REVIEW ARTICLE

Diabetes Management

Diabetes reversal: Stress management the missing link

Priti Nanda Siba*

ABSTRACT

Diabetes reversal in an Obese Woman the International Diabetes Federation 2017 data estimates that women in earlier stages of life experience higher healthcare expenditure than men across the globe. Globally, the prevalence of diabetes for women 20-79 years is estimated to be 8.4% with 1.7-2.7 million deaths attributable to diabetes in women compared to 1.5-2.3 million in men. Research study in a large cohort of middle-aged women showed that a combination of several lifestyle factors, such as maintaining a body-mass index of 25 or lower, eating a diet high in cereal fiber and polyunsaturated fat and low in saturated and trans fat and glycemic load, exercising regularly, abstaining from smoking and consuming alcohol moderately, was associated with an incidence of type 2 diabetes could avoid incidence of diabetes. Excess body fat is the single most important determinant of type 2 diabetes. Study data has revealed that diabetes cases preventable by diet and exercise independently of body weight is greater among women of normal weight than among obese women. In overweight and obese women, the combination of an appropriate diet, a moderate amount of exercise, and abstinence from smoking could substantially lower the risk of type 2 diabetes. Excess weight is an established risk factor for diabetes. Studies have identified links between obesity and type 2 diabetes suggesting the role of pro-inflammatory cytokines (tumor necrosis factor and interleukin-6), insulin resistance, deranged fatty acid metabolism, and cellular processes such as mitochondrial dysfunction and endoplasmic reticulum stress. The links between obesity and hyperinsulinemia is reflective of the compensation by insulin-secreting β-cells to systemic insulin resistance. Genetic factors may link β-cell predisposition. Hypoglycemia is one of the most important complications of diabetes treatment. Elderly, those with comorbidities such as vascular disease or renal failure, pregnant women are high risk groups for hypoglycemia. In type 2 diabetes, progressive insulin deficiency, longer duration of diabetes, and tight glycemic control also raise the risk of hypoglycemia. Oral hypoglycemic agents are the most common oral drugs used in the treatment of type 2 diabetes. However, these are associated with several established adverse effects such as hypoglycemia, weight gain, gastrointestinal disturbance, lactic acidosis, and fluid retention. Here we talk about how an obese woman chose functional medicine to change her life, which has not only put her diabetes into remission but she is also happy about to be able to take charge of her own health.

KEYWORDS

- diabetes
- hypoglycemia
- hyperinsulinemia
- pro-inflammatory cytokines
- type 2 diabetes
- lactic acidos

Introduction

Stress is a potential factors causing chronic hypoglycemia in diabetes, with major effects on metabolic activity. Recent years have seen a complex relationship between stress and diabetes. Some studies have suggested that stressful experiences might affect the onset and/or the metabolic control of diabetes. Research has indicated that stressful experiences are implicated in the onset of diabetes in individuals who are already predisposed to developing diabetes. In fact, it has also been suggested that

Department of Medicine, Mediskool Health Services, Gurgaon, India

Author for correspondence: ceo@medi-skool.com

negative stressful experiences in the first two years of life may increase the risk of developing Type-2 diabetes later in children. In a cross-sectional study, the an association between stressful experience and diagnosis of Type-2 diabetes has been revealed.

In a possible mode of reaction, it was suggested that as a physiological response to stressors, hypothalamus-pituitary-adrenal axis is activated which leads to several endocrine abnormalities such as high cortisol and low sex steroid levels, that oppose the actions of insulin. Several laboratory studies have also demonstrated that specific stressful situations may destabilize blood glucose levels. Both behavioral and physiological pathways have been suggested in the way stressful experiences impact metabolic control. Human studies have shown that stress can stimulate hyperglycemia, hypoglycemia, or have no effect at all on glycemic status in established diabetes.

Literature Review

▪ Depression in diabetes

Depression is a common and very serious medical disease with a lifetime prevalence ranging from approximately 11% in low-income countries to 15% in high-income countries. The risk of having a mental health problem in life is of about 50% and this leads to a drop in employment, productivity and wages. Depression and anxiety are the fourth cause, while diabetes is the 8th cause of Disability Adjusted Life Years (DALYs) in developed countries.

