Open Partial or Subtotal Cholecystectomy: Techniques and Indications

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12.1 Introduction

Laparoscopic cholecystectomy is the gold standard for gallstone disease [1]. Technical skills and learning curve are very important to reduce the risk of complications during the surgical procedure [2]. The complication most feared by surgeons is iatrogenic bile duct injury (BDI) which is associated with significant morbidity and mortality [3].

To reduce this complication, various measures have been proposed during laparoscopy: the use of a laparoscope at 30° and avoidance of tenting [4]; the use of a "critical vision" approach [5]; and the "dome-down" LC [6]. All these procedures have permitted to reduce BDI from 0.5% in 1990 to 0.3% in 2009 [7]. However, when the surgeon is not sure that he can manage the integrity of the biliary tract, the conversion to open surgery remains mandatory, especially in cases of difficult cholecystectomy as for acute cholecystitis [8].

Even today conversion to open surgery is part of the laparoscopic cholecystectomy which is required for patient safety. The conversion rate is between 5% and 7%. The causes of conversion are severe inflammation (55.3%), adhesion (26.0%), bleeding (5.3%), probable choledocholithiasis (4.3%), and inability to continue (5.3%) [9].

In all these cases in which the structures of the Calot's triangle (cystic duct, cystic artery, common bile duct) cannot be identified in a safe manner, open subtotal cholecystectomy has proved to be a safe, simple, and definitive procedure [10].

A recent systematic review has shown that male patients, aged between 60 and 65 years, sclerotic gallbladder or wall thickness (4–5 mm), and acute cholecystitis are at most risks of surgical conversion [11].

12.2 History

In 1882, the open cholecystectomy technique was described [12]. This technique was considered the standard technique until 1987 when laparoscopic technique was reported for the first time [12].

Many changes were proposed after the first technical description for the management of the difficulties that may arise during both open and laparoscopic surgery. Those difficult conditions can be classified into five categories: adhesions with greater neovascularization, difficulty in treating the liver, inadequate exposure of the

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Calot's triangle, a high-risk gallbladder bed, and a high-risk hilum [13].

The first modified cholecystectomy was described by Hans Kehr in 1898 when he reported the case of a 27-year-old lady with acute cholecystitis who underwent surgery. He could not remove the hardened posterior wall of the gallbladder and its part close to the cystic duct because of the adhesions. So, he modified the traditional technique in order to avoid severe injuries. However, he also reported a severe postoperative bile fistula which required a further operation [14]. After the description of Kehr, several techniques have been described in order to manage difficult cases.

In 1938, Estes [15] advised performing a subtotal cholecystectomy when the level of inflammation was too high to make a clear identification of the cystic duct. A longitudinal incision was made along the gallbladder's wall up to 1–2 cm from the cystic duct, and the wall was swabbed with tincture of iodine. In this way, the removal of the impacted stones was possible. The redundant wall was trimmed, preserving the part attached to the liver bed. The cystic duct was not sutured, so there was no gallbladder remnant, and drains were placed [15].

In 1939, a technique was described which involved opening the gallbladder in the longitudinal direction, extraction of the stones, and the thermal ablation of both part of the wall of the gallbladder up to the sierosa which were sutured together to re-peritonealize the liver bed. This technique requires the suturing of the cystic duct and cystic artery as in total cholecystectomy [16].

In 1950, a variation of this technique was described. It contemplates the resection of the free wall of the gallbladder until the cystic duct. Since the cystic artery has to be sectioned at the inferior level of the gallbladder (within or on the wall of the gallbladder) near the cystic duct, it is recommended to suture the wall at the point to avoid vascular damages [17].

