Mini-Review

DOI: 10.5582/irdr.2017.01027

Surgical management of hepatolithiasis: A minireview

Chuan Li, Tianfu Wen*

Department of Liver Surgery, West China Hospital of Sichuan University, Chengdu, China.

Summary **Hepatolithiasis is highly prevalent in Asia but rare in Western countries. However, the incidence of hepatolithiasis may be increasing in Western countries due to the increased rate of immigration from areas where hepatolithiasis is prevalent. There are many non-surgical treatments for hepatolithiasis, but surgical management remains the best curative treatment for some cases of hepatolithiasis. Surgical treatments can remove biliary stones and relieve stricture of the bile ducts. This review describes the indications for and the outcomes of surgical treatment of hepatolithiasis, including liver resection and liver transplantation.**

Keywords: Liver resection, liver transplantation, hepatolithiasis

1. Introduction

The incidence of hepatolithiasis varies. It is highly prevalent in parts of Asia, such as China, Japan, and South Korea, with a reported incidence between 3.1% and 21.2% (*1-3*). However, hepatolithiasis is rare in Western countries, with an incidence of about 1% (*2,4*). The mechanism by which hepatolithiasis develops has yet to be fully elucidated. Studies have suggested that cholestasis, cholangitis, an anatomical abnormality of the bile ducts, abnormal bile metabolism, malnutrition, and low socio-economic status are risk factors for hepatolithiasis (*5,6*). The incidence of hepatolithiasis may decrease in areas where the condition is prevalent because people in those areas have adopted a Western diet. A Japanese nationwide survey reported that the relative prevalence of hepatolithiasis was 4.1% in the years from 1970-1977, 3.0% in the years from 1975-1984, 2.3% in the years from 1985-1988, 2.2% in the years from 1989-1992, and 1.7% in the years from 1993-1995 (*6,7*). However, the incidence of hepatolithiasis may be increasing in Western countries due to the increasing rate of immigration from areas where hepatolithiasis is prevalent.

Released online in J-STAGE as advance publication May 28, 2017.

**Address correspondence to:*
Dr. Tianfu Wen, Department of Liver Surgery, West China Hospital of Sichuan University, Chengdu 610041, China.
E-mail: lichuan85@163.com

2. Surgical treatments

According to Japanese nationwide surveys over a period of 40 years, the primary treatments of hepatolithiasis in the 1970s were cholecystectomy with stone removal and insertion of a T-tube. Surgery was used for primary management of hepatolithiasis until 1998. However, its use later decreased (76.6% in 1998; 52.4% in 2006; 33.3% in 2011, including surgical and non-surgical treatment) (*7*). In contrast, use of nonsurgical treatments, including endoscopic retrograde cholangiography and percutaneous transhepatic cholangioscopic lithotomy, has markedly increased. However, endoscopic retrograde cholangiography with stone removal results in more residual or recurrent stones than surgery does (*7*).

3. Indications for hepatectomy

Studies have reported that hepatectomy is indicated for treatment of hepatolithiasis in the following instances: (*i*) unilobar hepatolithiasis, and particularly that on the left; (*ii*) atrophy or severe fibrosis of the affected liver segments or lobe; (*iii*) presence of a liver abscess; (*iv*) cholangiocarcinoma; and (*v*) multiple intrahepatic stones causing marked biliary stricture or dilation (*8-12*).

In China, Dong proposed a system for classification (Table 1) of hepatolithiasis (*13*). Dong also proposed corresponding treatments for different classes of hepatolithiasis (*13*). Dong suggested that patients with type I or type IIb hepatolithiasis are the best candidates for hepatectomy, whereas patients with type

Table 1. Dong's classification of hepatolithiasis

Type	Definition or content
Type I	Localized stones: unilobar or bilobar
Type II	Diffusely distributed stones
IIa	Without hepatic atrophy; no stricture of the intrahepatic bile ducts
IIb	Atrophy limited in segment or/and stricture of the intrahepatic bile ducts.
IIc	With biliary cirrhosis and portal hypertension
Additional Type E	Extrahepatic stones
Ea	Normal sphincter of Oddi
Eb	Relaxation of the sphincter of Oddi.
Ec	Stricture of the sphincter of Oddi.

