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MINIREVIEWS

Evolution of surgical treatment for hepatolithiasis

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Abstract

Hepatolithiasis is a common disease where stones are located in the intrahepatic bile duct. Hepatolithiasis is a disease with regional characteristics. The complication and postoperative recurrence rates of the disease are high. The intrahepatic cholangiocarcinoma and the incidence of liver cirrhosisare the main causes of death in patients with hepatolithiasis. Thus, it is difficult to treat. The majority of biliary stones are readily removed endoscopically, however complex intrahepatic or large refractory extrahepatic stones often require surgical or percutaneous interventions when standard endoscopic methods fail. At present, the main clinical treatment for hepatolithiasis is surgery, of which there are different methods depending on the patient's condition. With the continuous updates and development of medical technology, the treatment of hepatolithiasis has improved. In this paper, several mainstream surgical methods including partial hepatectomy, choledochojejunostomy, biliary tract exploration and lithotomy, percutaneous transhepatic chledochoscopic lithotripsy and liver transplantation used in the clinic are reviewed for clinicians' reference. Depending on the characteristics of each case, a suitable surgical method is chosen to obtain the best treatment effect.

Key Words: Hepatolithiasis; Biliary disease; Surgical treatment; Minimally invasive treatment; Clinical efficacy

Core Tip: Hepatolithiasis refers to the primary stones above the confluence of the left and right hepatic ducts, and its main component is brown bile pigment stones. Hepatolithiasis is a disease with regional characteristics. At present, there is no exact explanation for the etiology of hepatolithiasis. Studies at home and abroad suggest that it may be related to lifestyle, biliary bacterial infection, biliary parasite infection, biliary anatomical variation, gene mutation and abnormal gene expression and other factors.

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INTRODUCTION

Hepatolithiasis refers to primary stones above the confluence of the left and right hepatic ducts, and its main component is brown bile pigment stones. Hepatolithiasis is a disease with regional characteristics. The incidence of hepatolithiasis in Asia is higher than in Europe and America[1]. In recent years, the Japanese literature has reported an incidence of hepatolithiasis showing a downwards trend annually[2], but the outlook in China is still not optimistic, where the incidence in the population is 2%-25%[1], especially in the southwestern region.

Hepatolithiasis is characterized by concealed onset, long disease course, easy recurrence, and many serious complications; the two most serious complications are intrahepatic cholangiocarcinoma and liver cirrhosis. According to the literature, the incidence of intrahepatic cholangiocarcinoma in patients with hepatolithiasis is 1.3%-23.3%[2-6], and the incidence of liver cirrhosis in patients with hepatolithiasis is 3.7%-14.1%[3,7,8]. These two factors are the main causes of death in patients with hepatolithiasis. Therefore, early diagnosis of hepatolithiasis and appropriate treatment methods for intervention are helpful for reducing the incidence of complications, improving prognosis and improving the median survival time of patients[9-12]. At present, there is no exact explanation for the aetiology of hepatolithiasis. Studies at home and abroad suggest that it may be related to lifestyle, biliary bacterial infection[13-21], biliary parasite infection, biliary anatomical variation, gene mutation and abnormal gene expression and other factors[22-31].

SURGICAL TREATMENT OF HEPATOLITHIASIS

At present, the main treatment for hepatolithiasis is surgery, of which there are many methods. Each method has its own advantages and disadvantages. Depending on the characteristics of each case, a suitable surgical method is chosen to obtain the best treatment effect[32-44].

Partial hepatectomy

Hepatolithiasis generally shows a segmental distribution, so hepatectomy is a more effective means for the treatment of hepatolithiasis[45]. Since the first reported the success of partial hepatectomy in two patients with hepatolithiasis in 1956, partial hepatectomy has been widely used in the clinic and has achieved good curative effects. It is one of the main surgical methods for treating hepatolithiasis and can achieve the purpose of removing the focus, contact stricture and hepatolithiasis. At present, partial hepatectomy can be roughly divided into two types: Laparotomy and laparoscopic hepatectomy. Laparotomy for hepatectomy is a lengthy procedure, but the technology is mature, so it is the most widely practiced technique in the clinic[45].

In recent years, Li *et al*[46] conducted a single-center eight-year empirical study. Fifty-six patients with bilateral hepatolithiasis underwent hepatectomy combined with choledochoscopy for intrahepatic bile duct exploration and lithotripsy. The overall initial success rate was 85.7%, and the final clearance rate was 92.9%. Postoperative complications occurred in 15 patients (26.8%), 14 of whom were treated conservatively, and only 1 patient died of liver failure. Fifty-five patients were followed-up, among which 52 of them had stones removed completely during the first operation, and only 3 patients had residual stones. Among the 52 patients whose stones were removed, 7 (13.5%) experienced recurrence. The incidence of postoperative acute cholangitis was 10.9%. This study revealed that IHBDIL combined with hepatectomy is a safe and effective treatment for complex bilateral hepatolithiasis. However, this study involved a small number of samples and was based in a single center; thus, a larger sample size is needed to confirm the feasibility of this method.

Laparoscopic hepatectomy is a technique that has gradually developed in recent years and has been adopted by an increasing number of physicians because of its rapid recovery, relatively low degree of trauma, low degree of blood loss and low incidence of postoperative complications. Laparoscopic hepatectomy can be combined with laparoscopic ultrasound to monitor the intrahepatic condition in real time during an operation, which greatly improves the operation's safety, accuracy and thoroughness[47,48].

For patients with intrahepatic and extrahepatic biliary obstruction, Yang *et al*[49] selected 26 patients with hepatolithiasis, including 25 patients with left hepatolithiasis and 1 patient with right hepatolithiasis. Among the 26 patients, 18 had abdominal pain with jaundice, and 8 had abdominal pain with fever. All 26 patients underwent laparoscopic hepatectomy combined with endoscopic papillary balloon dilation. The operations were successful; only 1 patient experienced bile leakage after the operation, and the hepatolithiasis of the 26 patients was removed without any other complications. Twenty-six patients were followed up for 12 months, and no obvious abnormalities in B-ultrasound or liver function were detected post-operation. This operation is safe and effective in treating patients with intrahepatic and extrahepatic biliary obstruction, but it is difficult and requires experienced surgeons.

