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Medicine

MINIMALLY INVASIVE TREATMENT OF COMMON BILE DUCT LITHIASIS. A LITERATURE REVIEW

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ABSTRACT:
COMMON BILE DUCT LITHIASIS IS A FREQUENT FINDING IN PATIENTS UNDERGOING CHOLECYSTECTOMY FOR SYMPTOMATIC GALLBLADDER STONES. CURRENTLY IT IS ADDRESSED EITHER BY EITHER SINGLE-STAGE LAPAROSCOPIC EXPLORATION OF THE COMMON BILE DUCT AND CHOLECYSTECTOMY, EITHER BY THE TWO-STAGE ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY AND STONE EXTRACTION FOLLOWED BY CHOLECYSTECTOMY. THE RESULTS ARE SIMILAR FOR BOTH METHODS WHEN CONSIDERING COMMON BILE DUCT CLEARANCE RATE, OPERATIVE TIME, LENGTH OF HOSPITAL STAY, COMPLICATION RATE AND RECURRENCE RATE. LOCAL AVAILABILITY AND EXPERIENCE OF THE OPERATING TEAM SHOULD BE CONSIDERED WHEN CHOOSING BETWEEN THE TWO METHODS.

KEYWORDS: COMMON BILE DUCT (CBD) LITHIASIS, ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY (ERCP), LAPAROSCOPIC COMMON BILE DUCT EXPLORATION (LCBDE).

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INTRODUCTION

Common bile duct (CBD) lithiasis is a relatively frequent finding during the surgical treatment of the symptomatic gallbladder lithiasis; reported incidence ranges from 5% to 20% in the treated cases[8,9]. The diagnosis of CBD lithiasis requires the exploration of CBD in order to treat the disease. Open surgical exploration was initially replaced by endoscopic exploration via the endoscopic retrograde cholangiopancreatography (ERCP) performed either before or after the cholecystectomy, giving a two-stage approach of the pathology; over the past years, the development of laparoscopic techniques led to a new one stage approach, by the laparoscopic common bile duct exploration (LCBDE). Currently, the open surgical exploration of the CBD is used only in case of failure of the minimally invasive approach[10]. However, there is no current consensus regarding the optimal method – endoscopic or laparoscopic – to treat lithiasis of the main biliary tract associated with gallbladder lithiasis[11].

OBJECTIVES

The goal of the current paper is a review of the literature data comparing the endoscopic and laparoscopic exploration of the CBD in order to treat CBD lithiasis, comparing success rate, duration of the procedure, associated morbidity and mortality, length of the hospital stay and cost efficiency.

MATERIALS AND METHODS

We reviewed papers showing the results obtained by using the endoscopic or laparoscopic exploration of the CBD and comparative studies between the results of the two methods, published between 2013 and 2019 and indexed in Pubmed.

RESULTS

The endoscopic exploration of CBD is done by endoscopic retrograde cholangiography. This can be performed prior to the cholecystectomy or at the time of the cholecystectomy – the "rendez-vous"[12] technique (when preoperative investigations suggest the association of the CBD lithiasis), as well as following the cholecystectomy (when intraoperative findings such as a dilated cystic duct or the lithiasis of the cystic duct suggest the association of CBD lithiasis or in case of the CBD stones diagnosed after the cholecystectomy is performed).

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[8] Tan C et al, *Comparison of one stage laparoscopic cholecystectomy combined with intra-operative endoscopic sphincterotomy versus two-stage pre-operative endoscopic sphincterotomy followed by laparoscopic cholecystectomy for the management of pre-operatively diagnosed patients with common bile duct stones: a meta-analysis.* Surgical Endoscopy. 2018;32(2):770-778

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[10] Xiaohong Wang,et al ,*Endoscopic retrograde cholangiopancreatography versus laparoscopic exploration for common bile duct stones in post-cholecystectomy patients: a retrospective study*. Oncotarget. 2017; 8(47): 82114–82122.

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Laparoscopic options in CBD exploration include intraoperative laparoscopic transcystic cholangiography[13], laparoscopic transcystic exploration and exploration by laparoscopic choledochotomy. The intraoperative laparoscopic transcystic cholangiography is useful when preoperative investigations suggest the existence of CBD lithiasis but no ERCP is performed prior to surgery, or in the above-mentioned situations when intraoperative findings suggest CBD lithiasis; if CBD stones are found they can be extracted in the same operative session via laparoscopy or later on via ERCP. The laparoscopic transcystic exploration and the exploration via laparoscopic choledochotomy followed by primary closure or T-tube drainage can be used in both situations – when CBD lithiasis is diagnosed before surgery (via ultrasound, CT scan or MRI scan) or it is diagnosed during surgery (via intraoperative cholangiography or ultrasound).

