Section: Medicine

Subcutaneous Abdominal Fat Measurement using Ultrasonography in Individuals with Metabolic Syndrome

T.N. Dubey[1], Premlata Solanki[2], Nitin Nahar[3]

ABSTRACT

Introduction: Obesity is a health problem in the majority of the developed countries and is emerging as a serious problem in the developing countries. In this study abdominal subcutaneous fat measured by ultrasonography was correlated with the components of metabolic syndrome

Material and Methods: Study was carried out in the department of Medicine, Hamidia Hospital, Bhopal. The subjects were recruited randomly from medical and Endocrinology speciality OPD of Hamidia Hospital. A total of 100 subjects were taken with metabolic syndrome. Anthropometric measurement, biochemical tests and ultrasonography was done in these patients

Results: In present study according to statistical analysis subcutaneous fat was significantly associated with hypertension in male patients (p value 0.038) but this association was not found in female participants.

Conclusion: in conclusion waist circumference and subcutaneous fat appears as accommodative marker of obesity to detect Hypertension in males

Key words: Abdominal Fat, Ultrasonography, Metabolic Syndrome

INTRODUCTION

At the beginning of 21st century, Obesity has become the leading metabolic disease in the world so that WHO refers to obesity as the global epidemic.

Obesity is defined as an excessively high amount of body fat or adipose tissues in relation to lean body mass. It may be due to an abnormal growth of adipose tissues due to enlargement of fat cell size (hypertrophic) or an increase in fat cell number (hyperplastic.) or a combination of both (Park 2015)[1]. Hyperplastic obesity is usually seen in childhood and weight reduction is difficult in these cases (Pandsey S)[2]. Abdominal Obesity increases the risk of chronic complications like hypertension, diabetes, dyslipidemia[3,7]. Abdominal adipose tissue categorize into intra abdominal fat and subcutaneous fat[4]. With its peculiar metabolism, hyperlipolytic activity, and anatomic location, excess abdominal fat plays a key role in insulin resistance[5,6,7,8]. This can cause glucose intolerance and type 2 diabetes in genetically susceptible individuals. High amounts of intra-abdominal fat are also closely tied to the typical atherogenic dyslipidemia[9,10,11,12]. High blood pressure, a pro-thrombotic state, and—more recently—a pro-inflammatory profile are other abnormalities seen mainly in individuals with excess intra-abdominal fat, irrespective of body weight.several studies suggest that The android or male pattern of fat distribution has been associated with a higher incidence of coronary artery disease[6,7]

Numerous body composition assessment techniques are available and the more accurate technique include hydrostatic weighing, dual energy X-ray absorptiometry (DEXA), CT scan and MRI. But in truth, these are very expensive, lacks practicality and expose the patient to ionising radiation. Different anthropometric indices such as the waist circumference, waist-hip ratio have been used in routine daily practice to estimate the amount of abdominal adipose tissue while BMI measure the overall obesity

Aim of this study was to compare the association of intraabdominal subcutaneous fat measurement with components of metabolic syndrome

MATERIAL AND METHODS

This present study was carried out in the department of Medicine, Hamidia Hospital, Bhopal. The subjects were recruited randomly from medical and Endocrinology speciality OPD of Hamidia Hospital. A total of 100 subjects were taken with metabolic syndrome

Exclusion criteria of the study was:-
- Patient with history of midcompartment abdominal surgery
- Patient with ascitis
- Patient with distorting abdominal anatomy
- Patients who refuses to be enrolled in this study
- Pregnancy

Methods

Anthropometric measurements: Clinical examination; detailed history and relevant laboratory investigations were done for all selected patients as detailed in the performa. If the patients had any co-morbid medical condition it was recorded.

Height, weight, body mass index, WHR were the anthropometric parameters assessed. Height and weight were measured using the standard procedure suggested by Jelliffe (1966). Measurements were taken in subjects without wearing shoes or heavy outdoor clothing.

[1]HOD, Department of Medicine, GMC, Bhopal, [2]RMO 3rd Year, Medicine, [3]Assistant Professor, Department of Medicine GMC, Bhopal

Corresponding author: Premlata Solanki, Room No 8, "H" Block Medical Girls Hostel, Bhopal, Madhaya Pradesh, India

Height was measured to the nearest centimetre using an anthropometric inelastic measuring tap with the subject standing erect on the floor with the back against the wall.

Weight of the subjects was measured by weighing machine. Waist and hip measurements were taken using an inelastic measuring tape (Callaway et al 1988).

The amount of subcutaneous and abdominal adipose tissue was measured anthropometrically and ultrasonographically. The subjects' height and weight were measured while they wore indoor clothes and no shoes.

