



General Surgery

A PROSPECTIVE STUDY ON RISK FACTORS PREDICTING DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY AND ITS CONVERSION TO OPEN CHOLECYSTECTOMY AT A TERTIARY CARE CENTRE

Dr Shashanka R	Associate Professor, Department of general surgery, Hassan institute of medical sciences, Hassan-573201.
Dr Pramodh K N	Final year post-graduate, Department of general surgery, Hassan institute of medical sciences, Hassan-573201.
Dr Rajanna B	Professor and HOD, Department of general surgery, Hassan institute of medical sciences, Hassan-573201.
Dr Ishwaraprasad G D	Associate Professor, Department of general surgery, Hassan institute of medical sciences, Hassan-573201.

ABSTRACT

Background: The knowledge of reliable preoperative and intraoperative predicting factors could be an advantage for both the surgeon and patient in terms of options for management in order to avoid intraoperative complications and to obtain better postoperative outcomes. In view of this, the present study was undertaken to identify preoperative and intraoperative factors predictive of difficult LC and its conversion to open cholecystectomy. **Methods:** 86 patients aged > 18 years undergoing laparoscopic cholecystectomy in Hassan institute of medical sciences, Hassan were included in the study. **Results:** 25.6% were in 41-50 years age group. 80.2% were females, 48.8% had BMI between 25-29.9 kg/m², 40.7% of the subject presented with comorbidities. 34.9% had 2A grading of difficulty, 24.4% had grade 1, 24.4% had 2B grading. 7% had conversion to open surgery. 7.2% had intraoperative difficulties for conversion to open surgery. 98.8% recovered after surgery. **Interpretation & Conclusion:** Cushieri's scoring system served as an easy and reliable tool in the study. Thus, assessing the predictors for difficult laparoscopic cholecystectomy using Cushieri's scale helps the surgeon and the patients for the prior preparation to open surgery.

KEYWORDS : Cholecystitis, Conversion, Difficult cholecystectomy

INTRODUCTION:

Laparoscopic cholecystectomy is a minimally invasive surgical procedure for removal of a diseased gallbladder and is considered as the gold standard technique for treatment of gallbladder disease in both elective and emergency surgery [1]. Laparoscopic cholecystectomy has replaced the open technique for routine cholecystectomies since the early 1990s [2]. At this time, laparoscopic cholecystectomy is indicated for the treatment of cholecystitis (acute/chronic), symptomatic cholelithiasis, biliary dyskinesia, acalculous cholecystitis, gallstone pancreatitis, and gallbladder masses/polyps [3]. The advantages of laparoscopic cholecystectomy include earlier return to bowel function, less postoperative pain, cosmetic, shorter length of hospital stay, earlier return to full activity, and decreased overall cost [4].

Laparoscopic cholecystectomy (LC) has now become one of the most common operations performed by general surgeons. Since the introduction of laparoscopic cholecystectomy, the number of cholecystectomies performed in India has been increased due to widespread use of radiological investigation for screening [5].

At the beginning of the development of the laparoscopic technique, there was a high-rate complications due to the learning curve [6]. Minor complications (biliary and non-biliary) are usually treated conservatively. Major complications (biliary and vascular) are life threatening and increase mortality rate, therefore creating the need for conversion to open surgical approach in order to treat them [7].

It has been reported that 1.8-27.7% of laparoscopic cholecystectomies are converted to open surgery during the operation [8]. Converted cases are associated with increased numbers of infectious and other postoperative complications [9-11]. Also, conversion from laparoscopic to open operation results in longer postoperative stays and morbidity and mortality rates are higher in this group of patients [12, 13].

Multiple factors such as age, sex, anatomical variations, previous surgeries, obesity, pathologies such as severe inflammation or impacted stones, external factors such as failure of equipment or inappropriate equipment have been described to influence the difficulty of a laparoscopic cholecystectomy [14-16]. The evaluation of this difficulty can vary between surgeons. Multiple scales have been devised to evaluate the Intraoperative findings of Laparoscopic cholecystectomy [17-20].

