Prevalence of Dyslipidemia in Diabetes mellitus type2, Obesity and Hypertension

A THESIS

Submitted in partial fulfilment of the requirements of the

Degree of Master of Science

By

INDU BALA

Registration No. 11310823

Department of Paramedical Science

Lovely Faculty of Applied Medical Sciences

Lovely Professional University

Punjab, India

May 2015

RECOMMENDATION

This is to certify that ***Ms. Indu Bala*** bearing regd. No. ***11310823*** has completed her Msc project titled ***"Prevalence of Dyslipidemia in type 2 Diabetes Mellitus, Obesity and Hypertension"*** under my guidance and supervision. This report is record of the candidate own work carried out by her under my supervision. I certify that the matter embodied in this report is original and has been not submitted anywhere for the reward of any other degree.

Date: *Dr Pranav Kumar Prabhakar*

Place: LFAMS, LPU Punjab

CERTIFICATE

This is to certify that Ms. Indu Bala bearing regd. No. 11310823 has completed her MSc project titled ***"Prevalence of Dyslipidemia in Diabetes mellitus type 2, Obesity and Hypertension"*** under my guidance and supervision. This report is record of the candidate own work carried out by her under my supervision. The matter embodied in this report is original and has been not submitted for the reward of any other degree.

The project report is fit for the submission and the partial fulfilment of the conditions for the award of MSc. Clinical Biochemistry.

Date: Mrs. Monika Chadha

Place: (HOD), Biochemistry

Acknowledgement

First and foremost I would like to praise and thank the Almighty for blessing me with Good will which has enabled me to complete this project successfully. I would like to express my sincere thanks and deep sense of gratitude to Dr. Monica Gulati, Dean and Mr. Gurinder Singh Head, School of Paramedical Sciences, Lovely Professional University- Punjab.

My heart full thanks to the whole management team of "Satguru Partap Singh Hospital" and especially to Mrs. Monika Chadha who has guide me during my training period.

I am thank full to Dr. Pranav Kumar Prabhakar, School Of Paramedical Sciences, Lovely Professional University- Punjab for the inspiring guidance, useful discussion, support, Valuable suggestion and constant encouragement throughout my project. For the encouragement thorough out the course of work and valuable suggestions I am thankful to other members of the faculty Dr. Anania Arjuna**,** Dr. Nasib Singh, Dr. Ekta Chitkara, Mr. Naresh Kumar, Mr. Harpreet Singh, Mr. Himal Sapota School of Paramedical Sciences, Lovely Professional University-Punjab. Last but not least, I am very much thankful to my dearest, beloved friends who all made this project to be successful.

Place: LPU, Punjab (Miss. INDU BALA)

Date:

Prevalence of Dyslipidemia in Diabetes mellitus type2, Obesity and Hypertension

Abstract

Objectives: To study the prevalence of Dyslipidemia in diabetes mellitus type 2, obesity and hypertension. ***Background:*** - Dyslipidemia is the major cause of mortality and morbidity, lipid alterations are occurred in Dyslipidemia, it is most commonly defined as the impaired level of lipoproteins in blood like high levels of LDL, VLDL, Total cholesterol, Triglycerides and low level of HDL. The most common causes are diabetes mellitus type2, obesity and hypertension. There are many of mechanism by which the Dyslipidemia is occurred. ***Material and methods:-*** In this study the total 80 subjects are taken who have different type of complications like diabetes mellitus type 2, obesity and hypertension. There are 52 males and 28 females out of 80subjects. Subjects are divided into 3 groups; diabetic group, obesity group and hypertensive group. After that the lipid profile and fasting blood sugar is done after 12 hrs overnight fasting. Other things are also noted down like BMI, height, weight and their eating habits. ***Result:-*** After the analyzing of lipid profile the results are following:- out of 80 patients there are 32[40%] diabetic patients who have Dyslipidemia or altered lipid profile, 31[38.7%] obese subjects who have Dyslipidemia and 17[21.3%] hypertensive subjects who have Dyslipidemia. ***Conclusion: -*** Conclusion of the study is that the diabetic's patients who have type 2 DM [Group1] and the obese peoples [Group2] are more prone to cardiovascular disease compare to hypertensive subjects [Group3]. And also the study shows that the males are more prone than females for cardiovascular diseases.

CHAPTER 1

INTRODUCTION

1. Introduction

1.1. Dyslipidemia

Dyslipidemia is disorder of lipoprotein metabolism, including overproduction of lipoproteins or deficiency of lipoproteins in the body.

They may revealed as one or more of the following: - elevated total cholesterol, low density lipoproteins (LDL), and triglycerides or as decreased high density lipoproteins (HDL).Abnormalities in lipoproteins is very commonly seen in type2 diabetes mellitus pateint and also in cardiovascular diseases. [Grundy SM et, al. 2004]

Atherogenic Dyslipidemia is characterized by three lipoprotein abnormalities; elevated VLDL, small LDL and decreased HDL cholesterol levels [Grundy, S.M 1998]. Dyslipidemia is widely accepted risk factor for Coronary heart disease. Myocardial infarction is also one of the disorders which are caused by Dyslipidemia due to increase TG and decrease HDL cholesterol (reverse transport cholesterol).

1.1.1. Types of Dyslipidemia

a.) Primary Dyslipidemia

b.) Secondary Dyslipidemia

a.) Primary Dyslipidemia: - Primary Dyslipidemia is most commonly due to overproduction of lipoproteins or the insufficiency or decreased in clearance.

b.) Secondary Dyslipidemia: - Secondary Dyslipidemia is caused by the different disorders like hypothyroidism, nephritic syndrome, obesity, diabetes mellitus, glycogen storage disease, and alcohol and beta blockers.

1.2. Lipids

Lipids are organic solvents relatively insoluble in water, soluble in organic solvents such as alcohol and ether. Lipids are of great importance to our body as the chief concentrated storage form of energy, besides their role in cellular structure and various other biochemical functions.

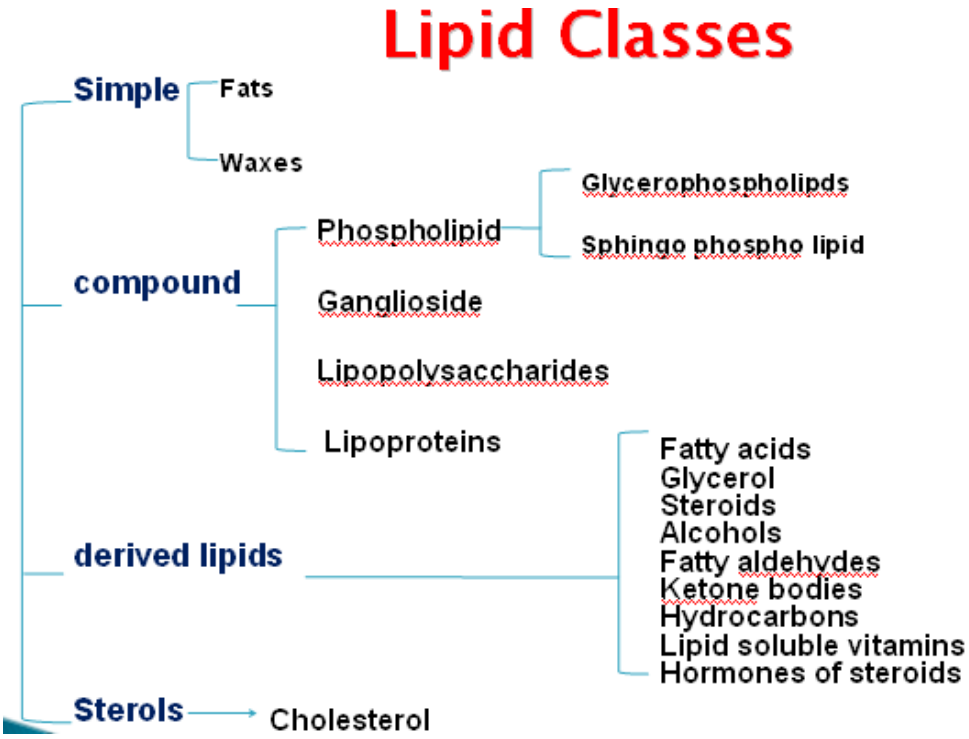
Lipids are divided based on their different properties, including their ability for saponification, their chemical composition and their building blocks.

Hydrolization of lipids like glycerol and fatty acids by basic solutions is known as saponification.

If we can divide lipids according to their chemical composition, lipids are simple lipids and compound lipids. Simple lipids contain one or two different compounds and compound lipid contain three or more type of chemicals.

According to building blocks classification lipids are divided in to 8 categories include fatty acids, glycerolipids, glycerophospholipids, sphingolipids, saccharolipids and polyketioes are derived from ketoacyle subunits and sterol lipids and phenol lipids derived from isoprene subunits. [4]

1.2.1. Classification of lipids



1. ***Figure 1 is show the classification of lipids***

1.2.1.1. Cholesterol

Cholesterol is essential for growth and viability of cells, because cholesterol is also present in the cell membrane along with the glycerophospholipids and and sphingomyelin[*Lev S 2012]*. Choleterol is the precurser for many steroidal hormones and it is very important sterol. We can obtained cholesterol from our diet and also obtained by the denovo pathway in body by liver[*Soccio RE, Breslow JL 2004]*.

