World Journal of Gastroenterology

Online Submissions: http://www.wjgnet.com/1007-9327office
wjg@wjgnet.com
doi:10.3748/wjg.v17.i38.4339

World J Gastroenterol 2011 October 14; 17(38): 4339-4343
ISSN 1007-9327 (print) ISSN 2219-2840 (online)

BRIEF ARTICLE

Comparison of laparoscopic and open surgery for pyogenic liver abscess with biliary pathology

Jin-Fu Tu, Xiu-Fang Huang, Ru-Ying Hu, He-Yi You, Xiao-Feng Zheng, Fei-Zhao Jiang

Jin-Fu Tu, Xiu-Fang Huang, Ru-Ying Hu, He-Yi You, Xiao-Feng Zheng, Fei-Zhao Jiang, Department of Laparoscopic Surgery, the First Affiliated Hospital of Wenzhou Medical College, Wenzhou 325000, Zhejiang Province, China

Author contributions: Tu JF wrote the paper; Huang XF and Hu RY collected and analyzed the data; Jiang FZ, Tu JF and You HY performed the laparoscopic operation; Zheng XF revised the manuscript.

Correspondence to: Dr. Jin-Fu Tu, Department of Laparoscopic Surgery, the First Affiliated Hospital of Wenzhou Medical College, Wenzhou 325000, Zhejiang Province, China. tujinfu@sina.com

Telephone: +86-577-88069206 Fax: +86-577-88069555
Received: February 26, 2011 Revised: May 19, 2011
Accepted: May 26, 2011
Published online: October 14, 2011

Abstract

AIM: To investigate the feasibility and therapeutic effect of laparoscopic surgery for pyogenic liver abscess (PLA) with biliary pathology.

METHODS: From January 2004 to October 2010, 31 patients with PLA combined with biliary pathology meeting entry criteria received surgical management in our hospital. Of the 31 patients, 13 underwent laparoscopic surgery (LS group) and 18 underwent open surgery (OS group). Clinical data including operation time, intraoperative blood loss, postoperative complication rate, length of postoperative hospital stay, and abscess recurrence rate were retrospectively analyzed and compared between the two groups.

RESULTS: All patients received systemic antibiotic therapy. Four patients underwent ultrasound-guided percutaneous catheter drainage before operation. Postoperative complications occurred in 5 patients (16.1%, 5/31) including 2 in the LS group and 3 in the OS group. One patient had retained calculus in the common bile duct and another had liver abscess recurrence in the OS group. No retained calculus and liver abscess recurrence occurred in the LS group. In the two groups, there was no mortality during the perioperative period. There were no significant differences in operation time, intraoperative blood loss and transfusion, postoperative complication rate and abscess recurrence rate between the two groups. Oral intake was earlier (1.9 ± 0.4 d *vs* 3.1 ± 0.7 d, $P < 0.05$) and length of postoperative hospital stay was shorter (11.3 ± 2.9 d *vs* 14.5 ± 3.7 d, $P < 0.05$) in the LS group than in the OS group.

CONCLUSION: Laparoscopic surgery for simultaneous treatment of PLA and biliary pathology is feasible in selected patients and the therapeutic effect is similar to that of open surgery.

Key words: Liver abscess; Biliary; Laparoscopy; Surgery; Therapeutic effect

Peer reviewer: Jon C Gould, MD, FACS, Associate Professor of Surgery, University of Wisconsin School of Medicine and Public Health, 600 Highland Avenue, H4/726, Madison, WI 53792, United States

Tu JF, Huang XF, Hu RY, You HY, Zheng XF, Jiang FZ. Comparison of laparoscopic and open surgery for pyogenic liver abscess with biliary pathology. *World J Gastroenterol* 2011; 17(38): 4339-4343 Available from: URL: http://www.wjgnet.com/1007-9327/full/v17/i38/4339.htm DOI: http://dx.doi.org/10.3748/wjg.v17.i38.4339