The knowledge of reliable preoperative and intraoperative predicting factors could be an advantage for both the surgeon and patient in terms of options for management (skills of surgeon, need for intraoperative cholangiography, operative timing) in order to avoid intraoperative complications (vasculobiliary injuries, conversion to open surgery) and to obtain better postoperative outcomes. In view of this, the present study was undertaken to identify preoperative and intraoperative factors predictive of difficult LC and its conversion to open cholecystectomy.

OBJECTIVE OF THE STUDY:

To study preoperative risk factors for difficult laparoscopic cholecystectomy, intra operative difficulties of laparoscopic cholecystectomy and to study factors leading conversion to open cholecystectomy

METHODOLOGY

STUDY DESIGN: Prospective cohort study

STUDY DURATION: 18 months (January 2021 - June 2022)

STUDY AREA: Hassan Institute of Medical Sciences, Hassan.

STUDY PARTICIPANTS: Patients undergoing laparoscopic cholecystectomy in Hassan institute of medical sciences, Hassan.

Inclusion Criteria

1. All patients aged > 18 years undergoing laparoscopic cholecystectomy

Exclusion Criteria

1. Patients with gallbladder carcinoma.
2. Gallbladder polyps.
3. Choledocholithiasis.
4. Patients not willing to give consent

Estimation Of Sample Size:

According to a study by Ghadhbhan et al [119] revealed that preoperative scoring 58% of total subjects were indicated for difficult laparoscopic cholecystectomy.

$$Z = 1.96$$

$$p = 58\% = 0.58$$

$$q = 1 - p = 0.42$$

$$d = \text{margin of error, } 5\text{-}20\% \text{ of } p$$

we have taken 19%
 $n = Z^2pq/d^2$
 $n = (1.96)^2 \times 0.58 \times 0.42 / (0.112)^2$
 $n = 77$ subjects
 Therefore, the sample size was fixed at 80.

METHOD OF COLLECTION OF DATA:

All patients > 18 years undergoing laparoscopic cholecystectomy in Hassan institute of medical sciences, Hassan were included in the study. Clearance from the institutional ethical committee was taken before starting the study. Study participants were included in the study by Purposive Sampling technique.

The study participants > 18 years undergoing laparoscopic cholecystectomy were included in the study, till the sample size was reached. Written informed consent was taken from the study participants after explaining risks, standard surgical procedure and complications of LC before surgery. A pre-tested, semi-structured questionnaire was used to collect information on clinical history, past history by interview method. Systemic examination and relevant laboratory and radiological investigations were done. Variables of difficult laparoscopic cholecystectomy were observed and documented and Cushieri's scale was used to grade the operative difficulty. A concise checklist was used to assess the reasons for conversion from laparoscopic to open surgery.

Statistical Analysis:

The data was collected and compiled in MS Excel. Descriptive statistics has been used to present the data. To analyse the data SPSS (Version 26.0) was used. Significance level was fixed as 5% ($\alpha = 0.05$). Qualitative variables are expressed as frequency and percentages and Quantitative variables are expressed as Mean and Standard Deviation.

RESULTS:

22 (25.6%) of the study participants were in the age group of 41-50 years, followed by 18 (20.9%) in age group of 51-60 years. 69 (80.2%) were females and 17 (19.8%) were males. 42 (48.8%) had BMI between 25-29.9 kg/m², 40 (46.5%) had BMI between 18.5-24.9 kg/m². 35 (40.7%) subjects presented with comorbidities. Among 35 subjects, majority 12 (14%) had HTN, followed by 7 (8.1%) had DM, 6 (7%) had hypothyroidism, 6 (7%) had previous surgeries, 2 (2.3%) had bronchial asthma, 1 (1.2%) had rheumatoid arthritis.

