

## PREDICTION OF CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY TO OPEN CHOLECYSTECTOMY USING A PREOPERATIVE SCORING SYSTEM

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### ABSTRACT

**Objectives:** The objective of the study is to use the risk score to predict the conversion of laparoscopic cholecystectomy (LC) to open cholecystectomy and to evaluate whether this scoring method can be used routinely.

**Methods:** A prospective observational clinical study conducted in 106 cases who underwent elective LC was analyzed prospectively both preoperatively and postoperatively using the scoring system.

**Results:** A total of 106 patients were studied. The highest incidence of gallstone in the present series is in the age group of 30–40 years. The gender ratio (male: female) is 1:2.3. Of the 106 patients, all had cholelithiasis, 6 patients had gallbladder wall thickening, 1 had impacted stone, and none had peri-cholecystic collection. In the present study, age >50, body mass index >27.5, H/O prior hospitalization for acute cholecystitis, wall thickening, and vomitings were significant predictors of difficult LC. The conversion rate from LC to open cholecystectomy was 12.3%. Of the total 19 cases falling under moderate risk, 12 were converted to open cholecystectomy. Rest was managed and completed by laparoscopically. Only one case in the mild risk group was converted to open, reason being the short cystic duct. The most common intraoperative reason for conversion was adhesions in 10 patients, followed by frozen calots, short cystic duct, and Mirizzi syndrome. The positive predictive value for easy prediction was 100%.

**Conclusion:** The scoring system used has got better significance in the prediction of conversion from lap to open cholecystectomy.

**Keywords:** Laparoscopic cholecystectomy, Open cholecystectomy, Conversion, Preoperative scoring system.

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### INTRODUCTION

Cholelithiasis is one of the most common biliary pathologies. Gallstones are present in 10–15% of the general population and 20% of them are symptomatic. The prevalence of gallstone varies widely, in India, it accounts for around 4%. North Indians have 7 times higher occurrence of gallstones as compared to South Indians according to an epidemiological study restricted to railroad workers [1]. In 1992, The National Institute of Health consensus development conference stated that laparoscopic cholecystectomy (LC) "provides a safe and effective treatment for most patients with symptomatic gallstones" [1]. The number of cholecystectomies performed in the United States has increased from 5 lakh/year to 7 lakh/year since the introduction of LC [2].

In 5–10% of cases, conversion to open cholecystectomy may be needed for the safe removal of gallbladder (GB), and the common risk factors for conversion were male sex, obesity, cholecystitis, and choledocholithiasis [3,4].

Risk factors of difficult LC are stocky male patients due to difficulty in initial port placement [5-7], multiparous women with flabby abdomen due to thinned-out lower abdominal musculature, the effect of pneumoperitoneum is confined only in the lower abdomen. Hence, there is less space in the right hypochondrium to work, previous upper abdominal surgery [8], cirrhosis of liver present or previous acute cholecystitis or acute severe pancreatitis [9], previous treatment for percutaneous drainage or cholecystostomy. Although LC has become the gold standard in the treatment of cholelithiasis and is replacing open cholecystectomy, the rate of conversion from LC to open cholecystectomy is ranging from 5% to 10%. Hence, it is necessary to

study the predictive factors for difficult LC. Therefore, this study was undertaken.

### METHODS

The present study was a prospective observational clinical study conducted in Department of General Surgery, Kamineni Academy of Medical Sciences and Research Centre, L. B. Nagar, Hyderabad, from September 2019 to August 2021, for a total period of 2 years.

#### Study sample

106 cases clinically and radiologically diagnosed as chronic calculus cholecystitis and underwent LC have been studied. Sample size has been calculated using single proportion formula:

$$n = Z^2 P (1 - P) / d^2$$

n – Sample size Z–1.96 P – Expected prevalence of proportion (5%) d – Precision (5%, d=0.05).

#### Inclusion criteria

All patients aged between 16 and 80 years, presenting with symptoms and signs of cholelithiasis/chronic calculus cholecystitis and diagnosed by Ultrasound Sonography (USG) examination in surgical ward undergoing LC at Kamineni Academy of Medical Sciences and Research Centre, L.B Nagar, Hyderabad.

#### Exclusion criteria

Patients below 15 years of age, patients with acute cholecystitis, and patients not willing for LC [10,11].