Li *et al*[50] conducted a meta-analysis of open hepatectomy and laparoscopic hepatectomy (involving 1329 cases). The results revealed that intraoperative blood loss in the laparoscopic treatment group was significantly lower [weighted average difference (WMD): 61.56, 95% confidence interval (95%CI): 14.91-108.20, $P = 0.01$], the recovery of intestinal function was faster (WMD: 0.98, 95%CI: 0.47-1.48, $P = 0.01$), and the length of hospital stay was shorter (WMD: 3.32, 95%CI: 2.32-4.32, $P < 0.00001$). In addition, the analysis revealed that there was no significant difference in operation time (WMD: 21.49, 95%CI: 0.27-43.24, $P = 0.05$), residual stone rate [odds ratio (OR): 0.79, 95%CI: 0.50-1.25, $P = 0.31$] or stone recurrence rate (OR: 0.34, 95%CI: 0.11-1.08, $P = 0.07$) between the two groups. In addition, through subgroup analysis, the results of this study show that the effect of laparoscopy in the treatment of hepatolithiasis in the left lateral lobe and left side is satisfactory.

Liu *et al*[51] conducted a meta-analysis (involving 1352 patients). The results revealed that intraoperative blood loss was significantly lower in patients with hepatolithiasis in the laparoscopic group [standardized mean difference (SMD): -0.52; 95%CI: -0.93 to -0.1; $I^2 = 91\%$; $P < 0.0001$]; the incidence of postoperative complications was lower (OR: 0.52; 95%CI: -0.70 to 0.39; $I^2 = 0\%$; $P < 0.0001$); the recovery of intestinal function was faster (SMD: -1.66; 95%CI: -2.41 to 0.92; $I^2 = 91\%$; $P < 0.0001$); and the hospital stay was shorter (SMD: -0.89; 95%CI: -1.19 to 0.59; $I^2 = 83\%$; $P < 0.00001$). However, in terms of operation time, no significant difference was found between LH and OH (SMD: 0.22; 95%CI: -0.21 to 0.65; $I^2 = 92\%$; $P = 0.31$), and no significant difference was found in the initial residual stone rate (OR: 0.79; 95%CI: -1.25 to 0.50; $I^2 = 0\%$; $P = 0.31$) or stone recurrence rate (OR: 0.67; 95%CI: -1.27 to 0.35 ; $I^2 = 0\%$; $P = 0.22$).

Therefore, the safety and postoperative recovery speed of laparoscopic hepatectomy are better than those of open hepatectomy[52-55]. However, some studies have shown[56,57] that laparoscopic hepatectomy takes longer than open hepatectomy, which is contrary to the results of the previous two studies and may be related to the technical proficiency of surgeons.

Choledochojejunostomy

The main inducing factor of hepatolithiasis is bile duct stricture. Plentz and Malek[58] reported that an average of 24.3% of patients with hepatolithiasis in China also have bile duct stricture. If the bile duct stricture is not removed during operation, even if the stones are removed, there is a high possibility of recurrence because the bile flow velocity will change at the bile duct stricture, and an eddy current may form when the bile flows through this location. It can also stagnate here, providing conditions for the formation of stones. Therefore, the bile duct stricture must be removed during operation. From the invention of Y-shaped anastomosis, which was proposed by Roux in 1897, to the invention of choledochoduodenojejunostomy and Roux-en-Y anastomosis in recent years, this method has improved many times and has achieved good results in patients with hepatolithiasis with bile duct stricture. At present, the most used surgical methods to solve biliary stricture are choledochojejunal Roux-en-Y anastomosis and modified choledochojejunal loop anastomosis[59]. Laparotomy or laparoscopy can also be used.

In recent years, Ejaz *et al*[60] had modified this method and proposed transantral choledochojejunostomy. A retrospective analysis of 392 patients (70 patients in the improved group and 322 patients in the control group) revealed that there was no significant difference in hospital stay, intraoperative blood loss or incidence of postoperative complications between the two groups compared with traditional choledochojejunostomy ($P > 0.05$). The incidence of gastric emptying disturbance in the improved group significantly decreased [2 (2.9%) *vs* 32 (9.9%), $P = 0.003$], and the time interval of eating fluid postoperation significantly decreased [(64.7 ± 16.3) *vs* (76.1 ± 24.6) h, $P = 0.041$]. Gastaca *et al*[61] proposed the high choledochojejunostomy method. However, regardless of how the operation is improved, its role in treating hepatolithiasis should be "unobstructed drainage" rather than removing choledocholithiasis through choledochojejunostomy. The implementation of choledochojejunostomy can lead to many complications, such as reflux cholangitis [62], biliary infection, anastomotic stricture, and bile duct carcinogenesis[63]. The main causes of these complications are the loss of sphincter function and changes in the intestinal anatomical structure, so clinicians should fully understand the indications for choledochojejunostomy and not perform the operation blindly. For patients with hepatolithiasis, choledocholithiasis should be removed, and the bile duct stricture should be corrected as much as possible before choledochojejunostomy; otherwise, the intrahepatic lesions may not be relieved, and the intestinal contents could flow back into the bile duct, aggravating biliary infection and causing biliary carcinogenesis[64], which can endanger the lives of patients. Moreover, to avoid the occurrence of residual stones and the recurrence of postoperative bile duct stricture, Roux-en-Y anastomosis with a subcutaneous blind loop can be performed. Post-operation, reexamination or cholangiography can be performed through the subcutaneous blind loop, and the biliary stricture can be dilated through this channel to avoid secondary operation.

Cui *et al*[65] proposed that to preserve the function of the sphincter of Oddi and minimize residual intrahepatic bile duct stones, subcutaneous choledochoplasty should be used. According to their study, 24% (32/146) of patients with recurrent or residual stones can undergo biliary drainage, stone removal and stricture dilatation through the subcutaneous passage, thus avoiding secondary operations. The subcutaneous passage retained by this operation has a certain necessity and practical value.

Laparoscopic choledochojejunostomy is currently advocated for in the clinic, but it has some technical difficulties and requires long-term in-depth study by surgeons[66,67]. Compared with open choledochojejunostomy, laparoscopic choledochojejunostomy can better expose the operative visual field and anatomical structure. Laparoscopic choledochojejunostomy is considered a safe and effective surgical method[67-70].