In 1954, McElmoyle [18] clearly illustrated his technique, underlying the difference with that one previously proposed by Pribram [19], Love [20], and Thorek [21]. In fact, these three authors advised to dissect and ligate artery and cystic duct

and leaving a part of the gallbladder attached to the liver bed. Conversely, McElmoyle suggested that when it was safe, the dissection of the artery and cystic duct should be performed and associated with complete removal of the gallbladder wall. Otherwise, in difficult cases, the isolation of the artery and cystic duct should not be attempted, especially when there was not a visible surgical field. Consequently, the portion of gallbladder's wall closer to the important ducts and vessels was left in order to protect them from unsafe surgical maneuvers [18]. At the end of the McElmoyle's procedure, the edge of the remaining wall was sutured to control the bleedings, the mucosa was treated with phenol or electric cautery, and drains were placed [18]. Similarly to McElmoyle, other authors have supported the idea that it is safer to not close the cystic duct in order to avoid risky manipulations of the area [22].

Alternatively, a safe method is the closure of the cystic duct from inside by a purse-string as suggested by Bornman and Terblanche [23]. They also advised introducing a probe into a cystic duct for easier identification and ligation. However, the probe could be wrongly advanced in the common bile duct, especially if the cystic duct is short, leading to its erroneous ligation [24].

The Tokyo Guidelines 2018 [25] have summarized the technique of subtotal cholecystectomy, referring to the paper of Strasberg et al. [24]. According to this chapter, after emptying the gallbladder and cystic duct from stones and, eventually, a cholangiography or intraoperative ultrasound done, the posterior wall of the gallbladder is usually left in situ and ablated [25]. The ablation of the mucosa should minimize the recurrence of gallstones [26]. If there is a risk of bile duct injury (BDI), intraoperative cholangiography, intraoperative ultrasound, intraoperative indocyanine green fluorescence imaging may be useful, but there is no unified consensus on their usefulness. It is also possible a partial or total excision of the posterior wall but gangrenous gallbladder should be removed mandatorily. Oversewing the cut edges with a continuous suture is not mandatory but it could be helpful where the cystic artery branches reach the gallbladder, even if they are often thrombosed

because of the inflammation. The suture from inside of the cystic duct is not compulsory but advisable. The number of drains depends on the degree of contamination. In the fenestrating subtotal cholecystectomy, the residual gallbladder lumen is open into the peritoneal cavity, while in the reconstituting one the lumen is closed with sutures or staplers [24].

12.3 Indication

Open conversion is required in 5–10% of cases with an increase in hospital days [38]. Between 0.2% and 1.1% of patients undergoing not converted laparoscopic difficult cholecystectomy reported bile duct lesions [27].

Open conversion is necessary in case of difficulty in identifying the bile duct, cystic duct, and cystic artery or in case of intraoperative complications (bile duct injury, hemorrhage, intestinal perforation, etc.).

In literature, several factors that can increase the possibility of converting into an open procedure are reported: age [28], male sex [29], obesity [30], cholecystitis [29], and ERCP [31].

The most common presentation of patients with acute cholecystitis is abdominal pain in the right hypochondrium, fever, and high white blood cells. The liver function tests can be normal.

During radiological examinations, it is possible to forecast the possibility to use the subtotal cholecystectomy technique. When the US or CT scan show a severe inflammation or complications as fluid collections or gas in the wall or the lumen of the gallbladder or free air in the peritoneum, an open technique with subtotal cholecystectomy can be necessary [10].

For this reason, many authors report scores to predict the possibility to convert to open surgery.

Sutcliffe et al. reporting CLOC score. This score is applicable before the laparoscopic surgery. Where a lower score ≤ 6 is a low risk, so patients can be treated by surgeons in the first phase of training. A higher score ≥ 6 is a high risk of conversion and the patient should be operated by experienced surgeons [32].

Sugrue et al. reported a 10-point intraoperative gallbladder scoring system (G10). The gallbladder surgery was considered easy if the G10 score < 2, moderate (2 ≤ 4), difficult (5 ≤ 7), and extreme (8 ≤ 10). Conversion occurred in 33% of patients with G10 scores of ≥ 5. Completely buried GB, impacted stone, bile or pus outside GB, and fistula represent the four factors statistically predictive of conversion [33].

