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Correlation of Gallstone Disease with Total Body Fat and Its Distribution: A Prospective Case Control Study

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Abstract

Background: Approximately one fifth of adults are diagnosed with gallstones worldwide. The risk of gallstones is influenced by a combination of genetic and life style factors, such as physical inactivity, diet, medications and obesity. In fact, body mass has been demonstrated to be a major risk factor for symptomatic gallstones

Aims & Objectives

a) To study any association between gallstone disease and distribution of total body fat.
b) To evaluate the efficacy of various anthropometric indicators as predictors of gallstone disease.

Methods: It was a prospective case control study conducted on 100 patients, (50 patients 0f gallstones as cases and 50 patients without gall stone as controls) obesity was measured by body mass index(BMI), waist hip ratio(WHiR), waist to height ratio(WHT) and Bioelectrical impendence analysis (BIA) in central research lab of our institute. A written informed consent will be taken from all cases before enrolment in the study.

Result: In this study % of total fat in cases & controls were 41.78±11.01 & 35.01±13.55 respectively, was found to be statistically significant. The mean Hip circumference and abdominal/hip ratio in cases was 95.84±9.14 & 0.90±0.15 respectively while in controls these were 86.45±11.02 & 1.01±0.12 respectively, which is statistically significant. The mean LDL & HDL cholesterol levels in cases were 102.54±29.24 & 59.46±15.67 respectively while its levels in controls were 73.16±22.83 & 79.44±27.52 respectively which is statistically significant, However VLDL cholesterol, triglyceride (TG) & total cholesterol did not reflect any significant difference between the two groups. Majority of patients in both groups (98%) were vegetarian. The mean age of the cases was 47.56±14.7 yr while it was 37.96±13.55 yr for the control group. The co morbidities like HTN, DM & TB have not shown any significant association with gall stones.

Conclusion: The % of total body fat is helpful in determining the risk of gall stone disease. The Hip circumference &Abdomen/hip girth ratio can play an important role in prediction of gall stone disease. The serum LDL & HDL levels have also showed the promising results in its prediction. Therefore, effective clinical indicators are valuable for predicting or preventing the development of gallstone disease.

Keywords: Bioelectrical Impedance Analysis, Diabetes, Gallstone Disease, Obesity

Introduction

Gallstone disease (GSD) is a common health problem reported in 10-20 % of the population worldwide.[1]The cholesterol constitutes 51-99 % of cholesterol or mixed stones which are the most common variety reported in western world.[2] The pathogenesis of cholesterol gallstones is affected by genetic factors, hepatic hyper secretion of cholesterol resulting in supersaturated gallbladder bile, impaired gallbladder motility, immune-mediated gallbladder inflammation & intestinal factors involving absorption of cholesterol, slow intestinal motility, and altered gut microbiota.[3]

The risk factors of GSD include both non modifiable (age, sex, genetic) and modifiable (obesity, diabetes, physical inactivity, low fibre diet and energy dense nutrition) factors. Obesity is a well- recognized risk factor for development of cholelithiasis which is attributed to the increased hepatic secretion of cholesterol[4] There is a linear correlation between increased cholesterol production and total body fat.[5] Increased cholesterol secretion in bile further increases its chances of precipitation and hence gallstones formation.[6] Each extra kilogram of body fat not only produces approximately 20 mg additional cholesterol but is also associated with a reduced gallbladder motility resulting to an increased GSD burden.[7]

The body fat distribution further plays a pivotal role in developing the GSD as central obesity has been found to have a strong association with GSD compared to total body fat mass which is independent of BMI.[7-9] With a reported global upsurge trend in prevalence of obesity, the burden of GSD is also expected to rise further.[10]

The total body fatness can be measured by body mass index (BMI) and Bioelectrical impedance analysis (BlA) while the various anthropometric indicators like waist circumference (WC), hip circumference (HC) and waist to hip ratio (WHR)are useful in measuring the central obesity.

Bioelectrical impedance analysis is a rapid, non-invasive and sensitive indicator of body fat composition. Therefore, we haveconducted a comparative study to assess the total body fat and its distribution in patients with and without GSD.

