



DIABETES AND ASSOCIATED COMPLICATIONS

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KEYWORDS :

I. HYPERTENSION**Introduction**

High blood pressure or hypertension is a condition that's often present in people with type 2 diabetes. It's unknown why there's such a significant correlation between the two diseases. It's believed that obesity, a diet high in fat and sodium, and inactivity contribute to both conditions. Hypertension is known as a "silent killer" because it has no obvious symptoms and many people are unaware that they have it. A 2013 survey by the American Diabetes Association (ADA) found that fewer than half of people at risk for heart disease or type II diabetes reported discussing biomarkers, including blood pressure, with their care providers. About 25% of people with Type 1 diabetes and 80% of people with Type 2 diabetes have high blood pressure.

Mechanism of hypertension development

Having diabetes increases risk of developing high blood pressure and other cardiovascular problems, because diabetes adversely affects the arteries, predisposing them to atherosclerosis (narrowing of the arteries). Atherosclerosis can cause high blood pressure.

Complications of hypertension

Compared with people with normal blood pressure readings, men and women with hypertension have an increased risk of:

- Coronary artery disease
- (heart disease)
 - Strokes

Peripheral vascular disease

- (narrowing of the arteries in the legs and feet)
- Heart failure

Even high yet normal blood pressure or pre-hypertension (defined as 120-139/ 80-89 mmHg) has an impact on health. Studies show that people with normal yet high range blood pressure readings, over a 10-year period of follow up time, had a two to three-fold increased risk of heart disease.

Review related to Hypertension among type 2 diabetes patients.

TURNER, RC. Et al.. (1993) conducted a study to determine the prevalence of hypertension in newly diagnosed type 2 diabetic patients and its association with risk factors for cardiovascular and diabetic complications. 3648 patients were enrolled in the study and it was found that Thirty-nine per cent of the patients (35% of the males, 46% of the females) were hypertensive and concluded that Hypertension is common in newly diagnosed type 2 diabetes and is associated with obesity.

Prof. Sasi kumar, Dr. Fathima Lathif, Dr.Vijaya Ragavan (2017) conducted a randomized pilot study on Mindfulness Based Stress Reduction (MBSR) on blood pressure among patients with type 2 diabetes at selected rural community, 40 participants were selected and experimental group received 8 weeks of MBSR, systolic blood pressure was reduced at ($p = 0.018$). It was concluded that MBSR was effective in controlling blood pressure.

II. SLEEP**Introduction**

The significance of good sleep cannot be over emphasized when it comes to chronic medicinal condition like DM. Poor sleep quality, apart from its usual effect of daytime sleepiness, has ramifications that affect every aspects of life. Diabetes mellitus (DM) is a highly

prevalent condition affecting about 347 million people worldwide. In addition to its numerous clinical implications, DM also exerts a negative effect on patient's sleep quality. Impaired sleep quality disrupts the adequate glycemic control regarded as corner stone in DM management and also lead to many deleterious effects causing a profound impact on health related quality of life. People who have diabetes often have poor sleep habits, including difficulty falling asleep or staying asleep. Some people with diabetes get too much sleep, while others have problems getting enough sleep. According to the National Sleep Foundation, 63% of American adults do not get enough sleep needed for good health, safety, and optimum performance.

Quality of sleep in diabetes mellitus

Clinical research has shown that up to one third of patients with DM suffered from concomitant sleep disorders, as compared with 8.2% of controls without DM. In another study, more than half of the patients with type II DM are likely to report being "poor sleepers",

Over effect of sleep deprivation in diabetes

Sleep deprivation has been shown to cause increased glucose levels due to reduced glucose metabolism and high cortisol levels. Besides aggravating diabetes by increasing glucose levels, it can pose a higher risk for the development of diabetes. The inability of diabetic patients to maintain a normal sleep pattern can involve more than feeling tired the next day since the metabolic control, production of glucocorticoids and blood glucose control are affected leading to the development of insulin resistance.

