***Review Article***

**Diabetes Melitus and Hypertension with its consequent Risk Factors-A Review**

**ABSTRACT**

Diabetes mellitus and hypertension has been considered to be more prevalent in developing countries and are universally accepted as two of the most important risk factors in the development of cardiovascular disease and represent a serious public health problem worldwide associated with increased morbidity and mortality. Diabetes mellitus (DM) is a chronic metabolic disorder, lifelong clinical syndrome characterized by hyperglycaemia in the fasting state due to absolute or relative deficiency of insulin or defect in its receptors or other abnormalities. The marked hyperglycemia associated with diabetes give rise to serious microvascular complications. An understanding of the pathophysiology of diabetes rests upon knowledge of the basics of carbohydrate metabolism and insulin action. Elevated blood pressure is the most significant risk factor for the development of atherosclerotic coronary artery disease and constitutes about 40% of all cardiovascular diseases. The incidence of hypertension in diabetes mellitus is related to the degree of obesity, advanced age and extensive atherosclerosis. Effective blood pressure control is an important goal for diabetic patients, Screening and initial evaluation ofpatients with diabetes should include blood pressure measured at the time of diagnosis and at each scheduled diabetes visit. Initial assessment of a hypertensive diabetic patient should include a complete medical history with special emphasis on cardiovascular risk factors and the presence of diabetes complication

***Keywords***; Diabetes, mellitus, Hypertension, Risk factors

**INTRODUCTION**

Diabetes mellitus (DM) is a chronic metabolic disorder, lifelong disease resulting from a defect of hormone (insulin) secretion, insulin action, or both. Insulin deficiency in turn leads to chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism (Aynalem & Zeleke, 2018). This disorder is defined by the International Diabetes Federation (IDF) and global advocate of diabetes care, as a state of raised blood glucose level (hyperglycaemia) associated with premature mortality. Similarly, diabetes mellitus is a clinical syndrome characterized by hyperglycaemia in the fasting state due to absolute or relative deficiency of insulin or defect in its receptors or other abnormalities (Tsabang *et al.,* 2016). The marked hyperglycemia associated with diabetes give rise to serious microvascular complications (retinopathy, nephropathy and neuropathy) and macrovascular complications (ischaemic heart disease, stroke and peripheral vascular disease) and damage of many body’s systems (Elhendi, 2015).

Deficiency in insulin or inefficiency of its action influence greatly almost all metabolic pathways including carbohydrate, protein, lipids, minerals and water metabolism. As a result, metabolic instabilities appear, and long-standing derangements result in structural and functional changes in the cells of the body and often cause permanent or irreversible damage. This leads to the development of various complications related to diabetes including biochemical, functional, symptomatic and morphological alterations (Tsabang *et al.,* 2016).

In 2015, the global prevalence of diabetes mellitus was 8.8%, accounting for 415 million people with the disease; and this was projected to reach 10.4% (642 million with the disease) by 2040, many of which will be from urban settlements (IDF, 2015). According to the International Diabetes Federation (IDF) 2017 data, around 425 million people worldwide suffer from diabetes (Njonnou *et al*., 2020). Also, one in two adults with diabetes mellitus are undiagnosed and in Africa, the figure is much higher at 66.7%, therefore, posing a serious risk to the effective management of this disease (IDF, 2015). Diabetes mellitus has been declared a global emergency of the 21st century because of its rising global prevalence. In Africa, 14.2 million people (prevalence of 3.8%) have diabetes mellitus as at 2015 and this is expected to reach 34.2 million (prevalence of 4.2%) by 2040 (IDF, 2015; Bello-Ovosi *et al*., 2018). It is estimated that developing countries will bear 77% of the global burden of the diabetes mellitus epidemic in the 21st century as a result of population growth, consumption of unhealthy diets, obesity and sedentary lifestyles (Aynalem & Zeleke, 2018). It is predicted that by 2025, the prevalence of hypertension will increase by 60% to a total of 1.56 billion worldwide (Arrey *et al*., 2016).

