بسم الله الرحـمن الرحيم

Sudan University of Sciences and Technology
College of Graduate Studies

Study of *Coronary Artery Disease* in Diabetes Mellitus *patients using* Cardiac Catheterization

دراسة أمراض الشرايين التاجية للقلب لدي مرضي السكر بإستخدام قسطرة القلب

A thesis Submitted for Partial Fulfillment of M.Sc. Degree in Diagnostic Radiology

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الآية

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قال تعالي :

(وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ ۚ وَكَانَ فَضْلُ اللَّهِ عَلَيْكَ عَظِيمًا)

صدق الله العظيم

سوره النساء الايه 113

DEDICATION

To my kind parents Father Babiker Ali Ahmed who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my Mother Nawal Adam Mohammed , who taught me that even the largest task can be accomplished if it is done one step at a time

To my supporting brothers and sisters Mohamed Almoutasim ,Tamador ,Tebyan,Tafawl and To the Spirit of my beloved Sister Tasneem babiker.

To the Spirit Of my Grandfather and Grandmother I raised up at their hands Saida Alkhaleel and Adam Mohammed .

To my supporting and continuous support of my study of Master Prof .AwadAbdalla Ahmed and prof. Anas babiker Albadwi consultant Interventional Cardiologist .

To my wise Supervisor ,Dr Asma Ibrahim.

I dedicated this work

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There are a number of people without whom this thesis might not have been written, and to whom I am greatly indebted

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I take this opportunity to express my thanks to my supporting family

- This thesis was aimed to study the Coronary Artery disease in Diabetes Mellitus patients by using cardiac catheterization. Descriptive study designed and conducted of diabetic patients who were admitted to Cardiac Catheterization lab unit at Royal care international hospital in the period from 5 of Sep 2017 to 29 of Nov 2017. The data was collected from 100 diabetic patients, 55% of them were males and 45% were female 'Coronary Angiogram was peformed for all of them by using seldenger technique and insertion of diagnostic catheter through the femoral artery to the root of aorta and coronary arteries under fluoroscopy fallowed by injection of contrast media then image obtained , The result showed that 80% of diabetic patients had uncontrolled while 20% of them had controlled and that come throw checking of HBA1c level, also according to the risk factor show that HTN represent main of other factor that equal 37.5% in all of them . in Conclusion we found that Patients with poor HBA_1c control had diffuse pattern coronary arteries of atherosclerotic disease in one vessel disease up to three vessels disease and most of them 52% was treated by medical treatment as mode of treatment rather than percutanous coronary Intervention and Coronary artery bypass graft , there For to controlled this the Hba1c should be <7.0% and other factor should be controlled to like blood pressure <130/80 mmHg and Lipids LDL cholesterol<100 mg/dl (<2.6 mmol/l) to reduce risk of diabetes complication on coronary arteries .

مستخلص الدراسة

تعتبر هذه الدراسة *دراسة وصفية لأمراض الشرايين التاجية للقلب لدي مرضي السكري* بإستخدام قسطرة القلب وقد اجريت في مستشفي رويال كير العالمية بقسم قسطرة القلب في الفترة مابين الخامس من سبتمبرالي التاسع والعشرون من نوفمبر من العام 2017 وقد تم جمع البانات من 100 مريض ممن يعانون من داء السكري حيث يمثل فيها 55% من الذكور و 45% من الإناث تم إجراء القسطرة التشخيصية لجميع المرضي عن طريق إدخال قسطرة القلب عبر شريان الفخذ مرورلا بالشريان الأورطي وصولا للشرايين التاجية للقلب وحقن صبغة التصوير من خلالها بإستخدام الاشعة المرئية للتصوير وهي الطريقة المتبعة عالميا والتي تنسب للعالم سيل دينقر. .وقد اظهرت النتايج ان هنالك 80% من مرضي السكري يعانون من ضعف التحكم في هذا الداء وهنالك 20% كان لهم التحكم فيه وقد اتت هذه النتايج اكثر من خلال فحص معدل السكر التراكمي في الدم , وقد وجد ان إرتفاع ضغط الدم العوامل المؤثرة المرتبطة بمرض السكري حيث يمثل 37.5% مقارنة بعوامل الخطر الأخري.ومن مستخلص هذا البحث نجد ان المرضي الذين كان التحكم في معدل السكر التراكمي لديهم ضعيف نتج عن ذلك انتشار الإصابة بتصلب الشرايين التاجية للقلب من اصابة في شريان واحد إلي ثلاثة شرايين وأغلبهم تم علاجهم طبيا بالأدوية كنمط علاجي بنسبة 52% أكثر من العلاج بدعامات الشرايين التاجية وعمليات القلب المفتوح لزراعة الشرايين .وللتحكم الأمثل فعلي مريض السكر ان يخضع لفحص معدل السكر التراكمي كل ثلاثة أشهر او مرتين علي الاقل سنويا ويجب ان يكون معدل السكر التراكمي أقل من 7% ويجب التحكم في عوامل الخطر الأخري كضغط الدم بمعدل اقل من 80/130 ومعدل تراكم الدهون والكلسترول أقل من 100 ملي مول لكل ديزي ليتر وذللك لتقليل مخاطر الإصابة بأمراض الشرايين التاجية.

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List Of Abbreviation:_

CABG	Coronary artery bypass graft
CAD	Coronary artery disease
CHD	Coronary heart disease
CK_KM	Creatinine Kinase muscle brain isoenzyme
DM	Diabetes mellitus
ECG	Electrocardiogram
FMC	First medical contact
HBA1C	glycosylated hemoglobin
HTN	Hypertension
MI	myocardial infraction
NON STEMI	non S T segment elevation myocardial infarction
PCI	percutaneous interventions
STEMI	S T segment elevation myocardial infarction
TI	Troponin I
TT	Troponin T
US	unstable angina
ACS	Acute coronary Syndrome

Chapter one

1.1 Introduction:

1.1.1 Cardiac catheterization:

Cardiac catheterization (heart cath) is Radiological Procedure by insertion of a catheter into a chamber or vessel of the heart followed by injection of contrast media . This is done both for diagnostic and interventional purposes. Subsets of this technique are mainly coronary catheterization, involving the catheterization of the coronary arteries, and catheterization of cardiac chambers and valves of the cardiac system, The history of cardiac catheterization dates back to Stephen Hales (1677-1761) and Claude Bernard (1813-1878), who both used it on animal models. Clinical application of cardiac catheterization begins with Werner Forssmann in 1929, who inserted a catheter into the vein of his own forearm, guided it fluoroscopically into his right atrium, and took an X-raypicture of it.[11] During World War II, André Frédéric Cournand, a physician at NewYork-Presbyterian/Columbia, then Columbia-Bellevue, opened the first catheterization lab. In 1956, Forssmann and Dr. Cournand were co-recipients of the Nobel Prize in Physiology or Medicine for the development of cardiac catheterization. (*The cardiac catheterization handbook. Kern, Morton J.,, Sorajja, Paul,,*).

Procedures can be diagnostic or therapeutic. For example, coronary angiography is a diagnostic procedure that allows the interventional cardiologist to visualize the coronary vessels. Percutaneous coronary intervention, however, involves the use of mechanical stents to increase blood flow to previously blocked (or occluded) vessels. Other common diagnostic procedures include measuring pressures throughout the four chambers of the heart and evaluating pressure differences across the major

heart valves. Interventional cardiologists can also use cardiac catheterization to estimate the cardiac output, the amount of blood pumped by the heart per minute Cardiac catheterization can be used as part of a therapeutic regimen to improve outcomes for survivors of out-of-hospital cardiac arrest.

Cardiac catheterization requires the use of Digital fluoroscopy Interventional Machine to visualize the path of the catheter as it enters the heart or as it enters the coronary arteries. The coronary arteries are known as "epicardial vessels" as they are located in the epicardium, the outermost layer of the heart. Fluoroscopy can be conceptually described as continuous x-rays. The use of fluoroscopy requires radiopaque contrast, which in rare cases can lead to contrast-induced kidney injury .Patients are constantly exposed to low doses of ionizing radiation during procedures Ideal table positioning between the x-ray source and receiver, and radiation monitoring via thermoluminescent dosimetry. (Leopold JA, Faxon DP. Diagnostic Cardiac Catheterization and Coronary Angiography).

1.1.2 Diabetes mellitus (DM)

is a syndrome of chronic hyperglycaemia due to relative insulin deficiency, resistance, or both. It affects more than 120 million people world-wide, and it is estimated that it will affect 220 million by the year 2020. Diabetes is usually irreversible and, although patients can have a reasonably normal lifestyle, its late complications result in reduced life expectancy and major health costs. These include macrovascular disease, leading to an increased prevalence of coronary artery disease, peripheral vascular disease , and stroke, and microvascular damage causing diabetic retinopathy and nephropathy.

(.Essentias of clinical cardiology first edition. Williams, J.A. Cusco, M.A. Roddy, M.T. Johnstone)

Cardio vascular is the leading cause of death among people with type 1 and type 2 diabetes. Coronary artery disease (CAD) is cause of death in more than half of all diabetic patient, and many are debilitated by symptoms of congestive heart failure (CHF) or angina. Patients with diabetes but without other conventional risk factor for atherosclerosis have a risk of death from CAD 2-4 times that of age match control.Thosewith type2 diabetes commonly have other associated risk factor, such as hypertension or hyperlipidemia thus further increasing their cardiovascular risk. Women with diabetes are at increase risk , with a risk of cardiovascular death up to 7.5 times that of women without diabetes . Diabetic women do not have the premenopausal benefit seen in the general population.(Sinderman,Michel1992)(Uusitupa,Niskanen1993).

Individual with diabetes and CAD fare worse than do other patients with CAD. Those who present with myocardial infarction (MI) are increased risk of dying from their event or of developing heart failure (Orlanderpr,1994). They benefit less from thrombolysis in the setting of an acute MI \(Fava,S1993). Coronary artery and by bass (CABG) and percutaneous trans luminal coronary angioplasty (PTCA) are associated with greater long term mortality in diabetic patientthan in those without diabetes (Stein b,weintraub1995) There for , early detection of CAD is important to ensure that medical interventions to improve outcome are instituted.

Diabetic patients exhibit an increased risk for development of atherosclerotic CAD for many reasons, including metabolic factors, like hyperglycaemia, dyslipidemia and insulin resistance, which lead to endothelial cell, vascular smooth muscle dysfunction,impaired platelet function and abnormal coagulation.(p.r Moreno 2000) Diabetic patients tend to exhibit other risk factors for CAD, like hypertension and obesity. Patients with diabetes have lipid-

rich atherosclerotic plaques, which are more vulnerable to rupture than the plaques seen in non-diabetic patientsYoo et al. described an overall increase in atherosclerotic burden and a 3.5-fold higher risk of coronary stenosis that was independent of other cardiovascular risk factors in diabetic patients,

Diabetes is major co-morbidity of cardiovascular disease. Blood glucose control is an important factor in improving outcome of diabetic patient undergoing cardiac catheterization ,the severity and duration of diabetes in diabetic patient determine the severity of complication associated with diabetes us atherosclerosis,hypertension, metabolic disorder,ophthalmic complication.

