A Study of association between Body Mass Index and Severity of Acute Calculus Cholecystitis

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Abstract- The aim of this study to evaluate whether or not Body Mass Index (BMI) is associated with the severity of Acute Calculus Cholecystitis. In this study 50 patients were enrolled and categorized as obese (BMI ≥25 kg/m^2) and non-obese (BMI< 25 kg/m^2). There was a significant association between BMI and severity of ACC (p=0.01). Similarly, the severity of ACC was more in obese female patients (p=0.05) whereas such association was not observed in obese male patients (p=0.18). Increased BMI is associated with severe form of ACC.

Index terms- Acute calculus cholecystitis, Body mass index, Obese.

I. INTRODUCTION

Gallstones are common biliary tract pathology which can lead to Acute Calculus Cholecystitis (ACC). Obesity, hypothyroidism, diabetes, insulin resistance, dyslipidemia and female gender are few of the established risk factors for gallstones.

There are many reports on association of obesity with gallstone, however its association with the severity of cholecystitis is lacking. Thus we aimed to find out if such association exist or not.

The objective of the study was to evaluate the association of severity of cholecystitis with Body Mass Index (BMI) and both the gender.

II. MATERIALS AND METHODS

This prospective observational descriptive cross-sectional hospital based study was conducted in the Department of Surgery of Manipal Teaching Hospital from July 2015- June 2018. The study was performed after approval from the Institutional Review Board and taking written, informed consent from all the patients. A total of 50 patients with Acute Calculus Cholecystitis (ACC), aged 18-65 years were included in the study. Patients on steroid, patients with preexisting thrombocytopenic condition, renal impairment, concomitant acute biliary condition like acute cholangitis, acute pancreatitis, acute hepatitis and immuno-compromised patients were excluded from the study.

Non random sampling technique was used. Based on the study carried out by Gomes et al, the incidence of ACC was 1-4% in patients with symptomatic gallstone [1]. Considering the prevalence rate as 3%; with 95% confidence interval with 5% allowable error, sample size was calculated using following formula:

$n= Z\alpha^2PQ/d^2$

where n= required sample size

Zα= standardized normal deviate (1.96)

P= estimated proportion in the population (0.03)

Q= 100-P (if P is in %) (0.97)

d = allowable error (0.05)

The minimum sample size required was 45, total of 50 cases were taken into the study.

The Tokyo Guidelines (TG13) was used for grading the severity of ACC (Table 1) [2].

Table 1: Tokyo Guideline (TG 13).

Severity of ACC	**Signs**
Grade I (Mild ACC)	Mild inflammatory changes in the gall bladder with no organ dysfunction.
Grade II (Moderate ACC)	Associated with any one of the following conditions 1. Elevated WBC count (>18,000/mm^3) 2. Palpable tender mass in the right upper abdominal quadrant 3. Duration of complaints > 72hour 4. Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis, emphysematous cholecystitis)
Grade III (Severe ACC)	Associated with dysfunction of anyone of the following organs/systems 1. Cardiovascular dysfunction- Hypotension requiring treatment with dopamine ≥ 5µg/kg per min, or any dose of norepinephrine 2. Neurological dysfunction- Decreased level of

	consciousness 3. Respiratory dysfunction- PaO_2 /FiO_2 ratio <300 4. Renal dysfunction- Oliguria, creatinine > 2.0mg/dl 5. Hepatic dysfunction – PT INR > 1.5 6. Hematological dysfunction- Platelet count < 100,000/mm^3

The patients with BMI $\geq$ 25 kg/m^2 were categorized as obese and patients with BMI < 25 kg / m^2 were categorized as non-obese. BMI was calculated by dividing the patient's weight in kilograms by the square of the height in meters. Height and weight were measured in standing position with light clothes and bare foot. We carried out this study to find out the association between BMI and severity of ACC.

Data was analyzed using SPSS (The Statistical Package for Social Sciences) version 21.0 software. Descriptive data are presented as frequency, mean and standard deviation. Chi-square was used to find out the association between BMI and Severity of ACC. Fishers exact was used to find out the association between gender and Severity of ACC. P value < 0.05 was considered statistically significant.