1.2.2. Lipoproteins

Lipoproteins are the complex of lipids and proteins. They are the biochemical transporters for lipid transportation. We all know that lipids are insoluble in water due to this the lipids are not transported by itself. Lipoproteins help to transportation of TAGs and cholesterol between the liver, asipose compartment and tissues[*Dashti M et, al.2011]*.

Lipoproteins are spherical complex particles made up of hundreds of lipids and protein molecules. Protein part of lipoprotein is also know as apolipoproteins which are present on the surface due to theie water soluble nature. The cholesterol and TAGs are present in the intra hydrophobic part[*Hoofnagle AN et,al. (2009), Tzen JT, et,al.(1992)*]

If we discuss about the lipid part of the lipoprotein that includes TAG, free cholesterol, cholesterol ester and phospholipids like phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol and sphingomyelin[*Mahley RW et,al.1984]*.

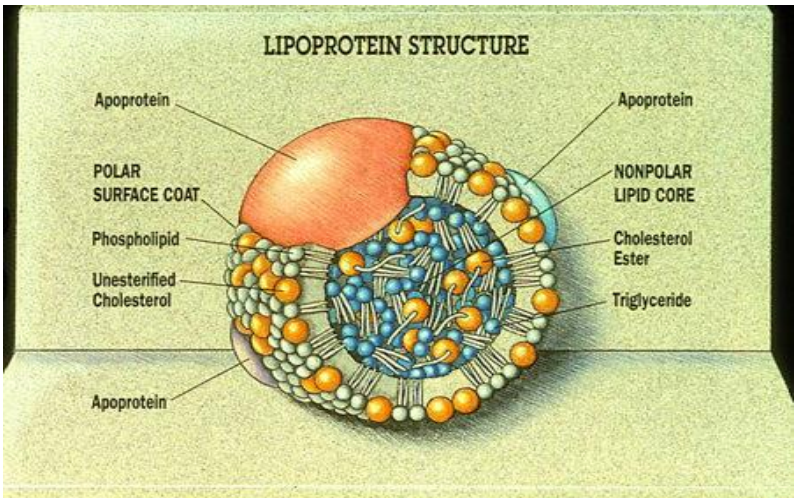


Figure 2:- show the lipoprotein structure

Apolipoprotein

Protein part of the lipoprotein is known as apolipoproteins. They are very important because due to the apolipoproteins the lipids are transported by lipoproteins. They are present on the surface of lipoproteins and it can interact with both lipid and water.Apolipoproteins are

different types like ApoA, ApoB, apoC and ApoE. The different lipoproteins contain different types of apolipoproteins.

1.2.2.1. Classification of lipoproteins

Lipoproteins are classified into 5 major categorised on the basis of their density and diameter they contain.

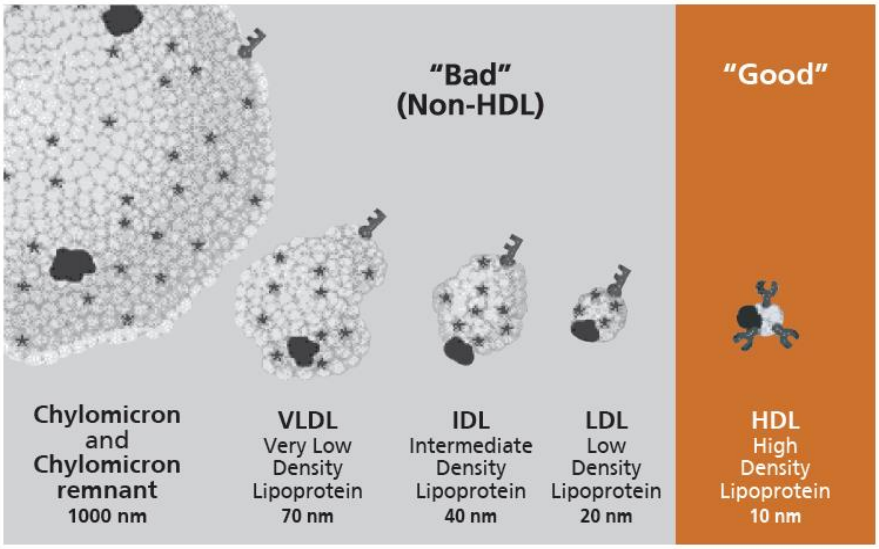


Figure 3:- it shows about the density of lipoproteins

Human plasma lipoproteins					
	chylomicron	VLDL	IDL	LDL	HDL
Density (g/ml)	0.95	0.950–1.006	1.006–1.019	1.019–1.063	1.063–1.210
Components (% dry weight)					
protein	2	7	15	20	40–55
triglycerides	83	50	31	10	8
free cholesterol	2	7	7	8	4
cholesteryl esters	3	12	23	42	12–20
phospholipids	7	20	22	22	22
Apoprotein composition	A-I, A-II, B-48, C-I, C-II, C-III	B-100, C-I, C-II, C-III, E	B-100, C-I, C-II, C-III, E	B-100	A-I, A-II, C-I, C-II, C-III, D, E
Source: From Christopher K. Mathews, K.E. van Holde, and Kevin G. Ahern, *Biochemistry* , 3rd ed. (2000), Table 18.1.					

Figure 4:- this figure is show about the human plasma lipoproteins and their contents

1. Chylomicrons

Chylomicrons are the largest and least dense lipoprotein and transport exogenous lipid or newly formed TAG from the intestine to all cells. Chylomicrons contain apoB48[*Rivellese AA,et.al 2004]*

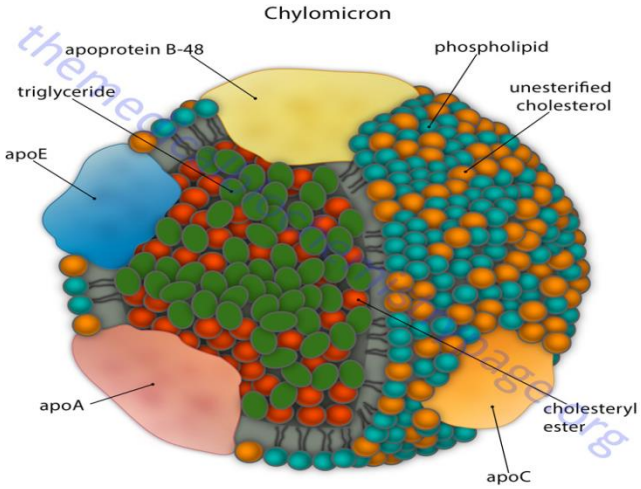


Figure 5 :- Shows the structure of Chylomicrons

2. VLDL (very low density lipoproteins)

The function of the VLDL is transport endogenous lipid from the liver to cells. VLDL containing Apo B100. [*Rivellese AA,et.al 2004]*

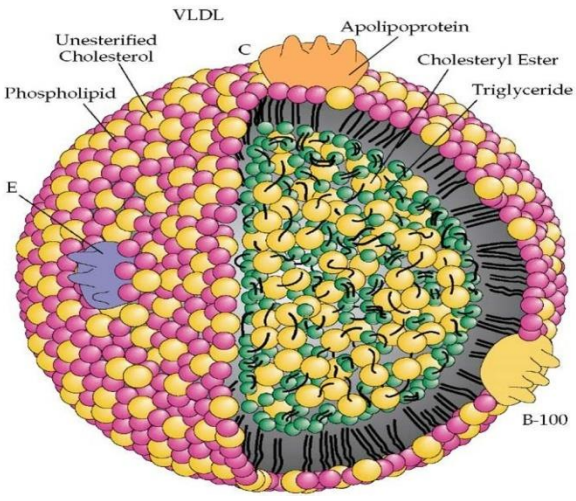


Figure 6:- shows about the structure of VLDL lipoprotein

3. ***IDL (intermediate density lipoprotein):***IDL is not normally present in plasma; it is formed during the conversion of VLDL to LDL.

4. ***LDL (low density lipoprotein)***

Low density lipoprotein is also known as *bad cholesterol* because their transport cholesterol from liver to various tissues. LDL is smaller than VLDL and it contains apo B100[*Bijlsma MF,et,al.2006*]

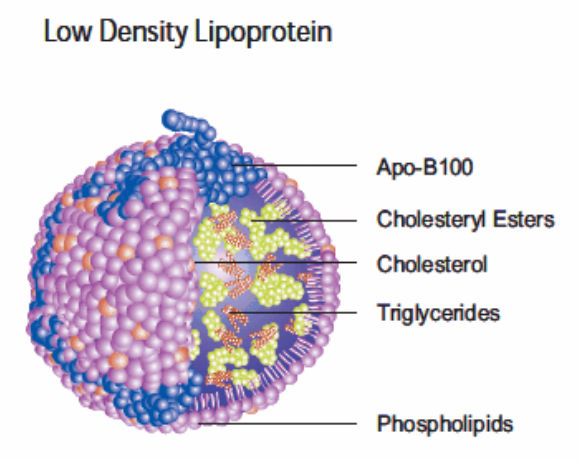


Figure 7: it shows the LDL lipoprotein structure

5. ***HDL (high density lipoprotein)***

HDL is smallest and very dense lipoprotein; it is also known as *good cholesterol* because it involves transporting cholesterol from tissues to liver (reverse cholesterol transportation). HDL has antiatherogenic effect and protective effect in body. [*Mulay V, et,al.2012*]

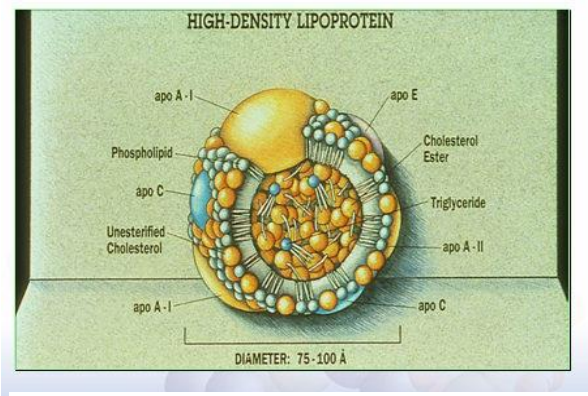


figure 8 :- shows the HDL structure

1.2. Metabolism of lipoproteins

Lipoprotein metabolism is of three types according to the origin of lipids.