Diabetes effect 20.8 million people and increasing at epidemic level and within the fifty next year diabetes is expected increase by 65%. Hispancis and African American have higher likelihood than any other nationality for developing diabetes especially within younger group age

.

1.2 Problem statement:-

Diabetes mellitus is common disorder that can lead to numerous costly complication in blood glucose is not adequately managed disease management program can focus on controlling glycemia in order to reduce risk of complication and chronic co morbidities and improve quality of life

Khartoum state the prevalenceof diabetes is 11%. In our country no study found related to the effect of diabetes mellitus in relation to coronary artery disease in the diabetic patients attending cath lab unit according to Sudanese research center .

1.3 Objectives:-

1.3.1 General objective:-

To study the effect of diabetes mellitus control among Patient

Attending cardiac cathertraizion laboratory unit.

1.3.2 Specific objectives:-

To identify commonest age group and gender of diabetic patient in relation to Coronary artery disease

To determine risk factor associated to atherosclerosis in relation to diabetes in development coronary artery disease

To detect commonest ECG changes in diabetic patient having coronary artery disease

To assess cardiac catheterization in diagnosis and treatment of coronary artery disease in diabetic patient .

1.4 Significant of the study:

Diabetic people of high risk from of coronary artery disease (CAD), tend to present late and have silent ischemia. Early detection by regular clinical checkup and labtoratory investigation may improve survival

1.5 Overview of the study:

This study consisted of five chapters, with chapter one is an introduction,while chapter two includes a comprehensive literature review and background, and chapter three describe the material and method. Chapter four includes result presentation ,finally chapter five will include the discussion and conclusion..

Chapter two

Background and Literature review:-

2.1 Anatomy:

The right and left coronary arteries arise from the aorta and run in the atrioventricular groove carrying the arterial blood to the heart. The coronary artery runs down over the front of the heart giving off the right marginal and posterior descending branch. The left coronary gives off the anterior descending branch , which anastomoses with the corresponding branch the right coronary of the right coronary at the apex , and continues as circumflex branch which in turn give the left marginal branches . Therefore ,there are three main coronary vessels : the right coronary , the left anterior descending and circumflex arteries in addition to the left main coronary artery.The right and left ventricles are mainly supplied by the right and left coronary arteries respectively. The interventricular septum and the right and left atria are supplied by both artery. The termination of the right and left coronary arteries and their interventricular branches anastomose with each other on the posterior surface of the heart taking a shape of crown , that is why they are called coronary arteries . Unfortunately, the anastomosis is not sufficient for the survival of the cardiac muscle if one coronary arteries is occluded suddenly.(Applegate E 2000)

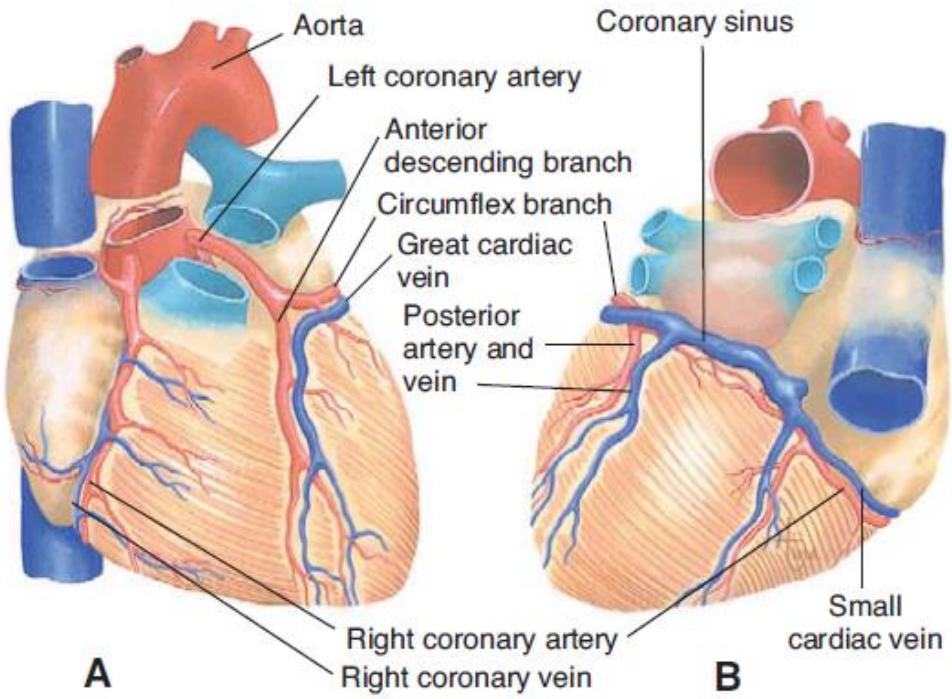


Figure (2.1): show anatomy of blood vessels of the heart anterior view(A), posterior view (B). (Applegate E 2000)

2.2 Physiology:

2.2.1 Coronary Circulation:

The heart muscle, like every other organ or tissue in your body, needs oxygen-rich blood to survive. Blood is supplied to the heart by its own vascular system, called coronary circulation.The aorta (the main blood supplier to the body) branches off into two main coronary blood vessels (also called arteries). These coronary arteries branch off into smaller arteries, which supply oxygen-rich blood to the entire heart muscle. The right coronary artery supplies blood mainly to the right side of the heart. The right side of the heart is smaller because it pumps blood only to the lungs

.The left coronary artery, which branches into the left anterior descending artery and the circumflex artery, supplies blood to the left side of the heart. The left side of the heart is larger and more muscular because it pumps blood to the rest of the body. (Applegate E: The anatomy and physiology learning system, ed 2, Philadelphia, 2000,).

2.2.2 The Conduction System of the heart :

Electrical impulses from your heart muscle (the myocardium) cause your heart to contract. This electrical signal begins in the sinoatrial (SA) node, located at the top of the right atrium. The SA node is sometimes called the heart's "natural pacemaker." An electrical impulse from this natural pacemaker travels through the muscle fibers of the atria and ventricles, causing them to contract. Although the SA node sends electrical impulses at a certain rate, your heart rate may still change depending on physical demands, stress, or hormonal factors.(Applegate E: The anatomy and physiology learning system, 2000,)

2.2.3 Cardiac biomarker :

Cardiac troponins (TT&TI) are the biomarker of choice,they are more sensitive and specific marker of cardiomyocyte injury than creatitinine kinase, its CK isoenzyme (CK-MB) and myoglobin . They play central role in establishing diagnosis. Also they distinguish between NSTMEI and UA patients (18). initials rise troponins occurs within 4 hours and may remain elevated for up to 2 weeks due to proteolysis of contractile apparatus.The result should be available within 60 mints. The test should be repeated 6-9 hours after initials assessment if the first measurement is not conclusive. Repeated test after 12-24 hours is advisable if the clinical condition still suggestive of CAD.(Jax TW,Peter AJ 2016)

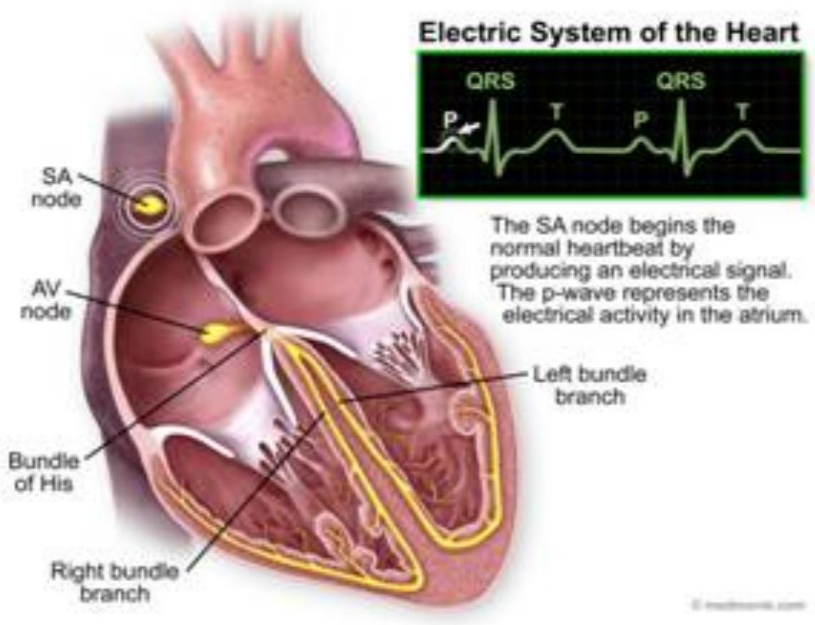


Figure (2.2) show Conduction System of the heart .(Applegate E: The anatomy and physiology learning system, 2000,)

2.3 Pathology:

2.3.1 Pathophysiology of Diabetes:-

Diabetes mellitus is a group of chronic metabolic conditions, all of which are characterized by elevated blood glucose levels resulting from the body's inability to produce insulin or resistance to insulin action, or both.[21]This group of conditions can be subdivided into 4 clinically distinct types. Type 1, which results from autoimmune beta-cell destruction in the pancreas and is characterized by a complete lack of insulin production.Type 2, which develops when there is an abnormal increased resistance to the action of insulin and the body cannot produce enough insulin to overcome the resistance;gestational diabetes, which is a form of glucose intolerance that affects some women during pregnancy; anda group of other types of diabetes

caused by specific genetic defects of beta-cell function or insulin action, diseases of the pancreas,or drugs or chemicals.(American Diabetes Accociation 2006)

2.3.2 Diabetes and atherosclerosis:-

Diabetic patients exhibit an increased risk for development of atherosclerotic CAD for many reasons, including metabolic factors, like hyperglycaemia, dyslipidemia and insulin resistance, which lead to endothelial cell, vascular smooth muscle dysfunction,(Suzuki LA,poot M2001) impaired platelet function and abnormal coagulation .Diabetic patients tend toexhibit other risk factors for CAD, like hypertension and obesity. Patients with diabetes have lipid-rich atherosclerotic plaques, which are more vulnerable to rupture than the plaques seen in non-diabetic patients.(Marfella R2006). Described an overall increase in atherosclerotic burden and a 3.5-fold higher risk of coronary stenosis that was independent of other cardiovascular risk factors in diabetic patients(YOO ,KIM 2009).