INTRODUCTION

Pyogenic liver abscess (PLA) is a potentially fatal disease. Before the 1970s open surgical drainage was often adopted for the treatment of PLA. With the development of imaging techniques, ultrasound or computed tomography (CT)-guided percutaneous catheter drainage combined with systemic antibiotics has become the preferred treatment, and mortality has significantly decreased[1-3]. In

some conditions such as percutaneous drainage failure or underlying biliary pathology, surgery is still required[4-6]. With the development of laparoscopic instruments and techniques, laparoscopic liver abscess drainage has become popular[7-11]. Compared with conventional open liver abscess drainage, laparoscopic drainage has some advantages in operation time, postoperative recovery and length of hospital stay[10,11]. However, little research has been done on laparoscopic surgery (LS) for simultaneous treatment of both PLA and biliary pathology. The purpose of this study was to explore the safety and feasibility of laparoscopic or open surgery (OS) for simultaneous treatment of both PLA and biliary pathology, and to compare the therapeutic effects of the two methods through retrospective analysis of 31 patients with PLA meeting entry criteria.

MATERIALS AND METHODS

Patients

From January 2004 to October 2010, 348 patients with PLA were treated in our hospital. Of the 348 patients, 31 met entry criteria. The entry criteria included (1) ultrasound, CT, surgery or pathogen culture-diagnosed PLA combined with biliary pathology including gallstone, choledocholith, hepatolithus, biliary stricture and biliary tract neoplasms; (2) simultaneous surgical treatment for both PLA and underlying biliary pathology. Patients undergoing drainage of liver abscess alone were excluded. Of the 31 patients with PLA, 13 underwent LS (LS group) and 18 OS (OS group). In the 13 patients in the LS group, 5 patients were men and 8 women, with a mean age of 57.5 years (range 37-69). In the 18 patients in the OS group, 8 patients were men and 10 women, with a mean age of 55.8 years (range 35-73). Fever and/or chills were common, then abdominal pain. Most patients had right upper quadrant tenderness. Symptoms and signs of patients are shown in Table 1.

Routine blood analysis, liver function tests and blood coagulation assays were performed in all patients. Increased white blood cell count was the most common laboratory abnormality in these patients (Table 2). Abdominal ultrasound examination was performed in 31 patients, and indicated liver abscess in 30 patients and biliary pathology in 28 patients. CT scan and contrast-enhanced CT scan were performed in 30 patients, and indicated liver abscess in 30 patients and biliary pathology in 26 patients. Magnetic resonance imaging (MRI) was performed in 5 patients, and indicated liver abscess in 5 patients, choledocholith in 3 patients and cholecystolithiasis in 2 patients. In the 13 patients from the LS group, 5 patients had right liver abscess, 7 left liver abscess and one both right and left liver abscess; 11 patients had single liver abscess and 2 multiple liver abscesses; and 5 patients had > 5 cm diameter liver abscess. In the 18 patients from the OS group, 9 patients had right liver abscess, 7 left liver abscess and 2 both right and left liver abscess; 15 patients had single liver abscess and 3 multiple liver abscesses; and 10 patients had > 5 cm-diameter liver abscess. In the 13 patients from the LS group, 6 patients had cholecystolithiasis combined with acute cholecystitis; 3 patients had choledocholith cholangitis (2 also had cholecystolithiasis); 3 patients had left multiple hepatolithiasis (one also had choledocholith); one patient had left intrahepatic biliary stricture. In the 18 patients from the OS group, 7 patients had cholecystolithiasis combined with acute cholecystitis (one also had primary gallbladder cancer); 5 patients had choledocholith cholangitis (2 also had cholecystolithiasis and one right hepatolithiasis); 4 patients had left multiple hepatolithiasis (one also had choledocholith); one patient had left intrahepatic biliary stricture; and another one had intrahepatic bile duct cystadenoma combined with hepatolithiasis (Table 3). Among the 31 patients, aerobic bacterium culture was positive in 21 patients. The common bacteria were colibacillus, then *Klebsiella pneumoniae*. Three of the 13 patients in the LS group had diabetes mellitus. Four of the 18 patients in the OS group had diabetes mellitus, 2 patients had hypertensive disease, one patient had a history of biliary surgery and another patient had a history of two-time biliary surgery. There were no statistic differences in age, sex, clinical manifestations, characteristics of liver abscess and underlying biliary pathology between the two groups.