1. Exogenous (dietary) pathway

2. Endogenous pathway

3. Reverse cholesterol transport [*Rivellese AA, et.al 2004]*

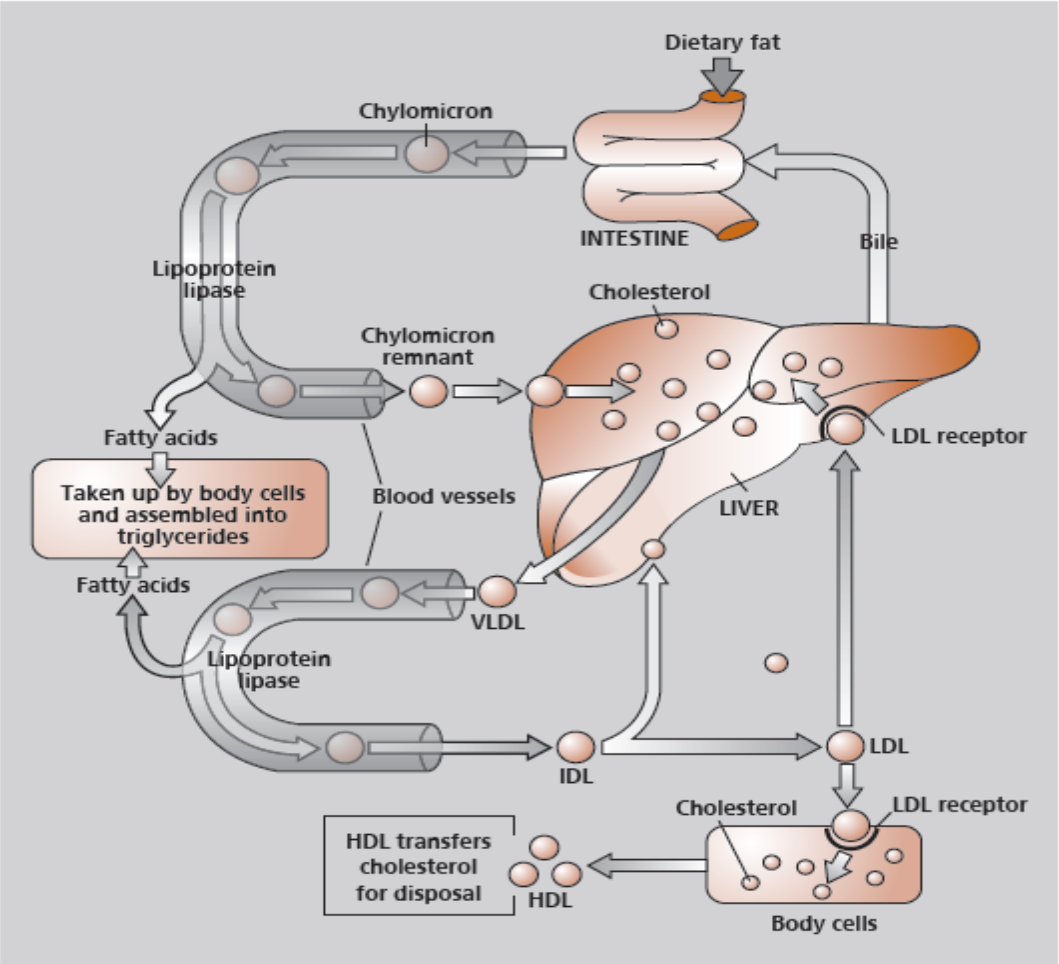


Figure 9:- shows about the pathways of lipoprotein metabolism

1.2.1. Exogenous (dietary) pathway

In the exogenous lipoprotein pathway, the lipid component of the lipoprotein is synthesized from dietary lipids by the intestine.If we discussed about the exogenous pathway of lipoprotein metabolism, the dietary lipids cholesterol, TAGs and phospholipids are digested

and absorbed by intestinal epithelium and from here the apoB48, apoA-1, apoA-2 and apoA-5 assembled to make nascent chylomicrons.

After this the nascent Chylomicrons are secreted to lymphatic vessels and by the subclavian vein released into the circulation. For the maturation of the nascent Chylomicrons, HDL delivers their apolipoproteins {apoC-2 and apoE} to nascent Chylomicrons.

In the blood, circulating Chylomicrons interact at the capillaries of adipose tissue and muscle cells releasing Tg to the adipose tissue to be stored and made available for the body`s energy needs. This process is done by the activation of endothelial LPL in the presence of phospholipids and cofactor apoC2. TAG hydrolysis to glycerol and free fatty acids are released, fatty acids are consumed for energy or stored by tissues and the glycerol is returned to kidney and liver converted to glycolytic intermediates and the apoA, apoC and phospholipids of the mature Chylomicrons is back to HDL. [*Adiels M, et,al,2008*, *Mahley RW et,al.1984*, .*Sarwar N,et,al.2007*]

1.2.2. ***Endogenous pathway***

In the endogenous pathway of lipoprotein metabolism, liver plays very important role. In the endogenous pathway VLDL is synthesized by liver.

In the liver apoB 100 is the main constituents which is maintained the assembly of cholesterol and intracellular TAG and delivered to the circulation[*Frayn KN (1998)]*.

VLDL contains cholesterol, cholesterol ester, apoB-100, apoC-1, apoC-2, apoC-3 and apoE. ApoE and apoC-2 is again delivered by HDL similar as in case of Chylomicrons [*Murdoch SJ, Breckenridge WC (1995), Murdoch SJ, et,al(1996)*].

After the Hydrolization of TAG is done by the LPL. FA and glycerol is released and also the loss of apoC from VLDL. ApoC is back delivered to HDL.After the Hydrolization and loss of

apoC the VLDL is converted into remnant VLDL which is also known as IDL (intermediate density lipoproteins) which have apoB-100 and apoE. IDL is the intermediate between VLDL and LDL.

The fate of some of the IDL particles require them to be reabsorbed by the liver again (by LDL receptor); and the other IDL particle is hydrolyzed by hepatic triglyceride lipase and loss of apoE to make LDL. ApoE is again back delivered to HDL.LDL has apoB100 and the main function of LDL is the transport the cholesterol from liver to other tissues. LDL has less affinity to bind with its receptor in liver because of lack of apoE.

1.2.3. Reverse cholesterol transport

RCT (Reverse cholesterol transport) is refers to the process by which cholesterol is taken from various tissues to back liver and it is done by HDL (high density lipoprotein).HDL is synthesized in the liver and small intestine [*Genrest J.1990,* Genrest J.1990].

It contains cholesterol, cholesterol esters and contains apo-A,apoA-1,poC-1,apo-2 and apoE and the enzymes including glutathione peroxidase1,platelet activating factor acetylhydrolase (PAF-AH), lecithin cholesterol acyltransferase (LCAT), cholesterol ester transfer protein (CETP) and sphingosine-1-phosphate (S1P).GPX,PON1 and PAF-AH having antioxidant activities.

Cholesterol esters are transferred to LDL and VLDL by HDL with the activity of CETP and its reverse cholesterol transport activity. When the TAG is transferred from VLDL to LDL then automatically the conversion of VLDL to LDL doing transfer cholesterol ester to hepatocytes by LDL receptor [Gotto A, 1999].

1.3. Alteration in lipoprotein metabolism

Alteration of lipoprotein metabolism causes many disorders. The most common disorder is Dyslipidemia.

1.3.1. Dyslipidemia in diabetes mellitus:-

Diabetes mellitus is group of metabolic disorders which can be characterized by increased blood glucose level due to low insulin secretion or insufficient insulin or both[*American Diabetes Association, 2005]*. Diabetic Dyslipidemia is defined by the increased level of triglycerides level, low high density lipoprotein (HDL) and also the low level of low density lipoprotein.

The type2 diabetes mellitus patients have more risk of CVD with atherogenic Dyslipidemia. The main cause of diabetes mellitus is either less insulin production or insulin is produced but it is not able to perform their function. In the both condition glucose level of blood is high and causing more thirst and more urination.

Diabetes is mainly of two types: -

a.) Insulin dependent diabetes mellitus or type 1 diabetes mellitus

c.) Non- insulin dependent diabetes mellitus or type 2 diabetes mellitus

a.) Insulin dependent diabetes mellitus or type 1:- This type of diabetes mellitus is caused when the beta cells of Langerhans are most of destroyed or all destroyed. Due to this the insulin is not produced or very small amount is produced.

b.) Non- insulin dependent diabetes mellitus or type 2:- Non- insulin dependent diabetes mellitus is also known as type 2 diabetes mellitus. In type 2 DM either the insulin is not produced by the cells or the insulin which is produced do not perform their function or

less effective. 90% of the diabetics are non- insulin dependent or type 2 diabetes mellitus [*Chatterjee M N and Shinde R 2005]*.

