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Original Research Article

Evaluation of relationship of body mass index with severity of cholecystitis

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ABSTRACT

Background: Obesity is an established risk factor for gall stone disease. Male sex has also been recently cited as a risk factor for severe symptomatic cholelithiasis. As a possible cause of several difference in regards to the severity of cholecystitis, many physiological differences between the two sexes can be examined. Many studies have been done on the risk factors for developing the gall bladder disease explaining its polygenic nature It is postulated that the total body fat, the main value of which is significantly higher for females than males, may contribute to this sex difference. Only a couple of studies are available on BMI and its effect on severity of cholecystitis hence depicting the need for this study in our setup.
Methods: This is a prospective study carried out on 70 patients for cholecystitis whose weight and height measurements had been recorded on admission. Patients were placed in either group-Obese (BMI e" 25kg/m^2) or Non-Obese (BMI <25kg/m^2). The association between BMI and severity of cholecystitis was investigated.
Results: 18% of the laparoscopic cholecystectomy surgeries required conversion to open cholecystectomy due to reasons like severe adhesions to an adjacent organ, etc. Pain in abdomen (100%) was the commonest complaint and was present in all the patients followed by dyspepsia (44%).69% of patients were having complaints for more than 72 hours. No significant difference observed among mean BMI of different grades of severity (p=0.963).
Conclusions: There is negative correlation between BMI and grade of severity of cholecystitis and BMI is not a predictor for the conversion from laparoscopic to open cholecystectomy.

Keywords: BMI, Cholecystitis, Laparoscopic cholecystectomy, Obesity

INTRODUCTION

Obesity has become the leading metabolic disease in the world to such an extent that the World Health Organisation refers to obesity as the global epidemic. Body Mass Index (BMI) is the most widely used indicator for obesity.[1] BMI or the Quetelet's index is a value inferred after dividing the body mass by the square of the height of the body, and is specified in units of kg/m^2.[2] Cholecystitis is defined as inflammation of the gallbladder and manifest as right upper abdominal pain, nausea, vomiting, and occasionally fever. More than 90% of the time acute cholecystitis is from blockage of the cystic duct by a gallstone.[3] Most patients with acute cholecystitis have had previous attacks of biliary colic.[4] In India women are twice as likely as men to form gallstones. Most common gallstone type found is mixed type and least is the cholesterol type. Age group most commonly affected is 31-50 years.[5] There is marked difference in prevalence between Indians living in north India who have prevalence rates seven times higher than the south Indians.[6]

Risk factors for gallstones include obesity, oral contraceptive pills, pregnancy, hereditary, diabetes mellitus, dyslipidaemia, drugs, rapid weight loss, etc. The mnemonic of 5 F viz. fair, fatty, fertile, female and forty in the development of gallstones is well known.[7]

Many studies have been done on the risk factors for developing the gall bladder disease explaining its polygenic nature. But only a couple of studies are available on BMI and its effect on severity of cholecystitis hence depicting the need for this study in our setup.

There was no association between body mass index and the severity of cholecystitis in a study conducted by Lee HK et al.[8]

Langenbuch performed the first successful cholecystectomy in 1882, and for more than 100 years, it was the standard treatment for symptomatic gallbladder stones. In 1987, laparoscopic cholecystectomy was introduced by Mouret P in France and quickly revolutionized the treatment of gallstones. It not only supplanted open cholecystectomy, but also more or less ended attempts for noninvasive management of gallstones, such as extracorporeal shock wave and bile salt therapy.[9]

Aim of the study was to evaluate of relationship of body mass index with severity of cholecystitis and to evaluate the relationship of body mass index with severity of cholecystitis. Also, to study whether higher BMI is a predictor for conversion (from laparoscopic to open cholecystectomy).

METHODS

This is prospective cohort type of study. This study was conducted at Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India. Sample size of 100 patients who were admitted to our hospital. This study was conducted between July 2016 to September 2018. The patients were informed regarding the purpose of the study.

Proforma

This consisted of detailed history taking, clinical examination etc. (Appendix B).

Inclusion criteria

All patients admitted with cholecystitis irrespective of age and gender and undergoing cholecystectomy.

Exclusion criteria

Immunocompromised patients. (HIV positive, steroid therapy).

