T-tube versus internal drainage tube in laparoscopic common bile duct exploration

HANZHANG DONG[1], SHAOBIAO KE[1], JIULIN ZHAN[1], MINGJIAN LUO[1], XI LIU[2] and ZHIWEI LI[1]

[1]Department of Hepatobiliary and Pancreatic Surgery, Kanghua Hospital, Dongguan, Guangdong 523080; [2]Research and Teaching Department, Shenzhen Traditional Chinese Medicine Hospital, Shenzhen, Guangdong 518033, P.R. China

Received March 14, 2023; Accepted August 11, 2023

DOI: 10.3892/etm.2023.12195

Abstract. The 203 patients who underwent laparoscopic common bile duct exploration for choledocholithiasis were retrospectively analyzed. The patients were divided into internal drainage tube group (n=87) and T-tube group (n=116). Total bilirubin, direct bilirubin, alanine aminotransferase (AST), aspartate aminotransferase (ALT), the diameter of common bile duct, number of stones, operation time, intraoperative bleeding, postoperative hospital stay and postoperative complications were compared between the two groups. Possible influencing factors were selected as independent variables, and the operation mode was selected as the dependent variable for multifactor unconditional logistic regression analysis. There were no significant differences in the sex, age, total bilirubin, direct bilirubin, AST, ALT, operation time, intraoperative blood loss, postoperative hospital stay and postoperative biliary leaks between the two groups (P>0.05). The diameter of the common bile duct was smaller and the incidence of multiple stones in the common bile duct was lower in the internal drainage tube group compared with that in the T-tube group (P<0.05). The results of multifactor unconditional logistic regression analysis demonstrated that the diameter of the common bile duct and the number of stones in the common bile duct were associated with the operation mode as influencing factors. In conclusion, Patients with multiple stones in the common bile duct or with a wide diameter of the common bile duct are more likely to have T-tube placed rather than an internal drainage tube.

Introduction

Choledocholithiasis is a common disease of the biliary system and surgery is the main treatment. The traditional surgical method involves removing the gallbladder, opening the common bile duct for stone extraction and placing a T-tube for drainage. There are a number of disadvantages in using the T-tube, such as inconvenient postoperative care, the risk of bile leakage and bleeding when the T-tube is removed, and patients needing to be re-hospitalized in certain serious cases (1,2). Due to carbon dioxide pneumoperitoneum, laparoscopic common bile duct exploration requires a longer time to form the T-tube sinus compared with open surgery. Therefore, the amount of time needed to remove the T-tube is extended, which is inconvenient for the patients postoperatively. The internal drainage tube avoids the aforementioned issues, such as bile leakage, bleeding and patients with T-tube in their abdomen (3,4). Our team has >10 years experience using the internal drainage tube in laparoscopic common bile duct exploration for choledocholithiasis and has published a study about the manufacture and application of the internal drainage tube (5).

The aim of the present study was to explore the effect of internal drainage tube and T-tube in laparoscopic common bile duct exploration, and discussed the factors that affect the operation mode. The present study retrospectively analyzed the data of 203 patients undergoing laparoscopic common bile duct exploration at the Department of Hepatobiliary and Pancreatic Surgery of Kanghua Hospital (Dongguan, China) between January 2016 and December 2022, discussed the efficacy of internal drainage tube and T-tube, and analysed the factors affected the operation mode. From this study, it was concluded that laparoscopic common bile duct exploration with internal drainage tube is a safe and reliable operation method, which may improve the quality of life of patients. However, surgical indications should be well understood for the use of the internal drainage tube. Patients with multiple stones in the common bile duct or with a wide diameter of the common bile duct are better suited for T-tube rather than internal drainage tube.

