Evaluation of performance of Lipid Accumulation Product (LAP), an obesity index as a marker for diagnosing overt type 2 diabetes mellitus over Body Mass Index (BMI)

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Abstract

Objectives of the study: To compare the indices available to measure obesity such as BMI and "lipid accumulation product" (LAP) with respect to risk for development of Type-II Diabetes mellitus.

Methodology: The study design was cross sectional with sample size of 120. Anthropometric measurements (BMI and LAP) and biochemical estimations (blood glucose & lipid profile) were carried out.

Results: We compared the values of LAP and BMI with Fasting blood glucose. The area under the curve was 0.75 and 0.73 respectively which meant LAP was better in identification of overt Type 2 Diabetes. The cut off for BMI is 25.98 with Sensitivity of 0.83, Specificity of 0.64 & youden index 0.47. The cut off for LAP is 50.79 with Sensitivity of 0.79, Specificity of 0.68 & youden index 0.46.

Conclusion: LAP was able to identify the risk for type 2 Diabetes better compared with BMI in our study subjects.

Introduction

Obesity is an endocrinal disorder associated with various co-mordities like metabolic syndrome. It is a constellation of metabolic risk factors associated with insulin resistance, abdominal obesity, raised triglycerides and high blood pressure which predisposes to type-2 Diabetes mellitus and cardiovascular diseases[2]. It is most common disorder prevalent in both developed and developing countries. Currently 90% of adults with type 2 diabetes are overweight or obese. People with severe obesity are at greater risk of type 2 diabetes than obese people with a lower BMI[2]. In India 55% of population between the age group of 20 and 69 years are overweight[2]. Central obesity is the most prevalent manifestation of metabolic syndrome. Obesity is measured mainly with BMI but it does not measure central adiposity whereas indices such as waist circumference (WC) are known to be better index for central adiposity or visceral adiposity[3,4]. According to various studies researchers have explored another index known as "lipid accumulation product" (LAP)[13]. LAP is based on a combination of waist circumference and fasting triglyceride. LAP is known to be a good marker of lipid accumulation in ectopic sites like the liver, skeletal system and in the beta cells of pancreas[5,6]. Ectopic lipid accumulation eventually leads to insulin resistance and hence LAP can be a better marker to diagnose metabolic syndrome and associated morbities like type-II DM in obese subjects[7]. The aim of our study was to evaluate the performance of LAP over BMI by comparing them with fasting blood glucose in our study population.

Materials and Methods

The study was a cross sectional study conducted on patients attending the Endocrinology Department at M S Ramaiah Medical College, Bangalore in India. Ethical clearance was taken from the Institute. The study subjects who signed the informed consent and who met the inclusion criteria were included in the study. Subjects with history of diabetes mellitus, endocrinal disorders, smoking, hypertension, cardiac diseases, bronchial asthma, acute or chronic inflammatory diseases, autoimmune diseases, on medications like steroids, antipsychotic drugs, women with menstrual disorders and PCOD & all known parameters that may affect lipid profile were excluded from the study. Weight, Height &Waist circumference were recorded; BMI (body weight in Kg/height in m^2) was calculated. Systolic (SBP) and diastolic blood pressures (DBP) were measured three times in the seated position after 10 min of rest by use of a sphygmomanometer. The index "lipid accumulation product" (LAP) – is based on a combination of two measurements. One is waist circumference (WC), a measure of truncal fat that includes the visceral (intra-abdominal) depot. The other is the fasting concentration of triglycerides (TG). LAP for men is (waist circumference [cm] - 65) × (triglyceride concentration [mmol/l]) and for women (waist circumference [cm] - 58) × (triglyceride concentration [mmol/l])[13]. Blood samples were taken for the determination of the fasting blood sugar, post prandial blood sugar and lipid profile. Blood glucose was assayed by the glucose oxidase kit (Vital Diagnostics Pvt. Ltd, Mumbai)method[10], serum cholesterol by the end point enzymatic kit (Bio systems, S.A Barcelona [Spain]) method[11], HDL-cholesterol by phosphotungstate Precipitation kit (Bayer Diagnostics, Baroda) method[11], serum triacylglycerol by glycerol phosphate oxidase kit (vital diagnostics Pvt Ltd, Mumbai) method[12], LDL and VLDL were calculated

from the estimated values of cholesterol, triglyceride and HDL-C, using Frieldwald equation.