Inflammation plays an important role in atherosclerosis.Inflammation activation in type 2 DM results from obesityand insulin resistance, in which an acute phase reactionoccur, and a large number of inflammatory and proinflammatorycytokines are released from adipose tissue.(Pickup JC2004) Endothelial dysfunction is generally present in diabeticpatients with CAD, as evidenced by high levels ofendothelin1and low levels ofnitricoxide.Vascularendothelial (VE)-cadherin was identified recently as anupdated marker of endothelial function that is wellcorrelatedwith endothelin1 in diabetic patients with CAD.(YanY2015) Enhanced thrombus formation occurs in type 2 DM because of increased platelet activity and blood coagulability.(Laakso M2010), Pathological alterations in fibrinogen andplasminogen activation inhibitors are primarily relevant forthe short-term incidence of cardiovascular events in patientswith type 2 DM.

Notably, not all diabetic patients develop cardiovasculardisease despite the presence of the same risk factors. However,recent studies focused on biomarkers of CVD in diabeticpatients, such as serum phospholipids and their role inthe progression of CVD. Beatriz Garcı´a-Fontana and colleaguesrecently found low serum levels of 4 phospholipids indiabetic patients with CVD compared to diabetic patientswithout CVD.(Stamler J1993)

2.3.3 Epidemiology:-

Type 1 diabetes accounts for 5% to 10% of all cases of diabetes. Its risk factors include autoimmune, genetic, and environmental factors. To date, there are no known ways to prevent type 1 diabetes. Type 2 diabetes accounts for 90% to 95% of all diagnosed diabetes cases(Eren E2013).This form of diabetes generally begins as insulin resistance and, because the body is unable to produce enough insulin to address the resistance, the pancreas may reduce the production of insulin or eventually stop producing it. Minority women, women who are obese, women with a family history of diabetes, and women who have had gestational diabetes in a previous pregnancy are at higher risk than other women for developing gestational diabetes. Strict glycemic control and management of women with gestational diabetes is necessary to prevent birth complications in the developing infant. Women who have had gestational diabetes have a 20% to 50% increased risk for developing type 2 diabetes later in life.(Dall,T,Mann,s 2007)

Prediabetes is a precursor condition to diabetes in which a person has elevated blood glucose levels but does not meet diagnostic criteria for diabetes. People with prediabetes can have impaired fasting glucose or impaired glucose tolerance, or both. From 1988 to 1994, approximately 25% of a cross-sectional sample of US adults 40 to 74 years of age were classified

as having prediabetes.[Benjamin SM2000] , For the year 2000, this would mean that 12 million people in the United States had prediabetes. This finding clearly indicates that there is a large population that is at risk for developing diabetes within a relatively short time frame.This review surveys the literature published on the characteristics and implications of pre-diabetes and type 2 diabetes mellitus (T2DM) for the Arab and Bedouin populations of Israel. T2DM is a global health problem. The rapid rise in its prevalence in the Arab and Bedouin populations in Israel is responsible for their lower life expectancy compared to Israeli Jews. The increased prevalence of T2DM corresponds to increased rates of obesity in these populations. A major risk group is adult Arab women aged 55-64 years. In this group obesity reaches 70%. There are several genetic and nutritional explanations for this increase. We found high hospitalization rates for micro and macrovascular complications among diabetic patients of Arab and Bedouin origin. Despite the high prevalence of diabetes and its negative health implications, there is evidence that care and counseling relating to nutrition,physicalactivity and self-examination of the feet are unsatisfactory. Economic difficulties are frequently cited as the reason for inadequate medical care. Other proposed reasons include faith in traditional therapy and misconceptions about drugs and their side effects. In Israel, the quality indicators program is based on one of the world's leading information systems and deals with the management of chronic diseases such as diabetes. The program's baseline data pointed to health inequality between minority populations and the general population in several areas, including monitoring and control of diabetes. Based on these data, a pilot intervention program was planned, aimed at minority populations. This program led to a decrease in inequality and served as the basis for a broader, more comprehensive intervention that has entered the implementation stage. Interventions that were shown to be

effective in other Arabic countries may serve as models fordiabetes management in the Arab and Bedouin populations in Israel.**(Center of disease** control and prevention 2005)

Diabetes mellitus, a common metabolic disorder, is often associated with severe coronary artery disease.In this study, we compared the angiographic severity of coronary artery disease in diabetic patients compared with that of non diabetic patients.Methods: This observational study comprised of 102 subjects who had coronaryartery disease on coronary angiography in the Department of Cardiology, Bangabandhu Sheikh Mujib MedicalUniversity (BSMMU), Dhaka, Bangladesh from January 2009 to December 2009. The patients were divided intotwo groups: one group with 24 (23.5%) diabetic patients and another group with 78 (76.5%) non diabetic patients. Demographic, clinical, laboratory and angiographic data were analyzed and compared between two groups. Results: Mean age±SD of the study subjects was 52.8±9.5 years and 94 (92%) of them were male. Diabetic patients were older (mean age±SD; 57.6±9.5 versus 51.3±9.9 years; p 004), and had higher frequency of hypertension(75% versus 50%, p 0.036), Chronic stable angina (71% versus 41%, p 0.018), and lower frequency of smoking (42% versus 67%, p 0.034) and acute coronary syndrome (29% versus 59%; p 0.018) in comparison to non diabetic patients. Left main stem disease (21% versus 5%, p 0.031) and three-vessel disease (50% versus 31%, p0.094) were more prevalent in diabetic patients. Severe coronary artery stenosis was significantly more present in diabetics than non diabetics (Gensini score, 50.9±29.9 versus 32.6±21.9, p 0.001).Conclusion: Diabetic patients are more likely to have severe and extensive coronary artery disease. Left main stem and triple vessel disease are more commonly seen in diabetic patients

compared to non diabetic patients (Srinidhi S.Hegde,P2014).

2.3.4 Effects of diabetes on the coronary artery:-

Diabetes mellitus is associated with a markedly increased prevalence of coronary artery disease. The prevalence of coronary artery disease as assessed by various diagnostic methods is as high as 55% among adult patients with diabetes mellitus as compared to 2–4% of the general population . Moreover, the cardiovascular mortality rate is more than doubled in men and more than quadrupled in women who have diabetes mellitus compared to those without. The restenosis rate after coronary balloon angioplasty is about 2-fold higher in diabetic than nondiabetic patients. Due to autonomic neuropathy diabetic patients have a decreased perception of ischemic pain, which contributes to a high prevalence of silent ischemia . Diabetic patients without previous myocardial infarction have as high a risk of myocardial infarction as nondiabetic patients with previous myocardial infarction . Myocardial ischemia is common in patients with hypertension and caused by several pathogenic mechanisms. Firstly, hypertension accelerates arteriosclerosis of the coronary arteries. The elevated blood pressure increases left ventricular wall stress, wall tension, and stroke work. Thirdly, resistance of the coronary microvasculature is abnormally elevated in hypertensive patients even in the absence of left ventricular hypertrophy. Moreover, long-standing hypertension causes left ventricular hypertrophy that increases the diffusion distance, compromises the vasodilator reserve of the coronary circulation and increases the oxygen demand of the myocardium. (W.S. Yoo,H.J.Kim 2009)

2.4 Imaging:

2.4.1 Physical Overview of Cathlab Equipment:

diagnostic imaging equipment used to visualize the arteries of the heart and the chambers of the heart and treat any stenosis or abnormality found, Most catheterization laboratories are "single plane" facilities, those that have a single X-ray generator source and an x-ray image intensifier for fluoroscopic imaging. Older cath labs used cine film to record the information obtained, but since 2000, most new facilities are digital. The latest digital cath labs are biplane (have two X-ray sources) and use flat panel detectors involve the imaging of 5 to 10 runs of a 6 to 7 second duration each with 30 fps. Thus, each patient study contains 2000 or more images. The minimum specifications of a 512 × 512 matrix and a pixel depth of 1 to 1.5 Bytes (8 to 12 bits) to capture the transmitted x-ray intensity data, result in each image and the entire study containing about 0.25 to 0.39 and 500 to 750 Megabytes (MB) of data, respectively. While the improved spatial resolution of a 1024 × 1024 matrix is preferred, the larger matrix size has disadvantages of increased quantum mottle and/or radiation dose to the patient as well as much larger data rates and total image data. The data acquisition rates for a 512 × 512 matrix are typically 7.5 to 12 MB per second which is equal to 60 to 90 MHz; for the 1024 × 1024 matrix, the data rates would be four times greater. Bi-Plane Cardiac Cath systems double the data acquisition rates that would have to be handled. For these reasons, most current equipment utilizes the 1024 × 1024 matrix only at lower frame rates of imaging; whereas, the 512 × 512 matrix is routinely used for most clinical studies (Saalfrak 1998; Holmes and Wondrow 1990),

The majority of x-ray tubes found in current cardiac cath labs contain only two focal spots. The small spot will have a nominal size of 0.5 to 0.6 mm with a kW rating for a single exposure of 40 to 50 kW. The large focal spot will be 0.9 to 1.2 mm in size with a kW rating of 80 to 110 kW. The large focal spot kW rating should be reasonably matched to the maximum kW of the generator. It is used for cine or digital image recordings. The small focal spot is used primarily for fluoroscopy. The small focal spot is also the correct choice for cine or digital image recordings of small children.,

Tube stand designs provide a switch that disengages the power assist to allow rapid manual motion by the operator in cases of emergency. C-arm configurations typically provide ±45 degree rotation in the cranial-caudal direction; the parallelogram can increase the range to ±55 degrees. Rotation in the LAO/RAO direction is typically ±135 degrees. Most manufacturers' equipment is capable of storing combinations of clinically used common angles in a computer-controlled positioning system. The stand automatically moves to the selected stored position. This system allows rapid and consistent position of the imaging equipment (Rauch and Strauss 1998).

Patient Table Floor-mounted special procedure tabletops in cath labs are typically supported by a pedestal base with motorized vertical motion sufficient to position any part of the patient's body at the vertical isocenter of the imaging plane. The tabletop should be wide enough to support the patient, but narrow enough to allow the positioning of the image intensifier adjacent to the exit plane of the patient during lateral imaging. The length of the table must be sufficient to comfortably support a tall adult, with some additional room. The composition of many tabletops is typically carbon fiber material. This composition provides the strength required to support at least a 350-pound patient cantilevered from the pedestal support while minimizing

the attenuation of the diagnostic x-ray. The tabletop must “float” with respect to the pedestal when electromagnets are released to allow axial and transverse motion of the tabletop relative to the isocenter of the imaging equipment. The longitudinal and transverse motion of the tabletop respectively should be at least at 100 cm and 30 cm (Rauch and Strauss 1998)

Control Console The control console for a cine system should have the ability to select both fluoroscopic and cine technique factors. For fluoroscopic operations, there should be selection switches to vary from continuous to pulsed fluoroscopy. Pulsed fluoroscopy should be available from 30 pulses per second to at least 7.5 pulses per second For all modes (Strauss 1998).