In the diabetes mellitus patients very large amount of fatty acid transport to the liver, when the fatty acids are entered into liver they are re-binding with triglycerides and make VLDL or secreted as VLDL. These are lipoproteins abnormalities caused due to defect in insulin action which leads to hyperglycaemia [*Taskinen MR2002*]. In these days the patients who have diabetes, the lipid profile is check in these patients and this is known as standard diabetic care []. Many organs of the body is affected by the diabetes but more prone areas are kidney [diabetic nephropathy], eyes, heart [CVD] and also blood vessels [*Shera, A.S., et,al2007*]. But if we discussed about the heart related diseases or CVD in diabetes mellitus. Coronary artery disease and myocardial infarction are the most common and the cause of death in patients with diabetes mellitus type2 in worldwide [*Roberto, T2006*]. If we discussed about the population who have diabetes mellitus, At least 61.4 million Indians peoples are affected with 12.4% prevalence, hypothetically says in the 2030 the diabetic patients population is 80 millions in India which is Capital diabetic area in world. In the entire world 347 million peoples are affected with diabetes mellitus with 10% of prevalence. 90% of patients having type2 diabetes mellitus. If we can say about mortality rate that is 1.2 million peoples died in 2008[].

1.3.1.1. Pathophysiology of Dyslipidemia in diabetes type 2

Now we discuss about the mechanism by which the diabetic Dyslipidemia occurs. In the presence of adequate glycogen stores increased free fatty acids in liver stimulate the production of TG. Because of triglycerides production automatically secretion of apolipoprotein B is stimulated and also VLDL cholesterol [*Mooradian, A.D (2008)]*.

The cause of atherogenic Dyslipidemia is accumulation of free fatty acid from the fat cells which is insulin resistant. [*Taskinen, M.R. (2003),. Krauss, R.M. & Siri, P.W. (2004), Chahil, T.J. & Ginsberg, H.N. (2006).*]

When the fat cells become insulin resistant it leads to accumulation free fatty acids and hepatic VLDL cholesterol production is also enhanced [*Frayn, K.N. 2001*] because of this the hepatic fat also accumulate [*Adiels, M.,et,al.2007*] When the VLDL an triglycerides level is increased, the HDL level is decreased but also the small dense LDL concentration is increased.[*Mooradian, A.D (2008*]

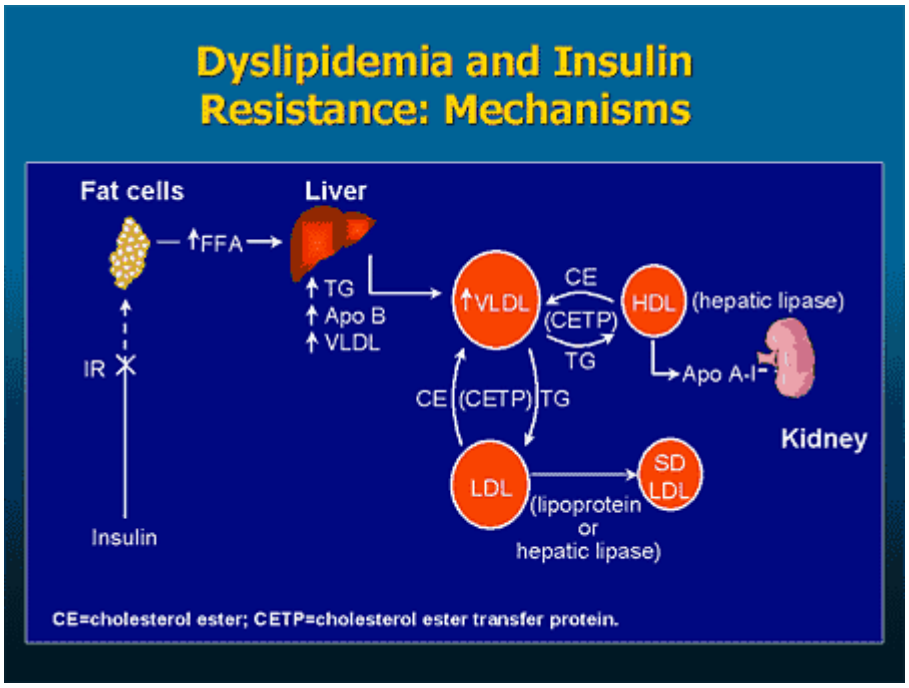


Figure 10:- it shows the mechanism of Dyslipidemia in diabetes

1.3.2. Dyslipidemia in obesity

Excessive or accumulation of fat deposit in body is known as obesity, it causes adverse or harmful effects on body. Obesity has become a major health cause worldwide. In every country, obesity is increased day by day.

Obesity causes many adverse or atherogenic disorders like diabetes mellitus type2, hypertension, insulin resistance, non alcoholic fatty liver and also Dyslipidemia. These all conditions are occurred in obesity (especially in central obesity). Obesity is also main cause of all cardiovascular diseases. [*Boden, G.2011*, *Zalesin, K.C.et, al.2011*]

In the typical Dyslipidemia of obesity is defined as accumulation of TG and free fatty acids, also decrease HDL cholesterol and its functions. LDL cholesterol may be normal or slightly increased with accumulation of small dense LDL. Apo lipoprotein B is also increased same as like we discussed in diabetes Dyslipidemia. Apo lipoprotein is increase due to the hepatic overproduction of VLDL lipoprotein which is containing apoB[*Franssen, R.et, al.2011*, *Wang, H, et,al 2011*]

Now we can discuss about how to check whether the person is obese or not. The most common method or parameter is used to check obesity is BMI [Body mass index]. BMI is a ratio of weight in kg and height divided by meters squares [kg/m2].[*Willett WC,et,al.1999*]

If we discuss about abdominal obesity it is check by easy method that is waist to hip ratio [WHR].

If BMI and WHR are both combined used [one is for generalised obesity and other is for abdominal obesity] it can better identified people which have risk of CVD.[*Ardern CI et,al 2003*, *. Meisinger C.et, al.2006*]

These all are about the obesity, but if we discuss about the genetics behind obesity that is Ob gene.

Ob gene is located on 6th chromosome and expressed in adipose tissue. Leptin is a product which is obtained from Ob gene. In the lateral or third ventricle of the brain the leptin is introduced, it is responsible for feeling of fullness, reduced weight. So if any mutation takes place in Ob gene that is also a major cause of obesity.

Sr.no.	***BMI [body mass index]***	***Category***
1	*Less than 18.5*	*Underweight*
2	*18.5 to 25*	*Normal*
3	*25 to 30*	*Overweight*
4	*Up to 30*	*Obese*

1.3.2.1. Pathophysiology of Dyslipidemia in obesity

We all know the Dyslipidemia is defined by the increased level of TG, small dense LDL and decrease in HDL cholesterol. The major cause of the abnormalities in lipid is hypertriglyceremia and it will cause late clearance of the lipoproteins which are TG-rich and also small dense LDL. [*Patsch, J.R.*,al 1992, *Capell, W.H,et,al. 1996*]

These all abnormalities are occurred due to impaired activity of LPL. By the suppressed mRNA expression the level of LPL is impaired.[*Clemente-Postigo,et,al.2011*], and also the activity of LPL is reduced in skeletal muscles. Between the VLDL and Chylomicrons the lipolysis competition takes place [*Klop, B.; et, al.2012].* Free fatty acids are also increased due to accumulation of postprandial lipemia from endothelial surface the LPL detachment takes place [*Peterson, J.; et, al1990*, *Karpe, F.;et,al. 1992*].

But if we discuss about the VLDL and IDL, the LPL activity may remain attach and involved in further TG depletion. CETP and hepatic lipase is also involved in this process. Due to excessive free fatty acids enter in the liver and it increases the hepatic production of VLDL [very low density lipoprotein]. After that when the VLDL is exchange by enzymatic with lipoprotein like HDL and LDL via CETP protein.

Due to this lipolysis of TG rich protein the HDL particles become small and also metabolized and excreted through kidney. When it excreted through kidney, the level of HDL is decrease in body. But LDL is also become small and dense when they are interacting with lipases. When again and again VLDL are lipolysis by lipases and become remnants of VLDL, which are atherogenic [*Tchernof, A.et,al.1996*].

