

## **DIABETES AS CARDIOVASCULAR RISK FACTOR: A REVIEW**

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### **Abstract**

This study was conducted at Department of Zoology, University of Gujrat, Pakistan in 2017. The data regarding diabetes as cardiovascular risk factor was obtained and compiled through a thorough review of various published research articles of international reputed journals and relevant books. Cardiovascular disease is the leading cause of morbidity in diabetic patients. Diabetic patients have greater risk of myocardial infarction than non-diabetics. Hyperglycemia, dyslipidemia, hypertension, insulin resistance are considered as metabolic syndrome that causes coronary artery disease, cerebral vascular disease and peripheral arterial disease and ultimately leads to death. Cardiovascular diseases can be treated by changing lifestyle and by using different hypoglycemic agents and different therapies.

**Keywords:** Diabetes, Risk factors, Cardiovascular Diseases

### **INTRODUCTION**

Diabetes mellitus is widely spread in humans and is associated with cardiovascular effects. Change in the signaling pathway of insulin is involved in pathophysiological process in heart [1]. 77.8% diabetic patients develop cardiovascular diseases. In diabetic patients, atherosclerotic chronic heart disease, diabetic cardiomyopathy, renal disease and stroke are different cardiovascular complications [2]. Insulin resistance, metabolic syndrome and type 2 diabetes mellitus are linked with each other [3]. Diabetic patients have metabolic syndrome including medical conditions such as obesity, hypertension, dyslipidemia and insulin resistance that increases the risk of cardiovascular disease. Patients with type II DM have the same chance of myocardial infarction as non-diabetic patients [4].

## **EPIDEMIOLOGY**

Ethnic background, gender and age are important factors of diabetes mellitus in epidemiological studies. In diabetic patients, risk of CVD increased about two to four times [5] mortality rate was four times higher among men but it was seven times among women. The rate of bypass surgery and angioplasty was doubled in diabetic men [6]. Micro-angiopathy and macro-angiopathy is more related to type 1 diabetes. Type 2 diabetes is associated with more lethal phenotype and higher mortality [7]. In 2013, global prevalence of diabetes was 8% and reached 35% in some areas. It was higher in males up to the age of 70. Diabetes is a higher risk factor for death. In 2012, according to WHO, the mortality rate in males was 2.3% and in females it was 3.1%. International Diabetes Federation predicted that the mortality rate was 8.4% between the age group of 20-79 years. It is affecting over 25% females in some areas [8].

## **HYPERGLYCEMIA AND HYPOGLYCEMIA**

Diabetes is a group of metabolic disorder. Digested food is broken down in to glucose, and glucose enters in to blood stream. Glucose moves throughout the body cells where energy is required, insulin helps in moving the glucose. In diabetic patients, enough insulin is not produced by the pancreas hence cells are not using insulin properly. As a result glucose increases in the blood while decreases in the cells. For a longer period of time, high glucose level damages the blood vessels [9]. Oxidative stress, elevated free fatty acids, insulin resistance act collectively and affects the endothelial cells and results in endothelial dysfunction. Some oral agents are used to reduce the effect of hyperglycemia [3,10]. Hyperglycemia activates oxidative stress and involved in atherogenesis [11]. In case of hypoglycemia, there is a fall in arterial pressure. Glucagon, epinephrine, nor-epinephrine, cortisol, growth hormone, corticotrophin are secreted in excess amount and these all are directly related to severity of hypoglycemia. Wall of arteries become less stiff due to more elasticity. It is the leading cause of death due to irregular activity in heart. In diabetic patients, sudden death was four times greater than non-diabetic patients [7,10].

## **METABOLIC SYNDROME**

Metabolic syndrome is related to metabolic abnormalities. It reflects cluster of traits and medical conditions [9] that increases the risk for cardiovascular disease and it includes obesity, dyslipidemia, insulin resistance and hypertension. All these risk factors cause metabolic abnormality and are responsible for cardiovascular disease. These factors have increased risk of cardiovascular disease when they are grouped together [12].

## **DYSLIPIDEMIA**

Dyslipidemia is characterized by elevated blood level of total triglyceride and fatty acids associated with low density lipoprotein (LDL) as well as high density lipoprotein (HDL). Pathological process involves endothelial damage with lipid profile. Hyper-triglyceridemia is the leading cause of LDL. Excess of reactive oxygen species and oxidized LDL is responsible for endothelial dysfunction[13].

## **HYPERTENSION**

Hypertension and diabetes are linked to each other and their combined effect leads to morbidity. The National Cholesterol Education Programme Adult Treatment Panel III reported that hypertension is alike diabetes if it acts as a cardiovascular risk factor [14]. Type I diabetic patients have 30% hypertension while type II diabetic patients have 60%. This condition is increasing the risk of macro-vascular and micro-vascular complications. Association between obesity and hypertension is the leading cause of death in diabetic patients [4]. It contributes to diabetic nephropathy. When hypertension coexists with diabetes

then the risk for cardiovascular disease is doubled [15]. Smoking and salt intake is also associated with hypertension. To overcome the hypertension, reduce the weight and its treatment includes less intake of salt, regular exercise and less consumption of alcohol. Drug treatment includes antihypertensive agents [16].

