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An Overview on Difficult Laparoscopic Cholecystectomy

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Abstract:

Laparoscopic cholecystectomy (LC) is the gold standard for the treatment of symptomatic gallstones and benign gallbladder diseases. However, in a subset of patients, the procedure becomes challenging due to factors such as inflammation, fibrosis, distorted anatomy, or prior abdominal surgeries. Difficult laparoscopic cholecystectomy (DLC) is associated with increased operative time, higher conversion rates to open surgery, and a greater risk of complications.

Keywords: Laparoscopic cholecystectomy, Difficult cholecystectomy, Conversion to open surgery, Gallbladder inflammation, Calot's triangle, Critical view of safety, Surgical difficulty.

Introduction:

Laparoscopic cholecystectomy (LC) remains the preferred surgical method for treating symptomatic gallstones and benign gallbladder diseases. It offers numerous advantages, including reduced pain, faster recovery, and shorter hospital stay. However, in certain clinical situations, the procedure becomes technically challenging due to anatomical variations, acute inflammation, or prior surgeries, leading to what is termed a "difficult laparoscopic cholecystectomy" (DLC) **(1).**

DLC is associated with longer operative time, higher rates of conversion to open surgery, and an increased risk of complications such as bile duct injury. Accurate identification of difficult cases is essential and can be predicted through preoperative factors like male sex, obesity, previous upper abdominal surgery, and ultrasonographic findings such as gallbladder wall thickening and pericholecystic fluid **(2).** Intraoperatively, dense adhesions, unclear anatomy, and fibrotic Calot's triangle further complicate safe dissection.

To minimize complications, surgeons should adhere strictly to safety protocols, especially achieving the Critical View of Safety (CVS) before clipping and cutting structures. In high-risk cases, the use of bailout techniques such as subtotal cholecystectomy or early conversion to open surgery is considered a safe alternative **(3).** Modern scoring systems and intraoperative grading tools help guide decision-making and improve outcomes in challenging cases.

Difficult Laparoscopic Cholecystectomy:

The difficult laparoscopic cholecystectomy (DLC) is a nightmare for surgeons, but the definition of DLC is not well established and may vary from surgeon to surgeon **(4).**

In times before the laparoscopic era the incidence of biliary injuries after conventional open cholecystectomy amounted about 0.2%. However, despite of contemplated advantages, a rapid learning curve and constant improvements in methodology, the complication rates of bile duct injuries after laparoscopic

cholecystectomy count from 0.4% to 0.5%, dependent on the underlying disease and remain higher than in the open approach **(5).**

DLC have more morbidity than open cholecystectomy. The risk of complication of laparoscopic cholecystectomy is increased with conversion as well as with longer operating time. Addition of each 30 minutes duration increases chances of both local and systemic post-operative complications **(6).**

Patient-specific factors including increased BMI, increased age, male gender, increased American Society of Anesthesiologists (ASA) score and abnormal LFT are significant predictorsof prolonged LC duration and may be indicators of increased procedural difficulty **(7).**

Although the LC procedure is a routine procedure that is performed in high volumes, an increase in difficult procedures will expose the surgeons and hospitals to a higher workload **(7).**

On the other hand, this procedure cannot be continued laparoscopically in all cases, and conversion to laparotomy may become inevitable. Conversion rates for Gallstone disease (GSD) have been the subject of various publications and are reported with an average of 5% in all age groups. Previous studies have demonstrated that, with the use of specific strategies, conversion rates can be decreased even in acute cases, such as senior surgeon supervision, modification of operative techniques, and laparoscopic experience of the surgeon (**8**).

Laparoscopic cholecystectomy though considered as safe and effective, yet can become difficult at times due to various problems faced during surgical procedure. The following are indications of difficult cases:

(1) Dense adhesions at the triangle of Calot,

(2) Contracted and fibrotic gall bladder,

(3) Previous upper abdominal surgery with dense scar marks,

(4) Gangrenous gall bladder,

(5) Acutely inflamed gall bladder,

(6) Gallbladder empyema,

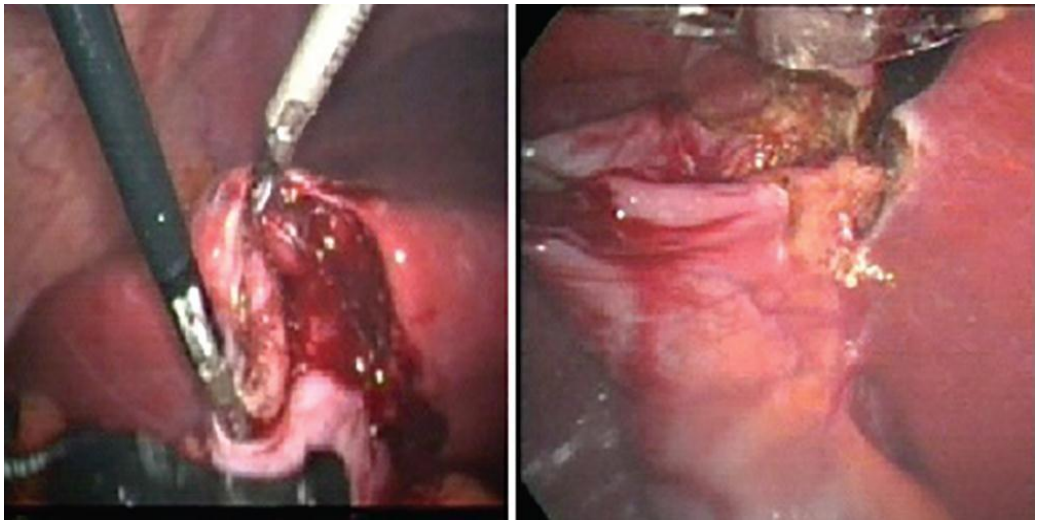
(7) Cholecystogastric and cholecystoduodenal fistula,

(8) An unclear anatomy,

(9) Mirizzi syndrome **(9).**

Essential points under consideration for performing safe difficult laparoscopic cholecystectomy are: preoperative workup and identification of co-morbid conditions, meticulous dissection, minimal use of cautery and no inhibitions for conversion to open cholecystectomy **(9).**

In difficult cases when the standard technique fails to achieve adequate exposure or to perform a safe dissection, fundus-first laparoscopic cholecystectomy could be performed by starting dissection from the fundus downwards as shown in **(figure 1)**. Kassem et al. in 2015 found that fundus-first laparoscopic cholecystectomy has a shorter operative time compared with the standard technique and patients complained of less postoperative pain and nausea. It was suggested that the fundus-first laparoscopic cholecystectomy to be the technique of choice as they found it simpler to perform with a shorter operative time **(10).**



(Figure 1): Fundus-first laparoscopic cholecystectomy **(a)** Dissection at the fundus with ultrasonic dissection shears, **(b)** traction–counter traction at the fundus. **(10).**

With advances in laparoscopic technique, Laparoscopic Partial Cholecystectomy (LPC) has become an effective and safe method for decreasing the rates of conversion to open surgery in patients with benign gallbladder disease and difficulties during their operations. LPC is a good and safe alternative to total cholecystectomy due to its shorter operation duration, a lower rate of surgical site infection, shorter length of postoperative hospital stays and lower incidence of postoperative complications **(11).**

In case of local severe inflammation, adhesions, bleeding in Calot's triangle or suspected bile duct injury, conversion to open surgery should be strongly considered **(12).**

Prediction of Difficult Laparoscopic Cholecystectomy:

LC is one of the more unpredictable operations in general surgery, due to the variable operative findings**.** Several studies have been published in the past years trying to assess predictive risk factors for difficulty during LC **(13).**

Preoperative prediction of difficult LC could help both the patient as well as the surgeon in order to remain better prepared for the intraoperative catastrophes as well as the conversions to open cholecystectomy. Prediction of a difficult LC would allow the patient to prepare psychologically as well as planning their recovery and explaining their absence from work. Another benefit would be to allow more efficient scheduling of the operative list and ensuring the availability of a more experienced laparoscopic surgeon for the procedure **(14).**

LC may be rendered difficult by various problems encountered during surgery, such as in accessing the peritoneal cavity, creating pneumoperitoneum, dissecting the GB from its bed or extracting the excised GB. Age, sex, obesity, duration of gallstone disease, number of attacks of cholecystitis, previous abdominal surgery and liver function tests with elevated alkaline phosphatase have been considered as factors responsible for difficult LC. Similarly, intra-operative findings like adhesions, diseases of liver, abnormal anatomy of GB and biliary tract, complication during dissection like bleeding, bile duct injury, GB perforation, stone loss and also visceral injury may render laparoscopic surgery difficult **(13).**