## Methodology

The study included 106 patients who were diagnosed as having chronic calculus cholecystitis radiologically. After obtaining approval from institutional ethics committee, prior informed consent was obtained from the patients to include in the study. In all the patients, clinical and laboratory evaluation was done, which includes brief information about age, sex, address, and investigations including major surgical profile, liver function tests, and USG abdomen. A total of 15 scores from history, clinical, and sonographic findings were used for prediction of risk. Score up to 5 is predicted easy, 6–10 is moderate risk, and above 10 is high risk. Results are evaluated preoperatively and postoperatively by paired t-test/Fisher exact test. For all comparisons,  $p=0.05$  is taken as clinically significant.

The patients confirmed by USG examination were evaluated with following factors: Age, gender, H/O previous hospitalization, body mass index (BMI) wt (kg)/ht (m<sup>2</sup>), abdominal scar - supraumbilical or infraumbilical, palpable gall bladder, sonographic findings - wall thickness, pericholecystic collection, impacted stone.

Intraoperatively LC was classified as easy and difficult based on the intraoperative time taken for surgery, bleeding, and conversion to open.

Easy	Time taken <90 min. No bleeding. No conversion to open
Difficult	Time taken >90 min.: Bleeding present. Conversion to open

Following evaluation, the patients were subjected to LC. Based on the preoperative risk score, the surgeon was informed in advance regarding the possibility of conversion based on the risk score (Tables 1 and 2). Operative time, intraoperative findings, and chances of conversion were noted. The findings were noted down in the proforma designed for the study. Data were entered in Microsoft Excel and analysis was done using the Statistical Packages for the Social Sciences version 20. Descriptive statistical analysis was done. Simple mathematical expressions like percentage were also used. Categorical data were represented as frequencies and percentages. Continuous data were represented as mean and standard deviation. Fisher exact test/paired t-test was used as test of significance for continuous data.  $p<0.05$  was considered as statistically significant.

## Ethical approval

The study was approved by the Institutional Ethics Committee institution and was informed consent obtained from study participants (IECECR/58/Inst/AP/2013/RR-19 and date- October 29, 2019). Study was in line with the Declaration of Helsinki.

## RESULTS

In the present series, the youngest patient was 17 years of age and the oldest was 73 years of age. Majority of the patients in the present series were in the age group of 51–60 years of age. Out of 106 patients, 69 were females and 37 were male patients. The male: female ratio is 1:1.9. Pain was the predominant symptom seen in almost all patients (105 cases). Vomiting was present in 8.5% (9 cases) of the patients with pain. Only 1 patient was asymptomatic without any pain. Out of the total 106 patients, 24 (22.6%) patients had a previous attack of acute cholecystitis and prior hospitalization history which accounts for about 22.6%. In the present study, 48 (43.4%) patients had a history of previous abdominal surgeries, with 22 patients having hysterectomy scars (vertical midline), 20 having tubectomy scars, 3 incisional hernia scars, and 3 supraumbilical scars. Study group consists of 43.4% (46) of population with type 2 diabetes, 25.5% (27) with hypertension, and 2% (1.9%) with bronchial asthma as comorbidities.

Patients with BMI <25 were relatively at low risk of conversion. In the present study of the total 106 study population, 30 (28.3%) were having BMI <25. Highest number of about 54 (50.9%) were between 25 and 27.5 group (Table 3).

**Table 1: Preoperative scoring system**

Scoring factor	Minimum	Maximum	Total - 15
History			
Age	<50 (0)	>50 (1)	1
Sex	Female (0)	Male (1)	1
History of hospitalization for acute cholecystitis	No (0)	Yes (4)	4
Clinical			
BMI	<25 (0)	25–27.5 (1) >27.5 (2)	2
Abdominal scar	No (0)	Infraumbilical (1) Supraumbilical (2)	2
Palpable gall bladder	No (0)	Yes (1)	1
Sonography			
Wall thickness	Thin (0)	Thick >4 mm (2)	2
Pericholecystic collection	No (0)	Yes (1)	1
Impacted stone	No (0)	Yes (1)	1

BMI: Body mass index

**Table 2: Predictive risk factors and scoring system**

Risk	Score
No risk	0–5
Moderate risk	6–10
High risk	11–15

**Table 3: Body mass index**

Body mass index	Number	Percentage
<25	30	28.3
25–27.5	54	50.9
>27.5	22	20.8

Of the total 106 patients confirmed with USG examination, 06 (5.7%) patients showed GB wall thickening with pericholecystic collection, 84 (79.2%) showed thin GB wall, and 16 showed normal gall bladder wall. Only 1 patient presented with impacted stone in the preoperative USG evaluation in the present study (Table 4).