Digital Image Storage for digital cardiac images have evolved from stacked magnetic disks, to digital archival tapes (DAT), to large optical disks and other devices. A common data storage device currently is either compact disks which can be written to one time and read many times (CD-ROM) or to erasable compact disks (CD-R/W). These disks are relatively inexpensive and hold about 650 MB of information. Thus, these disks have a capacity to store one complete diagnostic cardiac cath study on a single CD (Strauss 1998).

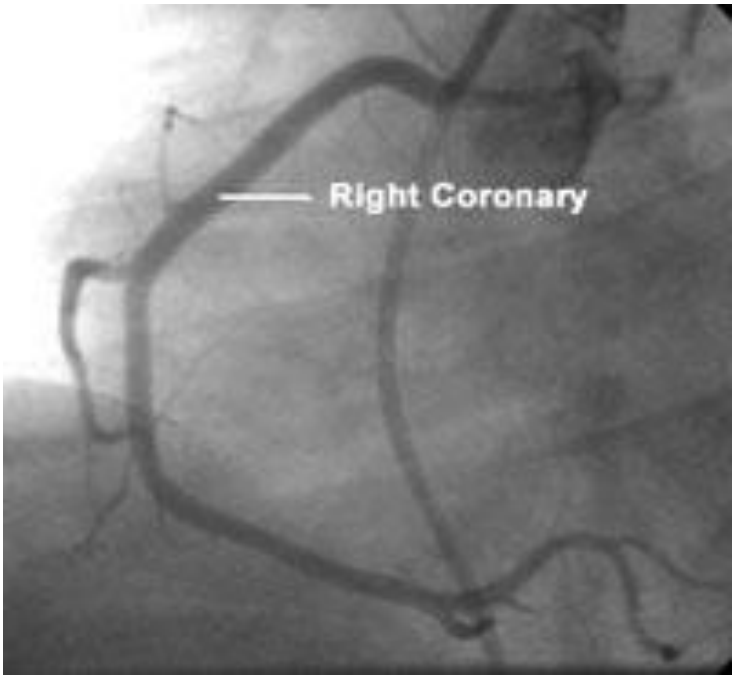
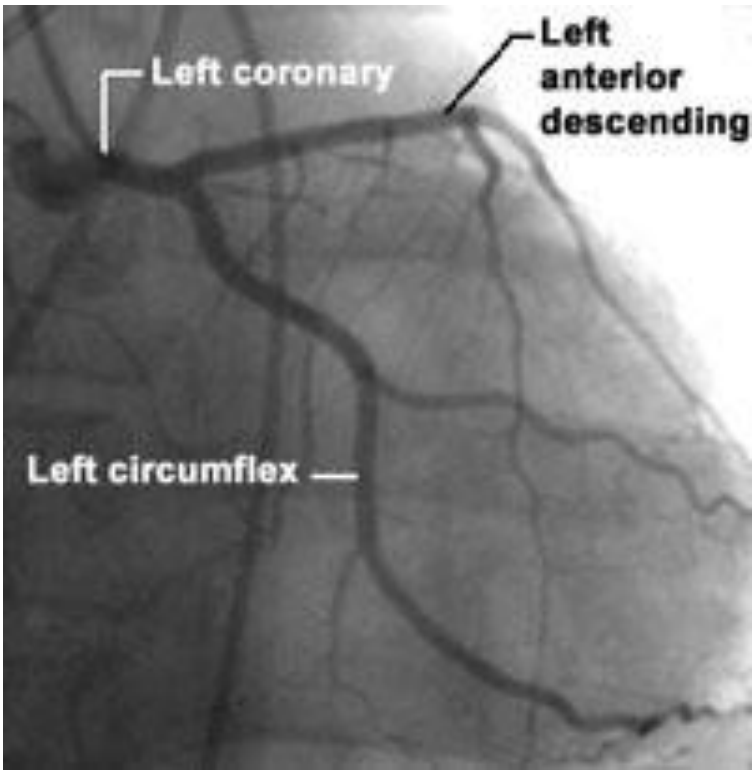


Figure (2.3):Image show right coronary artery (image was obtained by GE digital intervention machine).



Figure(2.4):Image show left coronary artery(image was obtained by GE digital intervention machine)

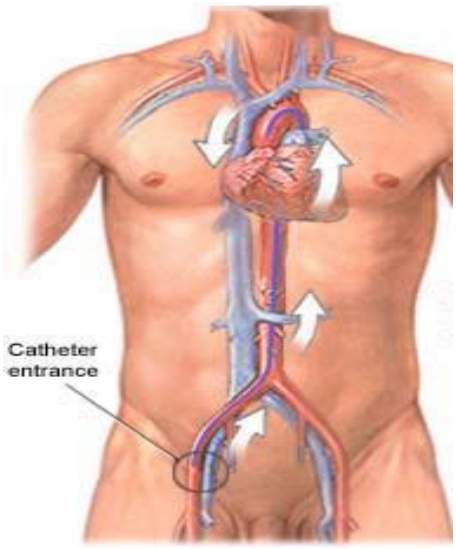
2.4.2 Technique of Clinical Cardiac Procedures

Clinical cardiac procedures basically fall into two categories: diagnostic(coronary angiography) and interventional (PCI). Cardiac catheterization is a diagnostic procedure which involves the insertion of catheters into either the femoral (most common) or brachial arteries which lead to the heart . The catheters are used to deliver contrast material either to the coronary arteries or the left ventricle in order to increase their opacification to x-ray transmission. In this fashion, the vessels can be clearly seen during angiographic x-ray imaging by obtiannig Seven imaging views Ap caudal ,Ap cranial,RAO/ LAO caudal ,RAO/LAO cranial and Lateral, and the left ventricle's ability to contract and pump blood can be analyzed. Coronary angioplasty is a treatment for coronary artery disease. Percutaneous Transluminal Coronary Angioplasty (PTCA) is a therapeutic intervention which commonly involves placing balloons with catheters into the occluded vessel and inflating the balloon in order to open the obstruction then deliver stents through the catheters to prop open vessels that have been opened with PTCA. Most stents are self-expanding stainless steel or tantalum alloy coils of wire which act as a structural support to the vessels while patient in supine postion during all Procedures (Bettmann 1998).

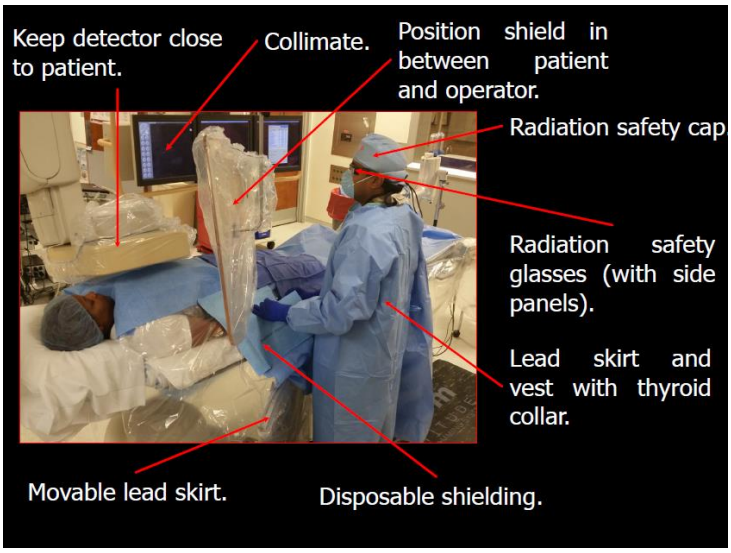
2.5 Radiation protection:

Ionizing radiation in the form of X-rays is used extensively in the modern cardiac catheterization laboratory diagnostic and percutaneous coronary interventional (PCI) procedures. Unlike patients who receive a dose of ionizing radiation during their procedure, interventional cardiologists and cardiac catheterization laboratory personnel are repeatedly exposed to ionizing radiation in the course of their duties. This issue has been magnified with increased exposure in the long duration of structural or complex adult

congenital heart disease intervention. Personnel not previously exposed to ionizing radiation such as echocardiographers, ultrasound technologists, cardiac surgeons, and anesthesiologists are frequently close to the X-ray field. Therefore, minimizing radiation exposure is of utmost importance.(Balter S, Hopewell JW, Miller DL,2010).



Figure(2.5) show technique of coronary Angiography.



Figure(2.6):show Radiation protection equipment

2.6 previous Studies:

American Journal Cardiology in 2006, it looked at the Association of hemoglobin A_{1c} level with the severity of coronary artery disease in patients with diabetes mellitus. Coronary angiography was performed in 152 men and 163 women with diabetes mellitus (mean age 55 +/- 8 years) because of chest pain. There was a significant increasing trend of hemoglobin A(1c) levels over the increasing number of vessels with CAD ($p < 0.0001$).

Cardiac adversity is by far the commonest cause of mortality in patients with diabetes. Cardiac involvement in diabetes commonly manifest as coronary artery disease (CAD). Definitive diagnosis,precise assessment and anatomic severity of CAD requires invasive diagnostic modality like coronary angiography. In our study 22 (44%) out of 50 diabetic patients had triple or multi-vessel disease compared to 8 (16%) out of 50 non diabetics. Hundred patients with ACS, number of vessels involved were 199, of which 61.3% in diabetics and 38.6% in non diabetics, 23(46%) of 50 diabetic patients required CABG as treatment outcome. HbA1c levels of >8.5%, 69.2% had triple / multi vessel disease and 19 (73.1%) of 23 patients who had to undergo CABG had HbA1c levels >8.5%, 24% of diabetics were in third decade, 40% were in fourth decade as compared to 10% and 26% of non-diabetics of similar age group.

This study showed that ACS in diabetic patients presented much earlier in life, the severity and extent of CAD and incidence of triple/multi vessel disease was significantly high in diabetics when compared to nondiabetics with ACS. Diabetics with high HbA1c had more number of coronary vessel involvement and the mode of treatment required in them was CABG.[30]

Several studies in the Arabian Gulf region had limitationsbecause a large proportion of expatriates were included inthe population. This inclusion was reflected in the results thatrevealed a similar prevalence in their country of origin.Therefore, we excluded many of these studies from the current review.