Method of collection of data

All eligible cases, considering inclusion and exclusion criteria, who were admitted under General Surgery, Dr. D.Y. Patil Hospital, Pimpri, Pune for the treatment of cholecystitis during the period of study have been encompassed in our study. BMI of the study subjects was computed by measuring their weight and height as shown below:

Body Mass Index (BMI) = Weight (kg)/Height (m^2)

This figure shows the method of taking height and weight of a person for calculating BMI according to which the patients will be classified as obese and non-obese. Weight of the patients were taken on digital machine for maintaining accuracy of the study. Also, the heights were taken manually as shown in Figure 1.

Figure 1: Weight and height measurement for BMI.

- BMI was interpreted as:[10]
- BMI <25 as non-obese
- BMI >25 as obese.

USG findings like thickened gall bladder wall more than 4mm, pericholecystic collection, etc. were noted. After cholecystectomy following intra operative findings or presence of complications were assessed for grading the severity of cholecystitis:

- Pericholecystic collection/abscess
- Empyema of gall bladder
- Gangrene of gall bladder

- Perforation of gall bladder
- Biliary peritonitis
- Hepatic abscess
- Emphysematous gall bladder
- Severe adhesions to an adjacent organ.

Severity of acute cholecystitis is classified into 3 grades based on Tokyo guidelines 2013 on acute cholecystitis as mentioned below:[11]

Grade III (severe) cholecystitis

Associated with dysfunction of any one of the following organs/systems:

- Cardiovascular dysfunction (hypotension requiring treatment with dopamine C5lg/kg per min, or any dose of norepinephrine)
- Neurological dysfunction (decreased level of consciousness)
- Respiratory dysfunction (PaO2/FiO2 ratio <300)
- Renal dysfunction (oliguria, creatinine>2.0mg/dl)
- Hepatic dysfunction (PT-INR>1.5)
- Hematological dysfunction (platelet count<100,000/mm^3).”

Grade II (moderate) cholecystitis

Associated with any one of the following conditions:

- Elevated white blood cell count (>18,000/mm^3)
- Palpable tender mass in the right upper abdominal quadrant
- Duration of complaints >72hours
- Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis, emphysematous cholecystitis).”

Grade I (mild) cholecystitis

Does not meet the criteria of ‘‘Grade III’’ or ‘‘Grade II’’ cholecystitis. Grade I can also be defined as acute cholecystitis in a healthy patient with no organ dysfunction and mild inflammatory changes in the gallbladder, making cholecystectomy a safe and low-risk operative procedure.”

Demographic characteristics like age and gender were analysed. Based on the clinical examination, blood investigations, ultrasound and intra-operative findings; the grading of severity of cholecystitis was done.

Laparoscopic cholecystectomy

In this procedure four small skin incisions are made in the abdomen for the insertion of operating ports, through which surgical instruments are put into the abdominal cavity. The laparoscope has a camera with a light source. The cystic duct and artery are identified and ligated; the gallbladder is then evacuated through one of the ports. This is the laparoscopic view of the Calot’s triangle while performing cholecystectomy which is also known as the ‘Strasburg’s Critical View of Safety’. It is the guide for performing cholecystectomy. Here, identification of CBD is not necessary as only two structures are seen entering the gall bladder i.e. cystic duct and cystic artery (Figure 2).

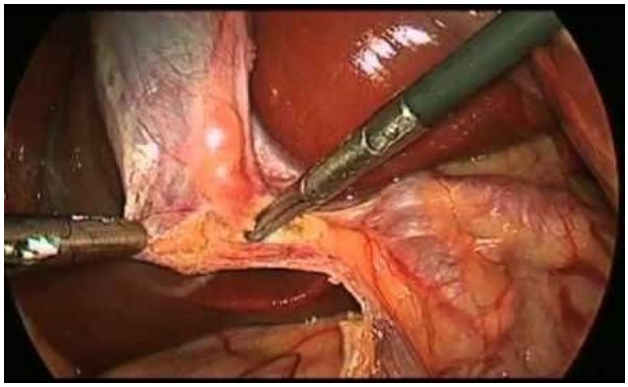

Figure 2: Laparoscopic cholecystectomy.

Open cholecystectomy

In open cholecystectomy, a skin incision of around 8 to 12cm is taken below the right subcostal margin and the gallbladder excised after identification and ligation of cystic duct and artery. Open cholecystectomy is often done if difficulties arise during a laparascopic cholecystecomy, It can also be done if the patient has severe cholecystitis, emphysematous gallbladder, blood dyscrasias, etc.

This is the view of the gall bladder and liver bed while performing open cholecystectomy after retracting the stomach, omentum and bowel. Now, the gall bladder can be dissected either by antegrade approach or retrograde approach. It can be clearly visualised that the amount of dissection required in open cholecystectomy is much more than the laparoscopic method (Figure 3).