In Cameroon, the prevalence of hypertension spans from 5.7% in rural settings through 21.9% in semi urban to 47.5% in urban milieu, with a national average survey of 31.0%. Despite the relatively better blood pressure control in urban over rural settings, levels of adequate blood pressure control as low as 2 to 27.5% (in men) and 38.7% (in women) have been reported in urban settings (Arrey *et al*., 2016). Hypertension contributes to the development and progression of microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (atherosclerotic) complications of diabetes. It is a major risk factor for cardiovascular mortality and morbidity through its effects on target organs like the brain, heart, eye, and kidney due to structural alterations in the microcirculation secondary to oxidative stress, inflammation, or endothelial dysfunction. Uncontrolled hypertension leads to heart attack, stroke, kidney disease or failure, vision loss, sexual dysfunction, and peripheral arterial disease (Akalu & Belsti, 2020).

Diabetes mellitus and hypertension has been considered to be more prevalent in developing countries and are universally accepted as two of the most important risk factors in the development of cardiovascular disease and represent a serious public health problem worldwide associated with increased morbidity and mortality (Tsabang *et al.,* 2016; Bello-Ovosi *et al*., 2018; Njonnou *et al*., 2020). Cardiovascular diseases and diabetes mellitus accounts for 48% (18.2 million) and 3.5% (1.33 million) respectively of the 38 million deaths due non-communicable diseases (NCDs) in 2012, 28 million of these deaths occur in low-and middle-income countries (Bello-Ovosi *et al*., 2018).

**Diabetes Mellitus**

Diabetes, also referred to as diabetes mellitus is a chronic condition which is considered as the number one killer among all chronic diseases. Currently, it ranks as the fourth most common cause of mortality with coronary artery disease. Diabetes mellitus takes an epidemic form and its prevalence is increasing at a scary rate, it is influenced by web of factors, some of which are related to physiology, genetics, and health behaviors, social and economic status (Wefuan, 2013).

Diabetes either occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. As a result, the concentration of glucose in the blood increases, a situation described as hyperglycaemia (Asiimwe *et al.,* 2020)

**Type 1 diabetes**

Type 1 diabetes is characterized by a lack of insulin production and victims rely on insulin injections for survival (Wefuan, 2013). This type of diabetes can be further classified as immune-mediated or idiopathic. The majority of type 1 diabetes is of the immune-mediated nature, where beta cell loss is a T-cell mediated autoimmune attack (Mahmud, 2012). Type I accounts for only about 5—10% of all cases of diabetes; however, its incidence continues to increase worldwide and it has serious short-term and long-term implications. Type I indicates the process of beta-cell destruction in the pancreas that may ultimately lead to diabetes mellitus in which “insulin is required for survival” to prevent the development of ketoacidosis, coma and death.

Management of Type I diabetes is best undertaken in the context of a multidisciplinary health team and requires continuing attention to many aspects, including insulin administration, blood glucose monitoring, meal planning, and screening for diabetes-related complications. These complications consist of microvascular and macrovascular disease, which account for the major morbidity and mortality associated with Type I diabetes (Skiadopoulos, 2013).

**Type 2 diabetes**

Type 2 diabetes is caused by the body’s ineffective use of insulin. It occurs often as a result of excess body weight and physical inactivity. Type 2 diabetes is the most common type of diabetes because it accounts for up to 90% of all cases of diabetes worldwide. Previously, reports of type 2 diabetes were usual in people over the age of 40 but it is increasingly seen in children too worldwide. Research holds that the occurrence of type 2 diabetes at a younger age is predominantly due to overweight caused by changes in people’s lifestyle resulting in unhealthy eating habits and a sedentary lifestyle. Several important risk factors for the disease have been identified which include: obesity, poor diet, physical inactivity, increasing age, family history of diabetes, ethnicity and poor nutrition during pregnancy affecting the developing child, just to name a few. Many studies have also elaborated the associations between several risk factors and the risk of type 2 diabetes. These factors include: body mass index (BMI), lipids, hypertension, smoking, low education, dietary patterns, and recently specific genes (Asiimwe *et al.,* 2020). In Type II diabetes, either the body does not produce enough insulin or the cells ignore it. Insulin is necessary in order for the body to be able to use glucose for energy. After food consumption, the body breaks down all sugars and starches into glucose, which is the basic fuel for the cells. Insulin takes the sugar from the blood into the cells. When glucose builds up in the blood instead of going into the cells, it can lead to diabetes complications (Mahmud, 2012; Wefuan, 2013).