The World Health Organization (WHO) initiated a crosssectionalstudy, the Prevention of Recurrences of Myocardial Infarction and Stroke (WHO-PREMISE), of 10,000 patientsin 10 countries, primarily the Middle East, which exhibitscoronary heart disease in approximately 85% of the population and cerebrovascular disease (CVD) in approximately15%. The working group found a high prevalence of somerisk factors, and DM was found in approximately one thirdof the patients (31.5%).[50]

National data from Lebanon are scarce. The LebaneseInterventional Registry provided data of the cardiovascularrisk factors of patients who presented for coronary angiography.The risk factors included DM (29%), hypertension(60%), smoking (50%), and dyslipidemia (29%).[51]

The INTERHEART study is a case-control study of modifiable risk factors in acute myocardial infarction patients. The investigators studied 15,152 patients and 14,820 controls, which included more than 1500 patients and 1700 controls from the Middle East. Subgroup analysis of the Middle East group revealed a diabetes prevalence of approximately 15%, hypertension was present in approximately 9%, and current smokers included approximately 45% of cases. Dyslipidemia and abdominal obesity were present in 70% and 25% of cases, respectively.[52]

The Gulf Registry of Acute Coronary Events (GulfRACE) is the first multi-national acute coronary syndrome registry in the Middle East. These investigators studied patients with in the United Arab Emirates, Kuwait, Bahrain, Oman, Qatar and Yemen. A total of 1484 ACS patients were recruited. Myocardial infarction formed the majority of cases (approximately 69%), and DM prevalence was relatively high (38%). Hypertension was present in 46% of the study population, hyperlipidaemia in 31%, and smoking in45%.[53]

The Second Gulf Registry of Acute Coronary Events (Gulf RACE 2) is a registry studying the effects of DM and new-onset hyperglycaemia on cardiovascular outcomes in ACS patients from Arabian Gulf countries. More than 7000 patients were recruited from 6 Arabian Gulf countries: KSA, Bahrain, Qatar, Oman, United Arab Emirates, and Yemen.The prevalence of DM was high; 49.2% of the study patients had been diagnosed previously with DM (23% on insulin, and 76% treated with oral anti-diabetic agents and/or diet control). New-onset hyperglycaemia was estimated at 8.8%.[33]

The DM prevalence reported in Gulf RACE 2 was very high compared to the Western data in the Global Registry of Acute Coronary Events (GRACE) registry (approximately24%)[54]and the Asian data found in treatment and outcomesof ACS in an Indian registry (about 30%).[55]Hersi et al. examined the gender difference between patientswith ACS from 17 participating centers in KSA. Morethan 5000 patients were recruited, and the prevalence of DM in the entire study population was even higher at 58%, 73% in the female subgroup, and 41% in the male subgroup.[56]Mobeirek and co-workers found a relatively high prevalence of risk factors in the SPACE registry (the

KSA Patients. Admitted with acute Coronary syndromes registry) in KSA: DM (57%), overweight or obesity (72%), hypertension (56.6%), dyslipidemia (42%), and smoking (32.4%).[57]A total of 16,736 patients with acute coronary syndromewere studied in a 20-year registry (1991 to the end of 2010)from Hamad Medical Corporation (HMC) in Qatar. Thiscenter provides medical services to different ethnicities in the area, and the results should be interpreted carefully. The prevalence rates of DM were 65.7% and 37.4% in females and males, respectively, and hypertension prevalence was estimated as 68.1% in females and 36.5% in males.[58]

Abdelmoneim and colleagues published the results of their cross-sectional observational study of the demographic of ACS in Egypt in 2014. They studied 795 ACS patients divided into 2 groups: group 1 (270 patients), ST segment Elevation Myocardial Infarction (STEMI) and group 2 (525 patients), Unstable Angina/Non-ST Segment Elevation Myocardial Infarction (UA/NSTEMI). The prevalence of DM in these groups was 34% and 45%, respectively. Other reported risk factors in these groups were hypertension (33% and 59%, respectively), dyslipidemia (29% and 39%, respectively), smoking (51% and 38%, respectively), family history (16% and 7%, respectively), and male gender (72%and 64%, respectively).[59]

Another Egyptian study recruited 142 patients with STEMI and classified patients into 2 groups according to waist circumference. The prevalence of diabetes was (53/142) 37.3% in the entire study population. The prevalence of other risk factors was hypertension 41.5%, current smoking 49.3%, and family history of coronary artery disease 16.2%.[60]Jain et al. (2015) investigated the risk factors for postmyocardialinfarctions and assessed coronary artery anatomy using coronary angiography. They found that theprevalence of DM was 28.2%, hypertension was 31.4%, dyslipidemia was 37.5%, and current smoker was 44.9%.[61]

Chapter three:

Material and Method

3.1 Material

3.1.1 Patients:

Descriptive, cross sectional hospital based study Sudanese diabetic patients, attending cath lab unit ages between 30 to 80 both male and female ,included criteria diabetic patients attending cathlab unit ,excluded criteria non diabetic patients and diabetic patients whose did not attending cath lab unit, Total coverage all patient meeting criteria attending cath – lab-Unit at royal care international hospital between 5 September to 29 November 2017.

3.1.2 Machine:

Cathlab unit at Royal care international hospital type Toshiba digital interventional machine with Single plane(single x.ray tube),rapid rotated movement ,large angulation avarage and ability to obtain image with 30 frame per second .

3.2 Method :-

3.2.1 Technique:

Technique used seldenger technique for insertion of catheter 79% of patients by radial access and 21% by femoral one , seven views was taken for imaging the coronay arteries .

3.2.2 Image Interpretation:

All patients images reported by interventional cardiologist .

3.2.3 Statical used:-

Descriptive analysis was performed on all patients in the study using SPSS . Categorical data expressed as percentageand Chi square. Less Significant statistical difference was taken at *Pvalue* less than 0.05

3.2.4 .Ethical consideration:

written consent was taken from all of patients after given all information about research at its objective and benefit of it .

CHAPTER FOUR:

Results

Part (4.1): Frequency distribution

Table (4.1): Distribution of participants according to age:-

Age group (years)	**Frequency**	**%**
30-39	2	2
40-49	9	9
50-59	23	23
60-69	34	34
70-80	32	32
Total	**100**	**100%**

Table (4.2): Distribution of participants according to gender

Gender	**Frequency**	**%**
Females	45	45
Males	55	55
Total	**100**	**100%**

Part (4.2) Investigations:-

Table (4.3): HbA1c

HbA1c	Frequency	%
Control	19	19
Poor control	30	30
Bad control	51	51
Total	**100**	**100%**

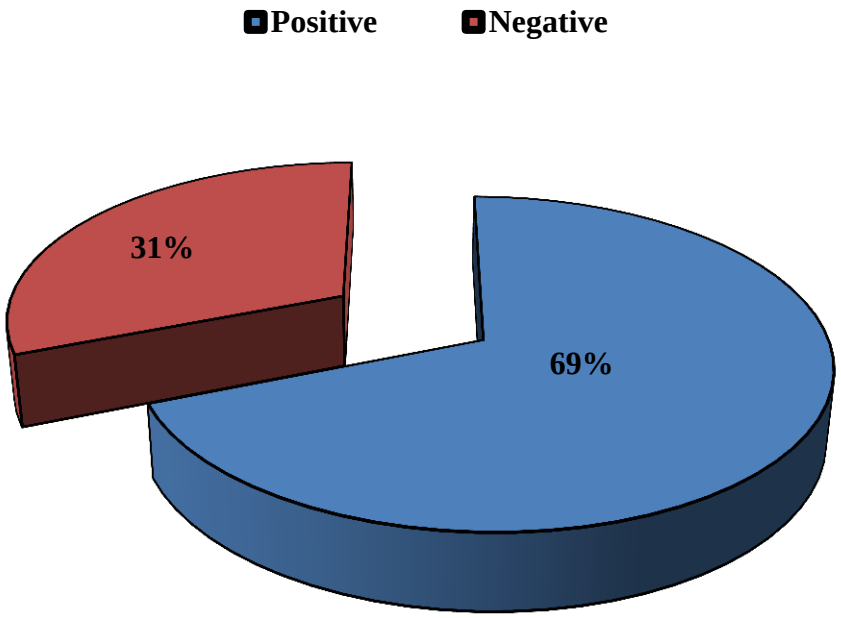


Fig. (4.1): Troponin

Table (4.4): ECG result

ECG result	Frequency	%
Unstable angina	23	23
STEMI	31	31
NSTEMI	46	46
Total	**100**	**100%**

Table (4.5): distribution of Diabetic patient according to HBA_1c

	Frequency	%
Controlled	20	20
Uncontrolled	80	80
Total	**100**	**100%**

Table (4.6): Diabetic with risk factors

Risk factors	Frequency	%
HTN	30	37.5
Dyslipidemia	12	15.0
Smokers	16	20.0
Dyslipidemia + smoker	3	3.8
HTN + Dyslipidemia	6	7.5
HTN + smokers	12	15.0
HTN + Dyslipidemia + smokers	1	1.2
Total	**80**	**100%**

Table (4.7): Cath lab result

Cath lab result	Frequency	%
Normal	20	20
1 vessel disease	38	38
2 vessel disease	19	19
3 vessel disease	23	23
Total	**100**	**100%**

Table (4.8): Mode of treatment

Mode of treatment	Frequency	%
Medical treatment	52	52
Percutaneous coronary intervention	39	39
Coronary artery bypass graft	9	9
Total	**100**	**100%**

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Part(4.3) Relationships:-

Table (4.9): Relationship between HbA1c and cath lab result

Cath lab result	**HbA1c**			
	un control		**Control**	
	No.	**%**	**No.**	**%**
Normal	14	14	6	6
1 vessel disease	29	29	9	9
2 vessel disease	17	17	2	2
3 vessel diases	21	21	2	2
P-value	**0.27**			

Table (4.10): Relationship between age and cath lab results according to gender

Age group (years)	Gender															
	Females								Males							
	Cath lab result															
	Normal		1 vessel		2 vessel		3 vessel		Normal		1 vessel		2 vessel		3 vessel	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
30-39	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-
40-49	2	2	-	-	1	1	-	-	1	1	4	4	1	1	-	-
50-59	1	1	6	6	1	1	-	-	2	2	1	1	5	5	6	6
60-69	7	7	7	7	1	1	3	3	2	2	8	8	2	2	4	4
70-80	3	3	6	6	2	2	4	4	1	1	5	5	6	6	5	5
P-value	0.0397								0.0211							
	0.0457															

Table (4.11): Association between diabetic without risk factors and cath lab results

Diabetic without risk factors	Cath lab results							
	Normal		1 vessel		2 vessel		3 vessel	
	No.	%	No.	%	No.	%	No.	%
Controlled	4	4	7	7	3	3	5	5
Uncontrolled	16	16	31	31	16	16	18	18
P-value	0.967							

Table (4.12): Association between diabetic with risk factors and cath lab results

Diabetic with risk factors	Cath lab results							
	Normal		1 vessel		2 vessel		3 vessel	
	No.	%	No.	%	No.	%	No.	%
HTN	7	46.6	9	29.0	8	50.0	6	33.3
Dyslipidemia	2	13.3	7	22.6	1	6.25	2	11.1
Smokers	2	13.3	9	29.0	1	6.25	4	22.2
Dyslipidemia + smoker	1	6.7	2	6.5	0	0	0	0
HTN + Dyslipidemia	2	13.3	1	3.2	2	12.5	1	11.1
HTN + smokers	1	6.7	3	9.7	4	25.0	4	22.2
HTN + Dyslipidemia + smokers	0	0	0	0	0	0	1	11.1
P-value	0.617							

Chapter five

Discussion Conclusion and Recommendation

5.1 Discussion:

Data was collect from 100 diabetic patients, 55% (55)of them were males and 45%(45) were female. 80% (80) had a non control HBA1C and 20% (20) control. ECG and troponin finding the main changes in ECG is NSTEMI 46% (46) and positive troponin is 69 % (69). The majority (80%) of diabetic patients with risk factors, while diabetic patients without risk factor represent (20%). The diabetic patients with other risk factors the majority is associated with HTN, (37.5%), (15%) were dysipidemia and HTN plus smokers, (20%) were smokers, (3.8%) were dysipidemia plus smokers, (7.5%) were HTN plus dyslipidemia, (1.2%) were all (HTN plus dysipidemia plus smokers). According to cath lab result and mode of treatment 38% (38) have one vessel disease and 52 % (52) was treated medically .

