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Original Research Article

Correlation Between Body Mass Index and Operative Difficulty in Laparoscopic Cholecystectomy: A Retrospective Analysis

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Abstract

Background: Laparoscopic cholecystectomy is the preferred treatment method for diseases of the gallbladder, but the difficulty level of surgery depends upon variables like BMI that relate to patients. Due to increasing obesity rates, it has become more imperative to understand how obesity affects the outcomes of surgery.

Aim: This study intended to assess the relationship between BMI and the complexity of surgery in individuals who underwent laparoscopic cholecystectomy.

Methodology: An analytical study was carried out through retrospective observations of 150 patients who had undergone cholecystectomy surgery within a span of one year. The patients were classified according to their body mass index into three different categories: normal, overweight, and obesity groups. The surgical complexity was evaluated from the intra-operative factors like the time taken for the operation, presence of adhesions, difficulties in port insertion, conversion of the surgery to an open surgery, and intraoperative complications.

Results: Out of 150 cases, 40% of patients had normal BMI, while 36.7% had high BMI, and 23.3% were considered obese. Patients with difficult surgeries had higher BMI, with 42.9% having difficult surgeries among obese individuals compared to 11.7% among normal BMI subjects. There was an increase in operative time from 48.5 minutes among normal BMI to 68.7 minutes among obese individuals.

Conclusion: BMI showed a highly significant correlation with the degree of difficulty during laparoscopic cholecystectomy. There was an association between high BMI and more complex surgeries, longer operation time, and complications, emphasizing the relevance of BMI as a factor for risk stratification before surgery.

Keywords: Body Mass Index, Laparoscopic Cholecystectomy, Operative Difficulty, Obesity, Surgical Outcomes, Conversion to Open Surgery.

Introduction

Laparoscopic cholecystectomy has emerged as the gold standard for the surgical treatment of gallbladder pathologies, especially cholelithiasis, due to the minimally invasive technique, low postoperative pain, short hospitalization period, better cosmetic results, and rapid resumption of normal daily activities [1]. Since then, laparoscopic cholecystectomy has almost completely substituted the open cholecystectomy method, becoming a routine procedure in various hospitals across the world and characterized by a high efficacy and safety level [1]. Despite the established safe character of the procedure, there are several problems associated with the procedure that can make the surgery much more complicated than usual [2].

A number of factors ranging from acute inflammation and adhesions to the surgeon's professional experience and anatomical peculiarities of patients have been recognized as determinants of surgical difficulties [3]. One of such factors is the patient's Body Mass Index (BMI), which has recently gained increased recognition as an important criterion [4]. Obesity increases the abdominal wall thickness and causes excessive fat deposition inside the abdomen, limiting the surgeon's maneuverability, thus making the procedure more challenging and leading to possible prolongation and even conversion of laparoscopy into open surgery [5].

In recent years, the incidence of obesity and overweight has increased drastically in the world, including in less developed nations, which makes it a matter of great significance from the point of view of public health [6]. Consequently, the surgeon often faces patients suffering from obesity who require laparoscopy surgery, which makes it essential to know more about the effects of the

BMI on the results of surgery [7]. Despite various researches being done in this regard, the results are inconsistent, some stating a direct relationship while others showing the opposite.

Background of the Study: Gall bladder pathologies such as gall stone disease are fairly common surgical problems that can be effectively treated through a variety of procedures, with laparoscopic cholecystectomy considered the gold standard due to high efficacy [8]. Nonetheless, the success rate and overall simplicity of laparoscopic cholecystectomy may be affected by various patient-specific parameters, of which one is the Body Mass Index (BMI). Given that the problem of overweight and obesity is growing around the world, many surgical patients have elevated BMIs. Obesity is associated with changes in patient anatomy and physiology, which in turn can lead to an increase in surgery complexity, time required to complete the procedure, and complication risks. Nevertheless, the impact of BMI on the success of a procedure, especially from the standpoint of new laparoscopic techniques, continues to be discussed [10]. This makes it important to conduct further studies on the problem, the results of which are presented below.