Biliary tract exploration and lithotomy

This operation is one of the most basic surgical procedures for treating hepatolithiasis. Traditional choledocholithotomy relies only on the experience of surgeons to remove stones, which has great limitations, and thus, the rate of postoperative residual stones is as high as 30%. At present, choledocholithotomy requires choledochoscopy combined with choledochoscopy or ultrasound localization to remove stones, mainly in the common hepatic duct near the hilum of the liver [71]. After all openings are created directly on the liver surface of the diseased area, the stones of the intrahepatic bile duct are removed using a choledochoscope. For critically ill patients with acute biliary obstruction, this operation can quickly relieve bile duct obstruction, control biliary infection, drain bile, relieve patients' symptoms, and create surgical opportunities for secondary hepatectomy in the future. After the operation, the T-tube is indwelled, and the stones are subsequently removed *via* a choledochoscope through the sinus, which effectively reduces the risk of relaparotomy, significantly increases the stone clearance rate, and reduces the postoperative residual stone rate to 2%-4%. This operation is not only effective for emergency and severe situations but is also effective for patients with a short course of disease or a small number of stones limited to the large bile duct in the liver. Thus, this operation can be the first choice. However, since most patients with hepatolithiasis encountered in the clinic have complex hepatolithiasis, removing the stones simply by choledocholithotomy is difficult, with a high rate of residual stones and recurrence rate of postoperative stones. Thus, it is usually necessary to combine hepatectomy and choledochojejunostomy so that it is possible to remove all stones at once, where the best therapeutic effect can be obtained[72].

Percutaneous transhepatic chledochoscopic lithotripsy

Percutaneous transhepatic punctures can be dated back to 1937. Huard and Hop[73] established a channel *via* percutaneous transhepatic puncture where they injected contrast media into the bile duct to observe biliary obstruction. In the following decades, this technology was continuously improved and applied by Japanese scientists. In 1974, Takada *et al* [74] builded upon the concept of percutaneous transhepatic cholangioscopic (PTCS) for establishing biliary access for the treatment of hepatolithiasis for the first time. After decades of development, this technology is becoming increasingly mature in clinical application. At present, for hepatolithiasis, doctors can remove stones by combining lithotripsy and/or lithotripsy equipment under the direct vision of a choledochoscope after percutaneous transhepatic puncture. For bile duct strictures, doctors can also use dilated balloons. For traditional PTCS lithotripsy (PTCSL), the local area is anaesthetized, and the target bile duct is punctured under the guidance of ultrasound or X-ray. After the guide wire is placed, the channel is dilated with an 8F dilator, and finally, the 8F drainage tube is retained. One week post-operation, the sinus is gradually dilated with an 8-16F series dilator once per week, 2F each time. Four weeks post-operation, the stones are removed *via* fiberoptic choledochoscopy through the sinus. Traditional PTCSL has many shortcomings in terms of treatment, such as a long treatment cycle, the inability of patients to tolerate the pain of sinus dilatation, and high cost; at the same time, the efficiency of stone removal is low, and its clinical application has decreased[75].

Wang *et al*[76] conducted a comparative study of traditional PTCSs and PTCSLs. A retrospective study was conducted on 118 patients with hepatolithiasis (51 patients treated with PTCS and 67 patients treated with PTCSL) from 2007 to 2014, and the efficacy and safety of the two groups were compared. The results revealed that there was no significant difference in operation time, intraoperative blood loss or blood transfusion between the two groups, and the stone clearance rate in the PTCSL group was significantly better than that in the PTCS group (P = 0.021; OR = 0.201; 95%CI: 0.051-0.785). The recurrence rate of stones was 9% in the PTCSL group and 22% in the PTCS group. The hospitalization time of the PTCSL group was also significantly shorter than that of the PTCS group (P = 0.001; OR = 1.337; 95%CI: 1.132-1.58). Traditional PTCS operation no longer meets the clinical needs for the treatment of hepatolithiasis, but PTOBF is an ideal method for the treatment of hepatolithiasis because of its good curative effect and high safety (Figure 1).

Liver transplantation

At present, liver transplantation (LT) is considered the last line of defence for the treatment of hepatolithiasis[77]. For patients with hepatolithiasis, the indications for LT are as follows: (1) Patients with primary hepatolithiasis secondary to decompensated biliary cirrhosis complicated with portal hypertension; (2) Diffuse hepatolithiasis of the whole liver combined with recurrent cholangitis, bile duct stricture and obstructive jaundice, which cannot be completely removed by partial hepatectomy, choledochojejunostomy or choledochoscopy, seriously affecting quality of life; and (3) Those who have undergone many operations where the focus of the stone cannot be removed. LT can be used for the treatment of hepatolithiasis, and the quality of life of patients undergoing LT is one of the conditions used to evaluate the suitability of the operation.

McLean *et al*[78] conducted a questionnaire survey on the quality of life of LT patients with liver diseases. The results revealed that the overall quality of life of LT patients significantly improved after long-term treatment, and the average therapeutic effect was 6.3 (95%CI: 2.1-10.9). Moreover, LT is affected by many factors, such as a shortage of liver sources, high cost of operation, difficulty of LT, many postoperative complications and immune repulsion reactions[79,80], which restrict the development of the operation. Although many researchers worldwide have made progress in recent years to reduce the risks associated with LT[81], there is still a long way to go.