**Gestational diabetes**

Gestational diabetes is characterized by hyperglycaemia, which is first recognized during pregnancy. Gestational diabetes is diabetes found for the first time when a woman is pregnant (Egbe *et al*., 2018). Women who are overweight, have had gestational diabetes before or have a strong family history of diabetes are at a higher risk of developing gestational diabetes. Untreated gestational diabetes may cause problems to the baby. Both the mother and the baby are at increased risk for Type II diabetes for the rest of their lives (Skiadopoulos, 2013).

**History and Discovery of Diabetes**

The ancients first described diabetes. The cardinal features of a polyuric state were described in an Egyptian papyrus, “Ebers papyrus” dating from 1550 BCE (Pickup & Williams, 2003). Aretaeus of Cappadocia, a Greek physician in the 2nd century, was the first to use the term “diabetes.” He gave the first complete clinical description of the disease when he described symptoms as immense thirst, “the melting down of flesh and limbs into urine”, and short survival (Christopoulou-Aletra & Papavramidou, 2008; Jansson, 2014). The word diabetes stems from the Greek word for siphon, “diabaino”, which also means “to go or run through” alluding to the incessant flow of urine through the body (Laios *et al.,* 2012).

The first written documentation of the sweetness of diabetic urine occurs in a Hindu document dated 400-500 BCE. In 1675 professor Thomas Willis at Oxford rediscovered the sweetness of urine, the taste of sugar or honey, and wrote the treatise entitled “Diabetes, or the pissing evil”. In 1776 the physician Matthew Dobson in Liverpool published the first description of hyperglycaemia. He found that both the serum and the urine from one of his patients tasted sweet (Pickup & Williams, 2003; Jansson, 2014).

The Scottish physician John Rollo created the first medical diet to treat diabetes consisting of rancid meat, blood pudding and a mixture of milk and limewater. He also added the term “mellitus” (the Greek word for honey) to “diabetes” in order to distinguish it from diabetes insipidus (Poretsk, 2010). Paul Langerhans, a German medical student, discovered in 1869 the islet cells of the pancreas but was unable to explain the nature and function of these cells. Later on these cells were named ‘islets of Langerhans (Davidson, 1999; Jansson, 2014). In 1889 scientists Oskar Minkowski and Joseph von Mering of the University of Strasbourg, made a total pancreatectomy of a dog, an operation that caused diabetes (Poulsen, 1982; Jansson, 2014).

Insulin was discovered by a quartet of researchers at the University of Toronto in 1921, Frederick Banting, Charles Best, J.J.R. Macleod, and James Collip. The researchers named the extract “insulin”, and Macleod was designated to present their research in a meeting in May 1922 at the Washington DC. They were all unaware of Jean de Meyer´s earlier suggestion of the term insulin in 1909 (Rosenfeld, 2002). The first patient treated with insulin in January 1922 was a 14-year old boy (Pickup & Williams, 2003). Banting and Macleod were awarded the Nobel Prize in 1923. However, Banting disliked the decision of the Nobel committee and shared his award with Best, while Macleod shared his with Collip (Pickup & Williams, 2003). The discovery of insulin saved many lives but it also led to treatment of a chronic disease with serious long-term complications. In the 1930s, research by Sir Harold Himsworth, London, led to the first differentiation of diabetes mellitus into ‘insulin-sensitive’ and ‘insulin-insensitive’ forms. Today they are commonly referred to as Type 1 (insulin sensitive) and Type 2 (insulin insensitive) diabetes (Kim, 2011). As type 2 diabetes became more prevalent there was need for oral hypoglycaemic agents in the treatment, along with lifestyle changes. In the 1950s the first two groups of oral drugs, sulphonylurea and biguanid, were launched on the market, and later on followed by other drug classes (Pickup & Williams, 2003).

In December 2006 the United Nations recognized diabetes as a global threat and designated a World Diabetes Day. In honour of Frederick Banting the UN chose November 14, his birthday, as a day to be observed every year starting in 2007 (UNGA, 2006).