Impact of Body Mass Index on Operative Difficulty in Laparoscopic Cholecystectomy: Operative difficulty in relation to BMI in laparoscopic cholecystectomy is clinically significant and complex [11]. The main reason behind this clinical observation is the effect of BMI increases in terms of various complications that make the surgical procedure extremely complicated. The first aspect in this regard is the increased thickness of abdominal muscles in obese individuals, thus making trocar placement difficult for surgeons [12]. Excess fatty tissue inside the abdomen reduces the visibility of the area during surgery, and surgeons might find themselves dealing with additional complications [13]. Obstruction of the Calot's triangle due to the presence of excessive fatty tissue reduces visualization. As a result, dissection in such conditions becomes significantly complicated. Surgeons might spend more time performing their tasks since they have to be very cautious about damaging other organs such as the bile duct. Another complication related to this issue is the increased probability of adhesions and inflammation of the gallbladder in obese individuals [14]. Furthermore, the reduced amount of workspace and difficulty in handling instruments due to obesity may also contribute to fatigue on the part of the surgeon. Despite the improvements in technology and surgical skill, BMI still plays a crucial role in predicting how difficult surgery will be, and is therefore a vital consideration before surgery takes place [15].

Objectives of the Study

1. To examine the distribution of patients who have undergone laparoscopic cholecystectomy based on their Body Mass Index (BMI).
2. To measure the degree of difficulty in performing laparoscopic cholecystectomy procedures.
3. To test for the relationship between Body Mass Index (BMI) and surgical difficulty during laparoscopic cholecystectomy procedures.
4. To analyze the effect of Body Mass Index (BMI) on surgical outcomes.

Methodology: This study was carried out to investigate the relationship between Body Mass Index (BMI) and the difficulty of the surgery performed on patients through laparoscopic cholecystectomy. The methodology employed was structured and systematic.

Study Design: This study was set up as an analytical observational study based on past experiences. The medical records of patients who underwent laparoscopic cholecystectomy were examined to extract important data.

Study Area: This study work was conducted in the Department of General Surgery, ICARE Institute of Medical Sciences and Research, Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India.

Study Duration: The study was conducted over a period of one year.

Study Participants (Inclusion and Exclusion Criteria)

Inclusion Criteria:

- Patients of 18 years and older who had laparoscopic cholecystectomy.
- Patients with cholelithiasis or gallbladder-related diseases that involve surgical procedures.
- Patients who have full medical and operative records in the hospital databases.

Exclusion Criteria:

- Patients who had open cholecystectomy as the initial operation.
- Patients who have undergone upper abdominal surgeries before, which may affect the difficulty of the operation.
- Patients with malignancy of the gallbladder.
- Incomplete or missing clinical or operative data of patients.

Sample Size: A total of 150 patients who met the inclusion criteria during the study period were included in the study. The sample size was calculated according to the availability of full patient records during the period of time.

Procedure: Retrospective data were gathered through hospital records, such as patient demographics, Body Mass Index (BMI), clinical presentation, and operative data. The standard formula was used to calculate BMI:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Patients were grouped into standard BMI groups (normal weight, overweight and obese) according to the set classification criteria.

Operative difficulty was assessed using predefined intraoperative parameters such as:

- Duration of surgery
- Difficulty in port placement
- Adhesions and inflammation around the gallbladder
- Need for conversion to open surgery
- Intraoperative complications

According to these parameters, cases were classified as easy, moderate, or difficult laparoscopic cholecystectomy.

Statistical Analysis: The data collected were transferred to Microsoft Excel and analyzed with the help of statistical software like SPSS (Statistical Package for the Social Sciences). Demographic and clinical variables were summarized using descriptive statistics.

Correlation between BMI and operative difficulty was determined by using the right statistical tests like Chi-square test of categorical variables and Pearson correlation coefficient where necessary. A p-value of below 0.05 was regarded as significant.