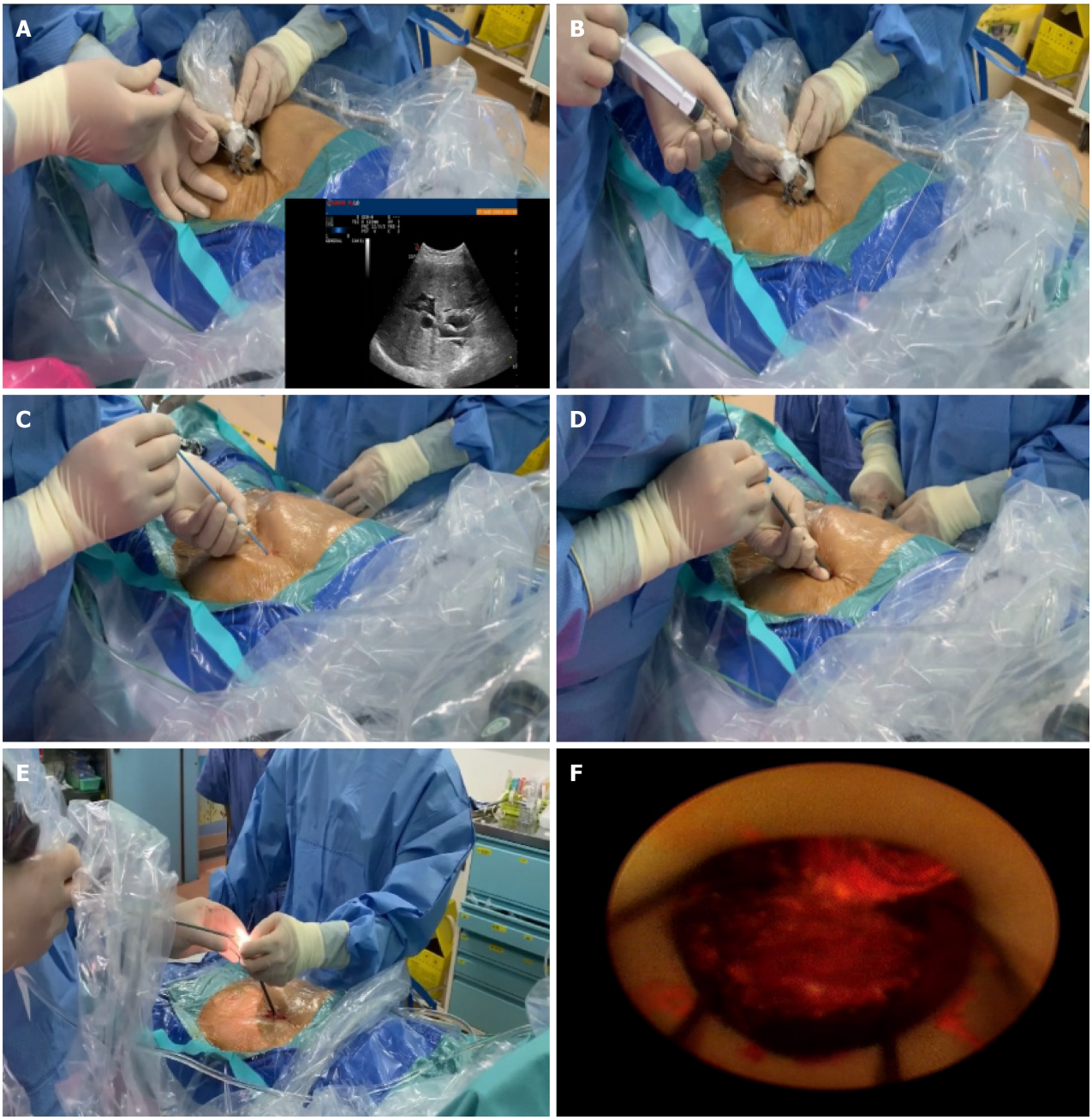

Figure 1 PTOBF stone extraction procedure. A: Ultrasound-guided percutaneous transhepatic target bile duct puncture; B: Syringe retraction after successful puncture, retraction of bile represents a successful puncture; C: Gradual dilation of the bile duct using 8Fr to 16Fr disposable fascial dilators *via* guidewire; D: 14Fr protective sheaths to establish choledochoscope access; E: Placement of the choledochoscope *via* the guidewire; F: Choledochoscopic mesh basket stone extraction.

CONCLUSION

With the continuous updates and development of medical technology, the treatment of hepatolithiasis has improved. Surgical treatment is still the most effective method for hepatolithiasis. Although there are many surgical methods at present, instead of separating these surgical methods, doctors should formulate a set of accurate surgical plans according to the condition of the patient and combine the advantages of the various surgical methods to achieve the clinical goal of removing lesions and stones, correcting stenosis, unobstructing drainage, preventing recurrence, and improving the quality of life of patients.

FOOTNOTES

Author contributions: Ye YQ, Li PH, Cao YW, and Wen SQ designed the research; Ye YQ and Yang SL performed the research; Zhuang BD and Xiao ZY contributed new analytic tools; Ye YQ and Li PH analyzed the data; Ye YQ and Li PH wrote the paper. Ye YQ and Li PH

contributed equally to this work as co-first authors. Ye YQ and Li PH wrote the paper. All the authors have read and approved the final manuscript. Ye YQ proposed, designed and conducted data analysis and prepared the first draft of the manuscript. Li PH was responsible for patient screening, enrollment, collection of clinical data and blood specimens. In summary, we believe that designating Ye YQ and Li PH as co-first authors is fitting for our manuscript as it accurately reflects our team's collaborative spirit, equal contributions, and diversity. In addition, Cao YW and Wen SQ contributed equally to this work as co-corresponding authors. The research was performed as a collaborative effort, and the designation of co-corresponding authorship accurately reflects the distribution of responsibilities and burdens associated with the time and effort required to complete the study and the resultant paper. This also ensures effective communication and management of post-submission matters, ultimately enhancing the paper's quality and reliability.