Radiological findings showed that all 86 (100%) had calculi, 39 (53.3%) had distended GB, 18 (21%) had pericholecystic fluid collection, 9 (10.5%) had GB wall thickness, 5 (6.8%) had pericholecystic fat stranding, 3 (4.5%) had presence of sludge.

30 (34.9%) subjects had 2A grading of difficulty, 21 (24.4%) had grade 1, 21 (24.4%) had 2B grading, 7 (8%) had Grade 3, 7 (8%) had 4 grading. 6 (7%) subjects had conversion to open surgery. Reasons for conversion to open surgery were gangrenous cholecystitis in 1 subject, Dense adhesion in 1, Duodenal perforation in 1 and CBD injury in 1 patient. 6 (7.2%) subjects had intraoperative difficulties for conversion to open surgery. 85 (98.8%) recovered after surgery and 1 (1.2%) died.

DISCUSSION:

In our study, 22 (25.6%) of the study participants were in the age group of 41-50 years, followed by 18 (20.9%) in age group of 51-60 years. 69 (80.2%) were females and 17 (19.8%) were males. This was similar to a study by Nidoni et al [21] in which majority i.e., 22.7% belonged to 41-50 years age group and females constituted to 63.8%. In a study by Gupta et al [22] females were predominant constituting about 85.71% of the study population which was in accordance with this study.

In our study, 42 (48.8%) had BMI between 25-29.9 kg/m², 40 (46.5%) had BMI between 18.5-24.9 kg/m². In a study by Goyal et al [23] majority i.e., 72.8% had BMI <25 kg/m² which was similar to this study.

Variables for difficulty in laparoscopic cholecystectomy were age, BMI, causes of admission like Acute Calculus Cholecystitis, Chronic Calculus Cholecystitis, Gb Polyp, Multiple Gb Polyp, Pain Abdomen and Symptomatic Cholelithiasis; GB wall thickness ≥ 4 mm, fibrosis of the GB, WBC $\geq 10 \times 10^9$ G/L and ≥ 5 attacks of pain that lasted longer for > 4 H. In a study by Dominguez et al [24] Leucocytes > 12,000 mm³, age >70 years, gallbladder wall enlargement and choledocholithiasis which were similar to this study. In a study by

Goyal et al [23] age, BMI, TLC >10,000/cu.mm and previous abdominal surgery and contracted gall bladder were associated with difficulty in Lap cholecystectomy.

In a study by Gupta et al [22] old age, history of hospitalization, obesity, previous abdominal surgery, palpable gall bladder, and ultrasonographic findings like gall bladder wall thickness, pericholecystic fluid collection, impacted stone were included as risk factors for difficulty in laparoscopy which were similar to this study. In a study by Nidoni et al [21] previous history of more than 2 attacks of acute cholecystitis, TLC >11000/cumm, gall bladder wall thickness >3mm were found to be risk factors for difficulty in lap cholecystectomy which was consistent with this study. In a study by Kidwai et al [25] BMI, ultrasonographic finding of presence of multiple stone or stones impacted in Hartmann's pouch were risk factors for difficult laparoscopy.

In a study by Thyagarajan et al [26] Age >50yrs, Male gender, Presence of Diabetes Mellitus, Obesity, previous Abdominal surgeries and Disease Related Factors - previous episode of Acute Cholecystitis, presence of Acute Cholecystitis, Gallbladder wall thickness >4mm, presence of Pericholecystic fluid were found to be significant risk factors in conversion of laparoscopic to open cholecystectomy which was consistent with this study. In a study by Dhanke et al [27] BMI, history of prior hospitalization, palpable gallbladder, impacted stone and pericholecystic collection were significant predictors of difficult laparoscopic cholecystectomy.

A large number of clinical studies have reported patient's risk factors like age, sex, BMI and previous abdominal surgery. Ultrasound findings like contracted gall bladder, large single stone, gall bladder thickness and peri cholecystic fluid collection are associated with difficult laparoscopic cholecystectomy [28] Haematological parameters like raised total leukocytes count and serum alkaline phosphatase are reported as risk factors for difficult laparoscopic cholecystectomy [29, 30].