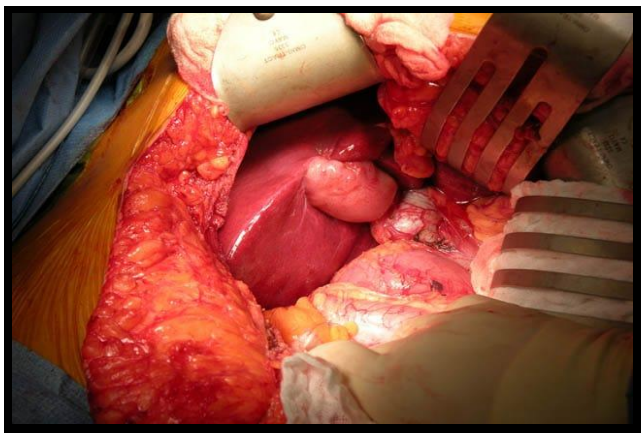

Figure 3: open cholecystectomy.

Data analysis

Data was analyzed using SPSS software version 16, Microsoft Excel 2007 and MedCalc statistical software version 12.1.1 software. Manifestation of the quantitative statistics is done as means±standard deviations (SD). Manifestation of the qualitative information is done as frequencies. The Chi-square test was used to compare categorical variables

RESULTS

There are 63% males and 37% females in our study and mean age of males is 42.46 years and mean age of females is 40.59. Highest age among the study samples is 66 years and lowest age is 25 years. Mean age is 41.77 years. As per the rule of 5 'F's occurrence of cholelithiasis is more in the 40s which is also depicted in our study. Thus, females are also at a higher risk of developing cholecystitis (Figure 4).

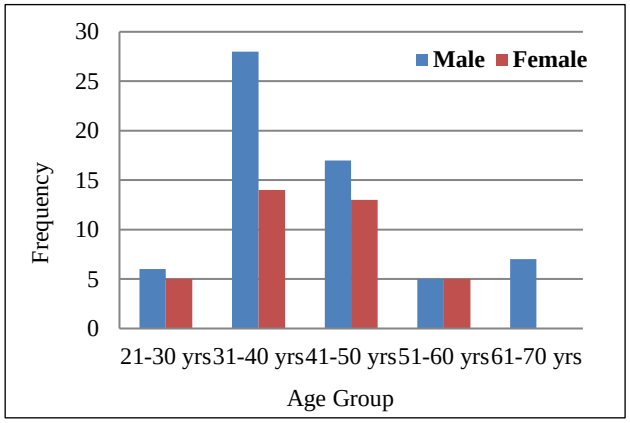

Figure 4: Age and gender wise distribution of the study samples.

Mean age of study sample is 41.77 years with standard deviation of 9.88 years, with the highest 66 years and lowest 25 years. There were 63 (63%) males and 37 (37%) females in the study. 42 (42%) subjects were in the cluster of 31-40 years of age succeeded by 30 (30%) subjects in the age group of 41-50 years. Mean age of males (42.46 years) was higher than the mean age of females (40.59 years) and the difference was statistically not significant (Table 1).

Table 1: Age distribution.

Age (Years)	
Mean	41.77
Std. Error of Mean	0.989
Std. Deviation	9.886
Range	41
Minimum	25
Maximum	66

Severe cholecystitis occurred equally among males and females. Thus, indicating that grade of severity of cholecystitis has no relation with the gender of the patient. However, this conclusion may be attributed to the small sample size too and thus it can be commented that larger sample size will be required to make a more definitive conclusion (Table 2).

Table 2: Grades of severity of cholecystitis among males and females.

Variables		Grade of severity			Total
		1	2	3	
Gender	Female	19	12	6	37
	Male	37	20	6	63
Total		56	32	12	100

Cells that have anticipated count less than 5 is 1(16.7%). The lowest anticipated count is 4.44. On application of "Chi-Square test" no association found between grade of severity of cholecystitis and gender i.e. p=0.577. Occurrence of cholelithiasis is definitely more in females but the grade of severity of cholecystitis has no definite relation with the gender (Table 3).

Table 3: Chi square test.