IIc hepatolithiasis should undergo liver transplantation (*13*). Moreover, a hepaticojejunostomy should also be performed to treat "Eb" and "Ec" hepatolithiasis (*13*).

4. Outcomes of hepatectomy for treatment of hepatolithiasis

Chen *et al.* (*10*) reported outcomes for 103 consecutive patients with hepatolithiasis who underwent a hepatectomy between 1989 and 2001. Ninety percent of those patients had immediate stone clearance, and 98% had final stone clearance after subsequent choledochoscopic lithotomy via a T-tube tract or cutaneous stoma (*10*). Twenty-eight percent of the 103 patients suffered postoperative complications and 2% died (*10*). Uenishi *et al*. (*14*) reported outcomes for 86 patients who underwent a hepatectomy from 1998 to 2012. Seventy-six patients (88%) had immediate stone clearance whereas 82 patients (95%) had final stone clearance (*14*). Li *et al*. (*15*) reported outcomes for 718 patients who underwent a hepatectomy. The immediate stone clearance rate was 93.5% for patients with unilateral hepatolithiasis and 71.1% for patients with bilateral hepatolithiasis. The final clearance rate was 99.3% for patients with unilateral hepatolithiasis and 90.2% for patients with bilateral hepatolithiasis (*15*). The mortality rate for hepatectomy was 0.4% (*15*). Yang *et al*. reported that the immediate stone clearance rate was 81.5% after bilateral hepatectomy and 65.9% after unilateral hepatectomy while the final clearance rate was 85.2% after bilateral hepatectomy and 81.7% after unilateral hepatectomy (*16*). Liver resection can also be performed on some patients with complex hepatolithiasis. Dong *et al*. reported outcomes for 12 patients with complex hepatolithiasis who underwent a subtotal hepatectomy (*17*). After surgery, one patient died from acute purulent cholangitis (*17*). The remaining 11 patients recovered without recurrent cholangitis (*17*).

Some techniques may improve the effectiveness with which hepatectomy treats hepatolithiasis. Fang *et al*. (*18*) suggested that hepatectomy for bilateral hepatolithiasis based on three-dimensional reconstruction resulted in a higher rate of stone clearance than conventional treatment. Both immediate (96.1% versus 81%) and final clearance rates (100% versus 90.5%) were improved by use of three-dimensional reconstruction (*18*). Guan *et al*. also reported similar results (*19*). Jarufe *et al*. (*20*) suggested that anatomical hepatectomy may reduce the incidence of postoperative complications and postoperative recurrence for patients with hepatolithiasis. A study by Jiang *et al*. (*21*) suggested that anatomical hepatectomy for treatment of hepatolithiasis was associated with fewer residual stones, fewer infections, and a lower incidence of bile leakage.

5. Laparoscopic hepatectomy for treatment of hepatolithiasis

Laparoscopic hepatectomy is a minimally invasive treatment for hepatolithiasis. Laparoscopic treatments may result in satisfactory outcomes for select patients with hepatolithiasis. Lai *et al*. (*22*) reported outcomes for 55 consecutive patients with hepatolithiasis who underwent a laparoscopic hepatectomy or bile duct exploration. The immediate stone clearance rate was 90.9% and the final stone clearance rate was 94.5% (*22*). During the follow-up period, only 3 patients suffered from recurrence (*22*). Ye *et al*. (*23*) reported outcomes for 36 patients who underwent a purely laparoscopic left hemihepatectomy for hepatolithiasis. Residual stones were noted in only 2 patients (*23*). Stones recurred after surgery in 2 patients (*23*). Namgoong *et al*. (*24*) compared the outcomes of laparoscopic versus open left hemihepatectomy for treatment of hepatolithiasis. Laparoscopic hepatectomy was associated with a longer operating time, briefer hospitalization, a lower postoperative morbidity, and a higher stone clearance rate (*24*). Ye *et al*. also noted similar results (*25*). However, Jin *et al*. (*26*) suggested that laparoscopic and open hepatectomy resulted in a similar operating time, duration of postoperative hospitalization, postoperative morbidity, rate of residual stones, and rate of recurrent stones. Recently, a systemic review and meta-analysis by Peng *et al*. (*27*) suggested that patients who underwent

a laparoscopic hepatectomy had significantly fewer intraoperative transfusions and overall complications and a significantly briefer duration of hospitalization. However, laparoscopic and open hepatectomy had a similar operating time and resulted in a similar rate of residual and recurrent stones.