**Symptoms of Diabetes Mellitus**

Diabetes mellitus may present with characteristic symptoms such as extreme thirst, polyuria, blurring of vision, and heavy weight loss over a short period. Others include fatigue, frequent infections, itching and rashes. In its most severe forms, ketoacidosis or a non-ketotic hyperosmolar state may develop and lead to stupor, coma and, in the absence of effective treatment, death can occur. The long-term effects of diabetes mellitus include progressive development of the specific complications such as retinopathy with potential blindness, nephropathy that may lead to renal failure, and neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease (Abubakar, 2012).

**Diagnosis of Diabetes Mellitus**

The diagnosis of diabetes mellitus is easily established when a patient presents the classic symptoms of hyperglycaemia and has a random blood glucose value of 200 mg/dL (11.1 mmol/L) or higher, and confirmed on another occasion.

A fasting plasma glucose test measures blood glucose in a person who has not eaten anything for at least 8 hours. This test is used to detect diabetes and prediabetes. An oral glucose tolerance test (OGTT) measures blood glucose after a person fasts at least 8 hours and 2 hours after the person drinks a glucose-containing beverage. This test can be used to diagnose diabetes and prediabetes. The FPG test is the preferred test for diagnosing diabetes because of its convenience and low cost. However, it may miss some diabetes or prediabetes that can be found with the OGTT. The FPG test is most reliable when done in the morning. This test, along with an assessment of symptoms, is used to diagnose diabetes but not prediabetes. Determination of glycated haemoglobin (HbA1c) is the most acceptable diagnosis of diabetes. Test results indicating that a person has diabetes should be confirmed with a second test on a different day (Skiadopoulos, 2013).

The current WHO diagnostic criteria for diabetes should be maintained – fasting plasma glucose ≥ 7.0mmol/l (126mg/dl) or 2–h plasma glucose ≥ 11.1mmol/l (200mg/dl) HbA1c 6.5%.

**Glucose Regulation**

Glucose homeostasis or regulation is the process by which the body maintain blood glucose at a constant level. The concentration of glucose in the bloodstream in healthy individuals is normally within the range of 3.9-5.5 mmol/l, an amount of 4 g glucose. The level depends on the rates of entry of glucose into the circulation, mainly from the liver and from the gut after meals, and of its uptake into the peripheral tissues (Jansson, 2014). The brain is dependent on continuous access of glucose in order to maintain normal function whereas other tissues can use different types of energy sources. The precise regulation of plasma glucose concentrations is mainly determined by hormonal and neural factors, which control endogenous production of glucose (Meley *et al*., 2006). Hormones are involved in the glucose regulation; insulin, reduces the blood glucose level while glucagon increases the blood glucose. These hormones are produced within the islets of Langerhans in the pancreas. Insulin is produced in β-cells and glucagon in α-cells (Jansson, 2014).

**Pathophysiology of Diabetes**

An understanding of the pathophysiology of diabetes rests upon knowledge of the basics of carbohydrate metabolism and insulin action. Following the consumption of food, carbohydrates are broken down into glucose molecules in the gut. Glucose is absorbed into the bloodstream elevating blood glucose levels. This rise in glycaemia stimulates the secretion of insulin from the beta cells of the pancreas. Insulin is needed by most cells to allow glucose entry. Insulin binds to specific cellular receptors and facilitates entry of glucose into the cell, which uses the glucose for energy. The increased insulin secretion from the pancreas and the subsequent cellular utilization of glucose results in lowering of blood glucose levels. Lower glucose levels then result in decreased insulin secretion (Abubakar, 2012; Skiadopoulos, 2013)

If insulin production and secretion are altered by disease, blood glucose dynamics will also change. If insulin production is decreased, glucose entry into cells will be inhibited, resulting in hyperglycaemia. The same effect will be seen if insulin is secreted from the pancreas but is not used properly by target cells. If insulin secretion is increased, blood glucose levels may become very low (hypoglycemia) as large amounts of glucose enter tissue cells and little remains in the bloodstream (Abubakar, 2012).

Multiple hormones may affect glycaemia. Insulin is the only hormone that lowers blood glucose levels. The counter-regulatory hormones such as glucagon, catecholamine, growth hormone, thyroid hormone, and glucocorticoids all act to increase blood glucose levels, in addition to their other effects (Meley *et al*., 2006; Skiadopoulos, 2013).