Chi-Square Test			
	Value	Df	Asymp. Sig. (2-sided)
"Pearson Chi-Square"	1.100[a]	2	**.577**
"Likelihood Ratio"	1.073	2	.585
"N of Valid Cases"	100		

Pain in abdomen (100%) was the commonest complaint and was present in all the patients followed by dyspepsia (44%). Pain in abdomen was confined to the right hypochondrium region which indicates the site of pathology while dyspepsia includes symptoms like nausea, heartburn, feeling of indigestion and satiety (Figure 5).

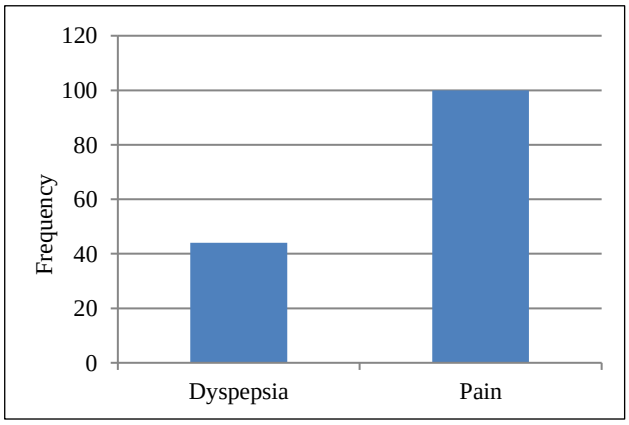

Figure 5: Clinical features among the patients.

On application of "Chi-Square test" no association found between complaints of the patient and obesity status (p=0.071). This indicates that the severity of symptoms has no relation with the obesity status of the patients in contrary to the age-old rule of 5 Fs. Thus, severe symptoms can occur in a non-obese individual too (Table 4).

Table 4: Chi square test.

Chi-Square Tests					
	Valuation	**df**	**Asymp. Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	3.266[a]	1	0.071		
"Continuity Correction"[b]	2.518	1	0.113		
"Likelihood Ratio"	3.249	1	0.071		
"Fisher's Exact Test"				0.082	0.057
N of Valid Cases[b]	100				
Cells that have anticipated count less than 5 is 0. Lowest anticipated count is 12.90.					
Computed only for a 2x2 table					

Around 69% of subjects were having pain for more than 72 hours while 31% were having pain for less than 72 hours. Symptoms lasting for more than 72 hours will classify the patient under grade 2 severity as per the already mentioned Tokyo guidelines for acute cholecystitis. Thus, it is a sign of severe disease (Figure 6).

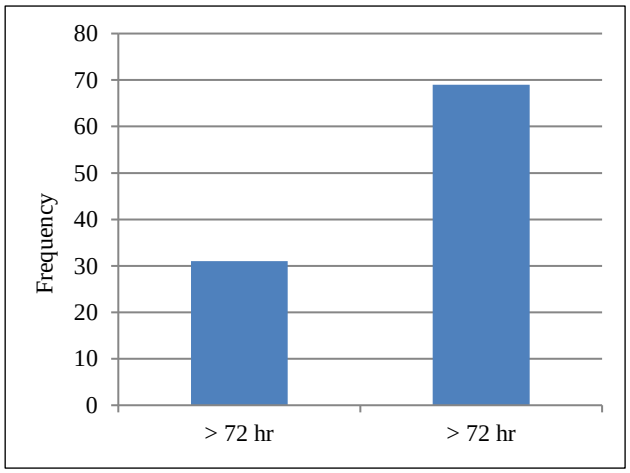

Figure 6: Complaint.

Incidence of fever among the obese and non obese patients showed that occurrence of fever was slightly more in the non obese patients which also indicates that presence of marked inflammation was also slightly higher in the non-obese patients. Fever indicates spreading inflammation and infection (Table 5).

On application of "Chi-Square test" no association found between obesity status and presence of fever (p=0.148). Though presence of fever is slightly higher in the non obese patients but it is statistically not significant (Table 6).

Table 5: Obesity status and presence of fever.

Variables		**Fever**		**Total**
		No	**Yes**	
Obesity status	Non-obese	58	12	70
	Obese	21	9	30
Total		79	21	100

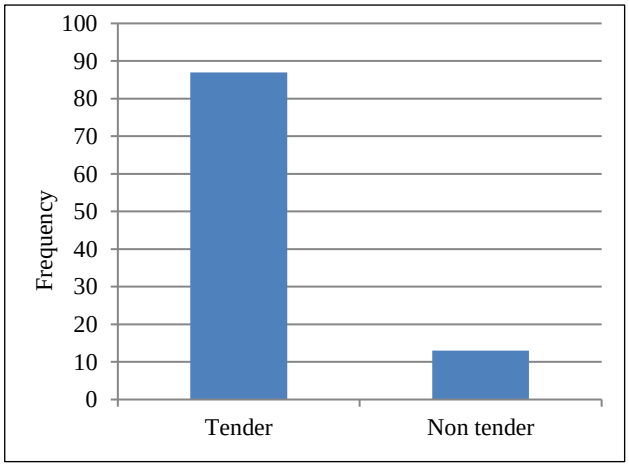

Figure 7: Per abdominal findings.