Sleep deprivation in diabetic patients has also been associated to eye problems. Retinopathy may be initiated or aggravated by hypoxia that occurs during sleep hours in the dark. Retinal blood flow in normal individuals is adequate during sleep. But diabetic patients with retinopathy when exposed to reduced lightness in a dark room during sleep do not have adequate oxygen supply to the retina.

In addition to high blood glucose that affect the sleep pattern of type 2 diabetic patients, low nocturnal blood glucose is often seen in 29% to 56% of insulin-dependent type 1 or type 2 diabetic patients and may go unnoticed or accompanied by manifestations that affect sleep quality.

Review related to type II Diabetes mellitus and quality of sleep

Tang, Y Et al.. (2014) conducted a study on Interaction of sleep quality and sleep duration on glycemic control in patients with type 2 diabetes mellitus. 551 patients with type II diabetes mellitus were enrolled in the study and the study found that the rate of patients who had insufficient sleep was much higher ($\chi(2) = 11.16, P = 0.037$). and it was concluded that Inadequate sleep, in both quality and quantity, should be regarded as a plausible risk factor for glycemic control in type 2 diabetes. Poor sleep might bring much more serious insulin resistance and could be the reason for bad glycemic control. A good night's sleep should be seen as a critical health component tool in the prevention and treatment of type 2 diabetes.

III. APPETITE**Introduction**

Diabetes mellitus is a chronic disease that interferes with the body's ability to control the level of glucose in the blood. No matter what type of diabetes you have, symptoms develop as a result of high blood glucose levels. Complications can cause a loss of appetite that lasts for more than a couple of days. One of the odd things about diabetes is that it can cause people to lose their appetite, or conversely, can cause them

to feel hungrier than usual. Both extremes are usually a warning sign of some possible issue to health so it's important to know about how appetite can signify a potentially more serious health problem.

Loss of Appetite

Many people would be delighted to lose their appetite if that made it easier to lose some weight, but when appetite loss is linked to diabetes it can be dangerous.

One possible cause of loss of appetite is gastroparesis, a condition where food moves too slowly through the digestive tract. This happens when over time high blood glucose levels damage the vagus nerve — the nerve that supplies nerve fibers to the pharynx (throat), larynx (voice box), trachea (windpipe), lungs, heart, esophagus, and intestinal tract. When this occurs, the muscles in the gut can no longer move food easily out of the stomach into the small intestine to continue the digestion process. This state is called gastroparesis.

Over hunger in diabetes

In uncontrolled diabetes where blood glucose levels remain abnormally high (hyperglycemia), glucose from the blood cannot enter the cells - due to either a lack of insulin or insulin resistance - so the body can't convert the food you eat into energy. This lack of energy causes an increase in hunger.

Review related to effect of hyperglycemia on appetite

Russell. A.W Et al.. (2001) conducted a study on the effect of acute hyperglycaemia on appetite and food intake in Type 1 diabetes mellitus. 16 patients with uncomplicated type II diabetes mellitus were enrolled in the study and separated into two groups, group A were fasted and group B receiving nutrient preload, the study revealed that acute hyperglycaemia suppresses hunger after a nutrient preload, but not in the fasted state, in patients with uncomplicated Type 1 diabetes. This effect is small and not associated with changes in food intake.

IV. BMI/WEIGHT

Introduction

Diabetes mellitus is a metabolic disorder where the body does not use energy properly. One of the symptoms of diabetes is sudden and unexplained weight loss. Excessive hunger and thirst are two other symptoms, and patients with untreated diabetes may find themselves losing weight even as they are eating and drinking more than usual. There are several reasons why people with diabetes lose weight, but to better understand why weight loss occurs. Obesity is a well known risk factor for type 2 diabetes mellitus. Individuals with type 2 diabetes mellitus are at risk for weight gain as a result of multiple influences, including sedentary lifestyle, high-calorie diet, diabetes medications, sociocultural factors, chronic medical and psychiatric illnesses, and dysregulated enteroendocrine axis.