Operative techniques

Laparoscopic liver abscess drainage: After general anesthesia, a small cut below the umbilicus was made followed by establishing pneumoperitoneum and placing a laparoscope into the peritoneal cavity. The pore site positions were determined according to the size and position of liver abscess. Under laparoscopy, the adhesions of the liver with the abdominal wall or diaphragm were separated using electrocautery. In large and superficial liver abscess, the surface of the liver was locally elevated with gray-and-white or yellowish-white color. After aspirating pus from the liver abscess through paracentesis, a small hole was made on the elevated or thinnest surface of the liver abscess. The abscess cavity was then unroofed using electrocautery, and samples were routinely obtained for bacterial culture and drug sensitivity testing. Debridement and irrigation of the abscess cavity were performed. Laparoscopic cholecystectomy or common bile duct exploration for calculus removed was routinely carried out. Laparoscopic left hepatolobectomy was performed as previously described[12]. Thick latex drainage tubes were left in the abscess cavity and subhepatic space, respectively. When B-ultrasonic image or CT confirmed abscess cavity collapse or closure 6-9 d after operation, and 24-hour drainage liquid was less than 20 mL, drainage tubes might be removed.

Open surgery: A right subcostal incision or a superior median abdominal incision was made to explore abdominal lesions. The position of the liver abscess was determined through paracentesis, and then hemostatic forceps entered the abscess cavity along the paracentetic needle to remove pus and separate fibrous septa. A latex drainage tube was left. At the same time, biliary pathology was also treated.

Clinical data including operation time, intraoperative

Table 1 Clinical manifestation of patients with pyogenic liver abscesses

Variables	LS group (n = 13)	OS group (n = 18)
Fever/chills	11	17
Abdominal pain	10	14
Vomiting	8	10
Jaundice	5	8
Septic shock	1	1
RUQ tenderness	10	15
Murphy's sign	6	7
Hepatomegally	4	6

LS: Laparoscopic surgery; OS: Open surgery; RUQ: Right upper quadrant.

Table 2 Initial laboratory values for pyogenic liver abscesses

Parameter	LS group (n = 13)	OS group (n = 18)
WBC count (> 10 000/mL)	12	18
Serum albumin (< 35 g/L)	8	11
Total bilirubin (> 20 μmol/L)	7	10
AST (> 60 U/L)	6	9
Serum creatinine (> 80 μmol/L)	2	3
PT (> 14.8 s)	2	2

LS: Laparoscopic surgery; OS: Open surgery; WBC: White blood cell; AST: Aspartate aminotransferase; PT: Prothrombin time.

Table 3 Origin of pyogenic liver abscesses

Variables	LS group (n = 13)	OS group (n = 18)
Cholelithiasis	6	7
Choledocholithiasis	3	5
Hepatolithiasis	3	4
Intrahepatic biliary stricture	1	1
Biliary cystadenoma	0	1

LS: Laparoscopic surgery; OS: Open surgery.

blood loss, postoperative complication rate, length of postoperative hospital stay, and abscess recurrence rate were compared between the two groups.

Statistical analysis

Categorical parameters in each group were compared by the chi-square test, and continuous parameters were compared using independent sample t test. All analyses were performed using SPSS 12.0, and $P < 0.05$ was considered statistically significant.