Many studies have been published proposing pre-operative scoring methods for predicting a difficult cholecystectomy. However, most scoring systems lack objective definitions of the difficulty encountered at the time of a cholecystectomy **(15)**, being correlated to different measures of intra-operative difficulty **(15-17).** These studies either had small sample sizes or lacked external validation. Other predictive scores calculated the risk of conversion to open surgery during cholecystectomy **(15, 16, 18).**

Moreover, this is variable depending on surgeon experience and equipment availability. In addition, as a variety of techniques and strategies are now available, allowing for the continuation of a laparoscopic approach where challenges arise, conversion to open surgery has become less relevant today than when laparoscopic cholecystectomy was in its infancy **(19).**

Intra-operative findings at the time of cholecystectomy vary according to the clinical presentation, and may lead to a range of operative challenges. The prediction of the difficulty encountered during the procedure can offer the surgeon a range of benefits, including surgical planning, informing the patient, and predicting certain outcomes, such as the potential for conversion to open surgery **(19).**

***Nassar scoring system for prediction of difficult laparoscopic cholecystectomy* (19).**

The Nassar scoring system **(table 1)** was validated using objective measures of operative difficulty, as opposed to the largely subjective measures used in previous studies. This score, employing simple pre-operative variables, can accurately predict the likelihood of a difficult operation, facilitating patient selection for day case surgery, optimizing pre-operative surgical planning and helping to inform patients during the consent process **(19).**

This system employed a multivariable binary logistic regression analysis to identify factors independently associated with difficult laparoscopic cholecystectomy, generating a risk score. This scoring system was then validated on an external independent dataset.

	Points
Age (years)	
• **< 40**	0
• **40+**	1
Gender	
• **Female**	0
• **Male**	1
ASA classification	
• **1**	0
• **2**	1
• **3**	2
• **4-5**	7
Primary diagnosis	
• **Pancreatitis**	0
• **Biliary colic**	0
• **CBD stones**	1
• **Cholecystitis**	4
Thick walled gall bladder (≥ 3 mm)	
• **No**	0
• **Yes**	2
CBD dilatation (> 6mm)	
• **No**	0
• **Yes**	1
Pre-operative ERCP	
• **No**	0
• **Yes**	1
`Admission type	
• **Elective**	0
• **Delayed**	1

• **Emergency**	2

(Table 1): Nassar scoring system

According to the total score, patients are classified into

- 0–1→ low risk
- 2-6 → medium risk
- 7+ → high risk

Cases of difficult cholecystectomy are candidates for the fundus-first approach. In the fundus-first approach, the dissection starts from the fundus of the gallbladder to the infundibulum, with the aim of giving the operating surgeon an easier task in identifying the structures within Calot's triangle **(20)**.

Reference:

1. Gad, M. M., Ayoub, S., & El-Bahrawy, A. H. (2022). Predictive factors and intraoperative grading of difficult laparoscopic cholecystectomy: A prospective study. International Journal of Surgery Open, 44, 100493. https://doi.org/10.1016/j.ijso.2022.100493
2. Hamdani, A., Alzahrani, H., & Alharbi, M. (2021). Preoperative predictors of difficult laparoscopic cholecystectomy: A clinical-based scoring system. Cureus, 13(6), e15864. https://doi.org/10.7759/cureus.15864
3. Ali, S. M., Raza, M., & Qureshi, A. (2023). Bailout strategies in difficult laparoscopic cholecystectomy: A multicenter analysis. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques, 33(1), 41–46. https://doi.org/10.1097/SLE.0000000000001085
4. Agarwal D., Arora D., Avasthi A., Kothari A. & Dangayach K.K. (2016): Study of 292 patients for prediction of DLC using detailed history, clinical and radiological parameters. International Surgery Journal, 3(1):349-353.
5. Dziodzioa T., Weiss S., Sucher R., Pratschke J. & Biebl M. (2014). A 'critical view' on a classical pitfall in LC. International journal of surgery case reports, 5:1218–1221.
6. Di Buono, G., Romano, G., Galia, M., Amato, G., Maienza, E., Vernuccio, F., Bonventre, G., Leonardo, G., Buscemi, S., & Agrusa, A. (2021). Difficult laparoscopic cholecystectomy and preoperative predictive factors. Scientific reports, 11(1), 2559.
7. Lowndes B., Thiels C.A., D.O., Habermann E.B., Bingener J., Susan Hallbeck S. & Yu D. (2016). Impact of patient factors on operative duration during LC: evaluation from the National Surgical Quality Improvement Program database. The American Journal of Surgery,212(I2):289–296http://dx.doi.org/10.1016/j.amjsurg.2016. 01.024.
8. Morales-Maza, J., Rodríguez-Quintero, J. H., Santes, O., Aguilar-Frasco, J. L., Romero-Vélez, G., García-Ramos, E. S., Sánchez-Morales, G., León, P., Pastor-Sifuentes, F. U., Terán-Ellis, S. M. Y., Álvarez-Bautista, F., Clemente-Gutiérrez, U., & Mercado-Díaz, M. A. (2021). Conversion from laparoscopic to open cholecystectomy: Risk factor analysis based on clinical, laboratory, and ultrasound parameters. Revista de Gastroenterología de México (English Edition), 86(4), 363-369.
9. Karim, S. T., Chakravarti, S., Jain, A., Patel, G., & Dey, S. (2022). Difficult laparoscopic cholecystectomy predictors and its significance: our experience. Journal of West African College of Surgeons, 12(4), 56-63.
10. Kassem M.I., Elzeiny M.M., El-haddad H.M. & AbuNasr A.A. (2015). Dome down approach for difficult laparoscopic cholecystectomy. The Egyptian journal of surgery, 34:203–209.
11. Tay, W. M., Toh, Y. J., Shelat, V. G., Huey, C. W., Junnarkar, S. P., Woon, W., & Low, J. K. (2020). Subtotal cholecystectomy: early and long-term outcomes. Surgical endoscopy, 34, 4536-4542.
12. Özdemir, A., Karakaya, A., & Pergel, A. (2022). CONVERSION FROM LAPAROSCOPIC CHOLECYSTECTOMY TO OPEN SURGERY: REASONS AND POSSIBLE RISKS: A SINGLE CENTER EXPERIENCE. Journal of Experimental and Clinical Medicine, 39(3), 781-785.
13. Bhandari, T. R., Khan, S. A., & Jha, J. L. (2021). Prediction of difficult laparoscopic cholecystectomy: An observational study. Annals of Medicine and Surgery, 72, 103060.

14. Trehan, M., Mangotra, V., Singh, J., Singla, S., Gautam, S. S., & Garg, R. (2023). Evaluation of preoperative scoring system for predicting difficult laparoscopic cholecystectomy. International Journal of Applied and Basic Medical Research, 13(1), 10-15.
15. Gupta, N., Ranjan, G., Arora, M. P., Goswami, B., Chaudhary, P., Kapur, A., Kumar, R., & Chand, T. (2013). Validation of a scoring system to predict difficult laparoscopic cholecystectomy. *International Journal of Surgery*, *11*(9), 1002-1006.
16. Siddiqui, M. A., Rizvi, S. A. A., Sartaj, S., Ahmad, I., & Rizvi, S. W. A. (2017). A standardized ultrasound scoring system for preoperative prediction of difficult laparoscopic cholecystectomy. *Journal of medical ultrasound*, *25*(4), 227-231.
17. Carbotta, G., Panebianco, A., Laforgia, R., Pascazio, B., Balducci, G., Bianchi, F. P., Tafuri, S., & Palasciano, N. (2018). A new clinical-ultrasound score to predict difficult videolaparocholecystectomies: A prospective study. *Annals of medicine and surgery*, *35*, 59-63.
18. Randhawa, J. S., & Pujahari, A. K. (2009). Preoperative prediction of difficult lap chole: a scoring method. *Indian Journal of Surgery*, *71*, 198-201.
19. Nassar A, Hodson J, Ng H, et al (2020): "Predicting the difficult laparoscopic cholecystectomy: development and validation of a pre-operative risk score using an objective operative difficulty grading system". *Surgical endoscopy*, *34*, 4549-4561.
20. El Boghdady, M., Arang, H., & Ewalds-Kvist, B. M. (2022). Fundus-first laparoscopic cholecystectomy for complex gallbladders: A systematic review. Health Sciences Review, 2, 100014.