In our study, 30 (34.9%) subjects had 2A grading of difficulty, 21 (24.4%) had grade 1, 21 (24.4%) had 2B grading, 7 (8%) had Grade 3, 7 (8%) had 4 grading. 6 (7%) subjects had conversion to open surgery. In a study by Dominguez et al [24] conversion rate to open surgeries was 13.8% which was more compared to this study. In a study by Gupta et al [22] conversion rate was 5.7% which was almost similar to this study. In a study by Rosen et al [30] conversion rate was 5.3% which was almost similar to this study. The overall conversion rate in a study by Nidoni et al [21] was 6%. Tiwary KS et al [31] found conversion rate in their study as 7.81%. Sharma SK et al [32] found conversion rate in their study as 4%. In a study by Kidwai et al [25] conversion rate was 11.1%. A large number of studies [29, 30] have reported the conversion rate of laparoscopic cholecystectomy to open cholecystectomy at 2 to 15%.

In our study, Reasons for conversion to open surgery were gangrenous cholecystitis in 1 subject, Dense adhesion in 1, Duodenal perforation in 1 and CBD injury in 1 patient. 6 (7.2%) subjects had intraoperative difficulties for conversion to open surgery. There were no technical difficulties found in conversion to open surgery. Whereas in a study by Gupta et al. [22] the only reason for conversion was adhesions in calot's triangle. In a study by Kidwai et al [25] adhesions and GB perforation were predictors for conversion to open surgery. In a study by Rosen et al [30] reasons for conversion were adhesions and severe inflammation of gall bladder.

Many studies have identified raised WBC as a risk factor for predicting conversion [33-36] similar to this study. Many studies [37, 38] have found morbid obesity to be associated with increased risk of conversion which was consistent with this study. The thickness of gall bladder associated with conversion varies from study to study. It was 3mm [37, 38], 4mm [39] which was in compliance with this study. Sanabria et al., [139] found in their study that patients with multiple attacks (ten or more) were significantly associated with conversion. In most of the studies age was considered as a risk factor for conversion [38-40] which was consistent with this study. Liu et al. [40] did not notice sex to be associated with conversion similar to this study.

CONCLUSION:

Cushieri's scoring system serves as an easy and reliable tool for predicting difficult laparoscopic cholecystectomy. Assessing the predictors for difficult laparoscopic cholecystectomy helps the

surgeon and the patients for the prior preparation to open surgery.

Table 1: Patient Characteristics

PATIENT CHARACTERISTICS		FREQUENCY	PERCENT
AGE	21-30 YEARS	17	19.8
	31-40 YEARS	17	19.8
	41-50 YEARS	22	25.6
	51-60 YEARS	18	20.9
	61-70 YEARS	7	8.1
GENDE R	MALE	17	19.8
	FEMALE	69	80.2
BMI	18.5-24.9 kg/m ²	40	46.5
	25-29.9 kg/m ²	42	48.8
	30-40 kg/m ²	4	4.7
CO-MORBIDITIES	YES	35	40.7
	NO	51	59.3
INTERVENTIONS ON CBD	YES	9	10.5
	NO	77	89.5
RADIOLOGICAL FINDINGS	PRESENCE OF CALCULI	86	100.0
	DISTENDED GB	39	53.3
	PERICHOLECISTIC FAT STRANDING	5	6.8
	PERICHOLECISTIC FLUID COLLECTION	18	21.0
	PRESENCE OF SLUDGE	3	4.5
	GB WALL THICKNESS	9	10.5