Materials and methods

General information. The data of 203 patients who underwent laparoscopic common bile duct exploration between January 2016 and December 2022 in the Department of Hepatobiliary and Pancreatic Surgery of Kanghua Hospital (Dongguan, China) were retrospectively analyzed. The enrolled population included 116 patients who underwent laparoscopic cholecystectomy and choledocholithotomy with T-tube drainage (T-tube group) and

Correspondence to: Professor Zhiwei Li, Department of Hepatobiliary and Pancreatic Surgery, Kanghua Hospital, 1000 Dongguan Avenue, Dongguan, Guangdong 523080, P.R. China
E-mail: lizhiwei67@126.com

Key words: laparoscopy, common bile duct exploration, choledocholithiasis, T-tube drainage, internal drainage tube

87 patients who underwent laparoscopic cholecystectomy and choledocholithotomy with internal drainage tube (internal drainage tube group). All patients met the following conditions: i) Diameter of common bile duct was >8 mm; ii) patients had no intrahepatic bile duct stones and no biliary malignant tumors; iii) the biliary tract had no malformation, stenosis or other diseases; and iv) the patients had no history of biliary surgery or endoscopic retrograde cholangio pancreatography (ERCP) surgery. Cases with incomplete data were not included in the present study. The present study met the requirements of The Helsinki Declaration and was approved by the Ethics Committee of Kanghua Hospital (approval no. 23005; Dongguan, China). The patients provided written informed consent and agreed to their data (shown in the tables) being published.

Operation method. All operations were performed under general anesthesia (anesthesia-inducing drugs: Sufentanil 0.3 μg/kg, etomidate 0.2 mg/kg, benzenesulfonacetracuronium 0.2 mg/kg. Anesthetic maintenance drugs: Remifentanil 0.1 μg/kg/min, propofol 2 mg/kg/h) with tracheal intubation, patient in the head high, feet low, right high and left low position for a clearer operating field. The 4-hole routine method for the common bile duct was used. The gallbladder duct and artery were first separated, and the proximal end of the cystic artery was clipped with a Hem-o-lok clip and then cut off. The gallbladder duct was clipped with a Hem-o-lok clip to prevent the gallstones from falling into the common bile duct. The gallbladder was not removed temporarily, and lifting the gallbladder was conducive to exposing the operating field of the common bile duct. The gallbladder duct and the common bile duct were separated, and then the common bile duct was cut open with a length of incision of ~1.5 cm. The common bile duct stones were removed using lithotomy forceps and subsequently the choledochoscope was inserted into the common bile duct for exploration. Any unremoved stones were removed using lithotomy forceps or lithotomy mesh. Small stones and inflammatory exudates in the common bile duct were rinsed off repeatedly with normal saline through a catheter placed into the common bile duct. The choledochoscope was used again to ensure that no stones remained in the common bile duct.

Patients were divided into a T-tube group and an internal drainage tube group. In the T-tube group, the short arm of the T-tube was cut and then was placed into the common bile duct. The incision of the common bile duct was intermittently sutured in full layer with 4-0 absorbable suture. The end of the T-tube was drawn out of the body. Normal saline was injected into the end of the T-tube to observe whether there was any leakage of water in the incision of the common bile duct, and then an abdominal drainage tube was placed in the foramen of Winslow and led out of the body, completing the operation.

In the internal drainage tube group, the internal drainage tube was placed in the common bile duct, and the circular head of the internal drainage tube was placed into the duodenum to prevent the retrograde entry of the tube into the common bile duct. After it was put into the common bile duct, the internal drainage tube was observed using the choledochoscope to ensure its proper position in the common bile duct. The common bile duct incision was intermittently sutured with 4-0 absorbable suture in full layer. An abdominal drainage tube was placed in the foramen of Winslow and led out of the body, and the operation was completed. The application and placement of the internal drainage tube was published in a previous study by our group (5). In general, the patient was told the time of tube removal from the body when the patient was discharged from hospital. Follow-up was required only in the case of any discomfort for the patient after discharge from hospital.

Observation indicators. The following indicators were measured in the patients before surgery: i) Total bilirubin; ii) direct bilirubin; iii) alanine aminotransferase (AST); and iv) aspartate aminotransferase (ALT). The following indicators were measured during and after the surgery: i) The diameter of the common bile duct; ii) the number of stones in the common bile duct; iii) the operation time; iv) the amount of intraoperative blood loss; v) the length of postoperative hospital stay; and vi) the number of postoperative biliary leaks per patient.

Statistical analysis. SPSS 20.0 software (IBM Corp.) was used for statistical analysis. The measurement data are expressed as the median, 25 and 75th percentile, and the Mann-Whitney U-test was used for analysis. The χ^2 and Fisher's exact tests were used to analyze the count data. The count data were expressed as n (%). The possible influencing factors screened from the single factor analysis were selected as independent variables, and the surgical method was selected as the dependent variable for multifactor unconditional logistic regression analysis. $P<0.05$ was considered to indicate a statistically significant difference.