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REFERENCES

1 **Kim HJ**, Kim JS, Joo MK, Lee BJ, Kim JH, Yeon JE, Park JJ, Byun KS, Bak YT. Hepatolithiasis and intrahepatic cholangiocarcinoma: A review. *World J Gastroenterol* 2015; **21**: 13418-13431 [PMID: 26730152 DOI: 10.3748/wjg.v21.i48.13418]
2 **Suzuki Y**, Mori T, Yokoyama M, Nakazato T, Abe N, Nakanuma Y, Tsubouchi H, Sugiyama M. Hepatolithiasis: analysis of Japanese nationwide surveys over a period of 40 years. *J Hepatobiliary Pancreat Sci* 2014; **21**: 617-622 [PMID: 24824191 DOI: 10.1002/jhbp.116]
3 **Suzuki Y**, Mori T, Abe N, Sugiyama M, Atomi Y. Predictive factors for cholangiocarcinoma associated with hepatolithiasis determined on the basis of Japanese Multicenter study. *Hepatol Res* 2012; **42**: 166-170 [PMID: 22151748 DOI: 10.1111/j.1872-034X.2011.00908.x]
4 **Tazuma S**, Nakanuma Y. Clinical features of hepatolithiasis: analyses of multicenter-based surveys in Japan. *Lipids Health Dis* 2015; **14**: 129 [PMID: 26475606 DOI: 10.1186/s12944-015-0130-2]
5 **Tabrizian P**, Jibara G, Shrager B, Schwartz ME, Roayaie S. Hepatic resection for primary hepatolithiasis: a single-center Western experience. *J Am Coll Surg* 2012; **215**: 622-626 [PMID: 22921329 DOI: 10.1016/j.jamcollsurg.2012.07.005]
6 **Kim HJ**, Kim JS, Suh SJ, Lee BJ, Park JJ, Lee HS, Kim CD, Bak YT. Cholangiocarcinoma Risk as Long-term Outcome After Hepatic Resection in the Hepatolithiasis Patients. *World J Surg* 2015; **39**: 1537-1542 [PMID: 25648078 DOI: 10.1007/s00268-015-2965-0]
7 **Pu Q**, Zhang C, Ren R, Huang Z, Jin K, Cao G, Zhu M, Zeng Y, Zhao W. Choledochoscopic lithotripsy is a useful adjunct to laparoscopic common bile duct exploration for hepatolithiasis: a cohort study. *Am J Surg* 2016; **211**: 1058-1063 [PMID: 27184197 DOI: 10.1016/j.amjsurg.2014.01.012]
8 **Park JS**, Jeong S, Lee DH, Bang BW, Lee JI, Lee JW, Kwon KS, Kim HK, Shin YW, Kim YS, Park SG. Risk factors for long-term outcomes after initial treatment in hepatolithiasis. *J Korean Med Sci* 2013; **28**: 1627-1631 [PMID: 24265526 DOI: 10.3346/jkms.2013.28.11.1627]
9 **Cha BH**, Jang MJ, Lee SH. Alcohol Consumption Can Reduce the Risk of Gallstone Disease: A Systematic Review with a Dose-Response Meta-Analysis of Case-Control and Cohort Studies. *Gut Liver* 2019; **13**: 114-131 [PMID: 30665280 DOI: 10.5009/gnl18278]
10 **Chang CM**, Chiu THT, Chang CC, Lin MN, Lin CL. Plant-Based Diet, Cholesterol, and Risk of Gallstone Disease: A Prospective Study. *Nutrients* 2019; **11** [PMID: 30720747 DOI: 10.3390/nu11020335]
11 **Ryu S**, Chang Y, Kim YS, Kim HJ. Prolonged sitting increases the risk of gallstone disease regardless of physical activity: a cohort study. *Scand J Gastroenterol* 2018; **53**: 864-869 [PMID: 30025506 DOI: 10.1080/00365521.2018.1476910]
12 **Zhang YP**, Zhao YL, Sun YL, Zhu RT, Wang WJ, Li J. Physical Activity and the Risk of Gallstone Disease: A Systematic Review and Meta-analysis. *J Clin Gastroenterol* 2017; **51**: 857-868 [PMID: 27322529 DOI: 10.1097/MCG.0000000000000571]
13 **Shen H**, Ye F, Xie L, Yang J, Li Z, Xu P, Meng F, Li L, Chen Y, Bo X, Ni M, Zhang X. Metagenomic sequencing of bile from gallstone patients to identify different microbial community patterns and novel biliary bacteria. *Sci Rep* 2015; **5**: 17450 [PMID: 26625708 DOI: 10.1038/srep17450]
14 **Schneider J**, De Waha P, Hapfelmeier A, Feihl S, Römmler F, Schlag C, Algül H, Schmid RM, Wantia N, Huber W, Weber A. Risk factors for increased antimicrobial resistance: a retrospective analysis of 309 acute cholangitis episodes. *J Antimicrob Chemother* 2014; **69**: 519-525 [PMID: 24084640 DOI: 10.1093/jac/dkt373]
15 **Stewart L**, Ponce R, Oesterle AL, Griffiss JM, Way LW. Pigment gallstone pathogenesis: slime production by biliary bacteria is more important than beta-glucuronidase production. *J Gastrointest Surg* 2000; **4**: 547-553 [PMID: 11077333 DOI: 10.1016/s1091-255x(00)80100-6]
16 **Stewart L**, Oesterle AL, Erdan I, Griffiss JM, Way LW. Pathogenesis of pigment gallstones in Western societies: the central role of bacteria. *J Gastrointest Surg* 2002; **6**: 891-903; discussion 903 [PMID: 12504229 DOI: 10.1016/s1091-255x(02)00035-5]
17 **Maki T**. Pathogenesis of calcium bilirubinate gallstone: role of E. coli, beta-glucuronidase and coagulation by inorganic ions, polyelectrolytes