The endoscopic treatment of the CBD lithiasis usually requires a two-stage approach – either initial endoscopic cholangiography, sphincterotomy and extraction of stones, followed by laparoscopic cholecystectomy in the following days[14] for the stones diagnosed prior to surgery, either laparoscopic cholecystectomy followed by ERCP if the postoperative evolution of the patient and subsequent investigations point to retained CBD stones (both symptomatic or asymptomatic)[15].

Performing the ERCP prior to surgery has - at least theoretically – the advantage of providing the surgeon with the comfort of a standard laparoscopic cholecystectomy, as well as with useful information about the anatomy of the CBD, thus decreasing the risk of a lesion of the CBD at the time of the surgery. The disadvantages of this method are the requirement for two separate procedures, the eventuality of stones migrating to the CBD in the timeframe between the ERCP and the cholecystectomy, as well as the possible complications directly related to the endoscopic procedure (post-procedural bleeding following the sphincterotomy, perforation of the duodenum, acute pancreatitis or cholangitis)[16].

The single-step approach using the "rendez-vous" technique keeps the advantages and disadvantages of the preoperative endoscopic approach, decreases the risk of stone migration following the endoscopic sequence, but can create intraoperative difficulties in case of excessive inflation of the digestive tract during the endoscopic sequence[17, 18].

Postoperative endoscopic retrograde cholangiography following laparoscopic cholecystectomy becomes mandatory when retained CBD stones become symptomatic. There is no current consensus regarding the management of asymptomatic retained CBD stones; there are recommendations for active treatment (British Society of Gastroenterology – 2008), as well

[13] Abdelaal A et al, *Role of intraoperative cholangiography for detecting residual stones after biliary pancreatitis: still useful? A retrospective study*. World Journal of Emergency Surgery. 2017;12:18.
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[17] ElGeidie AA *Single-session minimally invasive management of common bile duct stones*. World Journal of Gastroenterology. 2014; 20(41): 15144–15152.
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as recommendations to watch and wait, especially in elderly persons (European Society for Endoscopic Surgery – 2006)[19].

The surgical laparoscopic management of CBD lithiasis has the advantage of requiring a single therapeutic procedure, and it eliminates the risk of post-procedural acute pancreatitis and post-sphincterotomy bleeding associated to the endoscopic techniques. The main disadvantages of this method are the risk of developing a postoperative biliary fistula (reported incidence ranging between 3.3% and 12.5%, depending on the operative technique[20]), as well as being a difficult technique requiring a relatively long learning curve[21,22]. The most frequently used methods to laparoscopically explore the CBD are via transcystic exploration or via laparoscopic choledochotomy. Alternative laparoscopic methods described are cholangioscopy through the left hepatic duct orifice[23] and exploration through an incision of the cystic duct extended to the choledoc[24]. Stone extraction can pe performed under radiologic guidance using a Dormia-type basket or a Fogarty-type balloon catheter, or under direct visualization using intraoperative choledochoscopy. Large stones can be extracted by intraoperative lithotripsy and fragment retrieval[25,26]. The choledochotomy can be followed by primary closure via choledochoraphy, or by the insertion of a T-tube. These maneuvers can also be performed by robotic surgery, but high financial expense and similar results to the laparoscopic techniques do not support this alternative[27,28]

Table 1. Comparison between CBD clearance rates for laparoscopic common bile duct exploration vs. endoscopic retrograde cholangiopancreatography/ sphincterotomy.

Author (Year)	Laparoscopic common bile duct exploration		Endoscopic retrograde cholangiopancreatography/ sphincterotomy	
	Number of patients	CBD clearance rate	Number of patients	CBD clearance rate

[19]Costi R et al, *Diagnosis and management of choledocholithiasis in the golden age of imaging, endoscopy and laparoscopy*. World Journal of Gastroenterology. 2014; 20(37): 13382–13401.

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[28] Almamar A et al, *Cost analysis of robot-assisted choledochotomy and common bile duct exploration as an option for complex choledocholithiasis*. Surgical Endoscopy. 2018;32(3):1223-1227

Gantois D (2019)[29]	40	92.5%	42	73.8%
Pan L (2018)[30]	872	94.1%	885	90.1%
Sgourakis G (2012)[31]	101	88.1%	116	85.4%
Tantau M (2013)[32]	n/a	n/a	2986	97.7%
Wang X (2017)[33]	54	87.0%	87	97.7%
Al-Temimi MH (2017)[34]	105	88.6%	195	98.0%
Ying-chao G (2017)[35]	856	88.6%	807	87.1%
Mohamed MA (2015)[36]	75	94.7%	75	97.0%
Chan DS (2014)[37]	215	96.0%	n/a	n/a
Ding G (2014)[38]	110	93.6%	110	94.6%
Bansal VK (2014)[39]	84	91.7%	84	88.1%
Koc B (2013)[40]	60	96.5%	60	94.4%