RESULTS

All patients received systemic antibiotic therapy. Four patients (one patient in the LS group and 3 patients in the OS group) underwent ultrasound-guided percutaneous catheter drainage before surgery. Preoperative drainage lasted 2-8 d. After percutaneous catheter drainage, diameters of liver abscesses were decreased by 2-5 cm in 3 patients, while in another patient, the diameter of liver abscess was unchanged due to inadequate drainage. In 7 patients with diabetes mellitus, blood glucose levels were all controlled under 10 mmol/L by administration of insulin. General anesthesia was performed in 31 patients through endotracheal intubation. In the LS group, 6/13 patients received laparoscopic liver abscess drainage and cholecystectomy; 3 patients received liver abscess drainage, cholecystectomy, common bile duct exploration and T tube drainage; 2 patients with hepatolithiasis limited to the left lateral segment combined with liver abscess received left lateral segmentectomy, and of these 2 patients, one also received cholecystectomy, common bile duct exploration and T tube drainage; one patient with left hepatic duct stenostomia and another patient with hepatolithiasis limited in left hepatic lobe received laparoscopic left hemihepatectomy. In the OS group, 7/18 patients received laparoscopic liver abscess drainage and cholecystectomy, and of these 7 patients, one with gallbladder cancer also received radical cholecystectomy; 5 patients received liver abscess drainage and common bile duct exploration, and of these 5 patients, primary closure of the bile duct was performed in 2 patients and T tube drainage in 3 patients, and 4 patients also received cholecystectomy; 4 patients received left lateral segmentectomy, and of these 4 patients, two also received cholecystectomy, common bile duct exploration and T tube drainage; 2 patients received hemihepatectomy, and one of these patients also received cholecystectomy, common bile duct exploration and T tube drainage (Table 4).

Table 4 Operative procedures performed on the patients

Operative procedures	LS group (n = 13)	OS group (n = 18)
Drainage of abscess with cholecystectomy	6	7
Drainage of abscess with CBD exploration/and cholecystectomy	3	5
Left lateral segmentectomy	2	4
Left hemihepatectomy	2	2

LS: Laparoscopic surgery; OS: Open surgery; CBD: Common bile duct.

Postoperative complications occurred in 5 patients (2 patients in the LS group and 3 in the OS group, 16.1%). In the LS group, one patient had biliary leakage (100-200 mL of bile per day), and it automatically healed 7 d after drainage; another patient had right hydrothorax, and it was relieved 4 d after closed drainage. In the OS group, early postoperative inflammatory ileus occurred in one patient who recovered 10 d after conservative treatment; subphrenic abscess occurred in one patient and was relieved 8 d after ultrasound-guided puncture; and incision infection occurred in one patient who showed second-class healing after changing dressings. In the OS group, one patient had retained calculus in the common bile duct and left hospital with T tube, the retained calculus were removed using fibercholedochoscope 58 d after operation; liver abscess recurrence occurred in one patient 20 d after surgery and were relieved a week after systemic use of antibiotics and ultrasound-guided percutaneous cath-

Table 5 Comparison of results in laparoscopic surgery group and open surgery group

Variables	LS group (n = 13)	OS group (n = 18)
Operating time (min)	117 ± 27	112 ± 31
Intraoperative blood loss (mL)	139 ± 51	146 ± 47
Intraoperative blood transfusion (%)	1 (7.7)	1 (5.6)
Commencement of oral intake (d)	1.9 ± 0.4	3.1 ± 0.7
Postoperative complications (%)	2 (15.4)	3 (16.7)
Postoperative hospital stay (d)	11.3 ± 2.9	14.5 ± 3.7
Intermediate residual stone (%)	0 (0)	1 (5.6)
Abscess recurrence (%)	0 (0)	1 (5.6)
Perioperative mortality (%)	0 (0)	0 (0)

LS: Laparoscopic surgery; OS: Open surgery.

eter drainage. In the LS group, no retained calculus and liver abscess recurrence occurred. In the LS group, one patient was given 2U of concentrated red cells intravenously while in the OS group, one patient was given 4U of concentrated red cell intravenously. In the two groups, there was no mortality during the perioperative period. There were no significant differences in operation time, intraoperative blood loss and transfusion, postoperative complication rate and abscess recurrence rate between the two groups. Oral intake was earlier (1.9 ± 0.4 d *vs* 3.1 ± 0.7 d, $P < 0.05$) and length of postoperative hospital stay was shorter (11.3 ± 2.9 d *vs* 14.5 ± 3.7 d, $P < 0.05$) in the LS group than in the OS group (Table 5).