In literature, two techniques are reported for open cholecystectomy in difficult gallbladder: partial cholecystectomy and subtotal cholecystectomy. The difference between partial and subtotal cholecystectomy is not well explained in the literature because many authors have used the term partial and subtotal in a personal way. Partial should mean the removal of part of an organ while the subtotal should mean the removal of almost all of an organ.

Some authors suggest using the term subtotal to indicate the extent of the resection. If it is removed only upper part can be used the term fundectomy and eliminated the term partial [24].

12.4 Technique

The open techniques to remove gall bladder are summarized in three categories: the first reports to leave the cystic duct closed with clips or inside the Hartmann's suture bag and leaving the posterior mucosa adherent to the liver; the second technique reports to leave the cystic duct and the Hartmann's bag left open and drained; the third technique contemplates leaving the cystic duct open and the Hartmann's bag closed with stapler or suture [34].

The technique for subtotal cholecystectomy used by the authors is the following: a small right subcostal transverse incision (max 12 cm) is performed under general anesthesia (Fig. 12.1). After the gallbladder is incised by electrocautery at the fundus, the bile or pus is aspirated (Fig. 12.2a, b) and the stones evacuated. Then the fundus of the gallbladder are resected, and the anterior wall is transected until 1 cm before the cystic orifice in order to visualize it (Fig. 12.3). At this moment,
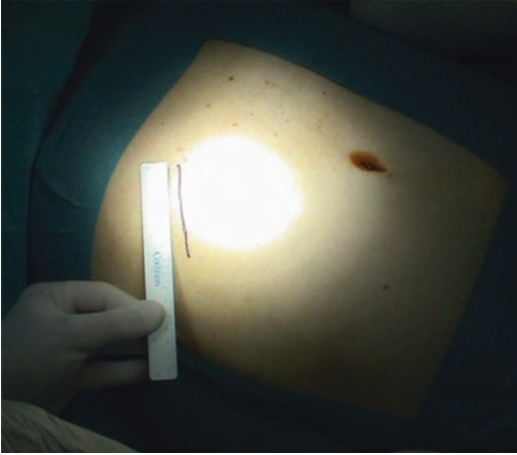
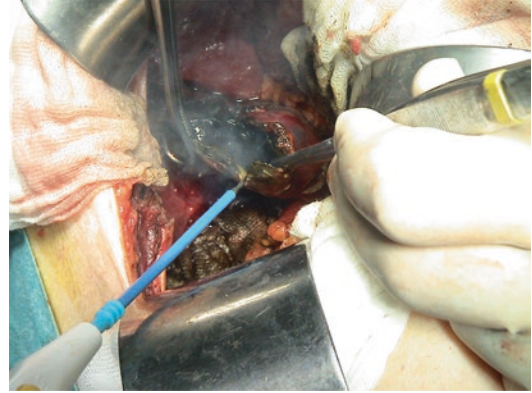Fig. 12.1 Skin incision up to 12 cm. (median incision is 8 cm)