Per abdominal examination was soft with tenderness in right hypochondrium in 87% of the patients while it was soft and non tender in 13% of the patients. Tenderness along with a palpable mass in the right hypochondrium classifies the patient under grade 2 severity of cholecystitis as per the Tokyo guidelines and thus points towards increasing severity and also it rules out the other abdominal pathologies (Figure 7).

Table 6: Chi square test.

"Chi-Square Test					
	Valuation	**"df"**	**"Asymp. Sig. (2-sided)"**	**"Exact Sig. (2-sided)"**	**"Exact Sig. (1-sided)"**
"Pearson Chi-Square"	2.092[a]	1	0.148		
"Continuity Correction"[b]	1.389	1	0.239		
"Likelihood Ratio"	1.999	1	0.157		
"Fisher's Exact Test"				0.183	0.120
N of Valid Cases[b]	100				
a. Cells that have anticipated count less than 5 is 0. The lowest anticipated count is 6.30.					
b. Calculated for a table of 2x2 only.					

Table 7: BMI and grade of severity.

BMI (Kg/m^2)						
Grade of severity	**Mean**	**N**	**Std. Deviation**	**Std. Error of Mean**	**Minimum**	**Maximum**
1	23.77	56.00	2.73	0.37	17.30	30.04
2	23.62	32.00	3.14	0.55	17.96	31.25
3	23.57	12.00	3.31	0.96	19.69	28.40
Total	23.70	100.00	2.91	0.29	17.30	31.25

Table 8: ANOVA table for BMI and grade of severity.

ANOVA table (Grade of severity vs BMI)					
Variable	**Sum of Squares**	**df**	**Mean Square**	**F**	**Significance**
Between Groups (Combined)	0.660	2	0.330	0.038	0.963
Within Groups	837.024	97	8.629		
Total	837.684	99			

Table 9: Comparison between BMI and grade of severity.

Correlations				
			Grade of severity	**BMI**
Spearman's rho	Grade of severity	Correlation Coefficient	1.000	-0.054
		Sig. (2-tailed)	0.0	0.592
	BMI	Correlation Coefficient	-0.054	1.000
		Sig. (2-tailed)	0.592	0.0

Table 10: Obesity status and conversion rate.

Variables		**Conversion**		**Total**
		No	**Yes**	
Obesity status	Non-obese	57	13	70
	Obese	25	5	30
Total		82	18	100

Severe cholecystitis was observed among 12 patients and occurred more in the non obese patients. The rule of 5 'F's indicates that occurrence of cholelithiasis is more in fatty females but it's not the same while calculating the severity of cholecystitis. Instead few studies have concluded that severe cholecystitis is more common in the non obese males (Table 7).

On application of ANOVA test no significant difference was observed among mean BMI of different grade of severity (p=0.963) among subjects. Though the

occurrence of severe cholecystitis is quite higher in non obese patients it is statistically not significant. This result is also supported with the few similar studies worldwide (Table 8).

Negative correlation was observed between BMI and grade of severity of cholecystitis and it was statistically not significant (p=0.592). Though obesity increases the risk of developing gall stones which is a well known fact; sudden weight loss also predisposes a person to gall stone formation and cholecystitis. The above result clearly states that the obesity status of a person is not related to the severity of cholecystitis (Table 9).

Around 18% of laparoscopic cholecystectomy surgery required conversion to open cholecystectomy due to reasons like dense adhesions to an adjacent organ, etc. This conversion rate is very small when compared to the advantages of laparoscopy against open cholecystectomy viz. shorter hospital stay, less post operative pain and complications, etc. Thus, laparoscopy is preferred over open method (Table 10).

On application of "Chi-Square test" no association found between obesity status and need for conversion from laparoscopic to open cholecystectomy (p=0.820). As the relation between obesity status and grade of severity is negative the conversion rate from laparoscopy to open is also negatively correlated with the obesity status.

Thus, the type of surgery to be performed cannot be predicted from the obesity status of the patient pre-operatively (Table 11).