In the present study group, out of 106 patients, 93 (87.7%) people underwent LC successfully and only 12.3% (13) of the population were converted from laparoscopic to open cholecystectomy (Table 5).

Of the total 106 study population, 51 were above the age group of 50 years, 35 were associated with mild risk, whereas 16 above the age group of 50 years were associated with moderate risk, and the  $p$ -value for age >50 years is 0.009 which is significant statistically (Table 6).

### Correlation of gender with risk

50% (11) of both male and female population of the study group were associated with moderate risk and 58 (69%) female and 26 (31%) of males were associated with mild risk. The risk of gender corresponds to  $p=0.095$ , which is not significant statistically.

### Association of pain abdomen with risk

Of the total 106 study groups, only one patient did not present with pain abdomen, 99.1% (105) were associated with pain abdomen, and 95.5% of the population with moderate risk were associated with pain abdomen and the  $p$ -value corresponds to 0.469 which is not significant statistically.

### Association of vomiting with risk

Of the total 9 people who presented with vomiting, 22.7% (5) people correspond to moderate risk accounting for a  $p=0.007$ , which is significant statistically. 4 people corresponds to mild risk.

Table 4: GB wall thickness in ultrasound findings.

GB wall thickness in mm	Number of patients	Percentages
Normal	16	15.1
Thick>4mm	6	5.7
Thin<4mm	84	79.2
Total	106	100.0

Table 5: Surgery executed

Surgery performed	Frequency	Percent
LAP chole	93	87.7
LAP to open	13	12.3
Total	106	100.0

Table 6: Correlation of age with risk:

Age in years	RISK		Total
	Moderate	Mild	
AGE			
<50			
Count	6	49	55
%	27.3%	58.3%	51.9%
>50			
Count	16	35	51
%	72.7%	41.7%	48.1%
Total			
Count	22	84	106
%	100.0%	100.0%	100.0%

**Previous attack of acute cholecystitis with risk**

The previous attack of acute cholecystitis corresponds to 86.4% of the moderate risk cases whereas only 6% of the mild risk cases account for a  $p=0.001$ , which is significant statistically.

**Risk associated with BMI**

Of the 22 people with BMI  $>27.5 \text{ kg/m}^2$ , 6 (27.3%) were associated with moderate risk and 16 (19.0%) were associated with mild risk the  $p=0.440$  which is not significant statistically (Table 7).

**Surgical scars**

Only 3 people among the study population presented with supraumbilical scars and only one case 4.5% was associated with moderate risk, the  $p=0.489$ , which is not significant statically.

**Sonography***GB wall thickness versus risk*

GB wall thickness of more than 4 mm was seen in 6 people in whom 4 were assigned moderate risk accounting for a  $p=0.008$ , which is significant statically.

*Impacted stone versus risk*

Only 1 person in the present study presented with impacted stone, and this has a  $p=0.469$  for the risk, which is not statistically significant.

*Correlation of pre-operative risk with post-operative outcome*

In the present study, only 12.3% (13) cases were converted to open from LC of which 54.5% (12) were under moderate risk score. There were no cases in the study population above the score of 10,  $p=0.001$ , which is statistically significant (Table 8).

The area under the curve for easy prediction, i.e., a score of 0-5 corresponds to 0.996 with a  $p=0.001$  proving the score is statistically significant (Fig. 1).

Table 7: Previous attack of cholecystitis with risk:

Previous attack	Risk		Total
	Moderate	Mild	
Previous attack of cholecystitis with risk			
No			
Count	3	79	82
%	13.6%	94.0%	77.4%
Yes			
Count	19	5	24
%	86.4%	6.0%	22.6%
Total			
Count	22	84	106
%	100.0%	100.0%	100.0%

Table 8: Correlation of preoperative risk with post op outcome

Surgery Performed	Risk			Total
	High 11-15	Moderate 6-10	Mild 0-5	
Laproscopy Performed				
Lap Chole				
Count	0	10	83	93
%		45.5%	98.8%	87.7%
Lap To Open				
Count	0	12	1	13
%		54.5%	1.2%	12.3%
Total				
Count	0	22	84	106
%		100.0%	100.0%	100.0%

The sensitivity for easy prediction  $<5$  corresponds to 86.36. It is 100% sensitivity for a score  $<4$ . Specificity for  $<4$  and  $<5$  corresponds to 94.5 and 100, respectively. The positive predictive value for easy prediction was 100% and for difficult (moderate risk 6-10) prediction was 100% (Table 9).

