasyonlarının Tanı Tedavi ve İzlem Kılavuzu.

Yıldırım A, Hacıhasanoğlu AB, Bozdemir N, Hacıhasanoğlu Aşılar R. (2020). Diyabet öz yönetiminde çok disiplinli ekip yaklaşımı. *TJFMPC,* 14(3), 479-491.

Yıldızhan B ve İlhan GA. (2016). Polikistik over sendromunda sağlık sorunları. *Van Tıp Derg,* 23(3), 302-306.