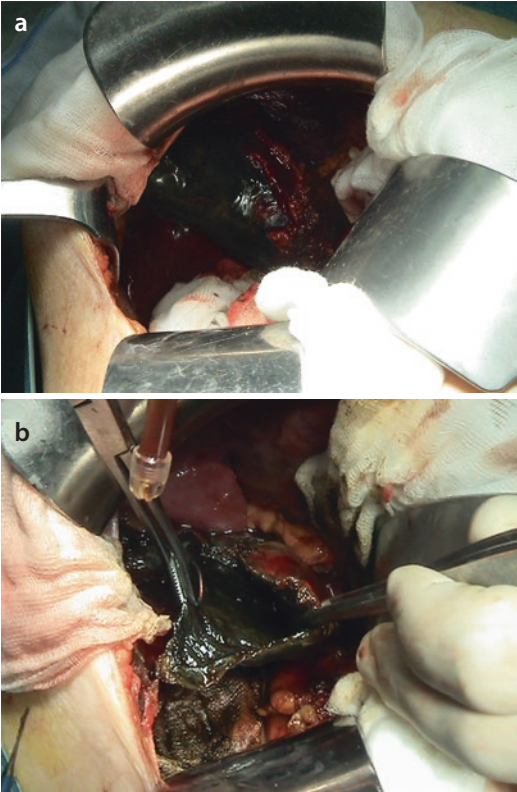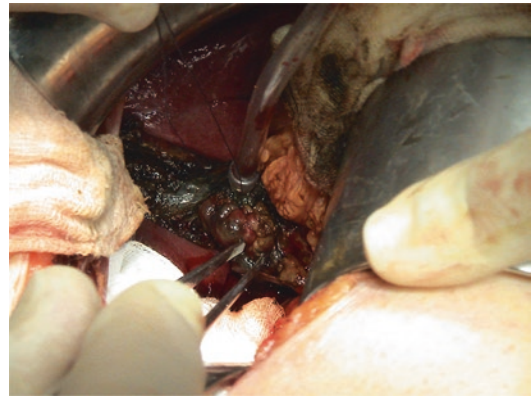Fig. 12.3 Resection of anterior wall until the cystic orifice

Fig. 12.4 Remaining infundibular anterior and posterior wall are sutured in order to safely avoid CBD lesion and to eliminate any residual cavity in the infundibulum

Fig. 12.2 (a) Intraoperative view of cholecystitis (b) The fundus is incised and resected, then the gallbladder is empty of all contest (bile, pus, stones)

the posterior wall is resected from the liver bed (also this, 1 cm before the cystic orifice). The remaining anterior and posterior infundibular tis-

sue is closed hermetically by double running suture in order to avoid bile leakage or, more important, the formation of a new cavity [10] (Fig. 12.4). A small drainage can be left in place depending from the intraoperative situation.

It is described by many authors how the anterior wall of the inferior infundibulum should be sutured to the posterior wall left adherent to the liver bed, but this difficult technique could create a new cavity and be the origin for stones recurrence. Furthermore, performing this suture, it is possible to damage the hepatic parenchyma causing bleeding.

When a high grade of inflammation is present, the limits between seromuscularis tissue and mucosa are hard to be individuated. For this rea-

son, in this case, it could be much cautious leaving in place the posterior wall of the gallbladder leaving open the cystic orifice.

Furthermore, the risk of a suture only with the mucosa can consequently create a subtle infundibulum wall that can be damaged by the traction practiced during the suture and causes necrotic degeneration or fistulas. This is why the technique of suturing the anterior wall to the posterior wall has to be practiced only when this last is separated from the liver bed, in order to create a stable structure with no risk of new biliary cavities [10].

12.5 Complications

During subtotal cholecystectomy, the dissection and ligation of the cystic duct is difficult, but needed, by some authors, to avoid a postoperative bile leakage [34].

Furthermore, patients undergoing subtotal cholecystectomy have a higher rate of biliary fistula, an overall increase in length of hospital stay with an additional cost due to ERCP, and biliary stenting. But debate is still open because the low incidence of biliary fistula and effective treatment with ERCP reduce morbidity and do not justify to exploration of the common bile duct or more difficult procedure to tie the cystic duct [35].

The use a 10 French endoprosthesis in the cystic duct stump to allow the complete closure of the persistent fistula in 6 weeks is reported in the literature, but is not commonly used [36].

Other authors show a technique in which a piece of omentum is plugged into the gallbladder stump to avoid bile leakage. This technique is used when it is not possible to close the cystic duct due to a difficult gallbladder [37]. Also, this technique is not commonly used.

The closure of the residual gallbladder (Hartmann's pocket) can be considered the safest method, but if not well performed it can cause the formation of the gallbladder residue which reduces the incidence of biliary fistula but in which the formation of the bile stones is possible [38]. In literature, there are no indications on the incidence of symptomatic residual gallbladder after subtotal or partial cholecystectomy because

there is no long follow-up, and the residual gallbladder can give clinical signs after many years of surgical treatment [38]. In the cases of the patients with residual gallbladder can be necessary a new surgical procedure to remove the residual gallbladder [24].