**DISCUSSION**

Most of the patients in the present series were in the age group of 51-60 years of age, which correlates with the Herman series [12] and Motiwala *et al.* series [13] in which most of them were in the age group of 51-60 years and 41-50 years, respectively. It also correlates with that of the Sigdel *et al.* [14] series where the age group is in between 40 and 50 years.  $p$ -value of age  $>50$  for a difficult score in the present study (0.009) shows the statistical significance and it correlates with Lee *et al.* study [15] ( $p<0.0009$ ).

In the present series, out of 106 patients, 69 were females and 37 were male patients. The male: female ratio is 1:1.9, which is like that of Puvvada [16] study which showed 31.3% of patients were male and 68.7% of patients were females. Bhattacharya [17] showed that 71.4% of the patients were females and 28.6% were males. Similar sex distribution was seen in the Motiwala series [13]. The present study showed the same level of difficulty for both males and females (50%) according to pre-operative risk scoring.

The pain was the predominant symptom seen in 105 patients. All 105 patients presented with chronic recurring pain. The pain was the most common symptom in the studies of both Ganey *et al.* [18] and Sharma [19]. Vomiting was present in 28.5% (9) of the patients with pain. Vomiting was spontaneous and occurred mostly during the attack of pain. It corresponds to the  $p=0.007$  like that of Sharma [19]. Of the total study population, 24 (22.6%) presented with a history of prior hospitalization of which 19 patients were categorized under the difficult (6-10 score) group and 13 patients got converted from lap to open cholecystectomy. Statistical significance of the previous attack of cholecystitis corresponds

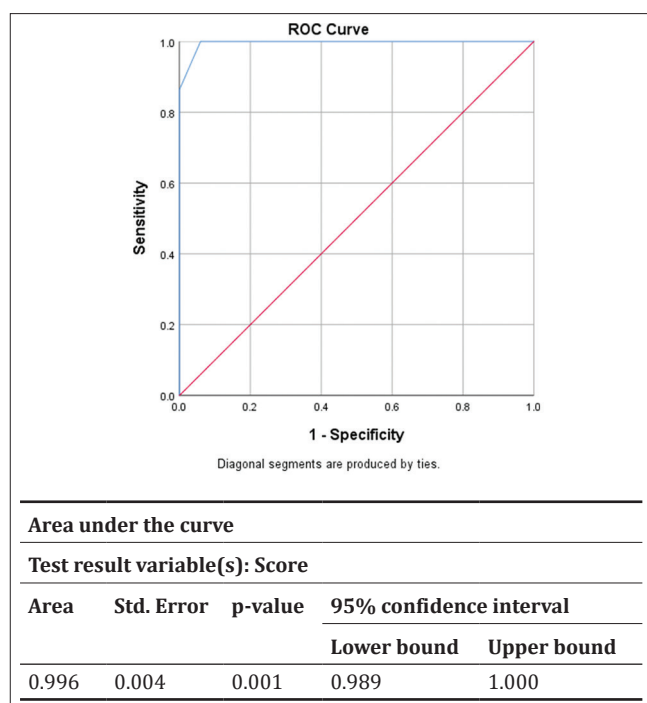


Fig. 1: Receiver operating characteristic curve

Table 9: Cut-off values for sensitivity, specificity, PPV, and NPV

Criterion	Sensitivity	Specificity	PPV	NPV
≥0	100.00	0.00	20.8	
>0	100.00	2.38	21.2	100.0
>1	100.00	19.05	24.4	100.0
>2	100.00	50.00	34.4	100.0
>3	100.00	75.00	51.2	100.0
>4	100.00	94.05	81.5	100.0
>5	86.36	100.00	100.0	96.6
>6	59.09	100.00	100.0	90.3
>7	22.73	100.00	100.0	83.2
>8	9.09	100.00	100.0	80.8
>9	0.00	100.00		79.2

PPV: Positive predictive value, NPV: Negative predictive value

to 0.001 which was similar to that of Prem *et al.* [14] of 0.001. It also corresponds to that of Venkata Rajeev *et al.* [20] of <0.001. And is similar to that of Randhawa and Pujahari [21] with  $p < 0.001$ .