As is defined by the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM-5), diabetes is a mood disorder that reunites several symptoms that alter the functionality of an individual. Depression disturbs emotions, cognition, and behaviors. According to DSM-5, the diagnostic criteria for a major depressive disorder consist of a core symptom-either a diminished/irritable mood or decreased interest/pleasure (anhedonia)-or both, and at least four of the following symptoms: feelings of guilt or worthlessness, fatigue or loss of energy, concentration problems, suicidal thoughts or thoughts about death, weight loss or weight gain (5% change in weight), psychomotor retardation or activation (change in activity), hypersomnia or insomnia (change in sleep) lasting for at least 2 weeks. Depression could be described as a first episode, a recurrent or chronic episode; could be mild, moderate or severe, with or without psychotic features.

There is evidence that the prevalence of depression is moderately increased in pre-diabetic patients and in undiagnosed diabetic patients, and markedly increased in the previously diagnosed diabetic patients compared to normal glucose metabolism individuals. The prevalence rates of depression could be up to three-times higher in patients with Type-2 diabetes and twice as high in people with Type-2 diabetes compared with the general population worldwide. Anxiety appears in 40% of the patients with Type-2 diabetes. The presence of depression and anxiety in diabetic patients worsens the prognosis of diabetes, increases the non-compliance to the medical treatment, decreases the quality of life and increases mortality. On the other hand, depression may increase the risk of developing Type-2 diabetes with 60%. It seems that there is a bidirectional association between diabetes and depression, a complex relation that might share biological mechanisms, whose understanding could provide a better treatment and improve the outcomes for these pathologies [1-12].

▪ Diabetes and abnormal biology

Diabetes can be described as the continuum of abnormal biology ranging from mild insulin resistance to full-blown diabetes. Most medicine today is based on clear-cut, on-or-off, yes-or-no diagnoses that often miss the underlying causes and more subtle manifestations of illness. However, practicing medicine using this approach is injudicious because it misses one of the most fundamental aspects of physiology, biology, and diseases: 'the continuum concept.'

There is a continuum from optimal health to hidden imbalance to serious dysfunction to disease. Anywhere along that continuum, we can intervene and reverse the process. The earlier this is tackled, the better are the chances of diabetes reversal. The case given below emphasizes on the four pillars of diabetes management: Breathing Exercise Diet Sleep (BEDS).

A 47-year old male patient presented to the clinic with diabetes and visible signs of fatigue, mood disorder and stress. He was living with hectic work schedules, eating late-dinner and also suffering from random and disturbed sleep pattern at night. He had gone through some personal trauma recently which had aggravated the diabetes control.

On clinical examination his FBS was 439, and

on taking history it was revealed that he was diagnosed with high glucose levels about 8 years ago but he had never been on any medication. He also had problems associated with his digestive system, sleep and organization skills.

▪ Diagnosis

He was diagnosed with stage 3 diabetes and stress was a major factor contributing to uncontrolled blood glucose levels.

▪ Treatment

Initial visit: Considering patient's physiological and psychological condition, he was prescribed treatment based on Breathing Exercise Diet Sleep (BEDS).

Breathing: He was prescribed deep breathing exercises 3 times a day including slow and deep breathing exercises daily before bed time.

Exercise: His prescription in addition included at least 40 minutes of daily aerobic exercise. He was advised high interval training and on his busy days, he was advised to climb the staircase 3 times a day. Over few weeks he was prescribed jogging and weight training.

Diet: He was put on Mediterranean diet with low glycemic index foods and lots of vegetables and fruits such as mushroom, broccoli, cabbage, zucchini, tofu, soya bean, cayenne pepper, black pepper etc. He was given functional foods and nutritional supplements including EBGB tea, cinnamon water, fenugreek seeds, coconut water, chamomile tea, lemon, ginger, garlic etc. He was asked to completely abstain from sugar. Along with this he was also prescribed ashwagandha, chlorella, and probiotics for gut health and stress relief Sleep: He was prescribed at least 7/8 hours of sleep every day. Sleep hygiene included no food 3 hours before sleep; 30 minutes before sleep no technology was to be used. Mobile phone was not to be kept near bedside. Age old tradition of reading before bedtime was advised. Some additional relaxing techniques and herbs such as chamomile tea was recommended for stressful days,.

Follow up visit: With improvements in night sleeping (waking up between sleeps had reduced at the end of first week of treatment), he was further prescribed on berberine tablets (400 mg) twice a day, stevia, ashwagandha tablet twice a day, triphala powder once a day, Vitamin B12, chamomile tea (after dinner) and cinnamon water early morning. He was counseled to monitor his blood glucose and weight every week. Over a period of 6 weeks his blood glucose level was reduced to 118 mg/dL.