Results

The analysis involved 150 patients who had laparoscopic cholecystectomy between the study period. The data obtained were compared to ascertain the correlation between Body Mass Index (BMI) and the difficulty of the operation. The results are given below.

Table 1: Distribution of Patients According to BMI Category (n = 150)

BMI Category	BMI Range (kg/m²)	Number of Patients	Percentage (%)
Normal Weight	18.5–24.9	60	40.0
Overweight	25.0–29.9	55	36.7
Obese	≥30.0	35	23.3
Total	—	**150**	**100**

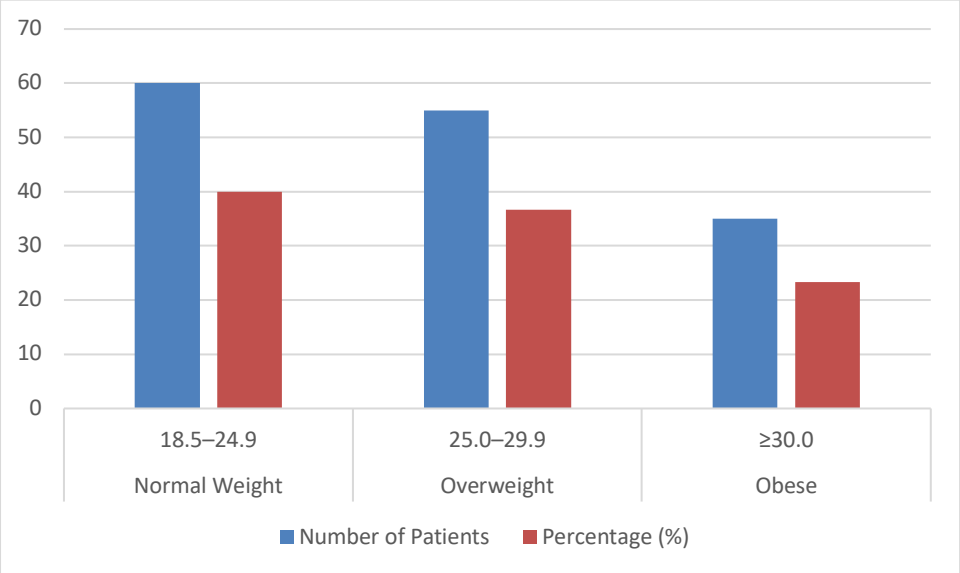

Figure 1: Visuals Representation of Distribution of Patients According to BMI Category

Out of 150 subjects, 60 (40%) subjects were normal, 55 (36.7%) subjects were overweight, and 35 (23.3%) were obese. Therefore, a substantial number of subjects (60%) were in higher BMI classes (obese and overweight). It was clear from the distribution that the subjects were evenly distributed, thus permitting a comparison. The inclusion of a substantial obese group of patients (one-fourth) in the study helped in determining the operating difficulty.

Table 2: Distribution of Operative Difficulty Among Study Participants (n = 150)

Operative Difficulty	Number of Patients	Percentage (%)
Easy	65	43.3%
Moderate	50	33.3%
Difficult	35	23.3%
Total	**150**	**100**