Results

Statistical results of observation indicators. There were no statistically significant differences in age, sex, total bilirubin, direct bilirubin, ALT and AST between the internal drainage tube group and the T-tube group before operation ($P>0.05$; Table I). There were statistically significant differences in the diameter of the common bile duct and the number of stones in the common bile duct between the two groups ($P<0.05$; Table I). There was no significant difference between the two groups in terms of operation time, intraoperative blood loss, postoperative hospital stay and postoperative biliary leakage ($P>0.05$; Table II).

Statistical results of multifactor unconditional logistic regression analysis. The results of multifactor unconditional logistic regression analysis demonstrated that the number of stones in the common bile duct and the diameter of the common bile duct were associated with the choice of the operation method, and were independent influencing factors of the operation method ($P<0.05$; Table III). Patients with multiple stones in the common bile duct or large diameter of the common bile duct were more likely to choose T-tube drainage.

Further observations. A total of 12 patients had a slight increase in blood amylase (range, 143 to 972 U/l; reference interval, 25-100 U/l). The catheter did not fall off in one patient, which was confirmed by abdominal standing plain film on the 55th day after the operation in the internal drainage tube

Table I. Characteristics of the patients.

Characteristics	Internal drainage group (n=87.0)	T-tube group (n=116.0)	χ^2/Z	P-value
Sex			0.007	0.935
Male	41.0 (47.1)	54.0 (46.6)		
Female	46.0 (52.9)	62.0 (53.4)		
Age, years	56.0 (43.0, 62.0)	59.0 (46.0, 63.0)	-1.855	0.064
Total bilirubin, μmol/l	43.2 (32.3, 61.5)	47.6 (34.1, 66.2)	-1.436	0.151
Direct bilirubin, μmol/l	27.2 (19.3, 43.1)	29.6 (18.6, 45.6)	-1.209	0.226
Aspartate aminotransferase, U/l	47.1 (32.8, 61.2)	51.3 (32.2, 70.5)	-1.134	0.257
Alanine aminotransferase, U/l	71.5 (41.3, 82.6)	75.2 (39.6, 95.2)	-1.663	0.096
No. of common bile duct stones			6.212	0.013
Solitary stone	29.0 (33.3)	21.0 (18.1)		
Multiple stones	58.0 (66.7)	95.0 (81.9)		
Diameter of common bile duct, mm	10.3 (9.2, 11.3)	12.6 (9.7, 13.7)	-3.099	0.002

Data are presented as the median (25 and 75th percentile) or n (%).

Table II. Surgical data.

Parameter	Internal drainage group (n=87.0)	T-tube group (n=116.0)	χ^2/Z/Fisher's	P-value
Operation time, min	90.2 (76.3, 106.2)	103.8 (81.2, 123.3)	-1.512	0.131
Intraoperative blood loss, ml	20.0 (10.0, 50.0)	22.0 (15.0, 50.0)	-0.521	0.603
Postoperative hospital stay, days	4.0 (3.0, 5.0)	6.0 (5.0, 6.0)	-1.076	0.282
Postoperative biliary leaks				0.508
Yes	0 (0)	2.0 (1.7)		
No	87.0 (100.0)	114.0 (98.3)		

Data are presented as the median (25 and 75th percentile) or n (%).

Table III. Multivariate unconditional logistic regression analysis of factors influencing surgical methods.

Parameter	b-value	Standard error	Wald value	P-value	Odds ratio	95% confidence interval
Age	0.018	0.026	0.471	0.492	1.018	0.967-1.072
Total bilirubin	0.008	0.010	0.667	0.414	1.008	0.989-1.028
Direct bilirubin	0.007	0.013	0.251	0.616	1.007	0.981-1.033
Diameter of common bile duct	0.483	0.225	4.603	0.032	1.621	1.043-2.520
No. of common bile duct stones	1.466	0.677	4.696	0.030	4.333	1.150-16.323

The odds ratio was calculated for stepwise increments of each parameter.

group. No abnormality was revealed in the catheter examination. The patient did not have any discomfort. The specific cause was unknown.