DISCUSSION

In the early 20th century, PLA was commonly secondary to pyelophlebitis caused by acute appendicitis. Since the mid 20th century, PLA has been mainly due to benign or malignant biliary pathology, accounting for about 40%-65%[1,13,14]. These common biliary lesions include cholecystolithiasis, intrahepatic and extrahepatic cholangiolithiasis, ascariasis of the biliary tract, biliary stricture and biliary tumor. When these biliary lesions lead to acute suppurative cholecystitis, acute suppurative cholangitis, and intrahepatic and extrahepatic cholangitis, bacteria may enter intrahepatic bile ducts and cholangioles to cause PLA. Perforation of gallbladder may also result in PLA[15]. Mezhir *et al*[5] have reported that 88% of patients with PLA have a history of malignant tumor including pancreatic cancer (36%), cholangiocarcinoma (17%), colon carcinoma (12%) and gallbladder cancer (10%) in 58 patients between 1998 and 2009. However, in India[14] and China[16], the main cause of PLA is still biliary calculi. Since the 1980s, the incidence of hepatolithiasis has been decreased and the incidence of cholecystolithiasis has been significantly increased. In China, cholecystolithiasis is increasingly becoming a main cause of PLA. In this study, the main causes of PLA were cholecystolithiasis and cholangiolithiasis

Before the 1970s, conservative treatment or open surgical drainage was mainly adopted for the treatment of PLA, but the mortality rate was as high as 65%[1]. With the development of imaging techniques and effective broad-spectrum antibiotics, image-guided percutaneous catheter drainage combined with systemic antibiotics have become preferred for the treatment of PLA, and the mortality rate is under 10%[2,3,17]. Image-guided percutaneous catheter drainage is suitable not only to unilocular abscess, but also to multiple unilocular abscesses and multiloculated abscess[2], and has some advantages including simple procedures, low cost and good therapeutic effect. However, percutaneous catheter drainage has some disadvantages. For example, multiple percutaneous drainages are required due to drainage tube block or inadequate drainage; it has the possibility of hepatic hemorrhea or pneumothorax; and it cannot simultaneously treat PLA with underlying hepatobiliary pathology.

Liver abscess surgical drainage and percutaneous drainage are complementary techniques. In this study, 4 patients received percutaneous drainage before operation, and following improvement of pathogenetic condition, underwent surgical management. Liver abscess open surgical drainage is suitable after percutaneous drainage failure or for patients having primary diseases such as biliary PLA, abscess rupture and so on[4-6]. Surgical drainage has some advantages including positioning accuracy, and simultaneous treatment of both abscess and primary diseases[4,14,18]. In this study, as well as liver abscess drainage laparoscopic cholecystectomy was also performed in 6 patients, open cholecystectomy was performed in 7 patients, laparoscopic common bile duct exploration for calculus removed was performed in 3 patients and open common bile duct exploration for calculus removed was performed in 5 patients. Hepatolobectomy is suitable for hepatolithiasis or hepatobiliary tumor combined with PLA[6,19]. In this study, 7 patients with hepatolithiasis combined with PLA underwent left lateral segmentectomy or left hemihepatectomy. Hepatolobectomy can achieve radical treatment results, because of removal of not only the abscess but also biliary stones, biliary stricture and hepatic lesions. Moreover, hepatolobectomy for treatment of hepatolithiasis combined with PLA is conducive to long-term prevention of biliary carcinogenesis. With the development of laparoscopic techniques, laparoscopic drainage may replace traditional open drainage in the treatment of PLA. A laparoscopic drainage group is better than an open drainage group in operation time, blood loss and length of hospital stay, and laparoscopic drainage is safe and feasible in patients who have no response to conservative treatment[10,11]. In this study, LS or OS were used to treat PLA combined with biliary pathology in 31 patients with a postoperative complication rate of 16.1%. In the two groups, there was no mortality during the perioperative period. There were no significant differences in operation time, intraoperative blood loss and transfusion, postoperative complication rate and abscess recurrence rate between the two groups. Oral intake was earlier and length of postoperative hospital stay was shorter in the LS group than in the OS group.