The patient was advised to avoid gluten and include healthy ingredients such as chia seeds, quinoa, vegetables, fruits, fish etc. in his diet. Through constant motivation and positive tutoring, he was encouraged to practice self-control and manage his own overall health. He was also taking metformin (500 mg) tablets every day.

Over the treatment period, when his stress was managed he was shifted to cyclic ketogenic diet plan. His glucose levels further reduced to 85 mg/dL and 105 mg/dL and his weight dropped down by 9 Kg in 3 weeks. A sample of his plan is given in Table 1.

Patient outcome: His parasympathetic

Table 1: Sample Prescription for week 1.

Breathing	Eat	Drink	Sleep
15 deep breaths-3 times	Egg/sprouts+egetables (3 times)	Fenugreek water	7 to 8 hours of sleep-mandatory
Before sleeping mandatory climbing the staircase	Ragi porridge; Milletts	Cinnamon tea	Sleep-3 hours after dinner
Jogging	3 Servings of vegetables+1 serving of legumes	Karela juice	hygiene around sleep
High resistance exercise 3 times in an exercise routine	No processed food; No sugar Poha+chia seeds+flax seeds+1/2 apple+beet root	Coconut water	30 minutes before sleep, no technology to be used; Mobile phone away from the bed
	Quinoa salad	Lemon water+ginger	Read a book before sleeping
	Strawberry+kale+baby spinach+pumpkin seeds+ chia seeds+yoghurt/ water+Bottle gourd+tomato soup+black pepper+onion+ginger+garlic+tomato+chia seeds Pumpkin+onion+ginger	Chamomile tea	
	Steamed fish, Egg Omelette	Sattu water	

breathing had increased. He lost weight and was able to sustain it. He could walk for longer distance and duration. His sleep pattern had drastically improved with longer duration of uninterrupted sleep. With a reduction of his stress levels, improved sleep patterns and better control of blood glucose levels, his professional life also improved and he was more energetic person and felt good about life. His blood sugar had reduced to 85 mg/dL. Six months later, the patient participated in 11 Km run for the first time in his life.

The benefits of managing the four pillars of health (physical activity, sleep hygiene, balanced diet and regulated breathing) are a better control of hyperglycemia, as well as alleviated stress levels and sleep related disorders in this patient.

Discussion

Studies have shown that elderly and obese Type-2 diabetic patients have increased late salivary cortisol levels. A trend for higher cortisol secretion is also seen in patients with diabetic retinopathy or cardiovascular complications. Cortisol is released in response to acute and chronic stress, leading to insulin resistance thus causing hyperglycemia. Detrimental effects of cortisol include insulin resistance, lipolysis, and glycogenolysis, leading to worsening hyperglycemia in patients of diabetes mellitus. Stress and sympathetic response to stress represent factors strongly associated with development of Type-2 diabetes. Learning and implementing stress management techniques can lead to improved glycemic status. Breathing may reduce the sense of stress, reduce sympathetic drive, and improve cardiovascular function. Additionally, psychological stress can alter gastrointestinal transit time thereby altering glucose handling. Psychological stress management regimens have also been shown to improve long term glycemic control. Reductions in sympathetic activity through altered breathing patterns can also influence fasting blood glucose. Sympathetic efferent activity in the liver, the main location of glucose production, causes an increase in production of the enzyme responsible for the rate limiting steps for gluconeogenesis.

Diabetes adversely affects our breathing in multiple ways. The risk of problematic breathing rises in patients with diabetes. Rapid or labored breathing or Kussmaul breathing is an indication of diabetic ketoacidosis. Untreated diabetic ketoacidosis can be fatal for the patient.

It has been shown that diaphragmatic breathing exercise has favorable effects in controlling blood sugar levels among diabetes Type-2 patients if it is combined with other exercises or therapies. The results of a randomized control trial showed that significant reduction in fasting blood sugar and post prandial blood sugar level is seen in the ninth week of breathing exercise. When combined with other exercises like posturing, walking, meditation, guided imagery and others, it can produce favorable effects in controlling blood glucose level.