General survey revealed that 30 (28.3%) patients had BMI <25, 54 (50.9%) had BMI in the range of 25–27.5, and 22 (20.8%) had BMI >27 with most of the population ranging between 25 and 27.5. Patients with BMI of 25–27.5 (54.5%) were at higher risk of conversion from laparoscopic to open cholecystectomy.

Of the total 106 patients, 48 patients had a history of previous abdominal surgeries, with 22 patients having hysterectomy scars (vertical midline), 20 have tubectomy scars, 3 incisional hernia scars, and 3 supraumbilical scars. 36.3% corresponds to moderate risk and 47.6% corresponds to mild risk with both infra and supraumbilical scars which was statistically non-significant in the present study.

All the 106 patients had stones in the GB, 6 patients had wall thickening and pericholecystic collection. 84 patients had thickened GB without any pericholecystic collection. Gall bladder wall thickness with pericholecystic collection corresponds to a difficult risk score with a statistical significance of 0.008. A thick-walled GB is an important predictor of conversion, and the present study is similar to that of Randhawa and Pujahari [21] of  $p (0.038)$ .

Age, sex, prior H/O hospitalization for acute cholecystitis/biliary pancreatitis/obstructive jaundice due to common bile duct calculus, BMI, abdominal scar from previous surgery, clinically palpable GB, wall thickness, pericholecystic collection, and impacted stone were among the criteria considered [21].

Out of the 106 patients, 13 were converted from laparoscopy to open cholecystectomy, which corresponds to 12% of the study population. The area under the curve for easy prediction, i.e., a score of 0–5 corresponds to 0.996 with a  $p=0.001$  proving the score is statistically significant. The sensitivity for easy prediction <5 corresponds to 86.36. It is 100% sensitivity for a score <4. Specificity for <4 and <5 corresponds to 94.5 and 100, respectively. The positive predictive value for easy prediction was 100% and for difficult (moderate risk 6–10) prediction was 100%.

Conversion rate from lap cholecystectomy to open cholecystectomy was 12% (13) in the present series. Our results are similar to that of studies by Sigdel *et al.* [14], of 136 patients studied, cases with a score between 0 and 5 were 120 of which 94 were easy, 22 were difficult, and 4 were very difficult. Receiver operating characteristic (ROC) is 0.824, sensitivity is 82.3%, and specificity is 72.7%.

The results of the present series are comparable with the studies by Venkata Rajeev *et al.* [20] of the 100 patients studied, of the total 78 easy group (0–5), 69 were easy LC, 7 were difficult LC, and 2 were very difficult LC.  $p$ -value of the scoring system is <0.001 with a sensitivity of 90.9%, specificity of 73.1%, and area under ROC of 0.8761.

In a similar study by Randhawa and Pujahari [21], of the 228 patients studied; cases with 0–5 pre-operative score were 178 of which 158 were easy LC, 14 were difficult LC, and 6 were very difficult LC. The positive predictive value for easy prediction was 88.8% and for difficult prediction was 92%. The conversion rate was 3/228, i.e., 1.315% and all were due to anomalous ducts.

This scoring system can be recommended routinely to predict conversion of LC to open cholecystectomy.

## CONCLUSION

The following risk factors were considered - age >50 years, male sex, H/O prior hospitalization for acute cholecystitis/biliary pancreatitis, BMI 25–27.5 and >27.5, abdominal scar, palpable GB, wall thickening, impacted stone, and pericholecystic collection. Out of this BMI >27.5, H/O prior hospitalization for acute cholecystitis/acute pancreatitis, palpable GB, wall thickening, and impacted stone were significant predictors of difficult LC, as per the present study.

The scoring system used has got better significance in the prediction of conversion from lap to open cholecystectomy. Prior intimation to the surgeon would reduce the unwanted morbidity intraoperatively. Prior intimation to the patient would help in preventing unwanted psychological stress to the patient and his or her relatives.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interests.

## FINANCING

The study was conducted with no financial support.

## AUTHOR CONTRIBUTION

No other authors.