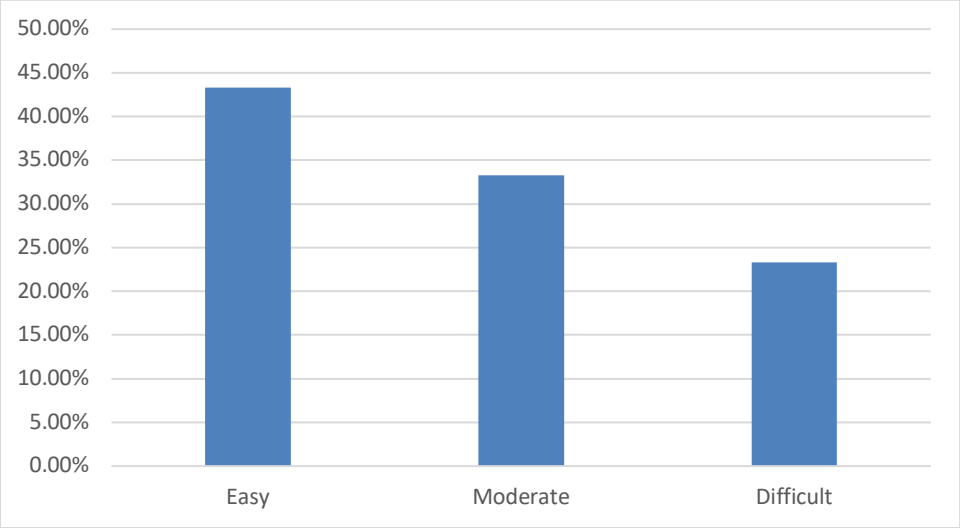

Figure 2: Visuals Representation of Distribution of Operative Difficulty Among Study Participants

In the sample population used for the research, 65 cases (43.3%) were easy, 50 (33.3%) were moderate, and 35 (23.3%) were hard. These findings revealed that although most of the surgeries were fairly easy to conduct, many cases (56.6%) had either moderate or hard difficulties associated with them. Since 23.3% of the cases were hard, this made BMI an important factor in explaining the problem under investigation.

Table 3: Association Between BMI and Operative Difficulty (n = 150)

BMI Category	Easy	Moderate	Difficult	Total
Normal Weight	35	18	7	60
Overweight	22	20	13	55
Obese	8	12	15	35
Total	65	50	35	150

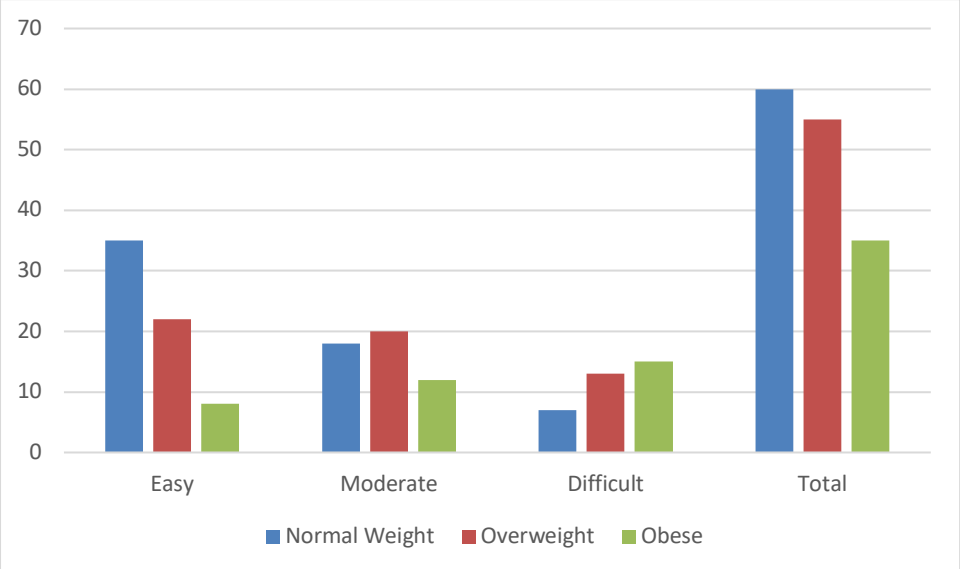

Figure 3: Visuals Representation of Association Between BMI and Operative Difficulty

In the group of patients with normal BMI, most of the surgeries were easy (35 out of 60, 58.3%), while few of them were difficult (7, 11.7%). On the other hand, the group with obese patients had more difficult surgeries (15 out of 35, 42.9%) but less easy surgeries (8, 22.9%). The group with overweight patients had medium values, where there were 13 difficult surgeries (23.6%). Thus, there was a clear trend that the higher the BMI is, the more difficult the operation becomes.