Materials and Methods

It was a prospective case control study conducted in 100 patients, (50 patients each with and without gallstones as cases and controls respectively). To avoid gender biasing, only female patients were included in the study. A written informed consent was taken from all the cases & controls before enrolment in the study. A detailed history was taken from patients followed by physical examination. The patients were investigated for complete hemogram, blood urea, blood sugar level and lipid profile. The ultrasonography (USG) was performed to confirm or rule out the gall stone disease in all 100 patients. After USG examination, people without gallstones were included in the controls group, while patients having gallstones were included in the cases group. The total body fatness was measured by BMI and TBFM (total body fat mass) while using the BIA. The central obesity was measured by non-stretchable standard tape while measuring the waist circumference at the level of umbilicus, hip circumference at the largest posterior extension of the buttocks and waist hip ratio (WHR). All participants underwent BIA with In Body s10 equipment. The outcome was studied using Microsoft excel and SPSS 20 by calculating the average, range, standard deviations, percentage and Chi square test, t test and ANOVA were applied where ever required for comparisons among the groups.

Equipment (In Body s10)

It is a direct segmental multi-frequency Bioelectrical Impedance analyser using 8-point tactile electrode system with thumb electrodes.[11] Electric currents have differing penetration abilities depending on their frequency. In Body makes use of multiple currents at varying frequencies in order to provide most accurate body composition analysis. It separately measures the impedance of the arms, legs and trunk. Impedance values in the arms and legs generally range between 200-5000 ohms while the values for the trunk are between 20-300 ohms. The information required to determine body compositions are height, weight & impedance.

Study area: Department of General Surgery, Bhagat Phool Singh Government Medical College for Women.

Study population: Female patients coming in Department of General Surgery, Bhagat Phool Singh Government Medical College for Women.

Inclusion criteria

Female patients with USG diagnosed gallstones disease were included as cases.

Exclusion criteria

1. Cases already on treatment of obesity
2. Postoperative cases of gallstone disease and bariatric surgery.

Sample size: Total number of patients included in the study were 100, which were further divided into two groups as cases& controls, 50 patients in each group.

Study design: A prospective case control study.

Results

It was a prospective case control study conducted in Department of General Surgery at Bhagat Phool Singh Government Medical College, Khanpur Kalan, Haryana. This study was planned to investigate the correlation of gallstone disease with total body fat and its distribution. In this study total 100 patients were included as two groups and each group containing 50 each, as cases and controls respectively.

Table 1: Mean age between cases and controls

Demographic data	Cases	Controls
Mean age (years)	47.56±14.7	37.96±13.55

The mean age of the patients in cases was 47.56±14.7 year & in controls, it was a 37.96±13.55 year as shown in table 1.

Table 2: Dietary history between cases & controls

Diet	Cases	Controls	P value
Non veg	2 (4%)	0	0.49
Veg	48 (96%)	50 (100%)	

Majority of patients in both groups (98%) were vegetarian as shown in table 3, while only 2% patients were non vegetarian.

Table 3: Lipid profile between cases & controls

Cholesterol	Cases	Controls	P value
LDL Cholesterol (mg/dl)	102.54±29.24	73.16±22.83	<0.001
HDL cholesterol	59.46±15.67	79.44±27.52	<0.001
VLDL cholesterol	49.86±25.48	49.78±16.80	0.98
Total cholesterol	181.28±32.60	170.52±45.27	0.17
TG	138.54±43.16	123.92±39.86	0.08

The mean LDL &HDL cholesterol levels in cases were 102.54±29.24 & 59.46±15.67 respectively while its levels in controls were 73.16±22.83 & 79.44±27.52 respectively, which are statistically significant (p value <0.001) as depicted in table 3. However, VLDL, TG& total cholesterol levels were not significant.