Body mass index (BMI) was calculated as weight (kg) divided by height^2 (m).

$$BMI = \frac{Weight\ (Kg.)}{Height\ (M^2)}$$

Normal range of BMI is considered in between 18.5 to 22.9. BMI 23 or more than 23 is considered as at risk(WHO consultation)

Waist circumference was measured halfway between the lower rib and the iliac crest, and hip circumference was measured at the level of the greater trochanter (10): In males, we used waist circumference cut offs at >90cm while in females, the cut offs used were at >80cm for Indian subjects. (International diabetes federation global consensus definition)

In making the ultrasound measurements

Of abdominal subcutaneous fat, Measurement of subcutaneous fat was performed with the patient in dorsal decubitus position and the convex 3-4 MHz transducer cross sectionally placed on midline,1cm above the umbilicus, during the expiratory phase without pressure on the abdomen in order not to distort measurement subcutaneous fat corresponds to distance in cm between the skin ant anterior surface of the linea alba which is the tendinous raphe that unite the two half of the rectus abdominis muscle.

Waist hip ratio was measured as:-

$$WHR = \frac{Waist\ circumference}{Hip\ circumference}$$

Normal waist hip ratio for Indian male is < 0.95 and for female it is <80 (Epidemiology Task Force Consensus Group.LANCET 2005;366:1059-69)

Investigations

Biochemical test(lipid profile) was performed in department of pathology Gandhi Medical College Bhopal.

Patients with Serum Triglyceride level >150mg/dl and males with HDL <40 females with HDL <50 were included in metabolic syndrome

STATISTICAL ANALYSIS

Data were entered in excel worksheet and analysed using stastical package for social science stastcal softwere for window (SSPE version 17) difference was considered statistically significant at $p \le 0.05$.

RESULT

The present study was undertaken to correlate intraabdominal

SEX	SC Fat [cm]	HDL		TG		HTN		DM	
		Low	Normal	High	Normal	Present	Absent	Present	Absent
Male	<1	4	0	3	1	2	2	3	1
	1.1-2	29	9	35	3	24	14	22	16
	2.1-3	10	1	10	1	10	1	9	2
	>3	1	1	1	1	2	0	2	0
	p value	0.63		0.55		0.038 [significant]		0.10	
Female	<1	4	0	4	0	1	3	3	1
	1.1-2	25	1	20	6	16	10	21	5
	2.1-3	13	1	12	2	8	6	10	4
	>3	1	0	1	0	1	0	0	1
	p value	0.61		0.58		0.83		0.32	
Table-1: Correlation of subcutaneous fat with Hdl Htn and DM2									

Sex	BMI Grade	HDL		TG		HTN		DM	
		Low	Normal	High	Normal	Present	Absent	Present	Absent
Male	Overweight	22	6	25	3	18	10	17	11
	OBESE 1	19	4	21	2	16	7	16	7
	OBESE 2	2	1	2	1	3	0	2	1
	OBESE 3	1	0	1	0	1	0	1	0
	p value	0.78		0.96		0.43		0.45	
Female	Normal	1	0	1	0	0	1	1	0
	Overweight	21	2	17	6	11	12	17	6
	OBESE 1	14	0	12	2	9	5	11	3
	OBESE 2	4	0	4	0	4	0	4	0
	OBESE 3	3	0	3	0	2	1	1	2
	p value	0.17		0.18		0.08		0.92	
Table-2: Correlation OF BMI with HDL HTN and DM2									

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Sex	WHR	HDL Low	HDL Normal	TG High	TG Normal	HTN Present	HTN Absent	DM Present	DM Absent
Male	0.9 - 1.0	4	1	5	0	2	3	3	2
	1.01-1.2	39	10	43	6	35	14	32	17
	>1.2	1	0	1	0	1	0	1	0
	p value	0.99		0.61		0.14		0.78	
Female	0.8--0.9	6	0	4	2	2	4	4	2
	0.9 - 1.0	16	0	15	1	9	7	14	2
	1.01-1.2	19	2	16	5	13	8	14	7
	>1.2	2	0	2	0	2	0	2	0
	p value	0.16		0.47		0.31		0.34	

Table-3: Correlation of Whr with HDL HTN and DM2

Sex	Waist circumference	HDL Low	HDL Normal	TG High	TG Normal	HTN Present	HTN Absent	DM Present	DM Absent
Male [55]	81-90	1	0	1	0	0	1	1	0
	91-100	14	4	16	2	10	8	11	7
	101-110	21	5	24	2	18	8	16	10
	>110	8	2	8	2	10	0	8	2
	p value	0.88		0.94		0.045 [significant]		0.79	
Female [45]	81-90	7	0	6	1	3	4	5	2
	91-100	15	0	12	3	7	8	13	2
	101-110	16	0	14	2	11	5	14	2
	>110	5	2	5	2	5	2	2	5
	p value	0.15		0.94		0.11		0.34	

Table-4: Correlation of waist circumference with HDL, TG, HTN and DM

subcutaneous fat measured by ultrasonography and anthropometry with other components of metabolic syndrome among patients attending Hamdia Hospital Bhopal.

100 patients with either symptomatic disease (CVA, CAD, peripheral arterial disease or a marked cardiovascular disease risk factors like HTN, dyslipidemia, or DM) were taken randomly from endocinology OPDs.

In our study BMI was not significantly related to any of component of metabolic syndrome P value was statistically insignificant other studies also declare the superceding of other indices over BMI.

Two indicator were studied purposely to measure abdominal obesity –WHR and WC.

In our study male participants showed statistically significant correlation between waist circumference and hypertention but this association was not shown by the female participants (p value 0.045) waist hip ratio could not be associated significantly with any component of metabolic syndrome.