**Risk Factors of Diabetes**

There are controllable risk factors associated with diabetes, including obesity and an inactive lifestyle. However, other uncontrollable risk factors, such as ethnicity and genetics, also play a dramatic role. The primary risk factor for type I diabetes is a family history of this lifelong, chronic disease. Having family members with diabetes is a major risk factor. The American Diabetes Association (Standards of medical care in diabetes-2007) recommends that anyone with a first-degree relative with type I diabetes –a mother, father, sister, or brother– should get screened for diabetes. A simple blood test can diagnose Type I diabetes.

In addition, injury or diseases of the pancreas can inhibit its ability to produce insulin and lead to type I diabetes. A range of relatively rare infections and illnesses can damage the pancreas and cause Type I diabetes (Skiadopoulos, 2013).

The risk factors associated with type II diabetes include obesity, diet and physical inactivity, increasing age, insulin resistance, family history of diabetes, genetic factors, and race and ethnicity. As concerns genetic factors, research has shown that certain gene variations raise the risk of developing diabetes. These genes can be associated with insulin sensitivity in the body's tissues, decreased insulin production and an increased risk of obesity. Race and ethnicity, on the other hand, are responsible for higher levels of diabetes in certain ethnic groups including African Americans, Mexican Americans, American Indians, native Hawaiians and some Asian Americans. The above mentioned groups have an increased risk of diabetes and heart disease. This is partly due to higher rates of high blood pressure, obesity and diabetes in these populations. African Americans are also more likely than other ethnic groups to develop Type II Diabetes (Boulton *et* *al.*, 2005).

Although genes and ethnicity are risk factors for diabetes, they are not the sole determinants of whether someone develops the disease. Changes in diet and decreased physical activity related to rapid technological development and urbanization have led to sharp increases in the numbers of people developing diabetes. History of substance use has been reported as a significant factor associated with earlier age of onset of Type II diabetes. Illicit drug use has also been associated to it, according to research in the United States (Karlon *et al.*, 2001).The most common drugs regularly used are marijuana and cocaine, while other illicit drugs (amphetamines, heroin, hallucinogens, and nonmedical inhalants) are regularly used by diabetic primary care patients.

**Infections**

Diabetic patients are also in greater risk of infections than healthy individuals. However, many specific infections are more common in diabetic patients and some occur almost exclusively in them. Other infections occur with increased severity and are associated with an increased risk of complications. Patients with diabetes mellitus are prone to severe forms of infections like gram negative septicaemia, pyelonephritis, perinephric abscess, emphysematous cystitis, and renal papillary necrosis. Diabetes mellitus patients are also prone to certain infections such as *pseudomonas* “malignant” Otitis externa, monilial skin infections, and rhinocerebral mucormycosis. Several aspects of immunity are altered in patients with diabetes (Abubakar, 2012).

**Complications of Diabetes**

Diabetes is a systemic disease that affects most of the body organs especially heart, blood vessels, kidneys, eyes, nerves and teeth. In high income countries, diabetes is the leading cause of chronic heart diseases, renal failure, blindness and non-traumatic lower limb amputation (Elhendi, 2015).

**Cardiovascular Diseases**

Chronic hyperglycemia and dyslipidemia affecting the blood vessels is a major cause of atherosclerosis which may lead to fatal myocardial infarction or cerebral stroke. Cardiovascular diseases are the most common cause of mortality in diabetic patients (Elhendi, 2015).

**Diabetic Nephropathy**

The metabolic and hemodynamic changes associated with diabetes can lead to glomerular sclerosis and fibrosis. Diabetic nephropathies manifest as progressive albuminuria, increased blood pressure and even end-stage renal disease. Type 2 diabetes leads to renal failure in 20-30% of patients especially in patients with longer duration since diagnosis (usually ≥10 years) (Elhendi, 2015).

**Diabetic eye disease:** A range of eye problems may occur as a complication of diabetes, which include:

**Diabetic retinopath**y: damage to the small vessels in the retina leads to poor vision or even blindness.

**Cataract**: Diabetes accelerates the onset of cataract which is clouding of the eye lenses.

**Glaucoma**: increase in the vitreous fluid pressure resulting in optic nerve damage, retinal detachment and loss of vision.