Discussion

Choledocholithiasis is a common disease, the presence of choledocholithiasis is 5-15% in the total of cholecystectomies performed for cholelithiasis every year (6). Surgery is the main treatment method. At present, laparoscopic common bile duct exploration is widely used. There are a variety of surgical methods for choledocholithiasis, each of which has advantages and disadvantages. ERCP can avoid common bile duct incision, postoperative biliary fistula, biliary stricture. However, ERCP may cause intraoperative complications, such as bleeding and intestinal perforation. In addition, ERCP

may destroy the function of Oddi's sphincter, and may cause reflux cholangitis, acute pancreatitis, stone recurrence after the operation.

At present, ERCP is considered to be mainly suitable for: i) Patients with a non-dilated common bile duct; and ii) patients with acute obstructive suppurative cholangitis. ERCP can quickly relieve biliary obstruction and reduce mortality (7,8). Common bile duct incision preserves the function of Oddi's sphincter; however, there is risk of biliary fistula and biliary stricture after the operation. Cholecystolithotomy through the cystic duct preserves the integrity of the common bile duct and reduces the risk of postoperative bile leakage and biliary stricture. However, stone extraction through the cystic duct has strict requirements on the diameter and course of the cystic duct and the size of common bile duct stones. Therefore, application of cholecystolithotomy through the cystic duct is limited. At present, it is considered that laparoscopic cholecystolithotomy is mainly applicable when: i) The diameter of the cystic duct is >5 mm, and the choledochoscope can pass through the cystic duct after expansion; ii) the diameter of the common bile duct stones is <10 mm, the number of stones is between one and three, and sediment-like stones are not present; and iii) no acute cholecystitis or cholangitis has occurred within 2 weeks (9,10).

Laparoscopic common bile duct exploration can be performed by placing the T-tube, or placing the internal drainage tube or closing using primary sutures. As the pressure in the common bile duct increases due to the edema of the duodenal papilla or the spasm of Oddi's sphincter after common bile duct exploration, the incidence of postoperative biliary fistula is increased. T-tube drainage can reduce the pressure in the common bile duct and the incidence of postoperative biliary fistula. Postoperative T-tube cholangiography can be used to check whether there are residual stones. If there are residual stones in the common bile duct, the stones can be removed through the T-tube sinus. However, the use of T-tube presents certain disadvantages. If the T-tube is left for a long time, a large amount of bile loss will cause electrolyte disorder and loss of digestive enzymes, which will affect the digestive function and postoperative recovery of the patient. Long term indwelling of the T-tube will affect the life quality of patients after the operation, and the T-tube may be removed unplanned. Complications, such as biliary bleeding, bile leakage and bile peritonitis, may occur when the T-tube is removed (11,12).

At present, the T-tube is mainly considered to be suitable for: i) When it is unclear whether stones have been completely removed; ii) when there is severe inflammation of the inner wall of the common bile duct; and iii) when the bile duct wall is damaged during stone removal (13,14). Compared with the T-tube, primary suture of the common bile duct reduces the hospitalization cost and hospitalization time, and avoids the disadvantages of the T-tube. However, primary suture of the common bile duct involves the risk of postoperative bile leakage and biliary stricture. The internal drainage tube can avoid the disadvantages of both the T-tube and primary suture of the common bile duct.

The internal drainage tube used in the present study was an 8F pig tail tube. The detailed manufacturing and placement methods have been presented in our previous study (5). The internal drainage tube was made of medical polyurethane, which has good compatibility with human tissues. The tube is soft and elastic, and can avoid damage to the biliary tract and intestinal tract. The holes on the tube are helpful for the smooth drainage of bile and can reduce the biliary pressure. The transverse short arm is placed in the common bile duct to prevent the catheter from falling off prematurely. The tension of the fast absorption line sutured on the transverse short arm decreases by 50% on the 5th day, and further decreases to 0% between the 9 and 14th day. After the fast absorption line is decomposed, the transverse short arm of the tube disappears, and then the tube returns to its original shape and is discharged from the body with the intestinal peristalsis. Shedding of the internal drainage tube depends on the degradation of the fast absorption line and the push of the chyme on the pig tail ring of the internal drainage tube. After the degradation of the fast absorption line, the internal drainage tube is dislodged into the intestine by the push of the intestinal peristalsis and chyme on the pig tail ring of the internal drainage tube, and then the internal drainage tube is expelled from the body. The internal drainage tube is removed from the body after ~2 weeks, and its drainage function in the biliary tract lasts for ~10 days. The incision of the common bile duct heals in ~10 days, and the internal drainage tube has achieved the purpose of drainage.