Table 4: Mean Operative Duration According to BMI Category

BMI Category	Mean Duration (minutes)	Standard Deviation
Normal Weight	48.5	±8.2
Overweight	56.3	±9.5
Obese	68.7	±11.1

Mean surgical operation time was found to have increased in a steady manner as BMI increased; whereas the mean surgical time was 48.5±8.2 min for normal BMI group, it was 56.3±9.5 min in the overweight group and 68.7±11.1 min in the obese group. The increase in surgical time from the normal BMI group to obese group was around 20 min. The increase indicated that BMI is responsible for increasing surgical time.

Increased surgical time indicates an increased difficulty level during the surgery.

Table 5: Conversion to Open Surgery and Complications by BMI Category

BMI Category	Conversion to Open Surgery (n, %)	Intraoperative Complications (n, %)
Normal Weight	2 (3.3%)	3 (5.0%)
Overweight	4 (7.3%)	5 (9.1%)
Obese	6 (17.1%)	7 (20.0%)

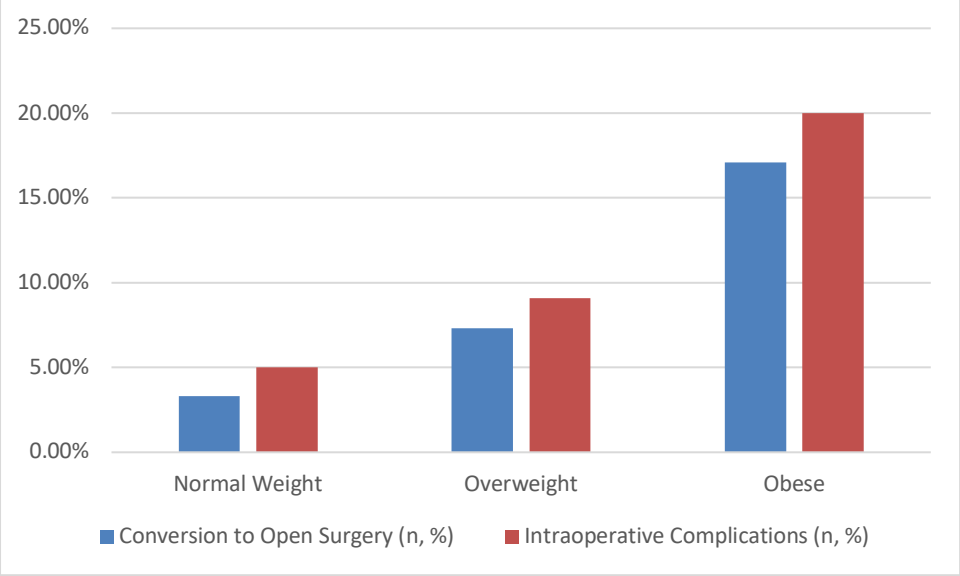

Figure 4: Visuals Representation of Conversion to Open Surgery and Complications by BMI Category

Conversions to open procedures were least in the normal BMI category (2 patients; 3.3%) and most in the obese category (6 patients; 17.1%). Likewise, intraoperative complications were least in the normal BMI category (5.0%; 3 cases) and most in the obese category (20.0%; 7 cases). Overweight category had intermediate rates of conversion (7.3%) and intraoperative complications (9.1%). This implied a steady increase in adverse effects with increasing BMI. These results demonstrated that obesity was related to increased surgical risk and complications.

Discussion

The present study established that cirrhosis of the liver had a higher prevalence among middle-aged men, where the majority of subjects aged between 46 and 60 years had 37.3% of them, while 68.0% of the population were male. The results are supported by previous studies which showed that men higher rates of liver cirrhosis because they were more exposed to alcoholism and other lifestyle-associated risks. (Raakow et al., 2019) study revealed the prevalence of liver disease across the world with high male prevalence and an increase among middle-aged people [16].

