

Imbalance Nutrition and Changed Lifestyle are Main Risk Factors for Metabolic Syndrome, Diabetes and Cardiovascular Disease

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Abstract:

Introduction - The metabolic syndrome is associated with prevalence and incidence of CHD, stroke. The Metabolic Syndrome is a modern day epidemic which predicts total and cardiovascular diseases (CVD) mortality; the incidence and progression of carotid atherosclerosis and sudden death independent of other cardiovascular risks. Subjects with metabolic syndrome have three-fold risk of a heart attack or stroke, two-fold risk of CVD or dying from such events, and five-fold greater risk of developing type 2 diabetes mellitus in both sexes when compared to people without it. Day by day the incidences of metabolic syndrome, diabetes and cardiovascular disease increases in urban as well as rural areas, rich and poor communities because of life style changes, imbalance nutrition and easy availability of cheap fast food. India which is considered diabetic capital of world needed to be explored in direction of insulin resistance and metabolic syndrome. With this background we decided to start a pilot project to find out the relation between visceral fat, metabolic syndrome and lipid profile to predict insulin resistance, diabetes and CVD.

Materials and methods - We studied 50 healthy and 50 metabolic syndrome patients, with matched for age and body mass index. Subjects were selected from medical, paramedical staff and general public who were around 40 to 60 year of age. All subjects were belonged to the Latur district of Marathwada region. Patient belonging to group II were selected after attending medicine OPD of MIMSR Medical College, Latur and diagnosed as metabolic syndrome. Fasting blood sample were collected and blood glucose and lipid profile were determined.

Results - In the control group I mean values of total cholesterol were 175.98 ± 26.14 mg %, serum triglycerides were 102.64 ± 31.13 mg %, and in the group II serum total cholesterol were 193.52 ± 46.20 mg %, triglycerides 165.28 ± 51.59 mg% and were significantly increased as compared to group I. The serum HDL-c in group II 39.89 ± 4.05 mg % were significantly decreased as compared to group I (45.43 ± 3.13 mg %). Triglyceride /HDL-c ratio were significantly increased in group II as compared to group I.

Conclusion - From results of this study, we conclude that dyslipidemia is a common feature of metabolic syndrome, and a large number of patients had more than one individual lipid abnormality. Evaluation of lipid profile indicates that HDL-c is decreased and triglycerides, and VLDL-c are increased in metabolic syndrome patients. Increased ratio of triglycerides/HDL-c is a feature of metabolic syndrome and a important predictor or marker of it. As metabolic syndrome, insulin resistance are reversible at this phase we can take preventive steps such as dietary modification, supplementation and exercise to achieve holistic health. The lipid profile, visceral fat as well as preventative measure are affordable or in hand and may be seriously considered before the development of end organ damage that may cause loss of life.

Keywords - Metabolic syndrome insulin resistance, imbalance nutrition lifestyle, diabetes, cardiovascular disease.

Introduction

The metabolic syndrome is a constellation of risk factors of metabolic origin that are accompanied by increased risk for

cardiovascular disease and type 2 diabetes. It is basically a constellation of central obesity, dyslipidemia (hypertriglyceridemia and low HDL-c) hypertension, and impaired glucose tolerance.^[1,2] Recent studies in India

shows that about one third of urban population in major cities has metabolic syndrome.^[3] The majority of persons with metabolic syndrome have insulin resistance. Insulin resistance and/or associated hyperinsulinemia are believed to be the direct cause of other metabolic syndrome risk factors.^[4]

Several terms such as Syndrome X, Metabolic syndrome X, the Deadly Quartet, Insulin Resistance Syndrome, Cardio metabolic syndrome, Reaven's syndrome (named for Gerald Reaven), CHAOS (in Australia) have been proposed for metabolic syndrome. Different guidelines issued by World Health Organization (WHO), National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP-III) and International Diabetes Federation (IDF) are used to identify metabolic syndrome in clinical practice.^[5] Irrespective of the criteria used metabolic syndrome is associated with increased risk of developing Type 2 Diabetes Mellitus, Coronary Artery Disease (CAD), cerebrovascular diseases, polycystic ovary syndrome (PCOS), sleep apnoea and several types of hormone sensitive cancer.^[6] Among the various studies conducted among Indians of different age groups, using different criteria, NCEP ATP III definition was found to be a better tool for screening, than definitions provided by WHO and IDF.^[7,8]