6. Factors associated with postoperative recurrence

Many risk factors are associated with the postoperative recurrence of stones. Li *et al*. (*15*) found that bilateral stones and limited resection of the liver (*i.e*. not all segments affected by stones were resected) were two independent risk factors for the postoperative recurrence of stones. A study of surgical and non-surgical treatment of hepatolithiasis suggested that non-surgical treatment, biliary cirrhosis, residual stones, and strictures were risk factors for the recurrence of stones (*28*). In a study of patients with hepatolithiasis in whom stones were merely removed, Cheung *et al*. suggested that bilateral stones, strictures, and atrophy were related to the postoperative recurrence of stones (*29*).

7. Liver transplantation for treatment of hepatolithiasis

Liver transplantation is an effective treatment for terminal hepatolithiasis. According to Dong's classification, liver transplantation should be undergone by patients with type IIc hepatolithiasis. In 2002, Strong *et al*. reported 4 liver transplants to treat hepatolithiasis (*30*). All patients had satisfactory outcomes after liver transplantation. Tang *et al*. reported a case of a patient with hepatolithiasis and situs inversus who underwent liver transplantation (*31*). The patient survived as of a 40-month follow-up. Chen *et al*. reported outcomes for 15 patients with hepatolithiasis who underwent liver transplantation (*32*). Two of those patients had cholangiocarcinoma. After liver transplantation, the 1-year survival rate was 100% and the 5-year survival rate was 73%. Although studies have suggested that liver transplantation results in satisfactory outcomes for patients with hepatolithiasis, no study has examined this point in a large sample.

Acknowledgements

This study was supported by grants from the Project for Scientific and Technological Support of Sichuan Province (2016SZ0025) and the Health and Family Planning Commission of Sichuan Province (17PJ393).

References

1. Nakayama F, Soloway RD, Nakama T, *et al*. Hepatolithiasis in East Asia. Retrospective study. Dig Dis Sci. 1986; 31:21-26.
2. Shoda J, Tanaka N, Osuga T. Hepatolithiasis – Epidemiology and pathogenesis update. Front Biosci. 2003; 8:e398-409.
3. Su CH, Lui WY, P'Eng FK. Relative prevalence of gallstone diseases in Taiwan. A nationwide cooperative study. Dig Dis Sci. 1992; 37:764-768.
4. Pausawasdi A, Watanapa P. Hepatolithiasis: Epidemiology and classification. Hepatogastroenterology. 1997; 44:314-316.
5. Ran X, Yin B, Ma B. Four Major Factors Contributing to Intrahepatic Stones. Gastroenterol Res Pract. 2017; 2017:7213043.
6. 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.
7. 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.
8. Chijiiwa K, Yamashita H, Yoshida J, Kuroki S, Tanaka M. Current management and long-term prognosis of hepatolithiasis. Arch Surg. 1995; 130:194-197.
9. Uchiyama K, Onishi H, Tani M, Kinoshita H, Ueno M, Yamaue H. Indication and procedure for treatment of hepatolithiasis. Arch Surg. 2002; 137:149-153.
10. Chen DW, Tung-Ping Poon R, Liu CL, Fan ST, Wong J. Immediate and long-term outcomes of hepatectomy for hepatolithiasis. Surgery. 2004; 135:386-393.
11. Sakpal SV, Babel N, Chamberlain RS. Surgical management of hepatolithiasis. HPB (Oxford). 2009; 11:194-202.
12. 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.
13. Feng X, Zheng S, Xia F, Ma K, Wang S, Bie P, Dong J. Classification and management of hepatolithiasis: A high-volume, single-center's experience. Intractable Rare Dis Res. 2012; 1:151-156.
14. Uenishi T, Hamba H, Takemura S, Oba K, Ogawa M, Yamamoto T, Tanaka S, Kubo S. Outcomes of hepatic resection for hepatolithiasis. Am J Surg. 2009; 198:199-202.
15. Li SQ, Liang LJ, Peng BG, Hua YP, Lv MD, Fu SJ, Chen D. Outcomes of liver resection for intrahepatic stones: A comparative study of unilateral versus bilateral disease. Ann Surg. 2012; 255:946-953.
16. Yang T, Lau WY, Lai EC, Yang LQ, Zhang J, Yang GS, Lu JH, Wu MC. Hepatectomy for bilateral primary hepatolithiasis: A cohort study. Ann Surg. 2010; 251:84-90.
17. Dong J, Lau WY, Lu W, Zhang W, Wang J, Ji W. Caudate lobe-sparing subtotal hepatectomy for primary hepatolithiasis. Br J Surg. 2012; 99:1423-1428.
18. Fang CH, Liu J, Fan YF, Yang J, Xiang N, Zeng N. Outcomes of hepatectomy for hepatolithiasis based on 3-dimensional reconstruction technique. J Am Coll Surg. 2013; 217:280-288.
19. Guan T, Fang C, Mo Z, Xiang N, Yang J, Zeng N. Long-Term Outcomes of Hepatectomy for Bilateral Hepatolithiasis with Three-Dimensional Reconstruction: A Propensity Score Matching Analysis. J Laparoendosc Adv Surg Tech A. 2016; 26:680-688.
20. Jarufe N, Figueroa E, Munoz C, Moisan F, Varas J, Valbuena JR, Bambs C, Martinez J, Pimentel F. Anatomic hepatectomy as a definitive treatment for hepatolithiasis:

A cohort study. HPB (Oxford). 2012; 14:604-610.
21. Jiang H, Wu H, Xu YL, Wang JZ, Zeng Y. An appraisal of anatomical and limited hepatectomy for regional hepatolithiasis. HPB Surg. 2010; 2010:791625.
22. Lai EC, Ngai TC, Yang GP, Li MK. Laparoscopic approach of surgical treatment for primary hepatolithiasis: A cohort study. Am J Surg. 2010; 199:716-721.
23. Ye X, Ni K, Zhou X, Xie K, Hong X. Laparoscopic Left Hemihepatectomy for Left-sided Hepatolithiasis. Surg Laparosc Endosc Percutan Tech. 2015; 25:347-350.
24. Namgoong JM, Kim KH, Park GC, Jung DH, Song GW, Ha TY, Moon DB, Ahn CS, Hwang S, Lee SG. Comparison of laparoscopic versus open left hemihepatectomy for left-sided hepatolithiasis. Int J Med Sci. 2014; 11:127-133.
25. Ye X, Ni K, Zhou X, Xie K, Hong X. Laparoscopic versus open left hemihepatectomy for hepatolithiasis. J Surg Res. 2015; 199:402-406.
26. 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.
27. Peng L, Xiao J, Liu Z, Li Y, Xiao W. Laparoscopic Versus Open Left-Sided Hepatectomy for Hepatolithiasis: A Systematic Review and Meta-Analysis. J Laparoendosc Adv Surg Tech A. 2016.
28. Cheon YK, Cho YD, Moon JH, Lee JS, Shim CS. Evaluation of long-term results and recurrent factors after operative and nonoperative treatment for hepatolithiasis. Surgery. 2009; 146:843-853.
29. Cheung MT, Kwok PC. Liver resection for intrahepatic stones. Arch Surg. 2005; 140:993-997.
30. Strong RW, Chew SP, Wall DR, Fawcett J, Lynch SV. Liver transplantation for hepatolithiasis. Asian J Surg. 2002; 25:180-183.
31. Tang DN, Wei JM, Liu YN, Qiao JC, Zhu MW, He XW. Liver transplantation in an adult patient with situs inversus: A case report and overview of the literature. Transplant Proc. 2008; 40:1792-1795.
32. Chen ZY, Yan LN, Zeng Y, Wen TF, Li B, Zhao JC, Wang WT, Yang JY, Xu MQ, Ma YK, Wu H. Preliminary experience with indications for liver transplantation for hepatolithiasis. Transplant Proc. 2008; 40:3517-3522.

(Received April 14, 2017; Revised May 20, 2017; Accepted May 23, 2017)