Diabetes and weight loss

When the cells are unable to use sugar for energy, they send a signal to the brain that they need more fuel. The brain then triggers the hunger response to encourage you to eat, hence the excessive hunger that often occurs with diabetes. However, the more you eat, the more sugar ends up in your bloodstream instead of in the cells, where it belongs. In addition to triggering the hunger response, the brain also breaks down muscle tissue and fat in an effort to provide energy for the cells. It is this process that causes the sudden weight loss associated with diabetes.

Diabetes and Weight gain

Throughout the natural history of type 2 diabetes, endothelial dysfunction is accompanied with obesity/insulin resistance in diabetes and prediabetes conditions (this includes people with impaired glucose tolerance and/or impaired fasting glucose). In order to develop insulin resistance and obesity, thereby causing type 2 diabetes, β -cells should not be able to compensate fully for decreased insulin sensitivity. The nonesterified fatty acids (NEFAs) that are secreted from adipose tissue in obese people may lead to the hypothesis that insulin resistance and β -cell dysfunction are most likely linked.

Review related to weight management in Type 2 Diabetes mellitus.

Luc Van Gaal and André Scheen (2010) conducted a study on weight management in type II diabetes mellitus: current and emerging approach to treatment, 200 patients with type II diabetes mellitus were enrolled in the study and 25 weeks of weight reduction program was undertaken by the participants, the study revealed that decreased in BMI drastically reduced the glycemic index level.

V. STRESS

Introduction

It's hard to dispute that most of us live life at breakneck speed. It's the nature of a fast-paced society, where numerous family, social, and work obligations can easily overpower precious time and resources. But for people with diabetes, both physical and emotional stress can take a greater toll on health. People who aren't diabetic have compensatory mechanisms to keep blood sugar from swinging out of control. But in people with diabetes, those mechanisms are either lacking or blunted, so they can't keep a lid on blood sugar, says David Sledge, MD, medical director of diabetes management at The Ochsner Clinic Foundation in Baton Rouge, La. In people with type 2 diabetes, mental stress often raises blood glucose levels. Physical stress, such as illness or injury, causes higher blood glucose levels in people with either type of diabetes.

Stress and Diabetes: Mechanism

When stress occurs, the body prepares to take action. This preparation is called the fight-or-flight response. In the fight-or-flight response, levels of many hormones such as cortisol, epinephrine, leptin, neuropeptide, corticotropin releasing factor shoot up. Their net effect is to make a lot of stored energy — glucose and fat — available to cells. These cells are then primed to help the body get away from danger. In people who have diabetes, the fight-or-flight response does not work well. Insulin is not always able to let the extra energy into the cells, so glucose piles up in the blood leading to hyperglycemia.

Ways to tame stress in diabetes

When handling such predictable stressors, you can either change the situation or change your reaction. When deciding which option to choose in any given scenario, it's helpful to think of the four A's: avoid, alter, adapt, or accept. **Take time to unwind.** Practice muscle relaxation, deep breathing, meditation, or visualization. Your doctor may know of classes or programs that teach these skills. You can also check for apps that do that. **Tap the power of exercise.** You can blow off steam with hard exercise, recharge on a hike, or do a relaxing mind-body activity like yoga or tai chi. You'll feel better. Keep up your healthy eating and exercise routine. Exercise can help lower blood sugar, so a stressful phase is not the time to forgo the stair stepper.

Review related to breathing exercise on stress among type 2 diabetes.

Hegde, Shreelaxmi V.et.al., (2012) conducted an experimental study on Diaphragmatic breathing exercise as a therapeutic intervention for control of stress in type 2 diabetes mellitus at KMC, Mangalore, 123 patients were involved in the study, 3 weeks of breathing exercise was undertaken by the participants, the study concluded that diaphragmatic breathing exercise was effective in controlling stress among patients with type 2 diabetes mellitus.

VI. LONG TERM COMPLICATIONS OF INCREASED POST PRANDIAL BLOOD GLUCOSE

Introduction

The word postprandial means after a meal; therefore, PPG concentrations refer to plasma glucose concentrations after eating. Many factors determine the PPG profile. In non diabetic individuals, fasting plasma glucose concentrations (i.e., following an overnight 8- to 10-h fast) generally range from 70 to 110 mg/dl. Glucose concentrations begin to rise ~10 min after the start of a meal as a result of the absorption of dietary carbohydrates. The PPG profile is determined by carbohydrate absorption, insulin and glucagon secretion, and their coordinated effects on glucose metabolism in the liver and peripheral tissues.