It is estimated that 39 million cases of blindness worldwide are caused by diabetes and 248 million diabetics are visually impaired (Courtright & Lewallen, 2011).

**Diabetic Neuropathy**

Diabetes affects the small vessels that supply the nerves which lead to neuronal dysfunction especially in the peripheral nerves and the autonomic nervous system. Adverse consequences of diabetic neuropathy include diabetic foot ulceration and lower limb amputation, diabetic gastropathy and erectile dysfunction in men. In addition, it may mask the symptoms of ischemic heart disease, resulting in the clinically ambiguous silent angina (Elhendi, 2015).

**Hypertension**

Hypertension, defined as blood pressure in excess of 140/90 mm Hg, is one of the most common diseases afflicting humans. It is a common condition in diabetes, affecting about 20-60% of patients with diabetes, depending on obesity, ethnicity, and age. Hypertension is a condition in which blood pressure is high. It can be caused by genetics, diet as well as stress (Anwer *et al*., 2011). Because of its associated morbidity, mortality and cost to society, hypertension is an important public health challenge. An estimated 20% of the world’s adults have hypertension and its prevalence dramatically increases in patients older than aged 60 years. Hypertension is now being widely reported in Africa and is the most common cause of cardiovascular disease on the continent. Hypertension became only second to malaria as the leading cause of outpatient morbidity (Cook-Huynh *et al*., 2012).

Elevated blood pressure is the most significant risk factor for the development of atherosclerotic coronary artery disease and constitutes about 40% of all cardiovascular diseases. The incidence of hypertension in diabetes mellitus is related to the degree of obesity, advanced age and extensive atherosclerosis (that is typically present) (Onuoha & Jideoma, 2017). Hypertension increases the risk of long term vascular complication of type 2 diabetes such as stroke, chronic renal failure, heart diseases, peripheral vascular diseases and death. Causes of hypertension in diabetic patients are commonly nephropathy, essential hypertension and particularly in type 2 diabetes mellitus, obesity. Hypertension in diabetes is generally attributed to hyperinsulinaemia with resultant increases in renal sodium retention and / or sympathetic nervous system activity. Hyperinsulinaemia induces hypertension through increased insulin resistance, renal tubular reabsorption of Na+ and water, increased sympathetic nervous system activity, proliferation of vascular smooth muscle cells and alteration of transmembrane cation transport (Kadiri & Onwubere, 2005; Onuoha & Jideoma, 2017).

Types of hypertension in diabetes mellitus include, essential hypertension, hypertension consequent to nephropathy, isolated systolic hypertension and supine hypertension with orthostatic fall (Anwer *et al*., 2011).

**Stages of Hypertension**

Stage one hypertension:consistent (i.e., two or more consecutive) readings of 140/90 -159/99 mmHg. Stage two hypertension**:** consistent readings of 160/100 mmHg or higher. Pre-hypertension:consistent readings of 120-139/80-89 mmHg (Anwer *et al*., 2011).

**Relationships between Diabetes and Hypertension**

Hypertension affects up to 70% of individuals with diabetes and is approximately twice as common in individuals with diabetes as in those without (Katte *et al*., 2014).

The prevalence of hypertension among diabetes mellitus patients is higher than in non- diabetes mellitus patients. Eighty percent of diabetes patients die from cardiovascular diseases, especially hypertension and stroke. The higher percentage of hypertension among diabetes patients is attributed by hyperglycemia, insulin resistance, and dyslipidemia (Akalu & Belsti, 2020). All of these factors induce the development and progression of atherosclerosis by disrupting the blood vessel wall through the promotion of vascular inflammation and endothelial cell dysfunction, derangements of various cell types like platelets and promotion of coagulation (Thiruvoipati, 2015). These lead to narrowing of blood vessels and an increment of total peripheral arterial resistance to causes hypertension. Hyperinsulinemia and insulin resistance contribute to elevated blood pressure because insulin is known to promote sodium retention and enhances sympathetic nervous system activity (Zhou *et al*., 2014).

Insulin resistance is associated with the inappropriate activation of the Renin-Angiotensin-Aldosterone System, once is activated, multiple mechanisms that increase blood pressure will get activated. For instance, angiotensin II, the product of activation of Renin-Angiotensin-Aldosterone System, stimulates vasoconstriction and production of aldosterone, a hormone responsible for retention of salt and water in the kidney to cause hypertension (Grillo *et al.,* 2019).

