International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

The Influence of Medical Nutritional Therapy on Type 2 Diabetes Mellitus: A Review Case Study

Pradeep M

Research Scholar, Srinivas Institute of Nursing Sciences Srinivas University Mukka Mangalore, Karnataka, India
Corresponding Author Email: *pmmhills[at]gmail.com*
Phone: 7406955266s

Abstract: ***The main objective of this investigates is to influence of diet counselling on patients with Type 2 Diabetes Mellitus (T2DM). Despite a number of approaches to T2DM management being already available, healthcare professionals in India still struggle to achieve health targets without the adjunct therapy of diet coaching or counselling. Type 2 diabetes is a global burden affecting over 400 million people across the world. The prevalence of type 2 diabetes is growing, driven by a sedentary lifestyle and unhealthy eating habits. In community settings, less than 1 in 1,000 people achieves type 2 diabetes remission. In the india, adults eat 300% the recommended intake of added sugar in the diet. People diagnosed with type 2 diabetes are treated with diet and exercise before progressing to medications including metformin and insulin. Nutrition therapy and counselling are an integral part of the treatment and self-management of diabetes. The goals of nutrition therapy are to maintain or improve quality of life and nutritional and physiological health and to prevent and treat acute- and long-term complications of diabetes, associated comorbid conditions and concomitant disorders.***

Keywords: A Review Case Study, counseling, Medical Nutritional Therapy, Type 2 Diabetes Mellitus

1. Introduction

Diabetes refers to any of the diseases characterized by an excessive discharge of urine. The word ‘diabetes’ literally translates as ‘siphon’, or ‘pass through’[1]. Diabetes Mellitus is a chronic hereditary disease characterised by a lack of endogenous insulin and resulting in hyperglycaemia and the excretion of excess glucose in urine. The basic defect appears to be an absolute or relative lack of insulin production from the pancreas, which leads to abnormalities mainly in carbohydrate metabolism, as well as in protein and fat metabolisms. Severe untreated diabetes, of which hyperglycaemia is just one aspect of metabolic derangement, can lead to both macro and microvascular complications. A relatively simple and non-invasive method of preventing these complications is to recognise the impact of diet on insulin production and maintenance. Therefore, people with diabetes mellitus need help in planning and accepting a daily diet which contains the appropriate amounts of carbohydrates, protein, fat and fibre, together with adequate amounts of vitamins and minerals[2]. It is important to distinguish that Type I Diabetes Mellitus (T1DM) is characterised as an autoimmune disease, while Type II Diabetes Mellitus is an acquired chronic disease characterised by decreased insulin secretion and an increase in insulin resistance. Although diet plays a role in T1DM, it has a greater impact in the management of T2DM. Asians from the Indian subcontinent are known to have a higher prevalence of T2DM than host populations and other migrant ethnic groups. Studies conducted in several Asian countries in the last decade highlighted a rising prevalence of T2DM in the urban population [3]. The most disturbing trend, however, is the significant shift in age of onset of T2DM, towards a younger population. This could have long-lasting adverse effects on the nation’s overall health and economy, particularly contributing to an increase in the burden of health [4]. The International Diabetes Federation predicts that India will reach a prevalence of about 73.5 million people with diabetes mellitus in the year 2025, and that it will emerge as the global capital for diabetes. Country-wise population prevalence of diabetes and an expected increase in number showed that India is likely to be followed by China and the U.S. . Wild opined that given the increasing prevalence of metabolic syndrome, it is likely that these figures provide an underestimate of future diabetes prevalence.[5-6]

Risk factors for type 2 diabetes mellitus

Risk factors as something that increases a person’s chances of developing a disease.[6] important risk factors for high prevalence of diabetes include obesity, central adiposity (increased waist to hip ratio), age, family history of diabetes and lifestyle changes due to urbanization. The ability to reverse or modify a risk factor results in two different subtypes of classification - non-modifiable and modifiable risk factors, otherwise known as host risk factors and reversible risk factors.[7]

A short discussion on these non-modifiable risk factors

Age: The incidence of T2DM is not limited to particular age groups, and can affect any person of any age. In Indians, T2DM is developing at a younger age compared to their European counterparts, with an increase in incidence seen in urban populations as compared to the rural population in India. Age-standardised prevalence of diabetes has increased in an urban population in India [8-9]

Gender: Many studies do not comment on differences between genders as a risk factor for T2DM [10-11]. Contrary to this, however, the prevalence of T2DM was higher in men than in women in a study conducted on Caucasians in the UK [12-13]. Women are generally considered at lower risk of cardiac-related morbidity and mortality than men. It is globally believed that diabetes erases this advantage in

females and increases the risk of coronary heart disease to a greater extent than in men [14]

Race: The risk for T2DM varies among different population groups. Diabetes also seems to pose higher or lower risks for specific complications among certain ethnic groups. Genetic and socioeconomic factors, or both, seem to be involved in some ethnic differences, but in most cases the observed increase in subcontinental Indians is due to dramatic changes in traditional lifestyles over a relatively short period of time. One important factor contributing to increased T2DM in Asian Indians is excessive endogenous insulin resistance when compared to their Caucasian counterparts. This difference in the degree of insulin resistance may be explained by either an environmental or a genetic factor, or by a combination of both [15]