Etiologically, alcohol was found to be the most common cause (48.0%), then viral hepatitis (30.0%). This trend was in line with the results of several previous studies. According to a systematic review of cirrhosis in India, alcohol was the most prevalent etiology (~43.2%), then there were viral and metabolic etiologies (Jones et al., 2016) [17]. Moreover, past epidemiological studies have also shown consistently that alcohol and viral hepatitis are the leading causes of cirrhosis in the world. Other complications like ascites (64.0%), hepatic encephalopathy (36.0%), and variceal bleeding (28.0%) were also very common in the present study, which is consistent with previous clinical findings where ascites and portal hypertension-related complications were the most frequent manifestations of decompensated cirrhosis (Al Masri et al., 2018) These results support the fact that cirrhosis is frequently diagnosed at a late stage with a high clinical load.

The etiology and complications association in the current study indicated that alcoholic cirrhosis was associated with increased rates of complications, especially ascites (70.8%) and hepatic encephalopathy (41.7%), and the relationship was statistically significant ($p = 0.032$). This finding aligns with the current body of literature that alcohol-related liver disease is associated with a more serious disease progression and a higher risk of decompensation (Sato et al., 2015) [19]. In addition, majority of the patients in this research were determined to be in the Child-Pugh Class B (44.0%) and Class C (40.0%), which is a sign of late presentation. The trends were also similar in the past literature wherein a large proportion of patients were found to have advanced liver dysfunction (Chindarkar et al., 2018) [20]. Overall, the findings of the present study were consistent with the existing literature, as they revealed the great significance of alcohol, late clinical presentation, and high morbidity of liver cirrhosis.

Conclusion

The present study found that Body Mass Index (BMI) was a significant factor affecting the difficulty of operations in laparoscopic cholecystectomy. Higher BMI patients, especially obese patients, had more complex surgery as the percentage of challenging cases, longer operation time, and higher conversion to open surgery and intraoperative complications were higher. Conversely, patients with normal BMI had an easier time and fewer complications in their procedures. The results were able to provide a positive correlation between the rising BMI and operative difficulty, thus meeting the aims of the study. On the whole, it can be concluded that BMI is a significant predictive variable that must be taken into account in preoperative evaluation and surgical planning to enhance patient outcomes and decrease the risk of surgery.

References

1. Ibrahim, Y., Radwan, R. W., Abdullah, A. A. N. M., Sherif, M., Khalid, U., Ansell, J., & Rasheed, A. (2019). A retrospective and prospective study to develop a pre-operative difficulty score for laparoscopic cholecystectomy. Journal of Gastrointestinal Surgery, 23(4), 690-695.
2. Yu, X., Yu, H., & Fang, X. (2015). The impact of body mass index on short-term surgical outcomes after laparoscopic hepatectomy, a retrospective study. BMC anesthesiology, 16(1), 29.
3. Radunovic, M., Lazovic, R., Popovic, N., Magdelinic, M., Bulajic, M., Radunovic, L., ... & Radunovic, M. (2016). Complications of laparoscopic cholecystectomy: our experience from a retrospective analysis. Open access Macedonian journal of medical sciences, 4(4), 641.
4. Lauro, A., Vaccari, S., Cervellera, M., Casella, G., D'ANDREA, V., Di Matteo, F. M., ... & Tonini, V. (2018). Laparoscopic cholecystectomy for acute cholecystitis: are intended operative approach, timing and outcome affected by BMI? A multicenter retrospective study. Il Giornale di Chirurgia-Journal of the Italian Surgical Association, 39(2), 87-91.
5. Ghadhban, B. R. (2019). Assessment of the difficulties in laparoscopic cholecystectomy among patients at Baghdad province. Annals of Medicine and Surgery, 41, 16-19.
6. Terho, P. M., Leppäniemi, A. K., & Mentula, P. J. (2016). Laparoscopic cholecystectomy for acute calculous cholecystitis: a retrospective study assessing risk factors for conversion and complications. World journal of emergency surgery, 11(1), 54.
7. Neylan, C. J., Damrauer, S. M., Kelz, R. R., Farrar, J. T., Dempsey, D. T., Lee IV, M. K., ... & Dumon, K. R. (2016). The role of body mass index class in cholecystectomy after acute cholecystitis: an American College of Surgeons National Surgical Quality Improvement Program analysis. Surgery, 160(3), 699-707.
8. Lowndes, B., Thiels, C. A., Habermann, E. B., Bingener, J., Hallbeck, S., & Yu, D. (2016). Impact of patient factors on operative duration during laparoscopic cholecystectomy: evaluation from the National Surgical Quality Improvement Program database. The American Journal of Surgery, 212(2), 289-296.
9. Menon, A. (2017). A comprehensive review of the factors predicting technical difficulty in