The internal drainage tube may also have side-effects. A total of 12 patients had a slight increase in blood amylase after the operation, which may be associated with the catheter indwelling in the duodenal papilla. Transient elevation of blood amylase is a common problem after ERCP surgery, which may be associated with obstruction of the pancreatic duct caused by spasm of the Oddi's sphincter, and generally does not cause any serious complications (15).

Surgical indications should be well understood for the use of the internal drainage tube. At present, it is considered that the internal drainage tube is mainly suitable for when: i) The diameter of the common bile duct is >8 mm; ii) the stones in the common bile duct are removed completely; iii) the common bile duct is unobstructed and without obvious stenosis; and iv) there is no severe inflammation in the wall of the common bile duct (16). The T-tube instead of the internal drainage tube is recommended for: i) When the stones cannot be removed completely; ii) when there are multiple intrahepatic bile duct stones or common bile duct sediment-like stones; iii) when the patient has suppurative cholangitis; and iv) when the patient has biliary pancreatitis (12,13). Sediment-like stones, inflammatory flocculants and blood clots may cause blockage of the internal drainage tube. Therefore, T-tubes should be used when there are sediment-like stones and inflammatory flocculants in the common bile duct (17).

There is still a risk of bile leakage in the application of the internal drainage tube. A peritoneal drainage tube is routinely placed in the foramen of Winslow. Bile leakage that occurs in the early postoperative period can generally heal within 2-3 days if the peritoneal drainage tube is unobstructed. Hypoalbuminemia is one of the risk factors for postoperative bile leakage (18,19). If necessary, serum albumin is injected intravenously, so that the serum albumin of the patient becomes >35 g/l (normal range, 40-55 g/l). According to previous studies, the suture type and suture mode have a certain influence on postoperative bile leakage, as non-absorbable suture may lead to bile duct stone,

and thick suture may lead to bile leakage (20,21). The present study used a 4-0 absorbable suture, and the suture mode used was full-layer mucosal to mucosal interrupted suture.

The present study demonstrated that there were no statistically significant differences in age, sex, total bilirubin, direct bilirubin, ALT and AST before operation, and there was no difference in operation time, intraoperative blood loss, postoperative biliary leakage and postoperative hospital stay between the two groups. There were statistically significant differences in the diameter of the common bile duct and the number of stones in the common bile duct. Patients with multiple stones in the common bile duct or large diameter of the common bile duct were more likely to choose T-tube drainage.

As long as the surgical indications are appropriately considered, it is safe and feasible to perform the internal drainage tube in laparoscopic common bile duct exploration, which may improve the postoperative life quality of patients.

Acknowledgements

Not applicable.

Funding

This work was supported by the 2022 Dongguan Science and Technology Program of Social Development (grant no. 20221800902302).