LS or OS for the concomitant treatment of both PLA and biliary pathology is suitable for (1) cholecystolithiasis, common bile duct calculi, ascariasis of biliary

tract, biliary stricture or biliary tumor-caused PLA; (2) vital signs stable, and tolerable anesthesia and surgery for the important organs such as heart, lung, liver and kidney. In patients with diabetes mellitus, the preoperative blood glucose level should be controlled under 10 mmol/L and sensitive broad-spectrum antibiotics should be given before and after operation. Preoperative ultrasound, CT and MRI indicate the conditions including abscess liquefaction, size of abscess cavity, pus volume, fibrous septa, abscess number and biliary pathology. If preoperative images indicate that the abscess cavity is deep, in order to prevent pus spill, fine needle aspiration is performed first, and thick needle puncture is done to remove pus. Radial incision from the porta hepatic may avoid the damage to intrahepatic bile ducts and blood vessels. If aspirated pus is significantly less than expected pus, there may be fibrous septa in the abscess and the incision should be extended to explore abscess cavities. During separation of fibrous septa of the abscess cavity, the hepatic frame structure cannot be transected and the separated stick should not enter normal tissue through the abscess cavity wall. Pulse-like arterial hemorrhage can be stopped by occlusion with titanium clips. Since adhesions are often severe in the cystohepatic triangle, cholecystectomy requires careful separation to avoid damage to the bile ducts. The key of laparoscopic hepatectomy is to prevent and control intraoperative hemorrhea[12].

In summary, for the treatment of most PLA, ultrasound-guided percutaneous catheter drainage combined with systemic antibiotics is preferred. In selected patients with biliary PLA, laparoscopic or open surgery for simultaneous treatment of PLA with underlying biliary pathology is safe and feasible. Laparoscopic surgery has advantages in postoperative recovery of gastrointestinal function and length of postoperative hospital stay.

COMMENTS

Background

Pyogenic liver abscess (PLA) is a potentially fatal disease. Before the 1970s, open surgical drainage was often adopted for the treatment of PLA. With the development of imaging techniques, ultrasound or computed tomography-guided percutaneous catheter drainage combined with systemic antibiotics has become preferred, and the mortality has been significantly decreased. In some conditions such as percutaneous drainage failure or underlying biliary pathology, surgery is still required. With the development of laparoscopic instruments and techniques, laparoscopic liver abscess drainage has become popular. Compared with conventional open liver abscess drainage, laparoscopic drainage has some advantages in operation time, postoperative recovery and length of hospital stay. However, little research has been done on laparoscopic surgery for simultaneous treatment of both PLA and biliary pathology.

Research frontiers

The feasibility and therapeutic effect of laparoscopic surgery for simultaneous treatment of both PLA and biliary pathology is a hotspot.

Innovations and breakthroughs

This study was performed to explore the safety and feasibility of laparoscopic or open surgery for simultaneous treatment of both PLA and biliary pathology, and to compare the therapeutic effects of the two methods through retrospective analysis of 31 patients with PLA meeting entry criteria

Applications

In selected patients with biliary PLA, laparoscopic or open surgery for simultaneous treatment of PLA and biliary pathology is safe and feasible. Laparoscopic surgery has advantages in postoperative recovery of gastrointestinal function and length of postoperative hospital stay.

Terminology

PLA is the result of bacterial infection of the liver parenchyma, with subsequent infiltration by inflammatory cells and formation of a collection of pus.

Peer review

This is a nice case series. The numbers of patients are obviously small, and meaningful comparisons between the 2 groups are difficult.