Relationship among PPG, FPG, and HbA_{1c}

Hemoglobin A_{1c} is a measure of the degree to which hemoglobin is glycosylated in erythrocytes and is expressed as a percentage of total hemoglobin concentration. It reflects the exposure of erythrocytes to glucose in an irreversible and time- and concentration-dependent manner. HbA_{1c} levels provide an indication of the average blood glucose concentration during the preceding 2–3 months, incorporating both pre- and postprandial glycemia. Because blood glucose concentrations vary widely during a 24-h period and from day to day in diabetes, the measurement of HbA_{1c} is the most accepted indicator of long-term glycemic control.

Long term complications of increased post prandial blood glucose

The complications of increased post prandial blood glucose are far less common and less severe in people who have well-controlled blood sugar levels. Acute complications include hypoglycemia and hyperglycemia, diabetic coma and nonketotic hyperosmolar coma. Chronic complications occur due to a mix of microangiopathy, macrovascular disease and immune dysfunction in the form of autoimmune disease or poor immune response, most of which are difficult to manage. Microangiopathy can affect all vital organs, kidneys, heart and brain, as well as eyes, nerves, lungs and locally gums and feet. Macrovascular problems can lead to cardiovascular disease including erectile dysfunction. Female infertility may be due to endocrine dysfunction with impaired signalling on a molecular level.

Macrovascular disease

- Coronary artery disease, leading to angina or myocardial infarction ("heart attack")
- Diabetic myonecrosis ('muscle wasting')
- Peripheral vascular disease, which contributes to intermittent claudication (exertion-related leg and foot pain) as well as diabetic foot.
- Stroke (mainly the ischemic type)
- Carotid artery stenosis occur more often in diabetes

Microangiopathy

- Diabetic nephropathy damage to the kidney which can lead to chronic renal failure.
- Diabetic neuropathy abnormal and decreased sensation
- Diabetic amyotrophy is muscle weakness due to neuropathy.
- Diabetic retinopathy growth of friable and poor-quality new blood vessels in the retina as well as macular edema which can lead to severe vision loss or blindness.
- Diabetic encephalopathy is the increased cognitive decline and risk of dementia, including (but not limited to) the Alzheimer's type, observed in diabetes.
- Diabetic cardiomyopathy damage to the heart muscle, leading to impaired relaxation and filling of the heart with blood (diastolic dysfunction) and eventually heart failure
- Erectile Dysfunction : Estimates of the prevalence of erectile dysfunction in men with diabetes range from 20 to 85 percent
- Periodontal disease is associated with diabetes which may make diabetes more difficult to treat.

Abnormal immune responses

The immune response is impaired in individuals with diabetes mellitus. Cellular studies have shown that hyperglycemia both reduces the function of immune cells and increases inflammation.

- **Respiratory infections** such as pneumonia and influenza are more common among individuals with diabetes.
- **Restrictive lung disease** is known to be associated with diabetes. Lung restriction in diabetes could result from chronic low-grade tissue inflammation, microangiopathy, and/or accumulation of advanced glycation end products.

Review related to complications of increased postprandial blood sugar in Type 2 diabetes mellitus

Sten Madsbad (2015) done a integrative review on Impact of postprandial glucose control on diabetes-related complications a key contributor to overall glucose control and a predictor of microvascular and macrovascular events, the need remains for definitive evidence to support the precise relationship between PPG excursions and the development and progression of cardiovascular complications of diabetes. Drawing firm conclusions on the relationship between PPG and microvascular and macrovascular complications is challenged by the absence of antidiabetic agents that can specifically exert their action on PPG alone, without a basal glucose-lowering effect. Nevertheless, current evidence supports PPG control as an important strategy to consider in the comprehensive management plan of individuals with diabetes.