laparoscopic cholecystectomy. Int Surg J, 4(4), 1147-53.
10. Tiong, L., & Oh, J. (2015). Safety and efficacy of a laparoscopic cholecystectomy in the morbid and super obese patients. HPB, 17(7), 600-604.
11. Drake, T. M., Nepogodiev, D., Chapman, S. J., Glasbey, J. C., Khatri, C., Kong, C. Y., ... & Haq, H. (2016). Multicentre prospective cohort study of body mass index and postoperative complications following gastrointestinal surgery. British Journal of Surgery, 103(9), 1157-1172.
12. Tandon, A., Sunderland, G., Nunes, Q. M., Misra, N., & Shrotri, M. (2016). Day case laparoscopic cholecystectomy in patients with high BMI: experience from a UK centre. The Annals of The Royal College of Surgeons of England, 98(5), 329-333.
13. Patel, R., Mushtaq, N., Haq, H., Pande, R., & Sellahewa, C. (2019). Does high body mass index impact surgical outcomes and hospital cost for day case laparoscopic cholecystectomy. British Association of Day Surgery, London, UK.
14. Augustin, T., Moslim, M. A., Brethauer, S., Aminian, A., Kroh, M., Schneider, E., & Walsh, R. M. (2017). Obesity and its implications for morbidity and mortality after cholecystectomy: a matched NSQIP analysis. The American Journal of Surgery, 213(3), 539-543.
15. Obuchi, T., Kameyama, N., Tomita, M., Mitsuhashi, H., Miyata, R., & Baba, S. (2018). Impact of obesity on surgical outcome after single-incision laparoscopic cholecystectomy. Journal of minimal access surgery, 14(2), 99-104.
16. Raakow, J., Klein, D., Barutcu, A. G., Biebl, M., Pratschke, J., & Raakow, R. (2019). Safety and efficiency of single-incision laparoscopic cholecystectomy in obese patients: a case-matched comparative analysis. Journal of Laparoendoscopic & Advanced Surgical Techniques, 29(8), 1005-1010.
17. Jones, A. D., Waterland, P. W., Powell-Brett, S., Super, P., Richardson, M., & Bowley, D. (2016). Preoperative very low-calorie diet reduces technical difficulty during laparoscopic cholecystectomy in obese patients. Surgical Laparoscopy Endoscopy & Percutaneous Techniques, 26(3), 226-229.
18. Al Masri, S., Shaib, Y., Edelbi, M., Tamim, H., Jamali, F., Batley, N., ... & Hallal, A. (2018). Predicting conversion from laparoscopic to open cholecystectomy: a single institution retrospective study. World journal of surgery, 42(8), 2373-2382.
19. Sato, N., Shibao, K., Mori, Y., Higure, A., & Yamaguchi, K. (2015). Postoperative complications following single-incision laparoscopic cholecystectomy: a retrospective analysis in 360 consecutive patients. Surgical endoscopy, 29(3), 708-713.
20. Chindarkar, H., Dumbre, R., Fernandes, A., & Phalgune, D. (2018). Study of correlation between pre-operative ultrasonographic findings and difficult laparoscopic cholecystectomy. Int Surg J, 5(7), 2605-2611.