[29] Gantois D et al, *One-stage laparoscopic procedure versus two-stage procedure in the management of common bile duct stones in patients aged 75 and more.* Journal of Visceral Surgery. 2019; pii: S1878-7886(19)30132-8
[30] Pan L et al, *The Safety and Efficacy of Laparoscopic Common Bile Duct Exploration Combined with Cholecystectomy for the Management of Cholecysto-choledocholithiasis: An Up-to-date Meta-analysis*. Annals of Surgery. 2018;268(2):247-253.
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[40] Koc B et al, *Comparison of laparoscopic common bile duct exploration and endoscopic retrograde cholangiopancreatography plus laparoscopic cholecystectomy for choledocholithiasis: a prospective randomized study.* American Journal of Surgery. 2013;206(4):457-63

The CBD clearance rate ranges from 87.0% to 96.5% for laparoscopic common bile duct exploration, respectively from 85.4% to 98.0% for endoscopic retrograde cholangiopancreatography/ sphincterotomy (the much lower clearance rate of 73.8% communicated by Gantois D. from a series of elderly patients – over 75 years – may be related to age-related comorbidities)[41].

Table 2. Average operative time (minutes) for laparoscopic common bile duct exploration, respectively endoscopic retrograde cholangiopancreatography/ sphincterotomy.

Author (Year)	Laparoscopic common bile duct exploration +cholecystectomy	Endoscopic retrograde cholangiopancreatography/sphincterotomy + cholecystectomy
Pan L (2018)[42]	112.28	132.03
Ying-chao G (2017)[43]	119.5	129.0
Bansal VK (2014)[44]	135.7	72.4

When considering larger patient series, such as the ones communicated by Pan L. and Ying-chao G., the operative time is similar for both methods. For smaller series (Bansal VK), in which the procedures may have been performed only by one operator, the difference may be due to the personal skills and experience of the operator.[45] Of note, in case of treating CBD stones in patients with previous cholecystectomy (Wang X, 2017), the average operating time is significantly lower for the endoscopic procedure compared to laparoscopic one (52.0 minutes vs. 102.9 minutes).[46]

[41] Gantois D et al, *One-stage laparoscopic procedure versus two-stage procedure in the management of common bile duct stones in patients aged 75 and more.* Journal of Visceral Surgery. 2019; pii: S1878-7886(19)30132-8

[42] Pan L et al, *The Safety and Efficacy of Laparoscopic Common Bile Duct Exploration Combined with Cholecystectomy for the Management of Cholecysto-choledocholithiasis: An Up-to-date Meta-analysis.* Annals of Surgery. 2018;268(2):247-253.

[43] Gao YC et al, *Efficacy and safety of laparoscopic bile duct exploration versus endoscopic sphincterotomy for concomitant gallstones and common bile duct stones. A meta-analysis of randomized controlled trials*. Medicine (Baltimore). 2017; 96(37): e7925.

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[46] Wang X et al, *Endoscopic retrograde cholangiopancreatography versus laparoscopic exploration for common bile duct stones in post-cholecystectomy patients: a retrospective study*. Oncotarget. 2017;8(47):82114-82122.

Table 3. Average length of hospital stay (days) for laparoscopic common bile duct exploration, respectively endoscopic retrograde cholangiopancreatography/ sphincterotomy.

Author (Year)	Laparoscopic common bile duct exploration +cholecystectomy	Endoscopic retrograde cholangiopancreatography/ sphincterotomy + cholecystectomy
Pan L (2018)[47]	4.94	6.62
Wang X (2017)[48]	5.9	5.5
Ying-chao G (2017)[49]	4.13	5.11
Bansal VK (2014)[50]	4.6	5.3

There are no significant differences in average length of hospital stay between the two methods, in both large and small patient series. However, it is possible that the length of hospital stay may be influenced by local conditions regarding postoperative follow-up, and it may increase in areas where primary care medical services are not involved in the postoperative care.

Table 4. Postoperative complications rate for laparoscopic common bile duct exploration, respectively endoscopic retrograde cholangiopancreatography/ sphincterotomy.