**Risk Factors of Hypertension and Diabetes**

**Body Mass** *–* Being overweight significantly increases the risk of both diabetes and high blood pressure.

**Diet** *–* High fat diets rich in salt and processed sugars are known to contribute to the development of organ problems that can lead to both diabetes and high blood pressure.

**Activity Level** – A low level of physical activity makes insulin less effective (which can lead to diabetes) and can contribute to the development of stiff blood vessels, increasing the risk of high blood pressure (Anwer *et al*., 2011).

**Pathogenesis of Diabetic Kidney Disease**

Early in the course of diabetic nephropathy, changes in kidney hemodynamics and hyperfiltration lead to an increase in glomerular filtration rate. The progression of nephropathy involves characteristic pathologic changes, including accumulation of the extracellular matrix, widening of the glomerular basement membrane, arteriosclerosis, and some degree of interstitial fibrosis. The first clinical manifestation of diabetic nephropathy is microalbuminuria (20 to 200 ug/min) which, if left untreated, can progress to overt nephropathy after 10 to 15 years of diabetes, and is also a marker for cardiovascular disease. Albuminuria may be present in 30 to 40% of patients with diabetic nephropathy. However, delayed diagnosis and poor control of plasma glucose and blood pressure among individuals reduce the chances of improvement and resolution of microalbuminuria. Although, poor glycemic control and hypertension are the major risk factors that contribute to a more rapid progression to renal (Lea and Nicholas, 2002).

**Pathogenesis of Hypertension and Kidney Disease**

Essential hypertension is typically recognized in subjects between 25 to 45 years of age but kidney impairment remains uncommon until the patient has experienced at least 10 years of sustained hypertension. In these patients, increased blood pressure results in the development of arteriolar nephrosclerosis with impaired kidney function. If hypertension is superimposed on intrinsic kidney disease, this adds to the progressive loss of kidney function. Proteinuria is present but usually at levels of < 2 g/day in progressive hypertensive nephrosclerosis. However, proteinuria can reach nephrotic ranges (> 3.5 g/day) in patients with malignant hypertension or poorly controlled blood pressure (Lea and Nicholas, 2002).

**Management of Hypertension in Diabetes**

Effective blood pressure control is an important goal for diabetic patients. The patients who suffer from both diabetes and hypertension have greater chances of developing cardiovascular disorder (Anwer *et al*., 2011).

Measurement of arterial blood pressure**:** The object of identifying and treating high blood pressure is to reduce the risk of cardiovascular disorder and associated morbidity and mortality. It is, therefore, necessary to provide a classification of blood pressure in adults so as to identify the high risk individuals and to provide guidelines for treatment and follow up (Kumar, 2000).

Screening and initial evaluation ofpatients with diabetes should include blood pressure measured at the time of diagnosis and at each scheduled diabetes visit. Initial assessment of a hypertensive diabetic patient should include a complete medical history with special emphasis on cardiovascular risk factors and the presence of diabetes complication. The physical exam should include height, weight, and careful evaluation of arterial circulation. Initial laboratory examination should include serum creatinine, electrolytes, fasting lipid profile, and urinary albumin excretion (Anwer *et al*., 2011).

Behavioral and dietary management: Moderate sodium restriction has been effective in reducing blood pressure in individuals with essential hypertension. Weight reduction can reduce blood pressure independent of sodium intake and can also improve normal blood glucose and lipid levels19. Reductions in daily sodium intake to levels of 10-20 mmol (230-460 mg) per day have resulted in decreases in systolic blood pressure of 10-12 mmHg. Smoking cessation and moderation of alcohol intake are also recommended to reduce blood pressure (Anwer *et al*., 2011).

## Conclusion

The global high prevalence of hypertension and diabetes mellitus with its attendant risk factors is a threat to global health burden. The risk factors: age, obesity, family history of diabetes and or hypertension, sedentary life style, excessive alcohol consumption and smoking commonly practice in developing countries are crucial complication in both diseases. Review of WHO NCD Global Action Plan 2013–2020, be activated to reduce the impact of diabetes and hypertension

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