Results

The sample size of the study population included 120. The age of the subjects ranged between 20-70yrs. The mean and SD of BMI was 26.27kg/m^2 ±8.22. The baseline characteristics of the subjects are shown in Table 1. The subjects were normotensive and lipid profile were in the normal range. But 20% of the subjects had FBS value above 100mg/dL.

But when we compared the values of LAP and BMI with Fasting blood sugar (one of the criteria for metabolic syndrome).The area under the curve was 0.75 and 0.73 respectively which meant LAP was better in identification of impaired glucose tolerance(Fig. 1). The cut off for BMI is 25.98 with Sensitivity of 0.83, Specificity of 0.64 & youden index 0.47. The cut off for LAP is 50.79 with Sensitivity of 0.79, Specificity of 0.68 & youden index 0.46.

Table 1: Baseline characteristics of the subjects

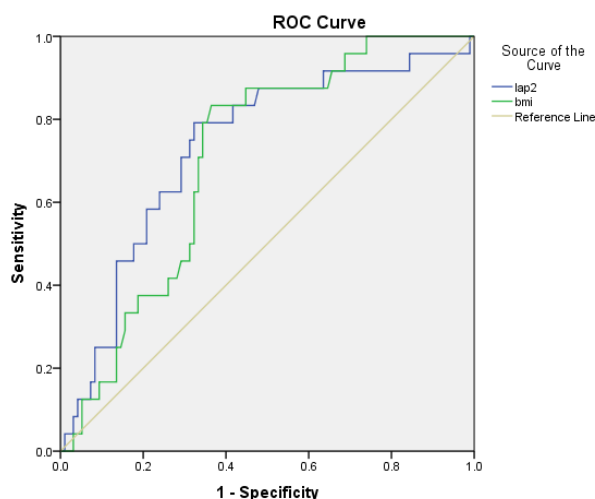|	Mean	±SD
BMI(kg/m2)	26.29	±8.21
Waist(cm)	86.15	±14.67
FBS (mg/dL)	88	±12.79
TC(mg/dL)	175.87	±20.81
TGL (mg/dL)	152	±24.22
HDL (mg/dL)	41	± 3.25
LAP	47	± 31.58

Fig. 1: ROC curve of LAP and BMI for FBS

Discussion

Our study comprised of subjects who were healthy, though 20% of them had blood glucose levels above 100mg/dL and all were normotensives. ROC analysis was done between LAP and BMI with respect to fasting blood sugar which is one of criteria for metabolic syndrome and also a predictor for development of type-II DM[8,9]. LAP performed better in identification of risk for developing impaired fasting glycemia. The area under the curve for LAP and BMI was 0.75 and 0.73 respectively. LAP a surrogate marker of insulin resistance able to recognize ectopic lipid deposition was first described by Kahn[13]. Kahn HS has conducted a population based comparison in which he has shown better performance of LAP over BMI almost proximity to fasting insulin and HOMA index.[13]

Malavazos A E et al, have also shown that LAP is superior to HOMA-IR in identifying different degrees of pathological glucose tolerance in their population based study, even in the subjects with normal fasting glucose[14]. It is evident from our study that LAP in subjects with BMI within normal limits is able to identify the hyperglycemia at the earliest.

The advantage of LAP over BMI is that the former can differentiate between visceral adipose tissue and subcutaneous adipose tissue. Increased Visceral adiposity is prone to more lipolysis, leading to development of insulin resistance further progressing to impaired glucose tolerance and overt diabetes mellitus[14]. Hence transition from obesity to type-II DM is not merely due to increase in body weight but it is due to increased lipid accumulation in ectopic sites[15]. Detection of ectopic lipid is difficult but increase in LAP will reflect the increase in ectopic lipid tissue which is highly lipolytic and can injure organs like pancreas, liver, etc. Whereas increase in BMI can be due to increase in lean tissue, increase in protective subcutaneous tissue or due to fluid retention[16].

Limitations of our study are that the sample size is less confined to a small population. We can elicit better performance of LAP if the sample size is large and if it was a multicentric study. Prospective study is required to establish the association of LAP and other available obesity indices to detect the risk of diabetes in these type of population.

We can conclude from our study that LAP a dichotomous index comprising of waist circumference and fasting triglyceride is a good obesity index than BMI.The advantage of LAP over BMI is that it can detect the healthy subjects going in for risk of development of diabetes mellitus in an early stage. LAP is cost effective, easily measurable obesity index can be utilized by clinicians as a tool to predict the risk of future diabetes in healthy subjects.

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