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

HD and ZL were involved in data interpretation, conception and design of the study and drafted the manuscript. SK, JZ, ML and XL collected the data and confirm the authenticity of the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The present study was approved by the Ethics Committee of Kanghua Hospital (Dongguan, China; approval no. 23005). Written informed consent for the use of their clinical data was obtained from the patients.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Martin IJ, Bailey IS, Rhodes M, O'Rourke N, Nathanson L and Fielding G: Towards T-tube free laparoscopic bile duct exploration: A methodologic evolution during 300 consecutive procedures. Ann Surg 228: 29-34, 1998.
2. Zhang LF, Hou CS, Xu Z, Wang LX, Ling XF, Wang G, Cui L and Xiu DR: Clinical effect of laparoscopic transcystic drainage combined with common bile duct exploration for the patients with difficult biliary stones. Beijing Da Xue Xue Bao Yi Xue Ban 54: 1185-1189, 2022 (In Chinese).
3. Yin Z, Xu K, Sun J, Zhang J, Xiao Z, Wang J, Niu H, Zhao Q, Lin S and Li Y: Is the end of the T-tube drainage era in laparoscopic choledochotomy for common bile duct stones is coming? A systematic review and meta-analysis. Ann Surg 257: 54-66, 2013.
4. Podda M, Polignano FM, Luhmann A, Wilson MS, Kulli C and 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 30: 845-861, 2016.
5. Dong H, Liu X, Luo M, Ke S, Zhan J and Li Z: Application of an internal drainage tube in laparoscopic common bile duct exploration. Med Int (Lond) 9: 1-5, 2021.
6. Cianci P, Tartaglia N, Alberto F, Antonio A and Neri V: Management of choledocholithiasis: Current opinions and personal experience. Surg Chron 23: 157-161, 2018.
7. Harvey PR, Baldwin S, Mytton J, Dosanjh A, Evison F, Patel P and Trudgill NJ: Higher volume providers are associated with improved outcomes following ERCP for the palliation of malignant biliary obstruction. EClinicalMedicine 18: 100212, 2020.
8. Fernandez Y Viesca M and Arvanitakis M: Early diagnosis and management of malignant distal biliary obstruction: A review on current recommendations and guidelines. Clin Exp Gastroenterol 12: 415-432, 2019.
9. Stirrat J, Patel NR, Stella SF, Mafeld S, Ho CS and Shlomovitz E: Safety and efficacy of percutaneous gallstone extraction in high-risk patients: An Alternative To Cholecystectomy Or Long-Term Drainage? J Am Coll Surg 232: 195-201, 2021.
10. Kim SK, Mani NB, Darcy MD and Picus DD: Percutaneous cholecystolithotomy using cholecystoscopy. Tech Vasc Interv Radiol 22: 139-148, 2019.
11. Vecchio R and MacFadyen BV: Laparoscopic common bile duct exploration. Langenbecks Arch Surg 387: 45-54, 2002.
12. Rendell VR and Pauli EM: Laparoscopic common bile duct exploration. JAMA Surg 158: 766-767, 2023.
13. Wang Y, Huang Y, Shi C, Wang L, Liu S, Zhang J and Wang W: Efficacy and safety of laparoscopic common bile duct exploration via choledochotomy with primary closure for the management of acute cholangitis caused by common bile duct stones. Surg Endosc 36: 4869-4877, 2022.
14. Jiang Y, Zhang J, Li W and Li L: Primary closure versus T-tube drainage after laparoscopic common bile duct exploration in patients with non-severe acute cholangitis. Updates Surg 74: 899-906, 2022.
15. Martínez-Segundo U, Pinto-Angulo VM, García-Álvarez J, Cruz-Reyes JM and Briceño-Sáenz G: Usefulness of serum amylase and lipase as predictors of the severity of post-endoscopic retrograde cholangiopancreatography pancreatitis. Cir Cir 88: 428-434, 2020.
16. Lyon M, Menon S, Jain A and Kumar H: Use of biliary stent in laparoscopic common bile duct exploration. Surg Endosc 29: 1094-1098, 2015.
17. Omar MA, Redwan AA and Alansary MN: Comparative study of three common bile duct closure techniques after choledocholithotomy: Safety and efficacy. Langenbecks Arch Surg 407: 1805-1815, 2022.
18. Kadaba RS, Bowers KA, Khorsandi S, Hutchins RR, Abraham AT, Sarker SJ, Bhattacharya S and Kocher HM: Complications of biliary-enteric anastomoses. Ann R Coll Surg Engl 99: 210-215, 2017.
19. Zafar SN, Khan MR, Raza R, Khan MN, Kasi M, Rafiq A and Jamy OH: Early complications after biliary enteric anastomosis for benign diseases: A retrospective analysis. BMC Surg 11: 19, 2011.
20. Seifert L, von Renesse J, Seifert AM, Sturm D, Meisterfeld R, Rahbari NN, Kahlert C, Distler M, Weitz J and Reissfelder C: Interrupted versus continuous suture technique for biliary-enteric anastomosis: Randomized clinical trial. BJS Open 7: zrac163, 2023.
21. Nassar AHM and Ng HJ: Risk identification and technical modifications reduce the incidence of post-cholecystectomy bile leakage: Analysis of 5675 laparoscopic cholecystectomies. Langenbecks Arch Surg 407: 213-223, 2022.