and agitation. *Ann Surg* 1966; **164**: 90-100 [PMID: 5329901 DOI: 10.1097/00000658-196607000-00010]
18 **Pan S**, Li X, Jiang P, Jiang Y, Shuai L, He Y, Li Z. Variations of ABCB4 and ABCB11 genes are associated with primary intrahepatic stones. *Mol Med Rep* 2015; **11**: 434-446 [PMID: 25323205 DOI: 10.3892/mmr.2014.2645]
19 **Pavithra S**, Rao U, Mohan P, Venkataraman J. Bactibilia in pigment gallstone disease: A report from the Indian subcontinent. *Dig Liver Dis* 2010; **42**: 231-232 [PMID: 19608467 DOI: 10.1016/j.dld.2009.05.010]
20 **Sung JY**, Leung JW, Shaffer EA, Lam K, Costerton JW. Bacterial biofilm, brown pigment stone and blockage of biliary stents. *J Gastroenterol Hepatol* 1993; **8**: 28-34 [PMID: 8439659 DOI: 10.1111/j.1440-1746.1993.tb01171.x]
21 **Prouty AM**, Schwesinger WH, Gunn JS. Biofilm formation and interaction with the surfaces of gallstones by Salmonella spp. *Infect Immun* 2002; **70**: 2640-2649 [PMID: 11953406 DOI: 10.1128/IAI.70.5.2640-2649.2002]
22 **Huang MH**, Chen CH, Yen CM, Yang JC, Yang CC, Yeh YH, Chou DA, Yueh SK, Yang YY, Nien CK. Relation of hepatolithiasis to helminthic infestation. *J Gastroenterol Hepatol* 2005; **20**: 141-146 [PMID: 15610459 DOI: 10.1111/j.1440-1746.2004.03523.x]
23 **Rana SS**, Bhasin DK, Nanda M, Singh K. Parasitic infestations of the biliary tract. *Curr Gastroenterol Rep* 2007; **9**: 156-164 [PMID: 17418062 DOI: 10.1007/s11894-007-0011-6]
24 **Lee CF**, Lee WC, Wu RC, Chen TC. Intrahepatic Duct Stones Harboring Ascariasis Ova: A Case Report. *Medicine (Baltimore)* 2016; **95**: e3139 [PMID: 27015193 DOI: 10.1097/MD.0000000000003139]
25 **Leung JW**, Yu AS. Hepatolithiasis and biliary parasites. *Baillieres Clin Gastroenterol* 1997; **11**: 681-706 [PMID: 9512805 DOI: 10.1016/s0950-3528(97)90016-6]
26 **ASAKURA S**. Crystallographic studies on the eggs of various human parasites. I. Observation with polarization microscope. *Tohoku J Exp Med* 1956; **64**: 105-115 [PMID: 13371604 DOI: 10.1620/tjem.64.105]
27 **Lim JH**. Oriental cholangiohepatitis: pathologic, clinical, and radiologic features. *AJR Am J Roentgenol* 1991; **157**: 1-8 [PMID: 2048504 DOI: 10.2214/ajr.157.1.2048504]
28 **Schulman A**. Intrahepatic biliary stones: imaging features and a possible relationship with ascaris lumbricoides. *Clin Radiol* 1993; **47**: 325-332 [PMID: 8508594 DOI: 10.1016/s0009-9260(05)81448-5]
29 **Pilankar KS**, Amarapurkar AD, Joshi RM, Shetty TS, Khithani AS, Chemburkar VV. Hepatolithiasis with biliary ascariasis--a case report. *BMC Gastroenterol* 2003; **3**: 35 [PMID: 14687416 DOI: 10.1186/1471-230X-3-35]
30 **Choi D**, Lim JH, Lee KT, Lee JK, Choi SH, Heo JS, Choi DW, Jang KT, Lee NY, Kim S, Hong ST. Gallstones and Clonorchis sinensis infection: a hospital-based case-control study in Korea. *J Gastroenterol Hepatol* 2008; **23**: e399-e404 [PMID: 18070015 DOI: 10.1111/j.1440-1746.2007.05242.x]
31 **Rim HJ**. Clonorchiasis: an update. *J Helminthol* 2005; **79**: 269-281 [PMID: 16153321 DOI: 10.1079/joh2005300]
32 **Pauli-Magnus C**, Lang T, Meier Y, Zodan-Marin T, Jung D, Breymann C, Zimmermann R, Kenngott S, Beuers U, Reichel C, Kerb R, Penger A, Meier PJ, Kullak-Ublick GA. Sequence analysis of bile salt export pump (ABCB11) and multidrug resistance p-glycoprotein 3 (ABCB4, MDR3) in patients with intrahepatic cholestasis of pregnancy. *Pharmacogenetics* 2004; **14**: 91-102 [PMID: 15077010 DOI: 10.1097/00008571-200402000-00003]
33 **Chen R**, Wang J, Tang S, Zhang Y, Lv X, Wu S, Yang Z, Xia Y, Chen D, Zhan S. Role of polymorphic bile salt export pump (BSEP, ABCB11) transporters in anti-tuberculosis drug-induced liver injury in a Chinese cohort. *Sci Rep* 2016; **6**: 27750 [PMID: 27293027 DOI: 10.1038/srep27750]
34 **Marschall HU**, Katsika D, Rudling M, Einarsson C. The genetic background of gallstone formation: an update. *Biochem Biophys Res Commun* 2010; **396**: 58-62 [PMID: 20494111 DOI: 10.1016/j.bbrc.2010.02.143]
35 **Gan L**, Pan S, Cui J, Bai J, Jiang P, He Y. Functional analysis of the correlation between ABCB11 gene mutation and primary intrahepatic stone. *Mol Med Rep* 2019; **19**: 195-204 [PMID: 30431138 DOI: 10.3892/mmr.2018.9661]
36 **Lee JY**, Kim JS, Moon JM, Lim SA, Chung W, Lim EH, Lee BJ, Park JJ, Bak YT. Incidence of Cholangiocarcinoma with or without Previous Resection of Liver for Hepatolithiasis. *Gut Liver* 2013; **7**: 475-479 [PMID: 23898390 DOI: 10.5009/gnl.2013.7.4.475]
37 **Ni ZK**, Lin D, Wang ZQ, Jin HM, Li XW, Li Y, Huang H. Precision Liver Resection: Three-Dimensional Reconstruction Combined with Fluorescence Laparoscopic Imaging. *Surg Innov* 2021; **28**: 71-78 [PMID: 32873180 DOI: 10.1177/1553350620954581]
38 **Acalovschi M**, Tirziu S, Chiorean E, Krawczyk M, Grünhage F, Lammert F. Common variants of ABCB4 and ABCB11 and plasma lipid levels: a study in sib pairs with gallstones, and controls. *Lipids* 2009; **44**: 521-526 [PMID: 19408031 DOI: 10.1007/s11745-009-3300-z]
39 **Kubitz R**, Dröge C, Stindt J, Weissenberger K, Häussinger D. The bile salt export pump (BSEP) in health and disease. *Clin Res Hepatol Gastroenterol* 2012; **36**: 536-553 [PMID: 22795478 DOI: 10.1016/j.clinre.2012.06.006]
40 **Martinez-Lopez E**, Curiel-Lopez F, Hernandez-Nazara A, Moreno-Luna LE, Ramos-Marquez ME, Roman S, Panduro A. Influence of ApoE and FABP2 polymorphisms and environmental factors in the susceptibility to gallstone disease. *Ann Hepatol* 2015; **14**: 515-523 [PMID: 26019038 DOI: 10.1016/S1665-2681(19)31173-1]
41 **Kubitz R**, Dröge C, Kluge S, Stindt J, Häussinger D. Genetic variations of bile salt transporters. *Drug Discov Today Technol* 2014; **12**: e55-e67 [PMID: 25027376 DOI: 10.1016/j.ddtec.2014.03.006]
42 **Hu G**, He P, Liu Z, Chen Q, Zheng B, Zhang Q. Diagnosis of ABCB11 gene mutations in children with intrahepatic cholestasis using high resolution melting analysis and direct sequencing. *Mol Med Rep* 2014; **10**: 1264-1274 [PMID: 24969679 DOI: 10.3892/mmr.2014.2349]
43 **Tai Y**, Xie Y, Tang CW. Compound heterozygous mutations of ABCB11 responsible for benign recurrent intrahepatic cholestasis. *J Dig Dis* 2015; **16**: 299-302 [PMID: 25565657 DOI: 10.1111/1751-2980.12227]
44 **Park JS**, Ko JS, Seo JK, Moon JS, Park SS. Clinical and ABCB11 profiles in Korean infants with progressive familial intrahepatic cholestasis. *World J Gastroenterol* 2016; **22**: 4901-4907 [PMID: 27239116 DOI: 10.3748/wjg.v22.i20.4901]
45 **Tan J**, Tan Y, Chen F, Zhu Y, Leng J, Dong J. Endoscopic or laparoscopic approach for hepatolithiasis in the era of endoscopy in China. *Surg Endosc* 2015; **29**: 154-162 [PMID: 25027471 DOI: 10.1007/s00464-014-3669-5]
46 **Li EL**, Yuan RF, Liao WJ, Feng Q, Lei J, Yin XB, Wu LQ, Shao JH. Intrahepatic bile duct exploration lithotomy is a useful adjunctive hepatectomy method for bilateral primary hepatolithiasis: an eight-year experience at a single centre. *BMC Surg* 2019; **19**: 16 [PMID: 30717712 DOI: 10.1186/s12893-019-0480-1]
47 **Jin RA**, Wang Y, Yu H, Liang X, Cai XJ. Total laparoscopic left hepatectomy for primary hepatolithiasis: Eight-year experience in a single center. *Surgery* 2016; **159**: 834-841 [PMID: 26518391 DOI: 10.1016/j.surg.2015.09.022]
48 **Gong Y**, Tang Y, Geng Y, Zhou Y, Yu M, Huang B, Sun Z, Tang H, Jian Z, Hou B. Comparative safety and effectiveness of ultrasound-guided radiofrequency ablation combined with preoperative three-dimensional reconstruction versus surgical resection for solitary