## REFERENCES

1. Tendon R. Diseases of gallbladder and biliary tract. In: API Textbook of Medicine. Dr. Siddarth N Shah. 7<sup>th</sup> ed. 2003.
2. NIH Consensus Conference. Gallstones and laparoscopic

- cholecystectomy. JAMA. 1992;269:1018-24.
3. Kama NA, Doganay M, Dolapci M, Reis E, Atli M, Kologlu M. Risk factors resulting in conversion of laparoscopic cholecystectomy to open surgery. *Surg Endosc*. 2001 Sep;15(9):965-8. doi: 10.1007/s00464-001-0008-4, PMID 11443475
  4. Palanivellu C, Perissat J, Asbun HJ. Difficult Cholecystectomy. *Art of Laparoscopic Surgery, Textbook and Atlas*. 1<sup>st</sup> ed., Ch. 39. New Delhi: Jaypee; 2005. p. 607-35.
  5. Daradkeh S. Laparoscopic cholecystectomy: What are the factors determining difficulty? *Hepatogastroenterology*. 2001 Jan-Feb;48(37):76-8. PMID 11269003
  6. Lein HH, Huang CS. Male gender: Risk factor for severe symptomatic cholelithiasis. *World J Surg*. 2002;26(5):598-601. doi: 10.1007/s00268-001-0275-1, PMID 12098053
  7. Fried GM, Barkun JS, Sigman HH, Joseph L, Clas D, Garzon J, et al. Factors determining conversion to laparotomy in patients undergoing laparoscopic cholecystectomy. *Am J Surg*. 1994 Jan;167(1):35-9; discussion 39-41. doi: 10.1016/0002-9610(94)90051-5, PMID 8311138
  8. Alponat A, Kum CK, Koh BC, Rajnakova A, Goh PM. Predictive factors for conversion of laparoscopic cholecystectomy. *World J Surg*. 1997;21(6):629-33. doi: 10.1007/pl00012288, PMID 9230661
  9. Kanaan SA, Murayama KM, Merriam LT, Dawes LG, Prystowsky JB, Rege RV, et al. Risk factors for conversion of laparoscopic to open cholecystectomy. *J Surg Res*. 2002;106(1):20-4. doi: 10.1006/jsre.2002.6393, PMID 12127803
  10. Daradkeh SS, Suwan Z, Abu-Khalaf M. Preoperative ultrasonography and prediction of technical difficulties during laparoscopic cholecystectomy. *World J Surg*. 1998 Jan;22(1):75-7.
  11. Jorgensen JO, Hunt DR. Laparoscopic cholecystectomy. A prospective analysis of the potential causes of failure. *Surg Laparosc Endosc*. 1993;3:49-53.
  12. Hermann RE. Biliary Disease in the Aging Patients. New York: Masson; 1983. p. 227-32.
  13. Motiwala HG, Jhawes PK, Purohit A, editors. *Operative Technique Cholecystectomy. A study of SES: Surgery in the Tropics*. Vol. 56. United Kingdom: McMillan India Ltd.; 1991. p. 204.
  14. Sigdel PR, Subedi N, Phuyal S, Pokharel A, Ghimire B, Singh YP. Assessment of a scoring system to predict difficult laparoscopic cholecystectomy. *J Inst Med Nepal*. 2020;43(3):71-5.
  15. Lee NW, Collins J, Britt R, Britt LD. Evaluation of preoperative risk factors for converting laparoscopic to open cholecystectomy. *Am Surg*. 2012 Aug;78(8):831-3. doi: 10.1177/000313481207800815, PMID 22856487
  16. Puvvada RT. A scoring system to predict conversion of laparoscopic cholecystectomy to open cholecystectomy preoperatively. *J Med Sci Clin Res*. 2019;7(2): 672-675. doi: 10.18535/jmscr/v7i2.119
  17. Katari A, Ramu M. A Clinical Study on Laparoscopic Cholecystectomy in a Tertiary Care Teaching Hospital. *Perspectives in Medical Research* 2021; 9 (2):15-18.
  18. Ganey JB, Johnson PA, Prillaman PE, McSwain GR. Cholecystectomy: Clinical experience with a large series. *Am J Surg*. 1986;151(3):352-7. doi: 10.1016/0002-9610(86)90466-6, PMID 3513652
  19. Maj. Alok Sharma, "Towards A Safer Cholecystectomy- The Fundus Porta Approach", *Indian Journal Of Surgery*, June 1997, volume-6: PP: 141-145.
  20. Venkata Rajeev M, Raza M. Predicting difficulty in laparoscopic cholecystectomy preoperatively using a scoring system. *Int Surg J*. 2019 Mar;6(3):957-62.
  21. Randhawa JS, Pujahari AK. Preoperative prediction of difficult lap chole: A scoring method. *Indian J Surg*. 2009 Aug;71(4):198-201. doi: 10.1007/s12262-009-0055-y, PMID 23133154