Table 2: Factors For Difficult Laproscopic Cholecystectomy

FACTORS FOR DIFFICULT LAPROSCOPIC CHOLECYSTECTOMY		FREQUENCY	PERCENT
AGE IN YEARS	YES	30	34.9
	NO	56	65.1
BMI IN KG/M2	YES	34	39.5
	NO	52	60.5
CAUSE OF ADMISSION	ACUTE CALCULUS CHOLECYSTITIS	14	16.27
	CHRONIC CALCULUS CHOLECYSTITIS	43	50.0
	SYMPTOMATIC CHOLECYSTOLITHIASIS	29	33.7
GB WALL THICKNESS >4 MM	YES	9	10.4
	NO	75	87.2
FIBROSIS OF THE GB	YES	1	
	NO	85	98.8
WBC >10 × 10 ⁹ G/L	YES	29	33.7
	NO	57	66.3
>5 ATTACKS OF PAIN THAT LASTED LONGER FOR > 4 H	YES	4	4.7
	NO	82	95.3

Table 3: Intraoperative And Post-operative Findings

INTRAOPERATIVE AND POST-OPERATIVE FINDINGS		FREQUENCY	PERCENT
CUSHIERI'S SCALE	1	21	24.4
	2A	30	34.9
	2B	21	24.4
	3	7	8
	4	7	8
CONVERSION	YES	6	7.0
	NO	80	93
REASONS FOR CONVERSION	GANGRENOUS CHOLECYSTITIS	1	16.6
	DENSE ADHESION	3	50
	DUODENAL PERFORATION	1	16.6
	CBD INJURY	1	16.6
INTRAOPERATIVE DIFFICULTIES	YES	6	7.2
	NO	80	92.8
OUTCOME	RECOVERY	85	98.8
	DEATH	1	1.2

REFERENCES:

- Agresta F, Campanile FC, Vettoretto N, Silecchia G, Bergamini C, Maida P, et al. Laparoscopic cholecystectomy: consensus conference-based guidelines. *Langenbecks Arch Surg*. 2015 May;400(4):429–53.
- Kapoor T, Wrenn SM, Callas PW, Abu-Jaish W. Cost analysis and supply utilization of laparoscopic cholecystectomy. *Minimally Invasive Surgery [Internet]*. 2018 Dec 10 [cited 2022 Jul 18];2018:1–5. Available from: <https://www.hindawi.com/journals/mis/2018/7838103/>
- Hassler KR, Collins JT, Philip K, Jones MW. Laparoscopic cholecystectomy. In: *StatPearls [Internet]*. Treasure Island (FL): StatPearls Publishing; 2022 [cited 2022 Jul 18]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK448145/>
- Paulino-Netto A. A review of 391 selected open cholecystectomies for comparison with laparoscopic cholecystectomy. *Am J Surg*. 1993 Jul;166(1):71–3.
- Bunkar SK, Yadav S, Singh A, Agarwal K, Singh P, Sharma AC. Factors predicting difficult laparoscopic cholecystectomy: a single institution experience. *Int Surg J [Internet]*. 2017 Apr 22 [cited 2022 Jul 18];4(5):1743. Available from: <http://www.ijurgery.com/index.php/ij/article/view/1162>
- Rose JB, Hawkins WG. Diagnosis and management of biliary injuries. *Current Problems in Surgery [Internet]*. 2017 Aug [cited 2022 Jul 18];54(8):406–35. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0011384017301168>
- Radunovic M, Lazovic R, Popovic N, Magdelinic M, Bulajic M, Radunovic L, et al. Complications of laparoscopic cholecystectomy: our experience from a retrospective analysis. *Open Access Maced J Med Sci [Internet]*. 2016 Nov 9 [cited 2022 Jul 18];4(4):641–6. Available from: <https://oamjms.eu/index.php/mjms/article/view/oamjms.2016.128>
- Lim KR, Ibrahim S, Tan NC, Lim SH, Tay KH. Risk factors for conversion to open surgery in patients with acute cholecystitis undergoing interval laparoscopic cholecystectomy. *Ann Acad Med Singap*. 2007 Aug;36(8):631–5.
- Alponat A, Kum CK, Koh BC, Rajnakova A, Goh PMY. Predictive factors for conversion of laparoscopic cholecystectomy. *World J Surg [Internet]*. 1997 Jul [cited 2022 Jul 18];21(6):629–33. Available from: <http://link.springer.com/10.1007/PL00012288>
- Asai K, Watanabe M, Kusachi S, Matsukiyo H, Saito T, Kodama H, et al. Risk factors for conversion of laparoscopic cholecystectomy to open surgery associated with the severity characteristics according to the Tokyo guidelines. *Surg Today*. 2014 Dec;44(12):2300–4.
- Brodsky A, Matter I, Sabo E, Cohen A, Abrahamson J, Eldar S. Laparoscopic cholecystectomy for acute cholecystitis: can the need for conversion and the probability of complications be predicted? A prospective study. *Surg Endosc*. 2000 Aug;14(8):755–60.
- Harboe KM, Bardram L. The quality of cholecystectomy in Denmark: outcome and risk factors for 20,307 patients from the national database. *Surg Endosc*. 2011 May;25(5):1630–41.
- Wolf AS, Nijse BA, Sokal SM, Chang Y, Berger DL. Surgical outcomes of open cholecystectomy in the laparoscopic era. *Am J Surg*. 2009 Jun;197(6):781–4.
- Bourgoin S, Mancini J, Monchal T, Calvary R, Bordes J, Balandraud P. How to predict difficult laparoscopic cholecystectomy? Proposal for a simple preoperative scoring system. *The American Journal of Surgery [Internet]*. 2016 Nov 1 [cited 2022 Jul 18];212(5):873–81. Available from: [https://www.americanjournalofsurgery.com/article/S0002-9610\(16\)30237-9/fulltext](https://www.americanjournalofsurgery.com/article/S0002-9610(16)30237-9/fulltext)
- Hussain A. Difficult laparoscopic cholecystectomy: current evidence and strategies of management. *Surgical Laparoscopy, Endoscopy & Percutaneous Techniques [Internet]*. 2011 Aug [cited 2022 Jul 18];21(4):211–7. Available from: <https://journals.lww.com/00129689-201108000-00001>
- Atta HM, Mohamed AA, Sewefy AM, Abdel-Fatah AFS, Mohammed MM, Atiya AM. Difficult laparoscopic cholecystectomy and trainees: predictors and results in an academic teaching hospital. *Gastroenterology Research and Practice [Internet]*. 2017 [cited 2022 Jul 18];2017:1–5. Available from: <https://www.hindawi.com/journals/grp/2017/6467814/>
- Kuo YL, Chen WC, Yao WJ, Cheng L, Hsu HP, Lai HW, et al. Validation of Memorial Sloan-Kettering Cancer Center nomogram for prediction of non-sentinel lymph node metastasis in sentinel lymph node positive breast cancer patients an international comparison. *International Journal of Surgery [Internet]*. 2013 Aug [cited 2022 Jul 18];11(7):538–43. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1743919113001192>
- Madni TD, Nakonezny PA, Imran JB, Taveras L, Cunningham HB, Vela R, et al. A comparison of cholecystitis grading scales. *J Trauma Acute Care Surg [Internet]*. 2019 Mar [cited 2022 Jul 18];86(3):471–8. Available from: <https://journals.lww.com/01586154-201903000-00013>
- West Midlands Research Collaborative, Griffiths EA, Hodson J, Vohra RS, Marriott P, Katbeh T, et al. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. *Surg Endosc [Internet]*. 2019 Jan [cited 2022 Jul 18];33(1):110–21. Available from: <http://link.springer.com/10.1007/s00464-018-6281-2>
- Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy- a new scoring system. *World J Emerg Surg [Internet]*. 2015 Dec [cited 2022 Jul 18];10(1):1–8. Available from: <https://wjvs.biomedcentral.com/articles/10.1186/s13017-015-0005-x>
- Nidoni R, Udachan TV. Predicting difficult laparoscopic cholecystectomy based on clinicoradiological assessment. *Journal of Clinical and Diagnostic Research*. 2015 Dec;9(12):09-12
- Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, Kumar R, Chand T. Validation of a scoring system to predict difficult laparoscopic cholecystectomy. *International journal of surgery*. 2013 Nov 1;11(9):1002-6.
- Goyal V, Nagpal N, Gupta M, Kapoor R. A prospective study to predict the preoperative risk factors for conversion of laparoscopic to open cholecystectomy. *J Contemp Med Surg Radiol*. 2017;2(4):148-52.
- Dominguez LC, Rivera A, Bermudez C, Herrera W. Analysis of factors for conversion of laparoscopic to open cholecystectomy: a prospective study of 703 patients with acute cholecystitis. *Cirugía Española (English Edition)*. 2011 Jan 1;89(5):300-6.
- Kidwai R, Pandit R, Issrani R, Prabhu N. Assessment of Risk Factors for Conversion from Difficult Laparoscopic to Open Cholecystectomy-A Hospital Based Prospective Study. *Journal of Krishna Institute of Medical Sciences (JKIMSU)*. 2016 Jul 1;5(3).
- Thyagarajan M, Singh B, Thangasamy A, Rajasekar S. Risk factors influencing conversion of laparoscopic cholecystectomy to open cholecystectomy. *International Surgery Journal*. 2017 Sep 27;4(10):3354-7.
- Dhanke PS, Ugane SP. Factors predicting difficult laparoscopic cholecystectomy: a single-institution experience. *International Journal of Students' Research*. 2014 Jan 1;4(1).
- Carmody E, Arenson AM, Hanna S. Failed or difficult laparoscopic cholecystectomy: can preoperative ultrasonography identify potential problems?. *Journal of Clinical Ultrasound*. 1994;22(6):391-6.
- Kama NA, Kologlu M, Doganay M, Reis E, Atli M, Dolapci M. A risk score for conversion from laparoscopic to open cholecystectomy. *The American Journal of Surgery*. 2001;181(6):520-5