This study is concentrated around the metabolic syndrome, visceral fat, dyslipidaemia and insulin resistance. Insulin resistance occurs when cells in the body (liver, skeletal muscle and adipose tissue) become less sensitive and eventually resistant to insulin, the hormone which is produced by the beta cells in the pancreas to facilitate glucose absorption. Glucose can no longer be taken by the cells but remains in the blood, triggering hyperinsulinemia; this over burdens the pancreatic beta cell of pancreas and eventually wears out the beta cells. This is the point where clinical diabetes develops.^[9]

It has been proved that insulin resistance and hyperinsulinemia are closely linked.^[10] Although hyperinsulinemia may compensate for insulin resistance to some biological actions of insulin, i.e. maintenance of normoglycemia in some tissues, it may cause over expression of insulin activity in normally sensitive tissues. This accentuation of some insulin actions coupled with resistance to other actions of insulin results in the clinical manifestations of metabolic syndrome.^[11] Hyperinsulinemia promotes sodium reabsorption and activates sympathetic system causing hypertension. Hyperinsulinemia have additional effects on growth and development as well as on carbohydrate, protein and lipid metabolism which might promote atherosclerosis.^[12] Chronic high levels of insulin secretion will eventually exhaust the beta cells of the

pancreas, increasing the likelihood of a functional deficit of these tissues, resulting in adult onset diabetes mellitus.

India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "diabetes capital of the world". According to the recent projections of World Health Organization (WHO), India already leads the world with the largest number of diabetic subjects (nearly 40 million) and it is predicted that this number would reach almost 80 million by the year 2030.^[13]

The International Diabetes Federation (IDF) estimates the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken. India and China contribute to 75% of total diabetic patient load of world. Diabetes is an iceberg disease. India faces a grave health care burden due to the high prevalence of type-2 diabetes and its complication like cardiovascular disease, retinopathy, nephropathy, and neuropathy.^[13,14] The metabolic syndrome is associated with prevalence and incidence of CHD, stroke. The Metabolic Syndrome is a modern day epidemic which predicts total and cardiovascular diseases (CVD) mortality.^[15] The incidence and progression of carotid atherosclerosis.^[16] and sudden death independent of other cardiovascular risks.^[17] Subjects with metabolic syndrome have three-fold risk of a heart attack or stroke, two-fold risk of CVD or dying from such events, and five-fold greater risk of developing type 2 diabetes mellitus in both sexes when compared to people without it.^[18]

Diabetes is multifactorial disease. there are so many factors like genetic traits, life style, environment, ethnicity that affect the outcome of metabolic syndrome. There are lots of studies done in western countries regarding metabolic syndrome. Day by day the incidences of metabolic syndrome, diabetes and cardiovascular disease increases in urban as well as rural areas, rich and poor communities because of life style changes, imbalance nutrition and easy availability of cheap fast food. India which is considered diabetic capital of world needed to be explored in direction of insulin resistance and metabolic syndrome. With this background we decided to start a pilot project to find out the relation between, visceral fat, metabolic syndrome and lipid profile to predict insulin resistance, risk of diabetes and CVD.

Materials and Methods

We studied 50 healthy and 50 metabolic syndrome patients, with matched for age and body mass index. Subjects were selected from medical, paramedical staff and general public who were around 40 to 60 year of age. All subjects were belonged to the Latur district of Marathwada region. Patients belonging to group II were selected after attending

medicine OPD of MIMSR Medical College, Latur and diagnosed as metabolic syndrome. The healthy subjects were nonsmokers, non obese, non alcoholic and free from any disease and not taking any drugs that alter lipid and carbohydrates metabolism. All subjects after taking informed consent was interrogated and detailed examination was done. All Criteria for diagnosis of metabolic syndrome were fulfilled i.e. blood pressure examination, waist circumference (central obesity) visceral fat measurement and blood glucose. and then patients included in study. Blood samples drawn after an overnight fast. After serum separation the analysis was done on the same day.