In this Study found that most common affected age classes 60-69 with percentage 34 % are male is same. study done by TanjimaParvin et al In study, they were compared the angiographic severity of coronary artery disease in diabetic patients compared with that of non diabetic patients they found mean age mean age±SD; 57.6±9.5 which close to this study and most are male 83% in diabetic.[25]

HbA1c in our research found to be bad controlled >8.5 (51) % which is similar to study done by Srinidhi S. Hegde et al diabetic patients with poor glycemic control, i.e. HbA1c >8.5%, 69.2% of them had triple vessel disease and 23.1% had double vessel disease suggesting poor

glycemic control with higher HbA1c levels having more number of coronary vessels and more the severity of the stenosis [26]

From result researcher found that the commonest presentation according to ECG was non STEMI with percentage of 46 % which differ from research done by TanjimaParvin et al found non STEMI are less common with percentage 13 % and this may be due to small study sample size[27]

From result researcher found that most common lesion found one vessel disease 39% which is differ from study done Srinidhi S. Hegde et al by showed that The lesions were more frequently located on distal arteries, more frequently had a pattern of three-vessel disease, and had a trend toward more diffuse disease [26]

From result researcher found that most common risk factor associated with diabetes is hypertension (37.5 %), smokers (20%),dyslipidemia (15%), which is same to recent study investigated the prevalence of CAD risk factors in 1056 healthy adults in Brazil and found that the prevalence of DM was 11%, systemic hypertension was 40%, family history of CAD was 50%, smoking was 23%, dyslipidemia was 43%, and overweight/obesity was 68%.[62]

5.2 Conclusion:-

Patients with poor HBA_1c control had diffuse pattern coronary arteries of atherosclerotic disease. Hence routine HbA1c levels to be measured and usage medications that decrease cardiovascular complications

All efforts, governmental and non-governmental,including all health organizations and scientific societies,should come together locally in country to combat thisepidemic of DM and CAD instead of individual scatteredefforts. We need uniformed programs at the national level towin this battle.

5.3 Recommendations:-

- The routine screening for CAD in diabetic patient is not essential in asymptomatic patients , as it does not improve outcomes as long as CVD risk factors are treated
- To perform of A1C test at least twice yearly in controlled diabetic patient to avoid the complication
- To reduce risk of cardiovascular events in patients with known CVD, we use ACE inhibitor , Aspirin , Statin therapy .In patients with a prior MI, Beta-blockers should be continued for at least 2 years after the event , Longer-term use of beta-blockers in the absence of hypertension
- Measuring of blood pressure is recommend at every routine visit to diabetic clinic
- Measuring of dyslipidemia fasting lipid profile at least annually.
- For perfect control should be Hba1c <7.0% and blood pressure <130/80 mmHg and Lipids LDL cholesterol<100 mg/dl (<2.6 mmol/l) to reduce risk of diabetes complication on coronary arteries .

Reference :-

.Dally,A.(2007) use of insulin and weight gain optimizion diabetes nutritional therapy .

Journal of the American Diabetic Association .107,1386-1393**2**.Dall,T., Mann,S., Martin J,. Chen,Y., &Hogen,P (2008) Economic cost of diabetic in US in 2007 Diabetic care 31,1-5 .

Stueuten,L., Bruijsten,M., &Vrijhof,H (2007) Economic evaluation of a diabetic disease management program with a central role for the diabetes nurse specialist .European Diabetes Nursing .

Stamler J,VaccareO, NeatonJD,Wentworth D: Diabetes ,other risk factor, and 12 year cardiovascular mortality for men screened the multiple risk factor intervention trial .Diabetes care 16:434-44,1993

.Sinderman A, Michel C,Racine N, Heart disease in patients with diabetes mellitus. JClinEpidemiol 24:1357-70,1992**.**

Uusitupa MI,Niskanen LK, Siitonrn O, VoutilainenE,Pyorala K : Ten year cardiovascular morality in reation risk factor can abnormalities in lipoprotein composition in type 2 (non- insulin –dependent) diabetic non diabetic subjects. Diabetologia 36:1175-84 ,1993**7.**

DeStafano F, Ford ES,NewmanJ,Stevenson JM, Wetterhall SF, Anda RF, Vinicor F: Risk factor for coronary heart disease mortality amongperson with diabetes .Ann Epidemiol 3-27-34,1993 .

Zuanetti G, Latini R, Maggioni AP, Santoro L, Franzosi MG: Infuence of diabetes on mortality in acute myocardial infarction : data from GISSI-2study .J Am Collcardiol

Fava S, Azzopardi J, Muscat HA, Fenech FF, factor that influence outcome in diabetic subjects with myocardial infarction. Diabetic care 16:1615-18,1993

orlanderPR, Goff DC,Morrissey M, RamesyDJ,Wear ML, Labarth DR, Nichaman MZ,. The relation of diabetes yo the severity of acute myocardial infarction and post- myocardial infarction survival in mexican Americans and non Hispanic whites , the group Christi heart project .Diabetes43:897-902,1994

Grray RP,Yudkin JS, Patterson DL, Enzymatic evidence of impaired reperfusion in diabetic patient after thrombolytic therapy for acute myocardial infarction: a role for plasminogen activator inhibitor ?Br Heart J70:530-36, 1995

Stein B, Weintraub WS, Gebhart SP, Cohen- Bernstein CL, Grosswald R, Liberman HA, Douglas JS jr, Morris DC, King SB: influence of diabetes mellitus on early and late outcome after percutaneous transluminal coronaryangioplasty.Circulation91-979-891995.

The BARI investigator : Comparison of coronaru bypass surgery with angioplasty in patient with multi vessel disease : the Bypass Angioplasty Revascularization Investigation (BARI).N Engl J Med 339:217-25,1996 Kumar & Clark's Clinical Medicine S eventh Edition Edited by Professor Parveen Kumar &Dr Michael Clark Diabetes mellitus and other disorders of metabolism(1029)

.Essentias of clinical cardiology first edition 1418\1997**16.**S.B. Williams, J.A. Cusco, M.A. Roddy, M.T. Johnstone, M.A. CreagerImpaired nitric oxide-mediated vasodilation in patients with non-insulin-dependent

diabetes mellitusJ Am CollCardiol, 27 (3) (1996), pp. 567-574ArticlePDF (842KB)

A.I. Vinik, T. Erbas, T.S. Park, R. Nolan, G.L. PittengerPlatelet dysfunction in type 2 diabetesDiabetes Care, 24 (8) (2001), pp. 1476-1485

P.R. Moreno, A.M. Murcia, I.F. Palacios, M.N. Leon, V.H. Bernardi, V. Fuster, *et al.*Coronary composition and macrophage infiltration in atherectomy specimens from patients with diabetes mellitusCirculation, 102 (18) (2000), pp. 2180-2184

R. Marfella, M. D'Amico, K. Esposito, A. Baldi, F.C. Di, M. Siniscalchi, *et al.*The ubiquitin-proteasome system and inflammatory activity in diabetic atherosclerotic plaques: effects of rosiglitazone treatmentDiabetes, 55 (3) (2006), pp. 622-632

W.S. Yoo, H.J. Kim, D. Kim, M.Y. Lee, H.K. ChungEarly detection of asymptomatic coronary artery disease in patients with type 2 diabetes mellitusKorean J Intern Med, 24 (3) (2009), pp. 183-189

American Diabetes Association. Diagnosis and classification of diabetes mellitus.Diabetes Care. 2006;29:S43–S48.

Centers for Disease Control and Prevention. National Diabetes Fact Sheet: General Information and National Estimates on Diabetes in the United States, 2005. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2005. Available at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf Accessed May 29, 2008.

Benjamin SM, Valdez R, Geiss LS, et al. Estimated number of adults with prediabetes in the US in 2000: opportunities for prevention. Diabetes Care. 2003;26:645–649

Benjamin SM, Valdez R, Geiss LS, et al. Estimatednumber of adults with prediabetes in the US in 2000: opportunities for prevention. Diabetes Care. 2003;26:645–649

TanjimaParvin et al. Angiographic Severity of Coronary Artery Disease inDiabetic and Non-Diabetic Patientsin a Tertiary Care Centre University Heart JournalVol. 10, No. 1, January 2014

Srinidhi S. Hegde, P. Mallesh,S.M. Yeli,Veeranna M. Gadad ,and GiriPunja M. Comparitive Angiographic Profile in Diabetic and Non-Diabetic Patients with Acute Coronary Syndrome J ClinDiagn Res. 2014 Sep; 8(9): MC07–MC10

Angiographic Severity of Coronary Artery Disease inDiabetic and Non-Diabetic Patients in a Tertiary Care Centre University Heart JournalVol. 10, No. 1, January 2014 Comparitive Angiographic Profile in Diabetic and Non-Diabetic Patients with Acute Coronary Syndrome J ClinDiagn Res. 2014 Sep; 8(9): MC07–MC10

AndersonHR,NielsenTT, RasmussenK, Thuesen L , Kelbaek H , Thyssen P, Abildgaard U, Pedersen F, Madsen JK, Grade P, Vi lladsen AB, Krusell LR, Haghfelt T, Lomhotl P, Husted SE, Vigholt E, Kjaergrad HK, Mortensen LS, A comparison of coronary artery with fibrinolytic therapy in acute myocardial infarction .N Engl J Med 2003:349:733-742

. Romgnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenz G, Di Russo C, Summmaria F, Patri GM, Radial vs .Femoral randomize investigation in STEMI

. Acute coronary syndrome : The RIFLE STEACS study . J Am CollCardiol 2012: in press J ClinDiagn Res.Comparitive Angiographic Profile in Diabetic and Non-Diabetic Patients with Acute Coronary Syndrome 2014 Sep; 8(9): MC07–MC10. Published online 2014 Sep 20. doi: 10.7860/JCDR/2014/9072.4851PMCID: PMC42259**31.**

. Applegate E: The anatomy and physiology learning system, ed 2, Philadelphia, 2000, Saunders

AlHabib KF, Sulaiman K, Al-Motarreb A, AlmahmeedW,Asaad N, Amin H, et al. Baseline characteristics, managementpractices, and long-term outcomes of Middle Eastern patients inthe Second Gulf Registry of Acute Coronary Events (GulfRACE-2). Ann Saudi Med 2012; 32(1): 9e18.