Family history: About a third of people living with T2DM have family members with diabetes and pose a forty per cent risk of developing diabetes. American Diabetes Association reported that people with a family hnnnnnnnistory of diabetes ha an increased risk of developing the disease at an earlier age and with more severe features. When clusters of T2DM appear within families, genetic factors should be strongly suspected.[16]

Management of type 2 diabetes mellitu

Early diabetes management should focus on lifestyle modification, specifically modest weight loss and increased physical activity. Even at an advanced stage of diabetes, lifestyle and diet intervention are likely to be beneficial in curbing the complications of sustained hyperglycaemia. Public health messages, health care professionals, and healthcare systems in general should advocate behaviour changes to achieve a healthy lifestyle and thereby reduce the negative impacts of T2DM. [17]

There are three streams of lifestyle and medical interventions:

i) Diet.
ii) Diet and oral hypoglycemic agents
iii) Diet and insulin.

Diet: Prolonged dietary treatment of diabetes is the very baseline of all forms of anti-diabetic treatment [18]. An important cornerstone in the management of diabetes and achievement of the aim of dietary treatment is a well designed meal, taking account of the total calorie content and nature of diet [19-20]

Diet and oral hypoglycemic agents: Diet combined with oral hypoglycaemic agents is the next tier in diabetes treatment. There are several classes of orally administered antidiabetic agents available for use in patients with T2DM, as discussed below. By taking advantage of differing mechanisms of action, combination therapy is evolving as a means of optimizing glycaemic control in patients in whom a single agent or insulin is inadequate. Combinations of orally administered agents can often delay the need for insulin or in combination with insulin aid in achieving glycaemic goals [19-21].

Diet and insulin: When a subject with T2DM cannot be managed with diet and oral hypoglycemic agents, insulin is introduced for better management of the condition. Insulin therapy in T2DM supplements endogenous insulin and is often given as a single injection before breakfast or at bedtime. Most insulin treated obese subjects with T2DM can be managed with three meals and a bed time snack[22-23]. Many of them receive sulphonylurea therapy as well as insulin because this combination decreases the amount of insulin required. When diabetes and obesity occur together, over eating is a major contributor to the hyperglycaemia in the insulin treated individuals, so any reduction in energy intake reduces insulin requirements [24].

Case Study

Case 1

- **Patient ID:** Ms. Leta 17 years and 5 months, female
- **Complaints:** Polydipsia, polyuria
- **Family history:** Mother with hypertension, father with heart failure.
- **Past medical/social history:** No significant history
- **History of present illness:** This 17-year-old girl was diagnosed with diabetes at another hospital after a 1-month history of persistent polydipsia and polyuria. She presented to Konkuk University Medical Center for further diagnosis and treatment of her persistent symptoms.
- **Physical examination:** On admission, her height was 173.1 cm (>97th percentile), weight was 107.2 kg (>97th percentile), and BMI was 35.8 kg/m^2 (>97th percentile). She appeared obese but did not look ill and her mental status was intact. Her vital signs were normal except for a blood pressure of 137/81 mmHg (95–99th percentile). Her skin was warm and no dry mucous membranes were observed. A chest examination was unremarkable. No enlargement of the liver or spleen was appreciated on an abdominal examination. The rest of the physical exam was unremarkable.
- **Lab findings:** Labs on admission revealed a glycated hemoglobin (HbA1c) of 11.1%, fasting plasma glucose level of 102 mg/dL, insulin level of 23.12 μIU/mL, and C-peptide level of 4.13 ng/mL. Liver function tests revealed an elevated serum aspartate transaminase (AST) level of 115 IU/L and serum alanine transaminase (ALT) level of 141 IU/L. A lipid panel demonstrated a total cholesterol level of 133 mg/dL, triglycerides of 71 mg/dL, and high-density lipoprotein cholesterol (HDL-C) of 49 mg/dL . The total protein and albumin level was 7.0 g/dL and that of albumin was 4.5 g/dL. The free fatty acid level was elevated at 1214 μEq/L.
- **Radiologic findings:** There were no abnormal findings on a chest radiograph. An abdominal ultrasound showed severe fatty infiltration of the liver.
- **Treatment and progress:** For glycemic control, the patient was started on oral medications (metformin 500 mg BID, glimepiride 1 mg QD) as well as a diet and exercise program as a lifestyle modification. Her dietary and nutritional knowledge were evaluated, and she was counseled to have regular meals with 70–75 g of