We estimated blood glucose by GOD method (Autopack Siemens kit) serum triglycerides by enzymatic method (Autopack Siemens kit), total cholesterol by enzymatic methods (Autopack Siemens kit) and HDL-c measured by phosphotungstate method (Autopack Siemens kit). LDL-c and VLDL- c values were calculated by Friedwald's equation.

All patients belonging to group II had metabolic syndrome.

Criteria for diagnosis of metabolic syndrome,

Following are the criteria used for the selection of subjects belonging to group 2 (metabolic syndrome)

- 1) The major criterion for selection of subject was central obesity. (Waist Circumference (WC) \geq 80 Cm for female and WC \geq 90 Cm for male which is ethnic specific value for Indians). This criterion was based on international diabetes federation's definition of metabolic syndrome. The IDF consensus worldwide definition of the metabolic

syndrome (2006) contains Central obesity (defined as waist circumference $>$ 90 cm for male, $>$ 80 cm for female, with ethnicity specific values)

- 2) Systolic BP \geq 130 or diastolic BP \geq 85 mm Hg or treatment of previously diagnosed hypertension (FPG) \geq 100mmHg.
- 3) Raised fasting plasma glucose (100 mg/dL i.e. 5.6 mmol/L) or previously diagnosed type 2 diabetes.
- 4) Visceral fat measurement. Visceral fat was measured by Omron Karda scan model HBF-362. For healthy subject results $<$ 9 % and for metabolic syndrome $>$ 10 %, were included in the study.

The HBF-500CAN estimates the body fat percentage by the Bioelectrical Impedance (BI) method. Muscles, blood vessels and bones are body tissues with high water content that conduct electricity easily. Body fat is tissue that has little electric conductivity. The HBF- 362 sends an extremely weak electrical current of 50 kHz and less than 500 μ A through our body to determine the amount of each tissue. This weak electrical current is not felt while operating the HBF-362. Visceral fat or abdominal fat also known as organ fat or intra-abdominal fat is located inside the abdominal cavity, packed between the organs (stomach, liver, intestines, kidneys, etc. Visceral fat is composed of several adipose depots, including mesenteric, epididymal white adipose tissue and perirenal depots. An excess of visceral fat is known as central obesity. The association between central obesity and cardiovascular disease and diabetes is strong. There are studies reporting that visceral fat is associated with diabetes, insulin resistance, inflammatory diseases, and other obesity-related diseases.^[19,20]

Result

Table 1: Serum Triglycerides and Other Biochemical Parameter in Normal Healthy Subjects (Group I) and metabolic syndrome patients (Group II)

Group	Total Cholesterol	Triglycerides	HDL-c	LDL-c	VLDL-c	TG/HDL-c
1st N=50	•175.98 \pm 26.14	*102.64 \pm 31.13	*45.43 \pm 3.13	#109.37 \pm 26.14	*20.50 \pm 6.22	*2.25 \pm 0.64
2nd N=50	•193.52 \pm 46.20	*165.28 \pm 51.59	*39.89 \pm 4.05	#120.59 \pm 46.18	*33.25 \pm 10.18	*4.11 \pm 1.42

* = $P < 0.0001$ The values are extremely statistically significant.

• = P is 0.0215 The values are statistically significant.

= P is 0.1381, The values are less statistically significant.

In the control group I mean values of total cholesterol were 175.98 ± 26.14 mg %, serum triglycerides were 102.64 ± 31.13 mg %, and in the group II serum total cholesterol were 193.52 ± 46.20 mg %, triglycerides 165.28 ± 51.59 mg% and were significantly increased as compared to group I. The serum HDL-c group II 39.89 ± 4.05 mg % were significantly decreased as compared to group I (45.43 ± 3.13

mg %). Triglyceride /HDL-c ratio were significantly increased in group II as compared to group I.

Discussion

Our Indian diet is rich in high glycemic foods (white breads, white flour, rice potato etc.) and low fibre, fruits, which in turn causes blood sugar to rise very rapidly and stimulates the release of insulin and rapid lowering of blood sugar.

Again we feel hungry, so we grab a snack or eat a big meal and a whole process restart. After a period of time pancreas overstimulated and body becomes less and less sensitive to insulin and, there is increase in insulin level. Such people's needs more and more insulin to normalize the blood sugar levels this leads to destructive metabolic changes (dysmetabolism) associated with syndrome X.