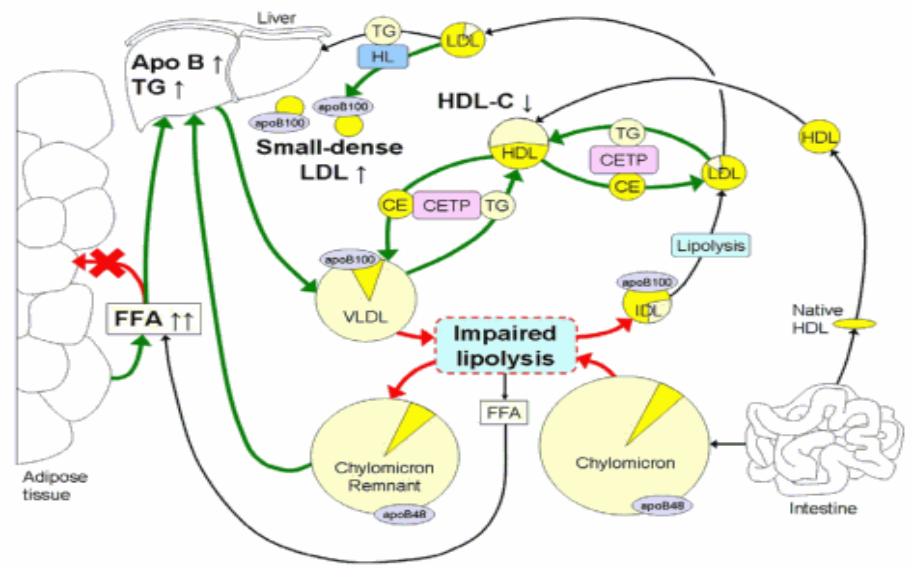


Figure 11:- it shows about the mechanism of impaired lipoprotein metabolism in obesity

1.3.3:- Dyslipidemia in hypertension

Hypertension is also known as high blood pressure. Hypertension is also the major contributor for the cardiovascular disease. Our dietary habits and other atherogenic factors also can cause cardiovascular disease [*Kannel WB,et,al.1975*].Hypertension and Dyslipidemia both are the major contributors for the cardiovascular disease [*Mc Mohan SW 1986*, . *Ross R,1986*]. The mechanism by which hypertension and Dyslipidemia both are associate is not fully understood [*Dzau VJ,1986*] several mechanism is here by which the Dyslipidemia causes the hypertension (increase blood pressure). The first mechanism is the atherosclerosis which is caused by Dyslipidemia:- it can cause the changing in structure and also it can decrease the

elasticity or flexibility of the large arteries when the elasticity of arteries is decrease it cause the narrowing of arteries and automatically the blood is passing through arteries with great pressure and causing hypertension.[*Chobanian AV.1983*] We all know about Dyslipidemia:- in case of Dyslipidemia in hypertension the lipids level is also altered. The same alterations occurs:- low level of high density lipoprotein {HDL} , accumulation of TG level, high level of low density lipoprotein, high total cholesterol level and also high level of VLDL cholesterol[*Sacks FM,et,al.1986*, *. Dzau VJ,et,al 1989*, *Leren JP.1985*,].

1.3.3.1:-Pathophysiology of Dyslipidemia in hypertension

Dyslipidemia causes hypertension by the changing in vasomotor activity. Dyslipidemia cause cardiovascular disease by changing the vasomotor activity and also by the endothelial damage.[*Nickenig G,2002*, *Nickenig G,et,al.2002*] Platelet functions also involved in this process with indirectly or directly involvement of lipids[*Dzau VJ.,1989*, *Chobanian AV,1983*]. Major cause of hypertension is alteration in the deposition or metabolism of lipoproteins, it may be also cause if any problem occurs during lipoprotein clearance. Due to the deposition of the lipoprotein or late clearance cause deposition in blood vessels. A protein across in the vessels is also greatly enhanced in case of hypertension [*Chobanian AA*, et.al 1986]. We all know that the LDL [low density lipoproteins] is bad cholesterol because it takes fat from liver and deposit in tissues and blood vessels. HDL is also the main lipoprotein which is directly involved in hypertension. Increase blood lipids or Dyslipidemia and high blood pressure [hypertension] is may be related genetically. Lipoprotein lipase is also involved in hypertension. Because the activity of LPL is also influenced the metabolism of lipoproteins. There are another factors are also involved in hypertension.

CHAPTER 2

REVIEW OF LITERATURE

Review of literature

1. ***M.Nakhjavani et.al [2006] did work on topic Dyslipidemia in type 2 diabetes mellitus:*** More atherogenic lipid profile in women. In this study they did compare of lipid profile between men and women, which are suffering from diabetes mellitus type 2.

During this study they are taken 350 patients which are having diabetes mellitus type2 [250 women and 100 men] between the age of 19-82 years. They were performing serum lipoproteins from these 350 patients. The treatment of DM type2 is same in both men and women respectively. During this study they will also check the BMI [body mass index], blood pressure of the patients. The conclusion of the study is that the women's have higher BMI. Blood pressure comparing of men's which are same age group. Women's have also higher level of lipids:- total cholesterol [233.7 vs. 190.3], Tg [219.7 vs. 180.6], LDL [141.2 vs. 116.1], HDL [47.1 vs. 39.4 mg/dl] and non HDL [186.1 vs. 150.8].

From this study the conclusion is that the women's are more prone to cardiovascular diseases than men which are having DM type 2.

2. ***Sapna smith et.al. [2009] did study on the topic "a study on lipid profile levels of diabetics and non-diabetics among Naini region of Allahabad, India"***. In this study the total 60 patients were taken out of these 60 patients, 30 were volunteers [15 men and 15 women] which are having normal blood sugar level [also selected as control]{group 11}. The other 30 patients [15 men's and 15 women's] 1{group 1} were taken having high sugar level or diabetics. After that the lipid profile is done of these all patients. The conclusion of the study is that the diabetic patients [group 1] is having higher lipids level than the non-diabetics or volunteers [group2]. They are also done comparison between diabetic male and diabetic females lipid profile. The diabetic male having higher lipid profile with comparison of female

diabetic pateint. Hypercholestremia, higher level of TG and lipoproteins are the main abnormality in diabetic which is the risk factor for CVD.

3. ***Narasimhaswamy K N et.al [2008] study on topic of ''A study of Dyslipidemia in type 2 diabetes mellitus''.*** This study was done in district hospital Shimoga Institute of Medical Sciences, Shimoga between the years of 2006 to 2008. In this study total 120 persons were taken; 60 confirmed type2 DM patients [35 males and 25 females] between the age of 30-60 years and the remaining 60 patients are healthy control which are having same age and sex [35 males and 25 females]. The 60 persons who are taken as control, they all have not history of diabetes, atherosclerosis, and thrombotic disease. No one had history of smoking or any diseases like neuropathy, nephropathy. The 60 patients which are confirmed type2 DM had do not take any oral drug of diabetic or any cholesterol lowering agents. The sample of blood which are taken of diabetic patient is postprandial glucose level <200mg%. During this also check the lipid profile of all patients which are diabetic and non-diabetic. This study is conclude that the BMI, glucose level and lipid profile is significantly high in diabetic patients but HDL level is low.

4. ***Syed Yasir Hussain Gilani et.al. [2010] did study on topic of "Gender differences of Dyslipidemia in type2 DM".*** The study is done at Ayub Teaching Hospital Abottabad from 27th may 2009 to 27th November 2009. Total 150 diabetic patients were taken in this study, out of 150 patients 80[53.33%] male and 76[46%] female patients. Diabetic patients having chronic renal failure, myxedema, family history of Dyslipidemia and also the patients which are taken drugs like thiazide, beta blocker, and glucocorticoids were not taken in this study. BMI and height are also check of all patients. After the checking of all lipids parameters the study conclude that out of 150 patients 87 patients have high cholesterol [43 males and 44

females], 124 out of 150 have increased level of serum TG [65 males and 59 females], 82 patients out of 150 having increased level of LDL [39 males and 43 females], 64% of patients have low HDL out of 64% [30% males and 70% females]. This is significant difference statically. Conclusion of study is that females have higher level of HDL which is risk factor for cardiovascular disease.

5. ***Khursheed Muhammad Uttra et, al. [2011] studied on topic of "Lipid Profile of patients with Diabetes mellitus".*** This study is done at combined military hospital and Liaquat university Hospital, Pakistan. In this study they were taken data of duration of 1year of patients having diabetes mellitus [type1 and type2]. OPD, IPD and COD mixed patients. Lipid profile [HDL, LDL, VLDL, Total Cholesterol and blood sugar level are analyzed during this study. In this study HbA1c level is also analyze to check the control or uncontrolled level of diabetes. During the study of six month period total 100 patients of diabetes mellitus were screening for the lipid profile. Out of 100 patients 72 [72%] were male and 28 [28%] females and 88 suffering from type 2 DM and the remaining 12 patients are type 1 DM. After the study the conclusion is that the lipid profiles abnormalities are present in type 2 DM higher than the type 1 DM. The majority of patients have uncontrolled diabetes [raised FBS and HbA1c]. Another thing is the diabetic males are more prone to risk for cardiovascular disease.

6. ***Samatha P.et.al.[2012] did their study on topic of " Lipid profile levels in Type 2 diabetes mellitus from the Tribal population of Adilabad in Andhra Pradesh, India".*** This study was conducted at Rajiv Gandhi Institute of Medical Sciences, Adilabad. For this study total 160 patients were taken having diabetes [80 males and 80 females] with the history of 10 years diabetes and 160 healthy subjects taken as control [80 males and 80 females] which all are

examined for Dyslipidemia and diabetes. In this study patients were not included which are having metabolic syndrome or disorders. During this study lipid profile of diabetic patients and healthy persons as check or evaluate. The conclusion of study is that the lipid profile and level of fasting blood sugar is significantly high in diabetics comparing to controls. it also shows that the HDL level is non-significantly low in females than males.

7. ***Arjola Zeqollari et.al. [2014] done their study on "Lipid profile in diabetes mellitus type2 patients in Albania and the correlation with BMI, hypertension and Hepatosteatosis".*** This study done at: Mother Theresa" University Hospital Centre during March 2014 to July 2014. In this study 102 total patients were taken in which all are having diabetes mellitus type2 [57 females and 45 were males]. The parameters which are done during this study is lipid profile, HbA1c and also check the BMI, waist to Hip ratio. So during the duration of 4 month the data is concluded that the females having higher BMI than the males [32.48 and 27.49]. This study shows that the 17.5 % patients having increase level of LDL, 28.5% having low HDL, 25.4% had increase level of total cholesterol and 51.9% having increased level of triglycerides. It shows that the females patients having significantly statically increased values of lipids then males.