Table 11: Chi square test.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
"Pearson Chi-Square"	0.052[a]	1	0.820		
Continuity Correction[b]	0.000	1	1.000		
"Likelihood Ratio"	0.052	1	0.819		
"Fisher's Exact Test"				1.0000	.532
N of Valid Cases[b]	100				

DISCUSSION

Age distribution

In this study, the patients undergoing treatment for cholecystitis were in the age group of 25-66 years (Table 1 and Figure 4). Mean age of study sample is 41.77 years with standard deviation of 9.88 years, with the highest 66 years and lowest 25 years.

There were 63 (63%) males and 37 (37%) females in the study. 42 (42%) subjects were in the cluster of 31-40 years of age succeeded by 30 (30%) subjects in the age group of 41-50 years. Mean age of males (42.46 years) was higher than the mean age of females (40.59 years) and the difference was statistically not significant (p = 0.365). Gender wise no significant difference was found in the age groups of the patients. This suggests that cholecystitis occur irrespective of age.

Sex distribution

There were 63 (63%) males and 37 (37%) females in the study, the overall sex ratio was much higher than sex ratio according to Census Maharashtra state 2016 (925 Females/1000 Males). On application of "Chi-Square test" (Table 2 and 3) no association is found between grade of severity of cholecystitis and gender (p=0.577).

Clinical features

Pain in abdomen (100%) was the commonest complaint (Figure 5) and was present in all the patients followed by dyspepsia (44%). Dyspepsia includes symptoms like feeling of indigestion, nausea, satiety and heartburn. Pain in abdomen involved only the right upper quadrant in all the patients which signifies the site of pathology. On application of "Chi-Square test" (Table 4) no association found between complaints of the patient and obesity status (p=0.071). 69% of subjects were having pain for more than 72hours while 31% were having pain for less than 72hours (Figure 6). Presence of pain in abdomen for more than 72hours categorizes the patient under grade 2 severity of cholecystitis as per the Tokyo Guidelines which have been mentioned earlier. On application of "Chi-Square test" (Table 5 and 6) no association found between obesity status and presence of fever (p=0.148). Per abdominal examination was soft with tenderness in right hypochondrium in 87% of the patients while it was soft and non tender in 13% of the patients (Figure 7). Presence of tenderness depicts marked inflammation of the gall bladder.

Body mass index

Obesity is a well known risk factor for the formation of Gall Stones and BMI is commonly used as a measure of Obesity. Not only overweight/obesity, but weight loss also increases the risk of gallbladder disease. The three factors viz. cholesterol super-saturation of bile, impaired gall bladder motility and nucleation defects are further increased during weight loss.[12] This study focuses upon the relationship between Body Mass Index and the severity of cholecystitis. The cutoff point of 25kg/m^2 was mentioned by Syed Mushtaq et al and the International Obesity Task Force for Asia-Pacific region, WHO.[13] Our study shows that there is an equal incidence of severe cholecystitis in the males and females (Table 7). The reason why severe cholecystitis occurs equally in both the genders cannot be answered from this study alone. No significant difference was found among mean BMI of different grades of severity of cholecystitis (Table 8 and 9). Similar results were found in the study by Khuroo MS et al.[10]

Grade of severity of cholecystitis has no correlation with BMI which was statistically not significant, similar negative correlation among males was observed by Lee HK, Han HS et al and Mushtaq S et al.[8,13]

Conversion to open cholecystectomy

Around 18% of the laparoscopic cholecystectomy surgeries required conversion to open cholecystectomy due to reasons like dense adhesions to an adjacent organ, etc. in our study (Table 10 and 11). Severity of inflammation was significantly correlated with an increased conversion rate to laparotomy in a study conducted by Simopoulos C et al.[12] Development of complications cannot be predicted by BMI of the patient. Proportion of complicated acute cholecystitis was higher in non obese in a study conducted by Lee HK et al.[8] In our study 53 patients were having grade 1 severity, 35 patients were having grade 2 severity and 12 were grade 3 severity of cholecystitis.

CONCLUSION

No association found between complaints of the patient and obesity status. No association found between obesity status and presence of fever. No association found between grade of severity of cholecystitis and gender. Moreover, there is negative correlation between BMI and grade of severity of cholecystitis. Larger sample size will be required to assess the influence of body weight and obesity on severity of cholecystitis. Also, no association found between obesity status and need for conversion from laparoscopic to open cholecystectomy.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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