The advantages of subtotal cholecystectomy are the reduction of recurrent gallstone formation because all the gallbladder mucosa is eliminated and the necrotic parts of the gallbladder are removed, avoiding the formation of empyema [35].

The disadvantages of subtotal cholecystectomy reported in the literature are the increased incidence of infection and intra-abdominal injury [35], cystic stump syndrome (continuous discharge of mucus from the retained gallbladder mucosa), subphrenic collections, or persistent drainage from the drainage site [39].

References

1. Abdelrahim WE, Elsiddig KE, Wahab AA, et al. Subtotal laparoscopic cholecystectomy influences the rate of conversion in patients with difficult laparoscopic cholecystectomy: case series. Med Surg (Lond). 2017;19:19–22.
2. Halbert C, Pagkratis S, Yang J, et al. Beyond the learning curve: incidence of bile duct injuries following laparoscopic cholecystectomy normalize to open in the modern era. Surg Endosc. 2016;30:2239–43.
3. Fullum TM, Downing SR, Ortega G, et al. Is laparoscopy a risk factor for bile duct injury during cholecystectomy? JSLS. 2013;17:365–70.
4. Hunter JG. Avoidance of bile duct injury during laparoscopic cholecystectomy. Am J Surg. 1991;162:71–6.
5. Strasberg SM. Avoidance of biliary injury during laparoscopic cholecystectomy. J Hepato-Biliary-Pancreat Surg. 2002;9:543–7.
6. Kato K, Matsuda M, Onodera K, et al. Laparoscopic cholecystectomy from fundus downward. Surg Laparosc Endosc. 1994;4:373-4.
7. Hogan AM, Hoti E, Winter DC, et al. Quality of life after iatrogenic bile duct injury: a case control study. Ann Surg. 2009;249:292–5.
8. Buddingh KT, Hofker HS, ten Cate Hoedemaker HO, et al. Safety measures during cholecystectomy: results of a nationwide survey. World J Surg. 2011;35:1235–41.
9. Knight JS, Mercer SJ, Somers SS, et al. Timing of urgent laparoscopic cholecystectomy does not influence conversion rate. Br J Surg. 2004;91:601–4.
10. Di Carlo I, Pulvirenti E, Toro A, Corsale G. Modified subtotal cholecystectomy: results of a laparotomy

procedure during the laparoscopic era. World J Surg. 2009;33:520–5.

11. Philip Rothman J, Burcharth J, Pommergaard HC, et al. Preoperative risk factors for conversion of laparoscopic cholecystectomy to open surgery - a systematic review and meta-analysis of observational studies. Dig Surg. 2016;33:414–23.

12. Jenkins PJ, Paterson HM, Parks RW, et al. Open cholecystectomy in the laparoscopic era. Br J Surg. 2007;94:1382–5.

13. Palanivelu C, Rajan PS, Jani K, et al. Laparoscopic cholecystectomy in cirrhotic patients: the role of subtotal cholecystectomy and its variants. J Am Coll Surg. 2006;203:145–51.

14. Kehr H. Introduction to the differential diagnosis of the separate forms of gallstone diseases: based upon his own experience gained from 433 laparotomies for gallstones. Philadelphia: P Blakiston's Son and Co.; 1901.

15. Estes WL. Acute gangrenous cholecystitis and the use of partial cholecystectomy in its treatment. Am J Surg. 1938;40:197–204.

16. Pribram BO. Mukoklase und drainagelose Gallenchirurgie. Zentralbl Chir. 1928;55:773–9.

17. Lerner AI. Partial cholecystectomy. Can Med Assoc J. 1950;63:54–6.

18. McElmoyle WA. Cholecystectomy: a method for the difficult gall-bladder. Lancet. 1954;266:1320–3.

19. Pribram BO. The electrosurgical operation in gall-bladder diseases: results of 13 years' experience. Lancet. 1939;234:927e929.

