

INTRODUCTION:

There are three ways to remove stones one at a time during laparoscopic cholecystectomy with transoperative cholangiography and laparoscopic bile duct exploration if necessary. In two stages with previous ERCP and later laparoscopic cholecystectomy or vice versa. And the current trend that has shown greater efficacy and safety is to perform transoperative cholangiography and trans operative ERCP in a single time for choledocholithiasis.

The recommendation in most of the guidelines is to perform preoperative ERCP. However, when ERCP fails due to choledocholithiasis, there are several ways such as: stent placement and repeat ERCP.(1)

There are advanced methods for the removal of difficult stones by endoscopy such as mechanical lithotripsy, cholangioscopy-assisted lithotripsy or extracorporeal lithotripsy. However, these methods can carry complications. Also in several hospitals these technologies are not available.

Both open and laparoscopic bile duct exploration remains a treatment in the case of difficult stones in many centers. Knowing the moment in which to perform surgical extraction in some centers that do not have advanced technology is important to offer optimal treatment. A study conducted in the United States presented at SAGES 2015 surveyed 32932 surgeons on the management of choledocholithiasis. 46% of surgeons had never done a laparoscopic bile duct examination and 30% had never done an open one.

METHODS:

A 5-year review of patients undergoing ERCP, open or laparoscopic bile duct exploration for choledocholithiasis was analyzed. The characteristics and factors (>65 years, female sex, bilirubin >4mg/dl, CBD ≥10mm, Stone ≥10mm, ≥2 stones and previous cholecystectomy) associated to more than 1 ERCP and surgery were registered. A calculation of risk using contingency tables and chi square was done.

RESULTS:

We found 72 cases with diagnosis of cholecocholithiasis, 49.3% were diagnosed with MRCP and 46.5% had previous cholecystectomy. In 35.20% of the 1st ERCPs a stent was placed because of residual stone. In subsequent ERCPs the CBD size, stone size and number of stones increased. Women and patients ≥65 years were at higher risk of CBDE. While BT ≥4mg/dl, CBD ≥10 mm, and ≥2 stones have an associated risk to require ≥1 ERCP and CBDE. Patients who did not undergo prior ERCP all arrived with severe acute cholangitis. Ten cases required CBDE, only 60% underwent preoperative ERCP and 20% were performed laparoscopic. The most frequent complication was biliary leak in 20%, only 10% had residual choledocholithiasis after surgery and 40% had a T-tube placed. The average ERCPs performed prior to surgery was 3 attempts with stent placement in all cases.

Patients Characteristics			
Female: 52.1% Male: 47.9%			
Age (mean [SD], y) (range)	66.41	18.664	(19-91)
Bilirubin (mean [SD], mg/dl) (range)	4.39	4.102	(0-23)
ALP (mean [SD], U/L) (range)	323.69	303.506	(60-2011)
GGT (mean [SD], U/L) (range)	597.92	399.043	(93-1256)
ALT (mean [SD], U/L) (range)	182.96	244.316	(10-1338)
AST (mean [SD], U/L) (range)	280.98	842.449	(12-6930)
CBD on US (mean [SD], mm) (range)	10.7 mm	9.868	(2-84)
MRCP	Non 40.8%	(+) 49.3%	(-) 4.2%
Time ERCP cholecystectomy	Preop: 43.7%	Postop: 46.5%	
number ERCP (mean [SD]) (range)	1.48	0.843	(0-4)
CBDE	22.50%		
ALP: Alkaline phosphatase. ALT: Alanine aminotransferase. AST: Aspartate aminotransferase. GGT: Gamma glutamyl transferase. CBD: common bile duct. US: ultrasound. MRCP: magnetic resonance cholangiopancreatography. ERCP: endoscopic retrograde cholangiopancreatography. CBDE: common bile duct exploration. SD: Standard Deviation.			

ERCP Charachteristics				
	1st ERCP	2nd ERCP	3d ERCP	4th ERCP
Choledocholitiasis n (%)	73.50%	81.50%	90.90%	100%
Cholangitis n (%)	26.50%	18.50%	9.10%	0
Diverticula n (%)	17.60%			
Cannulation attempt n (mean)	1.44	1.19	1	1
PDC n (%)	14.10%	7.40%	0	0
Stone number n (mean)	1.66	1.11	2.18	1
Stone size (mean mm)	8.79	8.15	11.8	10
Choledochal size (mean mm)	9.88	10	13.18	20
Pre-cut n (%)	11.80%	3.70%	1.40%	0.00%
EST n (%)	91.20%	40.70%	54.50%	0.00%
EPLBD n (%)	11.30%	18.50%	45.50%	0.00%
Balloon catheter n (%)	86.80%	88.90%	81.80%	100.00%
Dormia basket n (%)	30.90%	29.60%	27.30%	0.00%
ML n (%)	0.00%	0.00%	0.00%	0.00%
Stent n (%)	35.20%	33.30%	45.50%	100.00%
Hospital stay (mean days)	4.65	2.78	2.64	1
Amylase	183.22	133.11	185.82	84
Hyperamylasemia n (%)	40.90%	44.40%	36.40%	0.00%
Perforation n (%)	1.40%	0%	0%	0.00%
Dead n (%)	1.40%	0%	1.40%	0.00%
PEP n (%)	7%	7.40%	0%	0.00%
PDC: pancreatic duct cannulation, EST: endoscopic sphincterotomy, EPLBD: endoscopic papillary balloon dilation, ML: mechanical lithotripsy, PEP: post-ERCP pancreatitis,				