Grundy S, Becker D, Clark LT, Cooper RS, DenkeMA,Howard J, Hunninghake DB, Illingworth DR, LuepkerRV,McBride P, McKenney JM. Detection, evaluation, and treatmentof high blood cholesterol in adults (Adult Treatment PanelIII). Circulation e Hagertown 2002 Sep; 106(25): 3143.

Newman AB, Siscovick DS, Manolio TA, Polak J, Fried LP,Borhani NO, et al. Ankle-arm index as a marker of atherosclerosisin the Cardiovascular Health Study. CardiovascularHeart Study (CHS) Collaborative Research Group. Circulation1993; 88(3): 837e845

. Himmelmann A, Hansson L, Svensson A, HarmsenP,Holmgren C, Svanborg A. Predictors of stroke in the elderly.Acta Med Scand 1988; 224(5): 439e443

. Guariguata L, Whiting DR, Hambleton I, BeagleyJ,Linnenkamp U, Shaw JE. Global estimates of diabetes prevalencefor 2013 and projections for 2035. Diabetes Res Clin Pract2014; 103(2): 137e149.**37**. Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas:global estimates of the prevalence of diabetes for 2011 and 2030.Diabetes Res ClinPract 2011; 94(3): 311e321

.

Al-Nozha MM, Al-Maatouq MA, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, et al. Diabetes mellitus inSaudi Arabia. Saudi Med J 2004; 25(11): 1603e1610

Suzuki LA, Poot M, Gerrity RG, Bornfeldt KE. Diabetes accelerates smooth muscle accumulation in lesions of atherosclerosis:lack of direct growth-promoting effects of high glucoselevels. Diabetes 2001; 50(4): 851e860

.

Williams SB, Cusco JA, Roddy MA, JohnstoneMT,Creager MA. Impaired nitric oxide-mediated vasodilation inpatients with non-insulin-dependent diabetes mellitus. J AmCollCardiol 1996; 27(3): 567e574.

. Vinik AI, Erbas T, Park TS, Nolan R, Pittenger GL. Platelet dysfunction in type 2 diabetes. Diabetes Care 2001; 24(8):1476e1485.

. Moreno PR, Murcia AM, Palacios IF, Leon MN, Bernardi VH, Fuster V, et al. Coronary composition and macrophage infiltrationinatherectomy specimens from patients with diabetes mellitus. Circulation 2000; 102(18): 2180e2184

.

. Marfella R, D'Amico M, Esposito K, Baldi A, Di FC, Siniscalchi M, et al. The ubiquitin-proteasome system and inflammatory activity in diabetic atherosclerotic plaques: effectsof rosiglitazone treatment. Diabetes 2006; 55(3): 622e632.

YooWS, Kim HJ, Kim D, LeeMY, Chung HK. Early detection of asymptomatic coronary artery disease in patients with type 2diabetes mellitus. Korean J Intern Med 2009; 24(3): 183e189.

Pickup JC. Inflammation and activated innate immunity in the pathogenesis of type 2 diabetes. DiabetesCare 2004; 27(3): 813e823.

Eren E, Yilmaz N, Aydin O. Functionally defective highdensity lipoprotein and paraoxonase: a couple for endothelial dysfunction in atherosclerosis. Cholesterol 2013; 2013: 792090.

Yan Y, Chang Q, Li Q, Li L, Wang S, Du R, et al. Identification of plasma vascular endothelia-cadherin as a biomarker for coronary artery disease in type 2 diabetes mellitus patients. Int J ClinExp Med 2015; 8(10): 19466e19470.

Laakso M. Cardiovascular disease in type 2 diabetes from population to man to mechanisms: the Kelly West Award Lecture 2008. Diabetes Care 2010; 33(2): 442e449.

Jax TW, Peters AJ, PlehnG, Schoebel FC. Hemostatic risk factors in patients with coronary artery disease and type 2 diabetes e a two year follow-up of 243 patients.CardiovascDiabetol 2009; 8: 48.

Garcı´a-Fontana B, Morales-Santana S, Navarro C, Rozas-Moreno P, Genilloud O, Pe´rez F, et al. Metabolomicprofilerelated to cardiovascular disease in patients with type 2 diabetes mellitus: a pilot study. Talanta 2016; 148: 135e143.

Mendis S, Abegunde D, Yusuf S, Ebrahim S, Shaper G, Ghannem H, et al. WHO study on Prevention of Recurrences of Myocardial Infarction and StrokE (WHO-PREMISE). Bull World Health Organ 2005; 83(11): 820e829.

Holmes, D., and M. Wondrow. “Isn’t it about time to abandon cine film?” Cathet. Cardiovasc. Diagn. 20: 1–4, 1990.

Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associatedwith myocardial infarction in 52 countries (the INTERHEARTstudy): case-control study. Lancet 2004; 364(9438): 937e952.

Saalfrak, W. “Digital Cine Equipment Design” in Syllabus: Categorical Course in Diagnostic Radiology Physics: Cardiac Catheterization Imaging. E. L. Nickoloff and K. J. Strauss (eds.). Oak Brook, Illinois: Radiological Society of North America (RSNA), pp. 121–126, 1998
.

Franklin K, Goldberg RJ, Spencer F, Klein W, Budaj A, Brieger D, et al. Implications of diabetes in patients with acute coronary syndromes. The

Global Registry of Acute Coronary Events. Arch Intern Med 2004; 164(13): 1457e1463.

Xavier D, Pais P, Devereaux PJ, Xie C, Prabhakaran D, Reddy KS, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet 2008; 371(9622): 1435e1442.

Hersi A, Al-Habib K, Al-Faleh H, Al-Nemer K, AlSaif S, Taraben A, et al. Gender inequality in the clinical outcomes of equally treated acute coronary syndrome patients in Saudi Arabia. Ann Saudi Med 2013; 33(4): 339e346.

. Bettmann, M. "Adult Cardiac Interventions" Levin, D. "Clinical Overview of Cardiac Catheterization Procedures: Adult Diagnostic Procedures" in Syllabus: Categorical Course in Diagnostic Radiology Physics: Cardiac Catheterization Imaging. E. L. Nickoloff and K. J. Strauss (eds.). Oak Brook, Illinois: Radiological Society of North America (RSNA), pp.47–51, 1998.

. El-Menyar A, Ahmed E, Albinali H, Al-Thani H, Gehani A, Singh R, et al. Mortality trends in women and men presenting with acute coronary syndrome: insights from a 20-year registry. PLoS One 2013; 8(7): e70066

. Abdelmoneim HM,Hasan-Ali H, AbdulkaderSS.Demographics of Acute Coronary Syndrome (ACS) Egyptian patients admitted to Assiut University Hospital: Validation of TIMI and GRACE scores. Egypt J Crit Care Med 2014; 2(1): 3e11.

Rauch, P. L., and K. J. Strauss. “X-ray Generator, Tube, Collimator, Positioner, and Table” in Syllabus: Categorical Course in Diagnostic Radiology Physics: Cardiac Catheterization Imaging. E. L. Nickoloff and K. J. Strauss (eds.). Oak Brook, Illinois: Radiological Society of North America (RSNA), pp. 61–82, 1998.

The cardiac catheterization handbook. Kern, Morton J.,, Sorajja, Paul,, Lim, Michael J., (Sixth ed.). Philadelphia,

Jain S, Sarkar NC, Sarkar P, Modi N, Tilkar M. Evaluation of coronary artery status by coronary angiography after first survival of acute myocardial infarction. J Clin Diagnostic Res 2015; 9(12). OC06e8.

Gus I, Ribeiro RA, Kato S, Bastos J, Medina C, ZazlavskyC,et al. Variations in the prevalence of risk factors for coronary artery disease in Rio Grande do Sul-Brazil: a comparative analysis between 2002 and 2014. Arq Bras Cardiol 2015; 105(6):573e579.

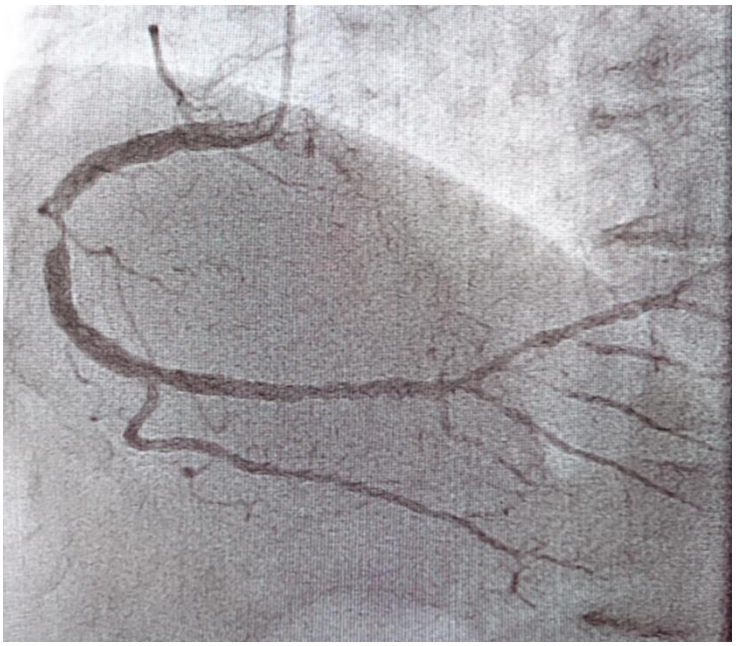
Leopold JA, Faxon DP. Diagnostic Cardiac Catheterization and Coronary Angiography. In: Kasper D, Fauci A, Hauser S, Longo D, Jameson J, Loscalzo J.eds. 'Harrison's Principles of Internal Medicine, 19e. New York, NY: McGraw-Hill; 2015.

Balter S, Hopewell JW, Miller DL, et al. Fluoroscopically guided interventional procedures: a review of radiation effects on patients' skin and hair. *Radiology*2010;254:326-41.