8. ***Nitesh Mishra et, al. [2012] did their study on topic Central obesity and Lipid profile in North India Males.*** This study was conducted in the department of physiology, G.S.V.M. Medical College Kanpur from April 2009 to September 2009. In this study they were taken 60 males total. the person which have history of DM, Hypertension, CAD or those taking any lipid altering drugs were not taken in this study. In this study the groups were dividing in obese and non-obese according to their weight circumference and weight to hip ratio. After this the blood were taken after 12-14 hours fasting and analyze the lipid profile, total cholesterol, HDL, LDL, VLDL, TG. The normal or control values of lipid profile is total

cholesterol <200 mg/dl, TG <150 mg/dl, LDL-C <130 mg/dl and HDL-C >40 mg/dl were taken. After they evaluate the lipid profile and statistics done, they conclude that the obese patients have high lipid profile and low level of HDL then the non-obese subjects.

9. ***Ugwuja El et, al. [2013] studied on topic of overweight and obesity, lipid profile and atherogenic indices among Civil Servants in Abakaliki, South eastern Nigeria***. This study was approved by research and Ethics Committee of Federal Medical centre, Abakaliki. In this study total 205 subjects were taken out of 205 the 106 was males and 99 were females and they work in different ministries [health, public utility, works and transport, women affairs. justice, urban and rural development and youth and sports]. The analyzing parameters are lipid profile also check the BMI of subjects to check whether there were obese or not. According to the BMI 34.2% [70/205] were overweight and 6.8% [14/205] were obese. And the conclusion of study is that men's are more affected than females. 37.1% [76/205] are affected with increased cholesterol level, 37.1% [76/205] are affected with increased level of LDL, 6.8% [14/205] having increased Tg, 8.8% [18/205] were having reduced level of HDL-C and 10.7% [22/205] having elevated atherogenic index and 9.8%[20/205] were having coronary risk index. And also males having high BMI but lower LDL-C and higher HDL-C than females.

10. ***Roopam Bassi et, al. [2014] did their study on topic of A study of changes in obese and non-obese females with acne vulgaris. In this study there was total 150 subjects were taken with age of 14-30 years between***. And these 150 females' subjects divided into three groups of 50 each group contains. Group A consists of obese females with acne, Group B have non-obese females with acne and group C were taken as control who were non-obese and also without acne. This study was conducted at Dermatology OPD in Guru Ram Das Institute of Medical Sciences and Research, Amritsar. The BMI and WHR are also done to check whether the females are obese or not. All history was taken from subject like any

medications, medical status etc. During study the fasting blood sample is taken and analyzes the lipid profile of all subjects by different methods. The conclusion of study is that the BMI of Group A [35.50+_ 3.20] was more than Group B [21.34+_2.37 & group C [21.32 +_ 2.59] significantly variations is found. But there is significance different between group B and C. And the lipid profile level was increased more in Group A compare to group B. The level of HDL was low in Group A and Group B compare to Group C. Conclusion is yes the Acne Vulgaris is association with alteration in lipid with marked in obese subjects.

11. ***Agu Chidozie Elochukwu et, al. [2015] did study on topic of evaluation of fasting lipid profile and glycated haemoglobin in obese subjects at university of calabar teaching hospital, Nigeria.*** In this study they were taken 70 obese persons, out of 70 [30 were males and 40 were females] with the age duration of 20-45 years. BMI of obese subjects is more than 30[>30kg/m2] and for the control they were take 30 persons, out of 30 there were 10 males and 20 females with BMI 18.5-24.9 kg/m2 and the age was same as obese persons. During or before the study they were ask from the subjects about family history, physical activity, eating habits, medications if they were taken any drugs and also 12 hours overweight fasting. During this study the lipid profile of the subjects is done. Conclusion of the study is that the BMI, WHR [WAIST TO HIP RATIO] HbA1c and lipid profile were significantly high in obese than the non-obese. So we can say that the obese person have more prone to CVD.
12. ***Alice T.C.R. Kiba koumare et, al. [2015] did their study on plasma lipid profile including the high density lipoprotein subclasses hypertensive patients in Ouagadougou, Burkina Faso***. In this study they were divided subjects in 5 subclasses: - In group 1 they were taken untreated hypertensive patients, In Group 2 having treated hypertensive, In Group 3 having treated hypertensive with complications like [coronary artery disease, peripheral] and Group

4 has treated hypertensive patients with diabetes. Group 5 were taken as control; in this normotensive subjects were taken. In this study total 201 subjects were taken, out of which 158 is hypertensive and 43 are control subjects which are normotensive. Out of 158, 53 were males and 105 were females respectively. In the control group 24 were males and 19 were females. After the analyzing of all parameters the study conclusion is that there were significantly higher levels of hypertensive females than males. And there was no significant level of lipids higher in females compare than males.

CHAPTER 3

MATERIAL AND METHODS

Material and Methods

A total 80 patients are taken for the study which is held at Satguru Partap Singh Hospital, Ludhiana. Topic of study is "***Prevalence of Dyslipidemia in type 2 Diabetes mellitus, Obesity and Hypertension"*** between the time period of 19 January 2015 to 2 may 2015. This study is done in Department of Biochemistry in Apollo Hospital, Ludhiana. In this study will take patients who are suffering from diabetes mellitus 2, obesity and hypertension with altered lipid profile. The other parameters are also check like BMI of all the subjects, height, weight, their eating habits. BMI is checked by the formula [weight in kg and height in meters square]. Out of 80 subjects 54 are males and 27 are females. After that the subjects are divided into different groups like:-

1. Group 1 having diabetic subjects
2. Group 2 having subjects who are obese
3. Group 3 having subjects who are hypertensive

Evaluate parameters for the study:-

1. Fasting blood sugar
2. Total cholesterol
3. Triglycerides
4. High Density lipoprotein
5. Low Density lipoprotein
6. Very Low density lipoprotein

Common things which are taken:-

1. BMI { Body Marks Index}
2. Height
3. Weight

4. Eating habits
5. Medication { if anyone have taken}

All the parameters of lipid profile and blood sugar is done in morning after 12 hrs overnight fasting.

CHAPTER 4

RESULT AND DATA ANALYSIS

Data analysis

Sr.no.	*LAB. I.D.*	*AGE*	*SEX*	*BMI*	*FBS*	*T.CHOL*	*TG*	*HDL*	*LDL*	*VLDL*	*DIAGNOSIS*
1	83913	59	F	24.4	190	338	715	50	175	114	DM TYPE2
2	5368	11	M	34.2	83	231	266	50	137	44	OBESITY DYSLIPIDEMIA
3	5369	37	F	23.2	90	207	85	42	148	17	DYSLIPIDEMIA
4	5370	33	M	23.1	96	193	313	40	105	48	DYSLIPIDEMIA,OBESITY
5	5518	63	M	30.3	132	101	168	35	52	14	DM TYPE2
6	5421	38	F		95	200	167	40	132	28	MILD HYPERTENSIVE
7	5528	62	F	23	204	194	145	41	127	26	DM TYPE2
8	5706	68	F	26.2	90	226	150	46	152	28	OVERWEIGHT
9	5354	59	F	34.2	190	338	715	50	175	114	DM TYPE2
10	5707	29	M		89	258	149	43	179	36	HYPERTENSIVE
11	5970	54	M	31.2	90	229	119	27	56	21	OBESITY
12	5972	44	M	36	83	223	207	45	128	50	OBESITY
13	5981	46	M	33.5	101	196	212	61	111	24	OBESITY
14	5709	65	F	21.6	134	210	58	57	132	21	DM TYPE2
15	5712	73	F	22	168	223	166	50	136	37	DM TYPE2
16	5714	24	M	26.3	83	180	211	50	102	28	OVERWEIGHT,
17	5882	84	F		95	250	127	68	152	30	HYPERTENSIVE
18	6004	37	M	23	100	203	162	54	117	32	HYPERTENSION,FATTY LIVER
19	6012	57	M	19.4	77	153	173	36	79	38	MODERATE HYPERTENSIVE
20	6027	64	F		90	200	148	76	96	29	HYPERTENSIVE
21	6202	56	M	26.2	93	214	174	46	136	32	HYPERTENSION
22	6303	59	F	30.3	80	264	254	56	159	47	OBESITY
23	6226	38	M	31.3	78	248	150	49	156	43	OBESITY
24	6227	30	M		96	164	153	37	105	23	HYPERTENSIVE
25	6404	50	M	30.7	86	199	228	68	105	26	OBESITY
26	6405	59	M	24.3	155	173	192	39	108	27	DM TYPE2
27	6407	32	M	31.4	94	200	320	36	122	42	OBESITY
28	6421	98	M	32	315	265	261	46	184	34	DM TYPE 2
29	6443	42	M	34	87	248	256	47	174	27	OBESITY
30	6448	48	F	32	100	231	230	57	155	19	OBESITY DYSLIPIDEMIA
31	6465	65	F	33.1	85	131	215	49	71	11	OBESITY
32	6566	64	F		70	205	77	58	133	14	HYPERTENSIVE
33	7923	47	M	31.4	78	197	255	37	126	34	OBESITY
34	7943	49	F		117	214	201	40	148	26	DM TYPE 2
35	8024	56	M	35	104	264	259	35	200	29	OBESITY
36	8072	65	M		108	222	137	42	154	27	DM TYPE2
37	8075	35	M		89	220	110	59	152	9	HYPERTENSIVE
38	8076	90	M	32.4	100	227	232	51	153	24	OBESITY
39	8077	50	F	32	85	240	219	54	155	31	OBESITY
40	8080	52	M	36	185	251	310	48	164	39	DM TYPE 2