hepatocellular carcinoma of 3-5 cm. *J Cancer* 2019; **10**: 5568-5574 [PMID: 31632501 DOI: 10.7150/jca.32342]
49 **Yang J**, Zhang F, Du X, Wang A, Lv S, Fang Z. Laparoscopic hepatectomy combined with endoscopic papillary balloon dilation for complex bile duct stones. *ANZ J Surg* 2018; **88**: E522-E525 [PMID: 28803451 DOI: 10.1111/ans.14132]
50 **Li H**, Zheng J, Cai JY, Li SH, Zhang JB, Wang XM, Chen GH, Yang Y, Wang GS. Laparoscopic VS open hepatectomy for hepatolithiasis: An updated systematic review and meta-analysis. *World J Gastroenterol* 2017; **23**: 7791-7806 [PMID: 29209120 DOI: 10.3748/wjg.v23.i43.7791]
51 **Liu X**, Min X, Ma Z, He X, Du Z. Laparoscopic hepatectomy produces better outcomes for hepatolithiasis than open hepatectomy: An updated systematic review and meta-analysis. *Int J Surg* 2018; **51**: 151-163 [PMID: 29367038 DOI: 10.1016/j.ijsu.2018.01.016]
52 **Lee KF**, Fong AK, Chong CC, Cheung SY, Wong J, Lai PB. Robotic Liver Resection For Primary Hepatolithiasis: Is It Beneficial? *World J Surg* 2016; **40**: 2490-2496 [PMID: 27138884 DOI: 10.1007/s00268-016-3528-8]
53 **Ye YQ**, Cao YW, Li RQ, Li EZ, Yan L, Ding ZW, Fan JM, Wang P, Wu YX. Three-dimensional visualization technology for guiding one-step percutaneous transhepatic cholangioscopic lithotripsy for the treatment of complex hepatolithiasis. *World J Gastroenterol* 2024; **30**: 3393-3402 [PMID: 39091711 DOI: 10.3748/wjg.v30.i28.3393]
54 **Kim YK**, Han HS, Yoon YS, Cho JY, Lee W. Laparoscopic approach for right-sided intrahepatic duct stones: a comparative study of laparoscopic versus open treatment. *World J Surg* 2015; **39**: 1224-1230 [PMID: 25623212 DOI: 10.1007/s00268-015-2942-7]
55 **Tian J**, Li JW, Chen J, Fan YD, Bie P, Wang SG, Zheng SG. The safety and feasibility of reoperation for the treatment of hepatolithiasis by laparoscopic approach. *Surg Endosc* 2013; **27**: 1315-1320 [PMID: 23306617 DOI: 10.1007/s00464-012-2606-8]
56 **Wu TJ**, Wang F, Lin YS, Chan KM, Yu MC, Lee WC. Right hepatectomy by the anterior method with liver hanging versus conventional approach for large hepatocellular carcinomas. *Br J Surg* 2010; **97**: 1070-1078 [PMID: 20632274 DOI: 10.1002/bjs.7083]
57 **Langenhuijsen J**, Birtle A, Klatte T, Porpiglia F, Timsit MO. Surgical Management of Adrenocortical Carcinoma: Impact of Laparoscopic Approach, Lymphadenectomy, and Surgical Volume on Outcomes-A Systematic Review and Meta-analysis of the Current Literature. *Eur Urol Focus* 2016; **1**: 241-250 [PMID: 28723392 DOI: 10.1016/j.euf.2015.12.001]
58 **Plentz RR**, Malek NP. Clinical presentation, risk factors and staging systems of cholangiocarcinoma. *Best Pract Res Clin Gastroenterol* 2015; **29**: 245-252 [PMID: 25966425 DOI: 10.1016/j.bpg.2015.02.001]
59 **Gadelhak N**, Shehta A, Hamed H. Diagnosis and management of choledochal cyst: 20 years of single center experience. *World J Gastroenterol* 2014; **20**: 7061-7066 [PMID: 24944503 DOI: 10.3748/wjg.v20.i22.7061]
60 **Ejaz A**, Spolverato G, Kim Y, Dodson R, Sicklick JK, Pitt HA, Lillemoe KD, Cameron JL, Pawlik TM. Long-term health-related quality of life after iatrogenic bile duct injury repair. *J Am Coll Surg* 2014; **219**: 923-32.e10 [PMID: 25127511 DOI: 10.1016/j.jamcollsurg.2014.04.024]
61 **Gastaca M**, Matarranz A, Muñoz F, Valdivieso A, Aguinaga A, Testillano M, Bustamante J, Terreros I, Suarez MJ, Montejo M, Ortiz de Urbina J. Biliary complications in orthotopic liver transplantation using choledochocholedochostomy with a T-tube. *Transplant Proc* 2012; **44**: 1554-1556 [PMID: 22841211 DOI: 10.1016/j.transproceed.2012.05.025]
62 **Said A**, Safdar N, Lucey MR, Knechtle SJ, D'Alessandro A, Musat A, Pirsch J, Kalayoglu M, Maki DG. Infected bilomas in liver transplant recipients, incidence, risk factors and implications for prevention. *Am J Transplant* 2004; **4**: 574-582 [PMID: 15023150 DOI: 10.1111/j.1600-6143.2004.00374.x]
63 **Jo JH**, Chung MJ, Park JY, Bang S, Park SW, Kim KS, Lee WJ, Song SY, Chung JB. High serum CA19-9 levels are associated with an increased risk of cholangiocarcinoma in patients with intrahepatic duct stones: a case-control study. *Surg Endosc* 2013; **27**: 4210-4216 [PMID: 23760942 DOI: 10.1007/s00464-013-3025-1]
64 **Tocchi A**, Mazzoni G, Liotta G, Lepre L, Cassini D, Miccini M. Late development of bile duct cancer in patients who had biliary-enteric drainage for benign disease: a follow-up study of more than 1,000 patients. *Ann Surg* 2001; **234**: 210-214 [PMID: 11505067 DOI: 10.1097/00000658-200108000-00011]