30. Rosen M, Brody F, Ponsky J. Predictive factors for conversion of laparoscopic cholecystectomy. *The American journal of surgery*. 2002 Sep 1;184(3):254-8.
31. Tiwary KS, Agarwal N, Prasanna G, Khanna R. Predictive factors for difficult surgery in laparoscopic cholecystectomy for chronic cholecystitis. *The internet journal of surgery*. 2008;16(12):11.
32. Sharma SK, Thapa PB, Pandey A, Kayestha B, Poudyal S. Predicting difficulties during laparoscopic cholecystectomy by preoperative ultrasound. *Kathmandu University Medical journal*. 2007;5(17):8-11.
33. Brodsky A, Matter I, Sabo E, Cohen A, Abrahamson J, Eldar S. Laparoscopic cholecystectomy for acute cholecystitis: Can the need for conversion and the probability of complications be predicted?. *Surgical Endoscopy*. 2000;14(8): 755-60.
34. Bedirli A, Sakrak O, Sozuer EM, et al. Factors effecting the complications in the natural history of acute cholecystitis. *Hepatogastroenterology*. 2001;48:1275-58.
35. Ibrahim S, Tay KH, Lim SH, et al. Risk factors for conversion to open surgery in patients undergoing laparoscopic cholecystectomy. *World J Surg*. 2006;30:1698-704.
36. Schrenk P, Woisetschlager R, Wayand WU. Laparoscopic cholecystectomy. Cause of conversions in 1,300 patients and analysis of risk factors. *Surg Endosc*. 1995;9:25-28.
37. 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;167(1):9e41.35-9.
38. Nachnani J, Supe A. Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. *Indian journal of gastroenterology*. 2005;24(1):16-8.
39. Sanabria JR, Gallinger S, Croxford R, et al. Risk factors in elective laparoscopic cholecystectomy for conversion to open cholecystectomy. *J Am Coll Surg*. 1994;179:696-704.
40. Liu C. Factors Affecting Conversion of Laparoscopic Cholecystectomy to Open Surgery. *Arch Surg*. 1996;131(1):98.