Environmental and lifestyle changes resulting from industrialization and migration to urban environment from rural settings may be responsible to a large extent, for this epidemic of Type 2 diabetes in Indians. Obesity, especially central obesity and increased visceral fat due to physical inactivity, and consumption of a high - calorie/high-fat and high sugar diets are major contributing factors. Strategies to achieve healthy fetal and infant growth and encouraging the use of traditional diets rich in fibre (fruits and vegetables) are also important steps. Such interventions should be attempted in those who are genetically predisposed to diabetes in order to tackle the explosion of, and thereby reduce the burden due to, diabetes within the Indian subcontinent. Also the Indians have high body fat percentage even with normal BMI. According to a study done by Deurenberg et al. in immigrants of Singapore who are from different ethnic groups the Indians have highest body fat percentage in comparison to muscle mass.^[21] There is another study done by Chandrasekharan N et al in Indian people which mention that Indian subjects showed higher body fat percentage and risk factors like hypertension and type 2 diabetes at normal BMI range proposed by the WHO.^[22]

Biochemical and physiological changes in syndrome X.

Significant inflammation of arteries which can cause heart attack and stroke. Hypertension, Elevated triglycerides. Lowered HDL-c, Increased LDL-c, Increased tendencies to form blood clots, Central obesity.

When all of the syndrome X factors are combined, risk of developing heart disease jumps twentyfold. Considering the fact that the heart disease is the number one killer in the industrialized world today, we cannot afford to disregard a growing risk of developing it.

In this study, the relationship between lipid levels and metabolic syndrome was examined. Hypertriglyceridemia was the most common lipid abnormality observed in these patients, Increased ratio of triglycerides/HDL-c is a features of metabolic syndrome and a important predictor or marker of it. Similar observation was made in a study conducted in north Indian population with metabolic syndrome where in triglyceride was the most prevalent lipid abnormality.^[23] High levels of triglyceride and low levels of HDL-c (increased ratio of triglyceride/HDL-c) in patients with metabolic syndrome result from decreased clearance of

these lipoproteins from the circulation. Lipoprotein lipase (LPL) is a major enzyme responsible for clearing triglyceride containing lipoproteins from the circulation, and insulin resistance is associated with impaired LPL activity.^[24] Hepatic lipase, which is responsible for clearing HDL particles from the circulation, shows increased activity in the presence of insulin resistance and causes HDL-c levels to decline.^[25] A low level of HDL-c is an important risk factor for CVD. The cardioprotective effects of HDL-c have been attributed to its role in reverse cholesterol transport, its effects on endothelial cells, and its antioxidant activity.^[26] In a study carried out on Indian population with type 2 diabetes, hypertriglyceridemia and high serum LDL-c levels (≥ 100 mg/dL) were recorded as major components of dyslipidemia, and most of these patients had mixed dyslipidemia. These findings are in concurrence with the results of this study.^[27] Whereas others have recorded normal levels of LDL-c.^[28] Insulin resistant individuals not having diabetes mellitus are likely to have lipid profiles that are nearly identical to those seen in the large majority of patients with type 2 diabetes as observed in this study.^[29]

From all of above views and angles it seems Indians are high risk subject for metabolic syndrome world-wide. To decrease the global burden of syndrome X, with our limited resource we must focus our preventive guideline. In our study total cholesterol, triglycerides and VLDL-c are positively related i.e. significantly elevated as compared with healthy subjects. Onkar Singh et al, Koma Makwana et al had reported that dyslipidaemia have role in advancement of metabolic syndrome to diabetes and cardiovascular disease. Our observations of this study are also correlated with these study.^[30,31]

Conclusion

From results of this study, we conclude that dyslipidemia is a common feature of metabolic syndrome, and a large number of patients had more than one individual lipid abnormality. Evaluation of lipid profile indicates that HDL-c is decreased and triglycerides and VLDL-c are increased in metabolic syndrome patient. Increased ratio of triglycerides/HDL-c is a feature of metabolic syndrome and a important predictor or marker of it. As, metabolic syndrome, insulin resistance are reversible at this phase we can take preventive steps such as dietary modification, supplementation and exercise to achieve holistic health. The lipid profile, visceral fat as well as preventative measures are affordable or in hand and may be seriously considered before the development of end organ damage that may cause loss of life.

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