Table 4: Waist circumference& hip circumference between cases & controls

Parameters	Cases	Controls	P value
Waist circumference (cm)	86.35±15.18	86.80±10.60	0.86
Hip circumference (cm)	95.84±9.14	86.45±11.02	<0.01
Waist /Hip ratio	0.90±.15	1.01±0.12	<0.01

The mean Hip circumference in cases was95.84±9.14 cm while it was 86.45±11.02 cm in the control group which is statistically significant. (p value<0.01) similarly, there is a significant difference in waist/hip ratio in both groups as reflected in table 4. However, the mean waist circumference in cases was 86.35±15.18 cm while in control group it was 86.80±10.60 cm with p value 0.86, which is not statistically significant.

Table 5: Mean BMI & total body fat mass (TBFM) between cases & controls.

Parameters	Cases	Controls	P value
BMI (kg/m^2)	25.85±5.28	23.90±5.67	0.07
TBFM (kg)	25.02±9.62	21.33±7.83	0.03
% of total fat	41.78±11.01	35.01±13.55	0.001

Table 5 indicates that TBFM and % of total fat showed a statistically significant difference in the two groups, with p values of 0.03 and 0.0001, respectively while BMI values did not reflect any significant differences among the two groups.

Discussion

Gallstone disease (GSD) is a quite common gastrointestinal disease in India with a prevalence of 3-10 % in Asian population.4,12The obesity plays a central role in its aetiology by attributing an increased hepatic cholesterol secretion.13Although the World Health

Organization has indicated body mass index (BMI) as the most accurate measure of obesity, but it really measures lean body mass and has a weak relationship with central adiposity, a significant risk factor for the development of metabolic syndrome and gallstones.

The prevalence of gallstone disease increases with the advancing age. In our study mean age of cases was47.56±14.7 years while it was 37.96±13.55 years (Table 1) in the controls which is comparable with the studies reported in recent literature.[11,14,15]

In present study, the mean LDL& HDL cholesterol levels were raised in cases group (Table 4) which were statistically significant as compare to control group while VLDL cholesterol, TG& total cholesterol levels were comparable in both groups. Pei-yuunSu et al have also reported14similar results in their study. Kim HS et al have reported that low HDL level was an independent risk factor (OR=0.858, 95 %CI, P=0.01) for GSD in both genders while high LDL was also significant risk factor for GSD in women.[10] ($p<0.01$)

The central obesity is defined as waist circumference of equal or more than 80 cm in Asian women.[14]The mean waist circumference in our cases was 86.35±15.18 & in control group it was 86.80±10.60 (p= 0.86). Although both the groups were fulfilling these criteria of central obesity in the Asian population[14]which is a significant risk factor of GSD but still, they showed no significant association with GSD in our study. In present study, the mean Hip circumference was significantly high (p value<0.001) in case group than the control group. (Table4) The waist/hip ratio was also significantly low (p value<0.001) in case group than the control group. Tsai et al have used waist circumference and W/H ratio for measuring the central obesity in their two separate studies. They have also reported a significant association between these two parameters with the GSD in both genders.[4,8,9]Similarly, Malik et al[15] and Radmard AR et al4and Harpreet et al have[16] also reported a significant correlation between W/H ratio and GSD. However, we could not find any study showing the association of hip circumference with GSD like the present study.

Although BMI is a useful tool to measure the overall obesity but it does not distinguish between fat and lean body mass and, therefore, may not be a perfect measure of adiposity, particularly in older adults as the adiposity in older persons may increase despite a decrease in BMI due to of the loss of lean body mass.[15] Thus, BMI has been frequently used an indicator of total body fatness but it is poorly correlated with central obesity, a more important risk factor for GSD than general obesity.[15,17] In our study, the mean values for TBFM (25.02±9.62 Kg) and percentage of total body fat (41.78±11.01) both were significantly high in case group than the control group. (table 6) Similar results are also reported by Boston MS and Yilmaz S in their recent study.[11]

Limitations

One of the limitations of our study is that it was conducted only in female population. Secondly, it was conducted on a small population of 100 females only. Thirdly, it was conducted on a homogeneous population of a small region.

Conclusion

It was found that total body fat mass and percentage of total body fat are better predictors of the risk of GSD than BMI which can be easily measured by non-invasive and simple BIA technique. The waist/hip ratio and hip circumference are better anthropometric indicators of GSD risk compare to waist circumference. However, a large, multi-centric study is required to further confirm the findings for definite recommendations.

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