20. Baily H, Love RJM. Electrosurgical obliteration of gallbladder without drainage: Thorek's operation. Br Med J. 1939;30:682e683.

21. Thorek M. Electrosurgical obliteration of gallbladder without drainage: a means of reducing mortality. Am J Surg. 1936;32:417e434.

22. Philips JA, Lawes DA, Cook AJ, et al. The use of laparoscopic subtotal cholecystectomy for complicated cholelithiasis. Surg Endosc. 2008;22:1697–700.

23. Bornman PC, Terblanche J. Subtotal cholecystectomy: for the difficult gallbladder in portal hypertension and cholecystitis. Surgery. 1985;98:1–6.

24. Strasberg SM, Pucci MJ, Brunt LM, Deziel DJ. Subtotal cholecystectomy-"Fenestrating" vs "Reconstituting" subtypes and the prevention of bile duct injury: definition of the optimal procedure in difficult operative conditions. J Am Coll Surg. 2016;222:89–96.

25. Wakabayashi G, Iwashita Y, Hibi T, et al. Tokyo Guidelines 2018: surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos). J Hepatobiliary Pancreat Sci. 2018;25:73–86.

26. Kuwabara J, Watanabe Y, Kameoka K, et al. Usefulness of laparoscopic subtotal cholecystectomy with operative cholangiography for severe cholecystitis. Surg Today. 2014;44:462–5.

27. Navez B, Ungureanu F, Michiels M, et al. Surgical management of acute cholecystitis: results of a 2-year prospective multicenter survey in Belgium. Surg Endosc. 2012;26:2436–45.

28. Ballal M, David G, Willmott S, et al. Conversion after laparoscopic cholecystectomy in England. Surg Endosc. 2009;23:2338–44.

29. Lipman JM, Claridge JA, Haridas M, et al. Preoperative findings predict conversion from laparoscopic to open cholecystectomy. Surgery. 2007;142:556–63.

30. Goonawardena J, Gunnarsson R, de Costa A, et al. Predicting conversion from laparoscopic to open cholecystectomy presented as a probability nomogram based on preoperative patient risk factors. Am J Surg. 2015;210:492–500.

31. Reinders JS, Gouma DJ, Heisterkamp J, et al. Laparoscopic cholecystectomy is more difficult after a previous endoscopic retrograde cholangiography. HPB (Oxford). 2013;15:230–4.

32. Sutcliffe RP, Hollyman M, Hodson J, et al. Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a validated risk score derived from a prospective U.K. database of 8820 patients. HPB (Oxford). 2016;18:922–8.

33. Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy- a new scoring system. World J Emerg Surg. 2015;10:14.

34. Hirajima S, Koh T, Sakai T, et al. Utility of laparoscopic subtotal cholecystectomy with or without cystic duct ligation for severe cholecystitis. Am Surg. 2017;83:1209–13.

35. Davis B, Castaneda G, Lopez J. Subtotal cholecystectomy versus total cholecystectomy in complicated cholecystitis. Am Surg. 2012;78:814–7.

36. Gholson CF, Dungan C, Neff G, et al. Suspected biliary complications after laparoscopic and open cholecystectomy leading to endoscopic cholangiography: a retrospective comparison. Dig Dis Sci. 1998;43:534–9.

37. Matsui Y, Hirooka S, Kotsuka M, et al. Use of a piece of free omentum to prevent bile leakage after subtotal cholecystectomy. Surgery. 2018;164:419–23.

38. Elshaer M, Gravante G, Thomas K, et al. (2015) subtotal cholecystectomy for "difficult gallbladders": systematic review and meta-analysis. JAMA Surg. 2015;150(2):159–68. https://doi.org/10.1001/jamasurg.2014.1219.

39. Sharp CF, Garza RZ, Mangram AJ, Dunn EL. Partial cholecystectomy in the setting of severe inflammation is an acceptable consideration with few long-term sequelae. Am Surg. 2009;75:249–52.