Several studies are also in favour of waist circumference as a stronger predictor for metabolic risk factors and cardiovascular disease as compare to WHR.

According to statistical analysis subcutaneous fat was significantly associated with hypertension in male patients (p value 0.038).

But this correlation was not found to be significant in females patients (p value 0.38).

DISCUSSION

The present study was undertaken to compare the association of ultrasonography and waist circumference measurement of abdominal subcutaneous fat with other component of metabolic syndrome among patients attending hamidia hospital Bhopal.

In this study patients visiting hamidia hospital were taken with either symptomatic cardiovascular disease (cerebral ischeamia, coronary artery disease, peripheral artery disease, or abdominal aortic aneurysm) or a marked cardiovascular disease risk factors like hypertension, diabetes dyslipidemia In present study 100 adults were taken out of which 55%were male and 45% were female

In this study study population was stratified in to 10 years of age group <30, 31-40, 41-50, 51-60, 61-70 and >70 age of the male and female ranged between 30 to 75 years.

A total of 1 (1%) subjects were in the age group of <30 years of age. Age group 31-40 consist of 18 (18%) subjects.

Age group 41-50 constitute highest no of population i.e.34 (34%), out of which 22 were males and 12 were females. Age group 51-60 years consisted of 29 (29%) individuals, males were 19 and females were 10.

Age group 61-70 years consist of 14(14%) subjects with 5 female and 9 male. Age group >70 years consists of 4 subjects (4%) out of which 3 were female and 1 was male.

In our study, prevalence of overweight (BMI23-29.9) was 51. 37 patients were put in obese class 1 (BMI 25-29.9) and 7 patients were found to be class 2 obese (BMI30.0-34.9) and 4 patients were included in the group of class 3 obese patient (BMI35.0 -39.9). (TABLE NO -2)

In this study the BMI was ranged between 22.08 - 43.2 in females and ranged between 23.43 - 40.90 in males. Mean BMI of the study population was 30.07±4.04, females were comparatively more obese than males. Defining obesity in

relation to BMI (cut off value >25gm/m^2) total 50 patients were labelled as obese (table no -2).

In our study BMI was not significantly related to any of component of metabolic syndrome (table no-2)

Similar observation were reported by

1. Visscher TL et al. total 6296 men and women were studied they found that BMI is a poor predictor of mortality as compare to waist circumference.[8]
2. Schneider HJ et al analysed 6355 no of subjects and found that BMI is a poor predictor of cardiovascular risks and mortality than WHR and WC.[9]

WHR of females ranged between 0.83 -1.33 with a mean 1.01 ±0.10 males were comparatively having more WHR then females. (table no-3)

In our study abdominal obesity according to waist hip ratio, was found in 98 individuals. We didn't find any significant correlation between WHR and component of metabolic syndrome. (table no 3)

We found a significant correlation between waist circumference and hypertention in male patient (p value 0.045) (table no 4) but this was not found to be significant in female participants.

In our study Ultrasound Intraabdominal fat measurements were performed in 100 participants and mean value of subcutaneous fat was 1.61±0.64 cm mean subcutaneous fat for female was 1.67±0.67 and mean cutaneous fat for male was 1.56±0.62. according to statistical analysis subcutaneous fat was significantly associated with hypertension in male patients (p value 0.038). (table no-1)

But this correlation was not found to be significant in females patients (p value 0.38). (Table NO -1).

Similar study was conducted in April 2003 by Ronald P stalk et al they analyse 600 participants. they found that subcutaneous fat measured by ultrasound was not significantly related to the presence of metabolic syndrome. which was against this study[10]

Table-1,2,3,4 provides the association between three anthropometric indices and subcutaneous fat with DM/HTN/ and Dyslipidemia

Obesity-associated arterial hypertension is characterized by activation of the sympathetic nervous system, activation of the renin-angiotensin system, and sodium retention, among other abnormalities.

More recent evidence indicate that upper body obesity imparts a greater risk for cardiovascular disease than lower body obesity regardless of gender (WHO)[11].

Praxis et al French study conducted in1996 Dec suggest that obesity of the male (Android obesity) is clearly a cardiovascular risk factor, more so than gynecoid obesity[12]

Another hypothesis of androgen and oestrogen receptors suggest that adipocytes have specific receptors for androgens, unlike most hormones testosterone induces an increase in no of androgen receptors after exposure to fat cells, thereby affecting lipid mobilization.

The androgen receptors in female adipose tissue seems to have the same characterstics as that found in male adipose tissue. however, estrogen treatment down regulate the density of this receptor, which might be a mechanism whereby oestrogen protect adipose tissue from androgen effect. Estrogen by itself seems to protect postmenopausal women receiving replacement therapy.

CONCLUSION

In conclusion waist circumference and subcutaneous fat appears as accommodative marker of obesity to detect Hypertension in males. However as this study is hospital based, a community based cohort study with representative sample is required to identify a sensitive and contextual marker in Indian sub-continent which will enable us to intervene in pre pathogenesis phase and to detect at earliest the cardiovascular morbidity.

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