### **INSULIN RESISTANCE**

Patients affected with type 2 diabetes have insulin resistance. It is a multifactor disorder that alters the metabolic reaction. Genetics, obesity and advancing age are different factors which contribute to insulin resistance. Abdominal obesity and pro-thrombotic state are different risk factors in diabetic patients [13]. In insulin resistance, vasodilation ability of insulin is low [10]. Insulin resistance, elevated lipid profile is the main contributory factor for atherogenic injury [17]. Desensitization of cell wall takes place and glucose becomes unable to enter and change in to energy. In the bloodstream, there is unused glucose and it is converted in to fat, ultimately result is weight gain. This imbalance is the leading cause of irregularity of menstrual cycle and female infertility [2].

### **OBESITY**

Obesity is a risk factor for type 2 diabetes mellitus (T2DM) and an element of metabolic syndrome. It is increasing parallel with the increase of T2DM [18]. Extra weight that is around the waist is obesity. Production of LDL (bad cholesterol) is more due to abdominal fat and it increases the risk of heart disease. Fat deposited on the inside of the blood vessels [9]. In the absence of glucose intolerance, obesity is associated with myocardial infarction, stroke and heart failure [19].

### **CLINICAL OUTCOMES**

#### **Myocardial Infarction and Heart Failure**

Blockage of arteries leads to heart attack and heart failure [20] and it is double in diabetic patients. Risk of recurrent myocardial infarction is greater than risk of myocardial infarction. Diabetic patients with autonomic neuropathy have angina recognition and nausea, vomiting, fatigue are not considered the symptoms of cardiac ischemia [21]. Silent myocardial ischemia was detected in those patients that do not have history of angina pectoris. The ratio of silent myocardial ischemia in diabetic patients was 33% while in non-diabetic patients it was 15% [6].

Heart failure is the result of damaging of heart muscles. Age, gender and hypertension is a major risk factor for heart failure. Aged person with diabetes has greater chance of heart failure than non-diabetic patients. Poor glycemic control can lead to the heart failure. Abnormal left ventricular relaxation is related with glycemic control. Association of diabetes and hypertension has more severe affect. Autonomic neuropathy is responsible for left ventricular dysfunction [6].

#### **Cerebrovascular and Peripheral Arterial Disease**

High blood pressure and blocking or hardening of arteries, which go the brain, affects the blood flow in the brain and it leads to stroke. A stroke results when blood vessels in the brain bursts and blood supply is insufficient. Oxygen is not reached to brain cells and ultimately cells death occurs. Stroke leads to the speech and vision problems and paralysis. Fatty deposits and blood clumps block the blood vessels. Clots can remain at their original position or may travel within the body. Diabetic patients are at increased risk for strokes. Peripheral arterial disease is also related to diabetes. Accumulation of fats in the blood vessels decreases the blood flow in the legs and feet. It increases the risk of heart attack and stroke. Due to insufficient blood supply to the arteries, risk amputations are raised [9].

## TREATMENT

By controlling cardiovascular risk factor in diabetic patients can prevent the cardiovascular events. Therapies that control blood pressure and low density lipoprotein can decrease macro-vascular event [22]. In diabetic patients, the objective of treatment of left ventricular dysfunction is same as non-diabetic patients. Patients must stop smoking; reduce weight if they are obese, dyslipidemia treat with serum low density lipoprotein cholesterol. Chances of mortality are less in those patients that adopt healthy lifestyle (limited intake of fish consumption, sufficient consumption of fruit and vegetables, and limited salt consumption) [23]. Early detection will help in reducing the risk of diabetes as well as cardiovascular risk factors [24]. Now a day, risk reducing statin therapy is suitable rather than cholesterol level in those patients, who are affected with diabetes. Efficient treatment of hyperglycemia reduces the risk of micro-vascular and macro-vascular diseases. Thiazide diuretics can be used for the treatment of mild heart failure but in case of acute heart attack, loop diuretics is recommended. Metolazone is also prescribed with loop diuretics in the situation of severe heart failure. If diuretics are not so effective then beta blocker can be used. If left ventricular ejection fraction is abnormal then calcium channel blockers must be avoided. Sulfonylureas were firstly used hypoglycemic agents and it triggers insulin release. In type II diabetic patients, thiazolidinedione is used as hypoglycemic agents and it lessen glucose level by increasing insulin sensitivity of target tissues [25].

## CONCLUSION

Cardiovascular disease is a major cause of mortality among patients with diabetes. Compared to non-diabetic patients, diabetic patients have greater chance of cardiovascular disease. Diabetic patients have less survival rate due to myocardial infarction and other risk factors including: hyperglycemia, hypertension, dyslipidemia and insulin resistance. Hyperglycemia and hypoglycemia can lead to the heart failure. Low density lipoprotein cholesterol, hypoglycemic agent and diuretics can reduce the risk for cardiovascular disease. Diabetes with cardiovascular disease is a major cause for concern.

## RECOMMENDATION

It is recommended that suitable strategies for improvement of risk factor management and control should be developed to prevent cardiovascular disease in diabetic patients.

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