REFERENCES

1 **Huang CJ,** Pitt HA, Lipsett PA, Lipsett PA, Osterman FA, Lillemoe KD, Cameron JL, Zuidema GD. Pyogenic hepatic abscess. Changing trends over 42 years. *Ann Surg* 1996; **223**: 600-607

2 **Liu CH**, Gervais DA, Hahn PF, Arellano RS, Uppot RN, Mueller PR. **Percutaneous hepatic abscess drainage: do multiple** abscesses or multiloculated abscesses preclude drainage or affect outcome? *J Vasc Interv Radiol* 2009; **20**: 1059-1065

3 **O'Farrell N**, Collins CG, McEntee GP. Pyogenic liver abscesses: diminished role for operative treatment. *Surgeon* 2010; **8**: 192-196

4 **Ng SS**, Lee JF, Lai PB. Role and outcome of conventional surgery in the treatment of pyogenic liver abscess in the modern era of minimally invasive therapy. *World J Gastroenterol* 2008; **14**: 747-751

5 **Mezhir JJ**, Fong Y, Jacks LM, Getrajdman GI, Brody LA, Covey AM, Thornton RH, Jarnagin WR, Solomon SB, Brown KT. Current management of pyogenic liver abscess: surgery is now second-line treatment. *J Am Coll Surg* 2010; **210**: 975-983

6 **Chung YF**, Tan YM, Lui HF, Tay KH, Lo RH, Kurup A, Tan BH. Management of pyogenic liver abscesses - percutaneous or open drainage? *Singapore Med J* 2007; **48**: 1158-**1165; quiz 1165**

7 **Yanaga K**, Kitano S, Hashizume M, Ohta M, Matsumata T, Sugimachi K. Laparoscopic drainage of pyogenic liver abscess. *Br J Surg* 1994; **81**: 1022

8 **Tay KH**, Ravintharan T, Hoe MN, See AC, Chng HC. Laparoscopic drainage of liver abscesses. *Br J Surg* 1998; **85**: 330-332

9 **Rozanski M**, Neuhaus V, Fahrner R, Schoeb O. Successful laparoscopic treatment of a hepatic abscess due to a chicken bone. *Am Surg* 2010; **76**: 1027-1028

10 **Zhang YD,** Li J, Li NF. **Laparoscopic drainage in treatment of** liver abscess(report of 46 cases). *Zhongguo Neijing Zazhi* 2004; **10:** 10-14

11 **Wang W**, Lee WJ, Wei PL, Chen TC, Huang MT. **Laparo**scopic drainage of pyogenic liver abscesses. *Surg Today* 2004; **34**: 323-325

12 **Tu JF**, Jiang FZ, Zhu HL, Hu RY, Zhang WJ, Zhou ZX. Laparoscopic vs open left hepatectomy for hepatolithiasis. *World J Gastroenterol* 2010; **16**: 2818-2823

13 **Chen SC**, Yen CH, Tsao SM, Huang CC, Chen CC, Lee MC, Bell WR. Comparison of pyogenic liver abscesses of biliary and cryptogenic origin. An eight-year analysis in a University Hospital. *Swiss Med Wkly* 2005; **135**: 344-351

14 **Malik AA**, Bari SU, Rouf KA, Wani KA. **Pyogenic liver ab**scess: Changing patterns in approach. *World J Gastrointest Surg* 2010; **2**: 395-401

15 **Peer A**, Witz E, Manor H, Strauss S. Intrahepatic abscess due to gallbladder perforation. *Abdom Imaging* **1995; 20**: 452-455

16 **Liu Q,** Wang YJ, Liu JF, Li F, Sun JB, Wang YH. Bacterial liver abscess: a retrospective analysis of twenty years, experience in single center. *Zhongguo Puwai Jichu Yu Linchuang Zazhi* 2009; **16:** 389-392

17 **Chen SC**, Tsai SJ, Chen CH, Huang CC, Lin DB, Wang PH, Chen CC, Lee MC. **Predictors of mortality in patients with** pyogenic liver abscess. *Neth J Med* 2008; **66**: 196-203

18 **Ferraioli G**, Garlaschelli A, Zanaboni D, Gulizia R, Brunetti E, Tinozzi FP, Cammà C, Filice C. Percutaneous and surgical treatment of pyogenic liver abscesses: observation over a 21-year period in 148 patients. *Dig Liver Dis* 2008; **40**: 690-696

19 **Strong RW**, Fawcett J, Lynch SV, Wall DR. Hepatectomy for pyogenic liver abscess. *HPB* (Oxford) 2003; **5**: 86-90

S- Editor Sun H **L- Editor** O'Neill M **E- Editor** Xiong L