41	8088	48	M	22.4	143	185	191	42	111	32		DM TYPE 2
42	8094	86	M	30.4	106	274	277	55	187	32		OBESITY
43	8098	46	M	32.3	98	232	221	52	165	15		OBESITY
44	8116	57	F		104	198	162	56	124	18		MILD HYPERTENSIVE
45	8243	44	M		132	160	77	47	102	11		DM TYPE 2
46	8246	40	F		129	160	149	40	106	14		DM TYPE 2
47	8263	41	M	36	104	206	227	36	131	39		OBESITY,
48	8264	35	M	35.6	96	170	266	33	104	33		OBESITY
49	8276	52	M	33.5	94	268	275	54	176	38		OBESITY,
50	8506	61	M	35.2	90	165	300	35	86	44		OBESITY
51	8508	87	M		80	211	190	37	138	36		MILD HYPERTENSIVE
52	8515	47	F		98	219	133	49	161	9		HYPERTENSIVE
53	8517	31	M	27.3	92	167	227	43	99	25		OVERWEIGHT
54	8518	54	M		141	170	73	50	109	11		DM TYPE 2
55	8519	42	M		173	187	262	31	136	25		DM TYPE 2
56	8530	29	M	31.7	103	185	216	62	107	16		OBESITY
57	8534	40	M	39.2	122	217	272	35	159	23		DM TYPE 2,
58	8535	37	F	27.3	106	147	176	43	83	21		OVERWEIGHT
59	8536	18	M		97	200	117	34	158	8		HYPERTENSIVE,
60	8537	52	F		125	258	244	49	181	28		DM TYPE2,
61	8539	34	M	34.4	107	217	570	40	81	16		OBESITY
62	8543	74	M		139	207	111	38	154	15		DM TYPE2
63	8545	40	M	36.4	92	245	219	42	168	28		OBESITY
64	8549	54	F		352	257	208	49	187	21		DM TYPE 2
65	8578	48	F		237	216	189	49	153	37		DM TYPE 2
66	8579	80	F		88	204	97	75	121	7		HYPERTENSIVE
67	8605	55	M	33.5	131	188	265	26	130	32		DM TYPE 2,
68	8615	60	M	32	201	137	125	33	94	10		DM TYPE 2,
69	8722	56	M	37.3	127	197	844	35	55	103		DM TYPE 2,
70	8725	25	F	30.7	99	195	261	24	136	34		OBESITY
71	8726	49	M	30.3	95	182	224	33	129	20		OBESITY
72	8748	56	F		91	226	136	61	148	17		HYPERTENSIVE
73	8922	52	M		137	187	123	42	135	10		DM TYPE 2
74	8933	67	M		163	176	154	41	120	15		DM TYPE 2
75	8955	66	F	32.4	330	268	217	59	166	43		DM TYPE 2
76	9091	44	M		118	220	148	65	105	50		DM TYPE 2
77	7271	42	F		122	233	342	38	148	47		DM TYPE 2
78	7459	45	M		96	149	387	39	67	43		DM TYPE 2
79	7501	56	m		88	239	236	41	167	31		DM TYPE 2
80	7483	35	m		154	207	197	43	152	12		DM TYPE 2

Result:-

In this study the total 80 subjects are taken and after analyzing the parameters the subjects are divided into 3 GROUPS according to the results of the parameters like out of 80 patients ***32[40%] are diabetics***, ***31[38.7%] are obese*** and overweight and ***17[21.2%] subjects are hypertensive.*** And the study shows that out of 80 subjects there are ***52[65%] males*** and ***28[35%] females.*** So we can say that the males are more prone to cardiovascular diseases with different complications. If we can discussed about the age difference in subjects so there was no difference, both up to 50 years and lower to 50 years the lipid profile alterations are same. There are 40 patients are above to 50 years and 40 patients are below to 50 years.

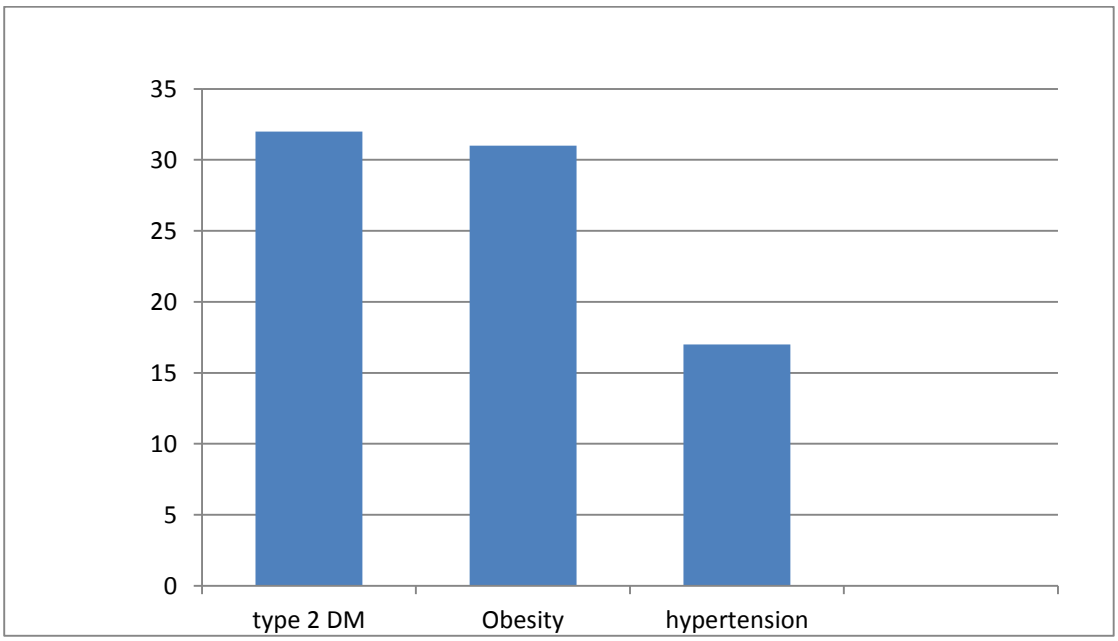


Figure show about the result of the study

CHAPTER 5

CONCLUSION

CONCLUSION

The conclusion of the study is that the Dyslipidemia is most occurring disorder worldwide. Dyslipidemia is characterized by impaired levels of lipoproteins which are responsible for the transportation of lipids in the body. Diabetic Dyslipidemia and Dyslipidemia in obesity are very common. This study is also show that the diabetics and obese peoples have more prone to cardiovascular diseases. The males are more affected then the females. Dyslipidemia is caused by many of reasons like our eating habits, lipid metabolism impaired and also other mechanism which are not fully understood. So am concluded my study here that we can reduce the chances of Dyslipidemia by changing our life style, our eating habits, by doing more physical activity.

.

References

Grundy SM Cleeman JI, Merz CN, Brewer HB Jr, Clark LT, Hunninghake DB. Implication of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel 111 guidelines. Circulation 2004; 110(2):227-39.

Grundy, S.M. 1998. Hypertriglyceridemia, atherogenic Dyslipidemia and the metabolic syndrome. Am J Cardio VOL.81, No. 4A, (February 1998), pp.18B-25B, ISSN 0002-9149.

Lev S (2012) Nonvesicular lipid transfer from the endoplasmic reticulum. Cold Spring Harb Perspect Biol Soccio RE, Breslow JL (2004) Intracellular cholesterol transport. Arterioscler Thromb Vasc Biol 24: 1150-1160

Dashti M, Kulik W, Hoek F, Veerman EC, Peppelenbosch MP, et al. (2011) Phospholipidomic analysis of all defined human plasma lipoproteins. Sci Rep 1: 139.

Hoofnagle AN, Heinecke JW (2009) Lipoproteomics: using mass spectrometry based proteomics to explore the assembly, structure, and function of lipoproteins. J Lipid Res 50: 1967-1975.

Tzen JT, Lie GC, Huang AH (1992) Characterization of the charged components And their topology on the surface of plant seed oil bodies. J Biol Chem 267: 15626-15634

Mahley RW, Innerarity TL, Rall SC Jr, Weisgraber KH (1984) Plasma Lipoproteins: apolipoprotein structure and function. J Lipid Res 25: 1277-1294

Rivellese AA, De NC, Di ML, Patti L, Iovine C, et al. (2004) Exogenous and endogenous postprandial lipid abnormalities in type 2 diabetic patients with optimal blood glucose control and optimal fasting triglyceride levels. J Clin Endocrinol Metab 89: 2153-2004.

Bijlsma MF, Peppelenbosch MP, Spek CA (2006) Hedgehog morphogen in cardiovascular disease. Circulation 114: 1985-1991.

Mulay V, Wood P, Rentero C, Enrich C, Grewal T (2012) Signal transduction Pathways provide opportunities to enhance HDL and apoAI-dependent reverse Cholesterol transport. Curr Pharm Biotechnol 13: 352-364.