proteins per day and maintain daily nutritional requirements of approximately 1,800 kcal. She was recommended to consume a low-carb, low-fat diet, limit high saturated fats, track her intake, and attend outpatient appointments every 1–2 months. She was instructed to perform aerobic and weight exercises that improve muscle strength for more than 1 hour at least 3 times per week. For 1 year, she did aerobic and anaerobic exercises for an hour or more per day. After 1 year, she incorporated a 7 km walk daily and Pilates more than 3 times per week to her exercise program. In the outpatient setting, we assessed her adherence to therapy at 1–2 month intervals, offered motivational support, and advised her to gradually increase her exercise duration rather than intensity. We measured her height and weight every year and used InBody720, a type of bioelectrical impedance analysis (BIA), to accurately evaluate her obesity. On diagnosis, the patient's BMI was 35.8 kg/m^2 (FMI, 18.0 kg/m^2; FFMI, 17.8 kg/m^2), scoring >97th percentile, and percent body fat (PBF) was 50.4%. During the 2 years of outpatient monitoring, she had no difficulty controlling her blood sugar level using the combination of oral medication and lifestyle modification. However, the dose of metformin was increased to 1,000 mg BID due to difficulty maintaining her HbA1c <7.0% on the previous regimen; at that time, she was still considered obese with a BMI of 35.1 kg/m^2 (FMI, 17.2 kg/m^2; FFMI, 17.9 kg/m^2) and PBF of 48.9%.

Case 2

- **Patient ID:** Ms. Anita, 12 years and 10 months, female
- **Complaints:** Hyperglycemia
- **Family history:** Father with type 2 diabetes under treatment
- **Past medical/social history:** No significant history
- **History of present illness:** 12-year-old female who presented to Konkuk University Medical Center with post-prandial hyperglycemia of 330 mg/dL measured by her father one day prior to admission. Menarche occurred 1 year prior and her menstrual cycles were regular.
- **Physical examination:** On admission, the patient's height was 158.9 cm (25–50th percentile), weight was 75.5 kg (>97th percentile), and BMI was 29.9 kg/m^2 (>97th percentile). Her vital signs were within the normal range with a blood pressure of 112/68 mmHg, pulse of 72 beats/min, respiratory rate of 20 breaths/min, and temperature of 36.6°C. She had a clear mental status, warm skin, and moist mucous membranes. A chest examination revealed no specific findings, while an abdominal examination revealed no hepatomegaly or splenomegaly. The rest of the physical examination was unremarkable.
- **Laboratory findings:** Laboratory tests at the time of admission revealed an HbA1c level of 9.9%, fasting blood glucose level of 202 mg/dL, insulin level of 15.85 μIU/mL, and C-peptide level of 2.97 ng/mL. Liver function tests showed an elevated AST level at 47 IU/L and ALT level at 69 IU/L. A lipid panel and comprehensive metabolic panel showed a total cholesterol level of 165 mg/dL, triglyceride level of 104 mg/dL, HDL-C of 50 mg/dL, total protein of 7.6 g/dL, and albumin of 4.8 g/dL. The free fatty acid level was elevated at 671 μEq/L.
- **Radiologic finding:** There were no significant findings on a chest radiograph. An abdominal ultrasound showed moderate fatty liver.
- **Treatment and progress:** For glycemic control, combination therapy of oral medication (metformin 500 mg BID) and lifestyle modification through adjustments in dietary habits was prescribed. We evaluated her dietary and nutritional knowledge and then counseled her to consume regular meals with 70–90 g of protein per day, maintain daily nutritional requirements of approximately 1800 kcal, and eat a low-carb, low-fat diet. She was recommended to modify her habitual preference of salty and spicy foods, reduce her salt intake, track her meals, and attend outpatient monitoring appointments every 1–2 months.For an exercise program, she was instructed to include aerobic and weight exercises that improve muscle strength. She was advised to walk >1 hour at least 5 days per week and visit a health training center for ≥1 hour of strength exercises at least 3 times per week. We measured her height and weight every 2 months, and used InBody720, a type of BIA for accurate assessment of obesity. On diagnosis, patient's BMI was 29.9 kg/m^2 (FMI, 12.7 kg/m^2; FFMI, 17.2 kg/m^2) and PBF was 42.5%. Two years later after the diagnosis, an abdominal ultrasound showed improvements in her fatty liver and her HbA1c was successfully reduced to 6.0%. The oral medication was discontinued due to the successful glycemic control. At the time, her fasting blood sugar was 97 mg/dL, insulin level was 5.62 μIU/mL, and C-peptide level was 2.79 ng/mL. Her BMI (FMI+FFMI) was 23.2 kg/m^2 (7.0 kg/m^2+16.2 kg/m^2), which was within the overweight range (85–90th percentile), and her PBF was 30.2%. Her BMI at that point was 6.7 kg/m^2 lower than that prior to therapy, with a 5.7 kg/m^2 reduction observed in her FMI. Liver function tests and a lipid panel revealed the following: AST, 20 IU/L; ALT, 34 IU/L; total cholesterol, 115 mg/dL; triglycerides, 70 mg/dL; and HDL-C, 30 mg/dL . The changes in the patient's weight and body composition during treatment are shown in . Since discontinuing the oral medication, the patient has maintained an HbA1c level <6.5%.[25]

2. Conclusion

Medical Nutritional therapies have a great role in management of diabetic mellitus especially type 2 diabetic mellitus. By following the dietary regimen assessed by trained dieatation client could get an easy way to prevent DM and its complication.

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