Contributing factors for >1 ERCP and CBDE		
	>1 ERCP OR (CI)	CBDE OR (CI)
Age≥65 years	0.879 (0.324-2.389)	1.467 (0.448-4.806)
Female sex	0.362 (0.132-0.992)	1.24 (0.404-3.801)
Bilirubin ≥4 (mg/L)	0.727 (0.271-1.952)	0.933 (0.304-2.864)
Prev cholecystectom	2.614 (0.94-7.272)	1.562 (0.441-5.526)
CBD ≥10mm	1.681 (0.579-4.881)	2.059 (0.508-8.351)
Stone ≥10 mm	1.956 (0.661-5.789)	1.486 (0.397-5.555)
Multiple stones ≥2	0.933 (0.307-2.841)	0.782 (0.2-3.057)
OR:Odds ratio, CI:Confidence Interval, ERCP: endoscopic retrograde cholangiopancreatography, CBDE: common bile duct exploration.		

DISCUSION:

In the absence of advanced technology, it is common to place a stent and undergo a new ERCP in difficult stone cases or failed cases due to difficult stones. A stent was placed in 35.30% of the patients in this study. There are factors studied for the risk of difficult stones such as stones ≥10-20mm, stone shape, bile duct angle and other factors.^{2,5,16,19} In this study only female and ≥65 years patients had risk for CBDE. While bilirubin ≥4mg/dl, CBD ≥10 mm, and ≥2 stones were associated for requiring more than 1 ERCP and/or CBDE. These results are not statistically significant. However, the difference in the confidence interval guides the trend of these results. More case studies are needed to determine significance. Despite this, only 10 patients underwent surgery. The average of previous ERCPs was 3. Only 31.3% was performed laparoscopically. 50% of the patients had a T-tube placed, reflecting the heterogeneity in the knowledge of CBDE.

CONCLUSION:

There are risk factors associated with difficult stones or failed ERCP due to difficult stones. Determining the risk can change the time when the patient needs a CBDE or can go to recurrent ERCP with stent. It is necessary to study these factors in larger studies as well as the impact and benefit of stents on ≥2 ERCPs with difficult stones.

REFERENCES:

1. Zhang WJ, Xu GF, Huang Q, Luo XL, Dong ZT, Li JM, et al. Treatment of gallbladder stone with common bile duct stones in the laparoscopic era Visceral and general surgery. BMC Surg. 2015;15(1):1-6. 2. Gad EH, Zakaria H, Kamel Y, Alshabary A, Zakeeraya T, Abbas M, et al. Surgical (Open and laparoscopic) management of large difficult CBD stones after repeated sessions of endoscopic failure: A retrospective cohort study. Ann Med Surg. 2019;43(Febuary):62-63. 3. Verbeke J, Birkett DH. Common bile Duct Exploration for Choledocholithiasis. Surg Clin North Am [Internet]. 2008;88(6):1315-28. Available from: <http://dx.doi.org/10.1016/j.suc.2008.08.0024>. 4. Doshi B, Yasuda I, Ryzawa S, Lee GH. Current endoscopic strategies for managing large bile duct stones. Dig Endosc. 2018;30:59-66. 5. Manes G, Paspartis G, Aabakken L, Anderloni A, Arvanitakis M, Ah-Soune P, et al. Endoscopic management of common bile duct stones: European Society of Gastrointestinal Endoscopy (ESGE) guideline. Endoscopy. 2019;51(5):472-91. 6. Maple JT, Ben-Menachem T, Anderson MA, Appalaneni V, Banerjee S, Cash BD, et al. The role of endoscopy in the evaluation of suspected choledocholithiasis. Gastrointest Endosc. 2010;71(1):1-9. 7. Hartarson JH, Hannesson P, Sverrisson I, Blöndal S, Varsosson E, Björnsson ES. The value of magnetic resonance cholangiopancreatography for the exclusion of choledocholithiasis. Scand J Gastroenterol. 2016;51(10):1249-56. 8. Ricci C, Pagano N, Taffurelli G, Fracito CA, Migliori M, Balzoli F, et al. Comparison of efficacy and safety of 4 combinations of laparoscopic and intraoperative techniques for management of gallstone disease with biliary duct calculi: a systematic review and network meta-analysis. JAMA Surg. 2018;153(7):1-8. 9. Zhou Y, Wu XD, Fan RG, Zhou GJ, Mu XM, Zha WZ, et al. Laparoscopic common bile duct exploration and primary closure of choledocholithiasis after failed endoscopic sphincterotomy. Int J Surg [Internet]. 2014;12(7):645-8. Available from: <http://dx.doi.org/10.1016/j.jsu.2014.05.05910>. 10. Park CH, Jung JH, Nam E, Kim EH, Kim MG, Kim JH, et al. Comparative efficacy of various endoscopic techniques for the treatment of common bile duct stones: a network meta-analysis. Gastrointest Endosc. 2016;87(1):43-57. 11. Williams E, Beckingham I, El Sayed G, Gurusamy K, Sargess F, Walster G, et al. Updated guideline on the management of common bile duct stones (CBDS). Gut. 2017;66(5):765-82. 12. Lee DK, Sahng JH. Alternative methods in the endoscopic management of difficult common bile duct stones. Dig Endosc. 2010;22(SUPPL 1):78-84. 13. Gang PK, Tandon RK, Ahuja V, Maheshwari GK, Bhatia Y. Predictors of unsuccessful mechanical lithotripsy and endoscopic clearance of large bile duct stones. Gastrointest Endosc. 2004;59(6):601-5. 14. Brown NG, Camillo J, Nordstrom E, Yen RD, Fukami N, Brauer BC, et al. Advanced ERCP techniques for the extraction of complex biliary stones: a single referral center's 12-year experience. Scand J Gastroenterol [Internet]. 2018;53(5):626-31. Available from: <https://doi.org/10.1080/00365521.2018.144143415>. 15. Tai CK, Tang CN, Ha JPY, Chau CH, Siu WT, Li MKW. Laparoscopic exploration of common bile duct in difficult choledocholithiasis. Surg Endosc Other Interv Tech. 2004;18(9):910-4. 16. Özdemir B, Kuzu UB, Öztaş E, Savilli F, Suna N, Coşkun O, et al. Endoscopic Management of the Difficult Bile Duct Stones: A Single Tertiary Center Experience. Gastroenterol Res Pract. 2016;2016:17. 17. Zhou Y, Zha WZ, Wu XD, Fan RG, Zhang B, Xu YH, et al. Three modalities on management of choledocholithiasis: A prospective cohort study. Int J Surg [Internet]. 2017;44:269-73. Available from: <http://dx.doi.org/10.1016/j.jsu.2017.06.03218>. 18. Karalotas C, Sgourakis G, Goumas G, Papaioannou N, Lillis C, Leandros E. Laparoscopic common bile duct exploration after failed endoscopic stone extraction. Surg Endosc Other Interv Tech. 2008;22(8):1826-31. 19. Kim HJ, Choi HS, Park JH, Park D II, Cho YK, Sohn C II, et al. Factors influencing the technical difficulty of endoscopic clearance of bile duct stones. Gastrointest Endosc. 2007;66(6):1154-60. 20. Uskudar O, Parlak E, Dıgıbeyaz S, Koksall AS, Çlek B, Kılıç ZMY, et al. Major predictors for difficult common bile duct stone. Turkish J Gastroenterol. 2019;24(9):264-5. 21. Jinfeng Z, Yin Y, Chi Z, Junye G. Laparoscopic management after failed endoscopic stone removal in nondilated common bile duct. Int J Surg [Internet]. 2016;29:48-52. Available from: <http://dx.doi.org/10.1016/j.jsu.2016.03.0722>. 22. Asian F, Arabi M, Celik M, Alper E, Unsul B. The effect of biliary stenting on difficult common bile duct stones. Prz Gastroenterol. 2014;9(2):109-15. 23. Bektaş H, Çelikkalep S, Sahin ZD, Düzköylü Y, Çolak S, Gürbülak EK, et al. Multiple plastic biliary stent placement in the management of large and multiple choledochal stones: Single center experience and review of the literature. Wideochirurgia i Inne Tech Maloinwazyjne. 2017;12(3):231-7. 24. García-Cano J, Reyes-Guevara AK, Martínez-Pérez T, Valiente-González L, Martínez-Fernández R, Viñuelas-Chicano M, et al. Fully covered self-expanding metal stents in the management of difficult common bile duct stones. Rev Española Enfermedades Dig. 2013;105(1):7-12. 25. Podda M, Polignano FM, Lühmann A, Wilson MSJ, Kull C, Tait IS. Systematic review with meta-analysis of studies comparing primary duct closure and T-tube drainage after laparoscopic common bile duct exploration for choledocholithiasis. Surg Endosc. 2016;30(3):945-61. 26. Baoum RB, Fauer ID, Shelton JS, Kummerow K, Hotzman MD, Paulose BK. Surgeons, ERCP, and laparoscopic common bile duct exploration: do we need a standard approach for common bile duct stones? Surg Endosc. 2016;30(2):414-23. 27. Duensing RA, Williams RA, Collins JC, Wilson SE. Common Bile Duct Stone Characteristics: Correlation with Treatment Choice during Laparoscopic Cholecystectomy. J Gastrointest Surg. 2000;4(1):6-12. 28. Gupta N. Role of laparoscopic common bile duct exploration in the management of choledocholithiasis. World J Gastrointest Surg. 2016;8(5):376.