III. RESULTS

The demographic variables of the patients included in the study is presented in Table 2.

Table 2: Demographic Variables

Variables	Values
Age (years)	47.4 ± 13.9
Sex(Male/Female)	20 (40%)/ 30 (60%)
Body Mass Index (BMI) (kg/m^2)	25.4 ± 4.09

Data presented as mean ± sd and number (percentage)

Out of 50 patients, 20 (40%) patients were non-obese and 30 (60%) patients were obese. Mild ACC was present in 17 (34%) patients, moderate ACC was present in 17 (34%) patients and 16 (32%) patients had severe ACC. There was a significant association between BMI and severity of ACC (Table 3). Similarly, the severity of ACC was more in obese female patients whereas such association was not observed in obese male patients (Table 4 and Table 5).

Table 3: Severity of Acute Calculus Cholecystitis according to BMI.

BMI	Mild ACC	Moderate ACC	Severe ACC	χ^2 Value	p value
<25 Kg/m^2	10(50.0%)	8 (40.0%)	2 (10%)	7.90	0.01
≥25 Kg/m^2	7 (23.3%)	9 (30.0%)	14 (46.7%)		

Data presented as number (percentage), analyzed by Chi square, p value ≤ 0.05 is considered clinically significant.

ACC: Acute Calculus Cholecystitis, BMI: Body Mass Index

Table 4: Severity of ACC according to BMI in female patients.

BMI	Mild ACC	Moderate ACC	Severe ACC	Fisher's Exact Value	p value
<25 Kg/m^2	8 (61.5%)	4 (30.8%)	1 (7.7%)	5.60	0.05
≥25 Kg/m^2	4 (23.5%)	6 (35.3%)	87 (41.2%)		

Data presented as number (percentage), analyzed by Fishers Exact, p value ≤ 0.05 is considered clinically significant

ACC: Acute Calculus Cholecystitis, BMI: Body Mass Index

Table 5: Severity of ACC according to BMI in male patients.

BMI	Mild ACC	Moderate ACC	Severe ACC	Fisher's Exact Value	p value
<25 Kg/m^2	2 (28.6%)	4 (57.1%)	1 (14.3%)	3.28	0.18
≥25 Kg/m^2	3 (23.1%)	3 (23.1%)	7 (53.8%)		

Data presented as number (percentage), analyzed by Fishers Exact, p value ≤ 0.05 is considered clinically significant

ACC: Acute Calculus Cholecystitis, BMI: Body Mass Index

IV. DISCUSSION

Obesity is an important risk factor for the development of cholesterol gallstone and gallstone related complications [3]. This study focuses on the severity of acute calculus cholecystitis and its association with BMI. BMI is an index of body fatness. The cut-off point of 25 kg/m^2 was used for defining obesity as proposed by International Obesity Task Force for Asia- Pacific region by WHO [4].

In obese individual there is increased production of cholesterol from liver which supersaturates the bile and results in formation of cholesterol gallstone. In addition, there is decreased sensitivity of gall bladder to cholecystokinin which decreases the motility of gall bladder. This leads to incomplete and infrequent emptying of bile and results in over-concentrated bile. These factors contribute for increased risk of stone formation in obese individual [5], [6].

Almost 10% of patients with asymptomatic cholelithiasis progress to develop some clinical symptoms and complications over 5 years [7]. ACC is a complication of cholelithiasis with an incidence of 0.5 % per year in asymptomatic patients.

We found that higher BMI was associated with severe form of acute cholecystitis. The probable explanation is that the incidence of gallstone is more in obese as compared to non-obese which place them at increased risk of developing associated complications, one of which is acute cholecystitis [4]. On further analysis, BMI was found to be positively correlated in obese female patients in terms of severity of ACC whereas no such evidence was seen in male patient.

It can be explained from the fact that fat in males have a protective anti-inflammatory role as evidenced by past studies [8], [9].

V. CONCLUSIONS

Obesity is a documented risk factor for the formation of gall stone and BMI is used as a tool to measure the body fatness or obesity. In our study we found a positive association of BMI and severity of ACC. This was confirmed in obese female patients whereas no such association was observed in obese male patients.

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