Another factor to be considered here is the presence of kidney disease in diabetes patients. If a person with diabetes feels breathless while climbing the stairs, it could be due to a kidney problem. Chronic kidney disease can also lead to anemia which again is the cause of shortness of breath due to the reduced number of oxygen carriers or red blood cells in the body. Obese patients also experience sleep apnea the chances of which are three times higher in diabetes patients. Any changes in circadian rhythms affect blood sugar level; optimal breathing exercises can help in controlling blood sugar and bringing insulin levels in the optimal range. Optimal breathing exercises stimulate parasympathetic nervous system which inhibits sympathetic nervous system and reverses insulin resistance. Breathing also results in improved oxygenation of body cells which helps in burning fat thereby managing obesity and diabetes.

Decrease in respiratory rates can lead to a decrease in stress and sympathetic outflow, ultimately causing a lower rate of gluconeogenesis and glucose release into the blood stream. This could play a role in explaining the improved fasting blood glucose levels typically observed as a result of de-stressing techniques. Alterations in breathing pattern than influence insulin sensitivity and glycemic status in individuals with diabetes. In a randomized case control study, those who performed slow breathing for 30 minutes daily over 8 weeks had decreased post-prandial serum glucose levels. Additionally, maintenance of glycemic control is especially important during exercise in insulin sensitive tissues such as skeletal and cardiac muscle. Physical exercise is known to improve insulin sensitivity, glycemic status, weight maintenance and cardiovascular health in individuals with diabetes.

Functional foods contain biologically active

ingredients associated with physiological health benefits for preventing and managing chronic cases of Type-2 diabetes mellitus. Regular consumption of functional foods may be linked with enhanced anti-oxidant, anti-inflammatory, insulin sensitivity and anti-cholesterol functions integral to diabetes management. Components of Mediterranean diet-fruits, vegetables, oily fish, olive oils and tree nuts acts as a model for functional foods based on their natural contents of nutraceuticals such as polyphenol terpenoids, flavonoids, alkaloids, sterols, pigments, and unsaturated fatty acids. Polyphenol-rich herbs such as green tea have shown clinically meaningful benefits on metabolic and microvascular activities, cholesterol and fasting glucose lowering, anti-inflammation and anti-oxidation in Type-2 diabetes patients. Personalized approach for preventing and managing Type-2 diabetes mellitus should consider biological and behavioral models embedding nutritional modification as part of lifestyle diabetes prevention strategy. Functional foods provide additional benefits in such an approach. Fruits and vegetables are rich sources of dietary fiber-soluble and insoluble fiber, vitamins, and various phytochemicals and play a vital role in health promotion and prevention of Type-2 diabetes. Regarding consumption of various fruits and vegetables in diabetic patients, it can lead to an improved glycemic control, reduced HbA1c and triglyceride levels, enhanced antioxidant defense system, attenuated oxidative stress and inflammatory markers, decreased risk of diabetic retinopathy and a lower burden of carotid atherosclerosis.

It has also been suggested that psychological stress can alter the integrity of indigenous microflora for several days (*Lactobacilli*). Stress results in an environment which is less conducive to *Lactobacilli* survival, adherence, and replication. Restless nights, changes in sleep patterns do more harm to the body than anticipated. As per a review lack of sleep may increase the risk of developing diabetes by imperiling glucose control and insulin sensitivity. Inadequate sleep is a form chronic stress on the body and stress causes blood sugar levels to rise. Consistent sleep routine and sleep hygiene is not only instrumental in improving overall health but also benefits by managing blood glucose within optimum levels. A review published in Endocrinology Reviews in 2017 suggested that lung should be considered by health care professionals for diabetes patients and raise the central issue of normalization of glucose levels in improving pulmonary function and ameliorating sleep-disordered breathing.

Sleep apnea represents a pathogenic non-voluntary alteration in the human breathing pattern. The breathing patterns found in sleep apnea result in decreased insulin resistance, elevated blood glucose levels, and increased risk for the development of Type-2 diabetes. Maintenance of insulin and glycemic control is essential for cognitive function, as the brain is an insulin sensitive tissue and is affected by impaired insulin control and irregular glycemic response.

Conclusion

Stress management through breathing techniques, exercise schedule and other exercises play a significant role in managing your sugar levels. Getting out of impulsive behavior while eating and other lifestyle practices such as sleeping or physical activity govern the way how our body responds to metabolic, physiological and psychological imbalances. Conscious and guided choices about what to eat will help the patient in reversing the disease condition. It is important to remember that, "what you eat may be feeding your diabetes too!" Keeping a track of diabetes progress through regular monitoring of weight and fasting blood sugar will provide clear indications about the patient's journey towards healing and recovering from diabetes.

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