65 **Cui L**, Xu Z, Ling XF, Wang LX, Hou CS, Wang G, Zhou XS. Laparoscopic hepaticoplasty using gallbladder as a subcutaneous tunnel for hepatolithiasis. *World J Gastroenterol* 2014; **20**: 3350-3355 [PMID: 24695884 DOI: 10.3748/wjg.v20.i12.3350]
66 **Hori T**, Oike F, Furuyama H, Machimoto T, Kadokawa Y, Hata T, Kato S, Yasukawa D, Aisu Y, Sasaki M, Kimura Y, Takamatsu Y, Naito M, Nakauchi M, Tanaka T, Gunji D, Nakamura K, Sato K, Mizuno M, Iida T, Yagi S, Uemoto S, Yoshimura T. Protocol for laparoscopic cholecystectomy: Is it rocket science? *World J Gastroenterol* 2016; **22**: 10287-10303 [PMID: 28058010 DOI: 10.3748/wjg.v22.i47.10287]
67 **Lee JS**, Hong TH. Laparoscopic choledochojejunostomy in various hepatobiliary and pancreatic surgeries: a single surgeon's experience. *J Laparoendosc Adv Surg Tech A* 2015; **25**: 305-310 [PMID: 25768335 DOI: 10.1089/lap.2014.0539]
68 **Chander J**, Mangla V, Vindal A, Lal P, Ramteke VK. Laparoscopic choledochoduodenostomy for biliary stone disease: a single-center 10-year experience. *J Laparoendosc Adv Surg Tech A* 2012; **22**: 81-84 [PMID: 22145606 DOI: 10.1089/lap.2011.0366]
69 **Chen D**, Zhu A, Zhang Z. Total laparoscopic Roux-en-Y cholangiojejunostomy for the treatment of biliary disease. *JSLS* 2013; **17**: 178-187 [PMID: 23815976 DOI: 10.4293/108680813X13654754535232]
70 **Hori T**, Aisu Y, Yamamoto M, Yasukawa D, Iida T, Yagi S, Taniguchi K, Uemoto S. Laparoscopic approach for choledochojejunostomy. *Hepatobiliary Pancreat Dis Int* 2019; **18**: 285-288 [PMID: 31023579 DOI: 10.1016/j.hbpd.2019.04.004]
71 **Lu MD**, Yin XY, Huang JF. Intraoperative liver ultrasound: the Chinese experience. *Ultrasound Q* 2001; **17**: 63-68 [PMID: 12973089 DOI: 10.1097/00013644-200103000-00006]
72 **Hatanaka H**, Yamamoto H, Yano T, Ushio J, Tomiyama T, Wada S, Sakamoto H, Okada M, Tamada K, Sugano K. Double-balloon endoscopy for hepatolithiasis with multiple stones associated with reflux of intestinal contents into the bile duct in a patient with Roux-en-Y hepaticojejunostomy. *Dig Endosc* 2012; **24**: 479 [PMID: 23078448 DOI: 10.1111/j.1443-1661.2012.01336.x]
73 **Atkinson M**, Happey MG, Smiddy FG. Percutaneous transhepatic cholangiography. *New Methods Diagn Res* 1960; **1**: 357-365
74 **Takada T**, Uchiyama K, Yasuda H, Hasegawa H. Indications for the choledochoscopic removal of intrahepatic stones based on the biliary anatomy. *Am J Surg* 1996; **171**: 558-561 [PMID: 8678199 DOI: 10.1016/s0002-9610(96)00041-4]
75 **Chen C**, Huang M, Yang J, Yang C, Yeh Y, Wu H, Chou D, Yueh S, Nien C. Reappraisal of percutaneous transhepatic cholangioscopic lithotomy for primary hepatolithiasis. *Surg Endosc* 2005; **19**: 505-509 [PMID: 15959714 DOI: 10.1007/s00464-004-8125-5]
76 **Wang P**, Sun B, Huang B, Xie J, Liu Y, Zhu C, Ye C, Zhou Z. Comparison Between Percutaneous Transhepatic Rigid Cholangioscopic Lithotripsy and Conventional Percutaneous Transhepatic Cholangioscopic Surgery for Hepatolithiasis Treatment. *Surg Laparosc Endosc Percutan Tech* 2016; **26**: 54-59 [PMID: 26679679 DOI: 10.1097/SLE.0000000000000222]
77 **Lorio E**, Patel P, Rosenkranz L, Patel S, Sayana H. Management of Hepatolithiasis: Review of the Literature. *Curr Gastroenterol Rep* 2020; **22**: 30 [PMID: 32383039 DOI: 10.1007/s11894-020-00765-3]
78 **McLean KA**, Drake TM, Sgrò A, Camilleri-Brennan J, Knight SR, Ots R, Adair A, Wigmore SJ, Harrison EM. The effect of liver

transplantation on patient-centred outcomes: a propensity-score matched analysis. *Transpl Int* 2019; **32**: 808-819 [PMID: 30793373 DOI: 10.1111/tri.13416]

79 **Stravitz RT**, Lee WM. Acute liver failure. *Lancet* 2019; **394**: 869-881 [PMID: 31498101 DOI: 10.1016/S0140-6736(19)31894-X]

80 **Yau AA**, Farouk SS. Severe hypercalcemia preceding a diagnosis of Pneumocystis jirovecii pneumonia in a liver transplant recipient. *BMC Infect Dis* 2019; **19**: 739 [PMID: 31438872 DOI: 10.1186/s12879-019-4370-z]

81 **Martins PN**, Selzner M, Dayangac M, Ling Q, Ng KT, Huang KT, Taner T, Mas VR, Ekser B. What Is Hot and New in Basic Science in Liver Transplantation in 2018? Report of the Basic Science Committee of the International Liver Transplantation Society. *Transplantation* 2019; **103**: 654-659 [PMID: 30801512 DOI: 10.1097/TP.0000000000002617]

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