Adiels M, Olofsson SO, Taskinen MR, Borén J (2008) Overproduction of very Low-density lipoproteins is the hallmark of the Dyslipidemia in the metabolic syndrome. Arterioscler Thromb Vasc Biol 28: 1225-1236.

Sarwar N, Danesh J, Eiriksdottir G, Sigurdsson G, Wareham N, et al. (2007) Triglycerides and the risk of coronary heart disease: 10,158 incident case among 262,525 participants in 29 Western prospective studies. Circulation115: 450-458.

Frayn KN (1998) Non-esterifies fatty acid metabolism and postprandial lipemia. Atherosclerosis 141 Suppl 1: S41-46.

Murdoch SJ, Breckenridge WC (1995) Influence of lipoprotein lipase and Hepatic lipase on the transformation of VLDL and HDL during lipolysis of VLDL. Atherosclerosis 118: 193-212.

Murdoch SJ, Breckenridge WC (1996) Effect of lipid transfer proteins of Lipoprotein lipase induced transformation of VLDL and HDL. Biochim Biophys Acta 1303: 222-232.

Genest J.Jr.Physician`s Guide to the Management of lipoprotein Disorders. Montreal, Canada: QUE. STA Communications.1990:30-31.

Genrest J.Jr Physicia`s Guide to the Management of lipoprotein Disorders. Montreal,, Canada: QUE. STA Communications.1990:32.

Gotto A, Pownall H. Manualof Lipid Disorders: Reducing the Risk for coronary Heart disease. Nd ed. Baltimore, MD: Williams & Wilkins; 1999:99.

American Diabetes Association, 2005. Diagnosis and classification of diabetes Mellitus. Diabetes Care 28, 1:537-42.

Chatterjee M N and Shinde R [2005] Text book of medical laboratory technology. Metabolism of carbohydrates. [Jaypee brother's medical publisher] sixth edition. 266-330, Delhi-India.

Taskinen MR, Diabetic Dyslipidemia Atheroscler Suppl 2002; 3(1):47-51

Shera, A.S., F. Jawad and A. Maqsood, 2007 Prevalence of diabetes in Pakistan. Diabetes Res. Clini. Pract. 76(2): 219-22.

Roberto, T., A.R. Dodesini, Lepore G. Lipid and Renal disease, 2006. J. Am. Soc. Nephrol., 17: S145-7.

Mooradian, A.D (2008). Dyslipidemia in type 2 diabetes mellitus. Nature Clinical Practice Endocrinology & Metabolism, Vol.5, No.3, (March 2009), pp. 150-159, ISSN 1759-5029.

Taskinen, M.R. (2003) Diabetic Dyslipidemia: from basic research to clinical practice. Diabetologia Vol. 46, No.6, pp. 733–749, ISSN 1432-0428

Krauss, R.M. & Siri, P.W. (2004). Dyslipidemia in type 2 diabetes. Med Clin North Am Vol.88, No.4, pp. 897–909, ISSN 1557-9859

Chahil, T.J. & Ginsberg, H.N. (2006). Diabetic Dyslipidemia. Endocrinal Metab Clin North Am Vol.35, No.3, pp. 491–510, ISSN 1558-4410.

Frayn, K.N. (2001) Adipose tissue and the insulin resistance syndrome. Proc Nutr Soc Vol.60, No.3, (August 2001), pp. 375–380, ISSN 1475- 2719

Adiels, M., Westerbacka, J., Soro-Paavonen, A., Häkkinen, A.M., Vehkavaara, S., Caslake, M.J., Packard, C., Olofsson, S.O., Yki-Järvinen, H., Taskinen, M.R. & Borén, J.(2007). Acute suppression of VLDL1 secretion rate by insulin is associated with Hepatic fat content and insulin resistance. Diabetologia Vol.50, No.11, (November2007), pp. 2356-2365, ISSN 1432-0428

Boden, G. Obesity, insulin resistance and free fatty acids. Curr. Opin. Endocrinol. Diabetes Obes. 2011, 18, 139–143.

Zalesin, K.C.; Franklin, B.A.; Miller, W.M.; Peterson, E.D.; McCullough, P.A. Impact of obesity on cardiovascular disease. Med. Clin. North. Am. 2011, 95, 919–937.

Franssen, R.; Monajemi, H.; Stroes, E.S.; Kastelein, J.J. Obesity and Dyslipidemia. Med. Clin. North. Am. 2011, 95, 893–902.

Wang, H.; Peng, D.Q. New insights into the mechanism of low high-density lipoprotein cholesterol in obesity. Lipids Health Dis. 2011, 10, doi: 10.1186/1476-511X-10-176.

Willett WC, Dietz WH, Colditz GA. Guidelines for healthy weight. N Engl J Med, 1999; 341(6): 427-34.

Ardern CI, Katzmarzyk PT, Janssen I, Ross R.Discrimination of health risk by combined body mass index and waist circumference. Obes Res, 2003; 11(1): 135-42.

Meisinger C, Doring A, Thorand B, Heier M, Lowel H. Body fat distribution and risk of type 2 diabetes in the general population: are there differences between men and women? The MONICA/KORA Augsburg cohort study. Am J Clin Nutr, 2006; 84(3): 483-9.T13

Patsch, J.R.; Miesenbock, G.; Hopferwieser, T.; Muhlberger, V.; Knapp, E.; Dunn, J.K.; Gotto, A.M., Jr.; Patsch, W. Relation of triglyceride metabolism and coronary artery disease. Studies in the postprandial state. Arterioscler. Thromb. 1992, 12, 1336–1345.

Capell, W.H.; Zambon, A.; Austin, M.A.; Brunzell, J.D.; Hokanson, J.E. Compositional differences of LDL particles in normal subjects with LDL subclass phenotype A and LDL subclass phenotype B. Arterioscler Thromb. Vasc. Biol. 1996, 16, 1040–1046.

Clemente-Postigo, M.; Queipo-Ortuno, M.I.; Fernandez-Garcia, D.; Gomez-Huelgas, R.; Tinahones, F.J.; Cardona, F. Adipose tissue gene expression of factors related to lipid processing in obesity. PLoS One 2011, 6, e24783; doi:10.1371/journal.pone.0024783.

Klop, B.; Jukema, J.W.; Rabelink, T.J.; Castro Cabezas, M. A physician's guide for the management of hypertriglyceridemia: The etiology of hypertriglyceridemia determines treatment strategy. Panminerva Med. 2012, 54, 91–103.

. Peterson, J.; Bihain, B.E.; Bengtsson-Olivecrona, G.; Deckelbaum, R.J.; Carpentier, Y.A.; Olivecrona, T. Fatty acid control of lipoprotein lipase: a link between energy metabolism and lipid transport. Proc. Natl. Acad. Sci. USA 1990, 87, 909–913

.

. Karpe, F.; Olivecrona, T.; Walldius, G.; Hamsten, A. Lipoprotein lipase in plasma after an oral fat load: Relation to free fatty acids. J. Lipid Res. 1992, 33, 975–984.

Tchernof, A.; Lamarche, B.; Prud'Homme, D.; Nadeau, A.; Moorjani, S.; Labrie, F.; Lupien, P.J.; Despres, J.P. The dense LDL phenotype. Association with plasma lipoprotein levels, visceral obesity, and hyperinsulinemia in men. Diabetes Care 1996, 19, 629–637.

Kannel WB. Sorlie P .Hypertension in Framinghane, In Paul O.ed. Epidemiology and control of hypertension Miami Symposia Specialist, 1975;553-92.

. *Mc Mohan SW, MacDonald GJ, Antihypertensive treatment and plasma lipoprotein levels:the association in data from a population study. Am J Med 1986:80[suppl 2A]:40-7.*

. *Ross R. The pathogenesis of atheroscelorosis an update.N Engl J Med 1986:31:488-500.*

. *Dzau VJ. Mechanism of the interaction of hypertension and hypercholestermia in atherogenesis: the effects of antihypertensive agents. Am Heart J 1988;166:1725-8.*

. *Chobanian AV. The influence of hypertension and other hemodynamics factors in atherogenesis. Prog Cardiovase Dis 1983:26:177-96.*

Sacks FM, Dzau VJ, Adrenogenic effects on plasma lipoprotein metabolism:speculation on mechanism of action. Am J Med 1986:80[suppl 2A]: 71-9.

Dzau VJ. Factors influencing the lipid response to selective Alpha-1 inhibitors J Cardiovasc Pharmacul 1989; 13C (suppl 2): S50-2.

Leren JP. Doxazosin increases low density lipoprotein receptor for activity. Acta Pharmacol Toxical 1985:56:269-72.

Estimation of global risk based on age, sex and major risk factors should be preferred to the individual risk factor levels.

Nickenig G. Central role of the AT (1)-receptor in atherosclerosis. J Hum Hypertens. 2002; 16 Suppl 3:S26 –S33.

. *Nickenig G, Harrison DG. The AT(1)-type angiotensin receptor in oxidative stress and atherogenesis: Part I: oxidative stress and atherogenesis. Circulation. 2002; 105:393–396.*

Dzau VJ. Mechanism of the interaction of hypertension and hypercholestermia in atherogenesis: the effects of antihypertensive agents. Am Heart J 1988;166:1725-8.

Chobanian AV. The influence of hypertension and other hemodynamics factors in atherogenesis. Prog Cardiovase Dis 1983:26:177-96.

Chobanian AV. Brecher PI . Haudenschild CC. Effect of hypertension and of antihypertensive therapy on atherosclerosis Hypertension 1986:8 C (suppl1) [15-21].

`