Author (Year)	Laparoscopic common bile duct exploration +cholecystectomy	Endoscopic retrograde cholangiopancreatography/ sphincterotomy + cholecystectomy
Pan L (2018)[51]	7.6%	12.0%
Sgourakis G (2012)[52]	8.0%	11.2%
Wang X (2017)[53]	11.1%	3.4%

[47] Pan L et al, *The Safety and Efficacy of Laparoscopic Common Bile Duct Exploration Combined with Cholecystectomy for the Management of Cholecysto-choledocholithiasis: An Up-to-date Meta-analysis*. Annals of Surgery. 2018;268(2):247-253.
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[49] Gao YC et al, *Efficacy and safety of laparoscopic bile duct exploration versus endoscopic sphincterotomy for concomitant gallstones and common bile duct stones. A meta-analysis of randomized controlled trials*. Medicine (Baltimore). 2017; 96(37): e7925.
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[51] Pan L et al, *The Safety and Efficacy of Laparoscopic Common Bile Duct Exploration Combined with Cholecystectomy for the Management of Cholecysto-choledocholithiasis: An Up-to-date Meta-analysis*. Annals of Surgery. 2018;268(2):247-253.
[52] Sgourakis G et al, *Laparoscopic versus endoscopic primary management of choledocholithiasis. A retrospective case-control study*. Der Chirurg; 2012;83(10):897-903
[53] Wang X et al, *Endoscopic retrograde cholangiopancreatography versus laparoscopic exploration for common bile duct stones in post-cholecystectomy patients: a retrospective study*. Oncotarget. 2017;8(47):82114-82122.

Ying-chao G (2017)[54]	10.2%	9.1%
Ding G (2014)[55]	3.6%	5.1%
Koc B (2013)[56]	7.0%	11.1%

The rate of postoperative complications is similar between the two methods and it varies from 3.6% to 11.1% for laparoscopic exploration of CBD, respectively from 3.4% to 12% for endoscopic retrograde cholangiopancreatography/sphincterotomy. The mortality rate is approximatively 1% for both instances.

Table 5. Lithiasis recurrence rate following laparoscopic common bile duct exploration vs. endoscopic retrograde cholangiopancreatography/ sphincterotomy.

Author (Year)	Laparoscopic common bile duct exploration +cholecystectomy	Endoscopic retrograde cholangiopancreatography/ sphincterotomy + cholecystectomy
Pan L (2018)[57]	1.8%	5.6%
Tantau M (2013)[58]	n/a	4.3%
Wang X (2017)[59]	7.4%	6.9%
Ding G (2014)[60]	2.1%	9.5%

Recurrence rate appears to be higher, although not significantly, in patients treated by endoscopic retrograde cholangiopancreatography/sphincterotomy and cholecystectomy. Higher recurrence rates usually occur in patients having multiple CBD stones.

[54] Gao YC et al, *Efficacy and safety of laparoscopic bile duct exploration versus endoscopic sphincterotomy for concomitant gallstones and common bile duct stones. A meta-analysis of randomized controlled trials*. Medicine (Baltimore). 2017; 96(37): e7925.
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DISCUSSION

There is no significant difference between the results of the two methods.

The success rate for treating CBD lithiasis is 85.4 - 98.0% for the endoscopic procedure, compared to 87.0 - 96.5% for the laparoscopic one. The rate of CBD clearance is usually lower for patients presenting with multiple CBD stones. It is also influenced by the experience of the operator performing the procedure.

The operative time for the procedure averages around 120 minutes for both laparoscopic and endoscopic techniques. This may also vary depending of the experience of the operator, considering that the laparoscopic exploration of the CBD requires undergoing a long learning curve.

The cost of the treatment is similar for both procedures. According to Wang X, it amounts to 3787.1 ± 1061.5 USD for patients treated by ERCP, respectively to 3983.54 ±1 257.1 USD for patients treated by CBD laparoscopic exploration.[61]

The length of hospital stay (5 +/- 2 days) are also similar in both situations.

The complication rate for the endoscopic procedure is 3.4 -12.0%, compared to 3.5 – 11.1% for the laparoscopic procedure. It is significantly higher in elderly patients, due to associated comorbidities. Emergency procedures also have a higher complication rate.

Recurrence of CBD stones is documented in 4.3 – 9.5% in patients treated endoscopically, respectively 2.1 – 7.4 in patients treated laparoscopically. Higher recurrence rates occur in patients presenting initially with multiple CBD stones. Average time between the initial procedure and the diagnosis of the recurrence is around 12 months.

CONCLUSION

Literature data analysis suggest similar results for both endoscopic and laparoscopic treatment of CBD lithiasis. In choosing one of these techniques, local factors, like availability of the required equipment and experience of the operating team should be considered.

[61] Wang X et al, *Endoscopic retrograde cholangiopancreatography versus laparoscopic exploration for common bile duct stones in post-cholecystectomy patients: a retrospective study*. Oncotarget. 2017;8(47):82114-82122.

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