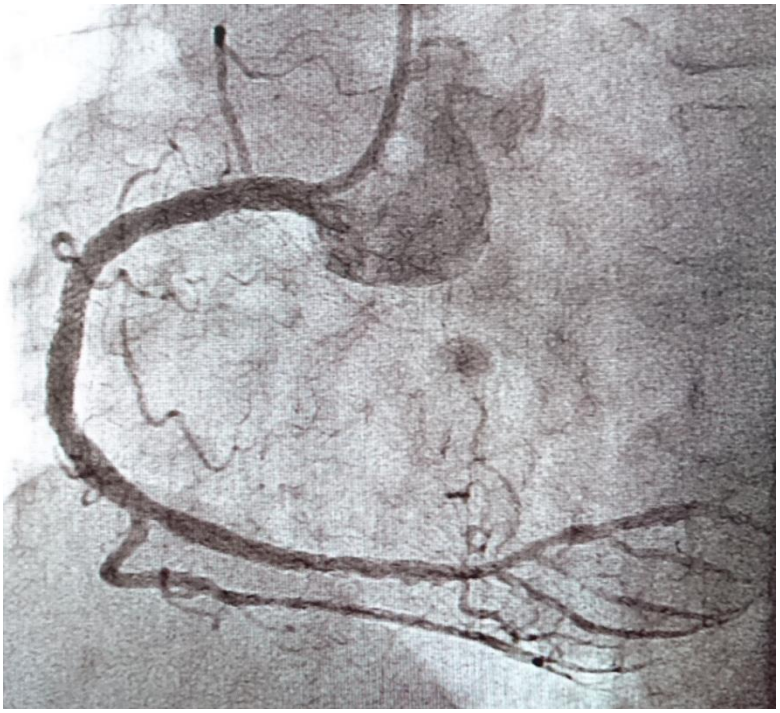
Appendix:

Anex(1): Ap caudal view of 45 yrs female patient DM show normal left Coronary Arteries.

Annex(2): Image show normal Right coronary Arteries of the same patient in annex(1)

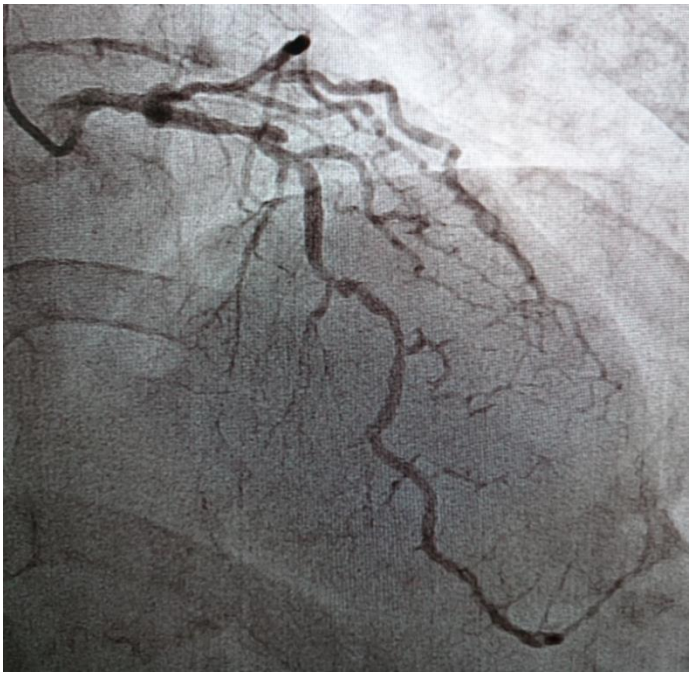


Anex(3): 71 yrs old DM patient with poor control image show (97%) Stenosis at the mid of R.t Coronary Artery.

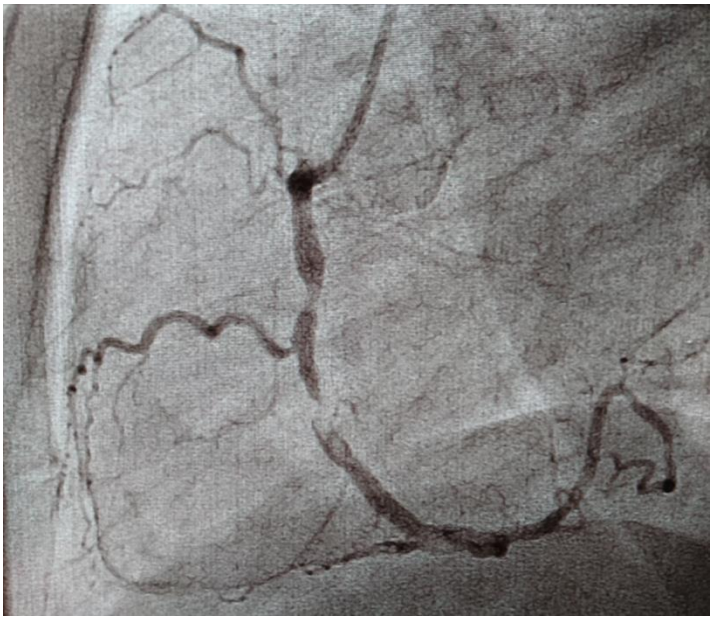


Annex(4): image show R.t coronary Artery of the same patient [annex 3] After PCI procedure and Stent indused.

Annex (5)

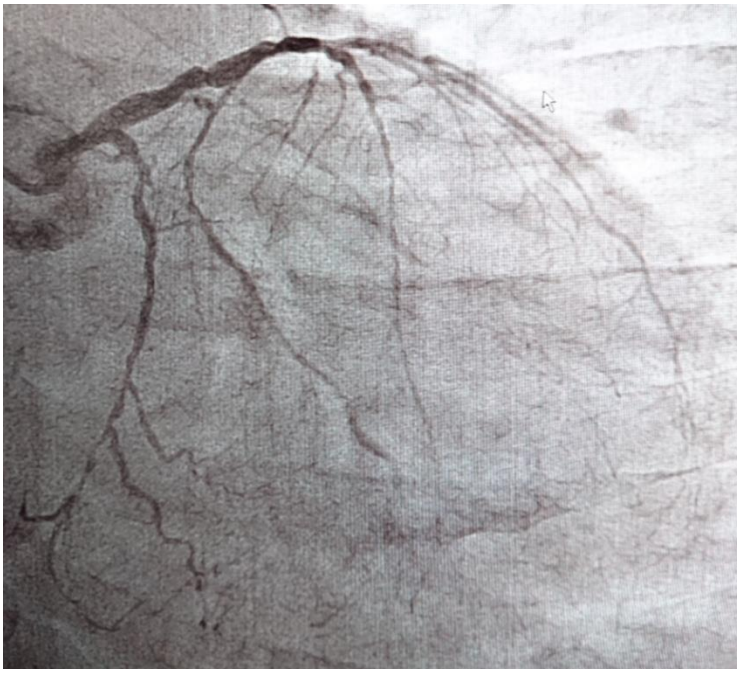


Annex (6)

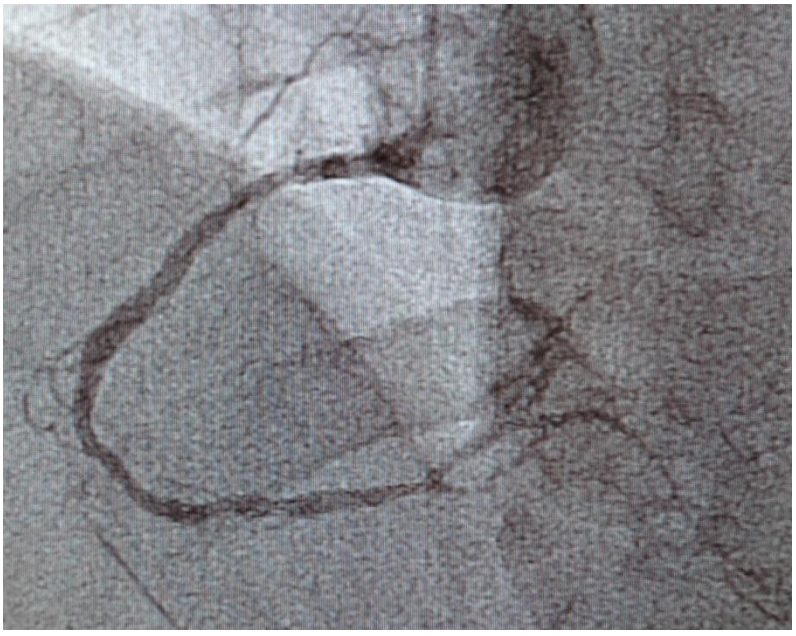


Annex (5,6): 68 yr old male p.t DM l images show diffuse three vessles disease in left coronary arteries (LAD,LCx) [annex 5] and (RcA) [Annex 6] treated by CABG.

Annex(7):



Annex(8):



Annex(7,8): 74 yrs old male DM with bad HBA1c conrol Image show occluded LCx and severe three vessles disease for medical treatment .

Sudan university for science and technology

College of Graduate Studies

Questionnaire

Nationality : Sudanese

Personal data:-

Age:-

1-30-39 ( )

2-40-49 ( )

3- 50-59 ( )

4-60-69 ( )

5-70-80 ( )

Sex:-

1-Male ( )

2- Female ( )

Investigation:-

HAB_1c:-

1- control( )

2- un control( )

Troponin:-

1- positive ( )

2- negative ( )

ECG :-

1-STEMI ( )

2-Non STEMI( )

3- Un stable angina ( )

4-Normal ( )

control ( ) 2- un control ( )

diabetic without other risk factor :-

1- control ( ) 2- un control ( )

diabetic with other risk factor :-

1- HTN ( )

2- Dyslipidemia ( )

3- smoking ( )

control ( ) un control( )

Cath lab result :-

1-Normal ( )

2-1vessel disease( )

3-2vessel disease ( )

4- 3 vessel disease ( )

Mode of treatment :-

1-Medical treatment ( )

2- PCI ( )

3- Coronary artery bypass graft ( )

Consent form:

موجهات اقرار الشخص الخاضع للبحث

انا الباحث / مصعب بابكر علي أحمد

طالب في كلية الدراسات العليا برنامج ماجستير الأشعه التشخيصية

التـــــــابع الـــــي جامعـــة الســـودان للعلوم والتكنلوجيا ببحـــث عـــن .....

.....

.....بمستشفي رويال كير العالمية وقد تم اختيارك ضمن عدد من المشاركين حتي نتمكن من معرفة المشكلة ونضع لها الحلول .

سنطرح عليك بعض الاسئله ونقوم بالاطلاع علي ملفك الطبي ونؤكد علي سرية المعلومات الخاصة بك ولن يطلع عليها غير الباحث المعني ولجنة البحوث والاطراف الذين لهم علاقة مباشرة بالبحث ونود اعلامك ان مشاركتك في البحث طوعية ورفضك في المشاركة لا يفقدك حق الاستفادة من النتائج .

اذا كان لديك اي تساؤل يمكنك التفضل بطرحه في اي وقت .