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Management of Bile Leakage After Laparoscopic Cholecystectomy Based on Etiological Classification

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Abstract

Purpose. To analyze and classify bile leakage after laparoscopic cholecystectomy (LC) according to its etiology. This classification will help to determine the most appropriate management strategy, whereby unnecessary intervention can be avoided.

Methds. We examined the medical records of 16 patients in whom bile leakage occurred as a complication of LC.

Results. Bile leakage was classified according to its cause into the following groups: insecure closure of the cystic duct stump ($n = 3$); retention of a common bile duct (CBD) stone ($n = 1$); CBD injury ($n = 10$); unsuspected accessory bile ducts ($n = 1$); and unknown origin ($n = 1$). The management strategies included observation ($n = 3$), laparoscopic intervention with drainage ($n = 4$), laparotomy with drainage ($n = 3$), and laparotomy with Roux-en-Y choledochojejunostomy for CBD transection ($n = 6$). All 16 patients recovered uneventfully with similar hospitalization.

Conclusions. Bile leakage is not always caused by bile duct injury, and it would be inappropriate to attribute leakage to bile duct injury if there is a retained CBD stone, an unsuspected accessory duct, or an unsecured cystic duct stump. Thus, the management of each condition should vary accordingly. Reviewing a videotape of the surgery and early cholangiogram can help to establish the etiological diagnosis and select the most appropriate course of action.

Key words Bile leakage · Laparoscopic cholecystectomy · Complication

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Introduction

Laparoscopic cholecystectomy (LC) was introduced over 10 years ago[1] and is becoming the gold standard of treatment for symptomatic cholelithiasis, even in patients with acute cholecystitis.[2–10] However, LC is associated with a higher incidence of bile duct injury then open cholecystectomy, leading to prolonged hospitalization, difficult reconstruction, and increased morbidity.[11–13] Although there has been much discussion about the classification and management of bile duct injury,[14–17] the relationship between bile leakage and bile duct injury is still not fully understood. Therefore, we need to establish a systematic approach to the management of bile leakage. The importance of the etiological classification of bile leakage, which can be used to determine appropriate management strategies, has not been emphasized enough. Thus, we present our experience of managing bile leakage based on its etiological classification.

Patients and Methods

Between December 1990 and December 2000, 4100 LCs were performed at the Cathay Medical Center, 80.5% ($n = 3300$) of which were done for symptomatic cholelithiasis, 16% ($n = 656$) for acute cholecystitis, and 3.5% ($n = 144$) for polypoid lesions of the gallbladder. The same surgical team performed all of the procedures, and collected the perioperative data for analysis.

Laparoscopic Cholecystectomy Procedures

Elective LC procedures followed a standardized protocol, but modified techniques were used for acute cholecystitis to ensure that surgery was complete. These modifications included decompression of the gallblad-

der, closure of the cystic duct stump with preformed loops or suture ligation instead of a surgical clip, the use of an endo-pouch to envelop the gallbladder and prevent contamination, intraperitoneal lavage, and postoperative drainage. The latter was only used for patients with severe acute cholecystitis when a closed suction drain (Jackson-Pratt) was placed over the Morrison's pouch to drain any blood, ascites, or bile accumulation.

Indications for Cholangiogram During or Before LC

To exclude concomitant common bile duct (CBD) stones preoperatively, we perform endoscopic retrograde cholangiopancreatography (ERCP) in patients with an elevated serum bilirubin level or when abdominal sonography shows a dilated CBD diameter. We do not perform routine intraoperative cholangiography (IOC), to avoid prolonging the operative time, to minimize costs, and to prevent too much negative exposure. Intraoperative cholangiography was performed only when ERCP failed or if the patient could not tolerate ERCP and a CBD stone was highly suspected. We recently introduced magnetic resonance cholangiopancreatography (MRCP), which functionally resembles ERCP, but without the discomfort. However, the efficiency and cost-effectiveness of this procedure are still under evaluation.

Patients with Bile Leakage

There were 16 patients enrolled in this study, including 12 (12/4100, 0.29%) in whom bile leakage was found during or after LC in our hospital and 4 referred from other hospitals, in whom bile leakage was found after LC. The medical records of these patients, including videotapes, imaging studies, and reports of their clinical course, were analyzed retrospectively.

A Medline search of the literature was done using key words such as bile leakage and bile duct injury. The published classifications, schemes, and management strategies for bile duct injury and bile leakage were also analyzed.

Results

Bile leakage during or after LC was seen in 16 patients, being 7 women and 9 men (Table 1), ranging in age from 33 to 71 years. Laparoscopic cholecystectomy was performed electively for symptomatic cholelithiasis in 3 of these patients (19%) and as an emergency procedure for acute cholecystitis in the other 13 (81%). The overall incidence of the bile leakage in our series was 0.29% (12/4100; referred cases not included), but when LC was performed for acute cholecystitis, the incidence was 1.37% (9/656), being obviously higher than that for elective surgery (0.09%, 3/3300; Fisher's exact test, $P <$

Table 1. Clinical features of the 14 patients with bile leakage

Case	Age/sex	Procedure	Onset of bile leak	ERCP	Etiology and treatment
1	48/M	Elective	Within 6 h	No	Laparotomy, suture ligation of cystic duct stump leak
2	58/M	Acute	Within 6 h	No	Laparoscopic loop close of cystic duct stump leak
3	71/M	Acute	Intraoperative	No	CBD transection, conversion, Roux-en-Y choledochojejunostomy
4	57/F	Acute	Intraoperative	No	CBD transection, conversion, Roux-en-Y choledochojejunostomy
5	39/M	Acute	Intraoperative	No	CBD puncture injury and conversion with T-tube choledochotomy
6	65/M	Acute	Referred	Yes	CBD perforated injury and observation for 6 weeks
7	37/M	Acute	Referred	Yes	CBD perforated injury and observation for 4 weeks
8	44/F	Acute	2 days	Yes	Retained CBD stone, cystic duct stump leak, laparotomy choledocholithotomy, T-tube choledochotomy
9	52/M	Acute	Intraoperative	No	CBD transection, conversion Roux-en-Y choledochojejunostomy
10	52/F	Acute	1 day	Yes	Cystic duct stump leak, observation 4 days and spontaneous stump closure
11	68/F	Elective	Within 6 h	Yes	CBD transection, conversion, Roux-en-Y choledochojejunostomy
12	42/M	Acute	Intraoperative	No	Liver bed leakage, Endo-clip clamp
13	33/F	Acute	Intraoperative	No	CBD perforation, IOC and laparoscopic choledochotomy with T-tube
14	52/F	Elective	2 weeks (biloma)	No	Laparoscopic irrigation and drainage
15	34/F	Acute	Referred	Yes	CBD transection, Roux-en-Y choledochojejunostomy
16	63/M	Acute	Referred	Yes	CBD transection, Roux-en-Y choledochojejunostomy

ERCP, endoscopic retrograde cholangiopancreatography; CBD, common bile duct; IOC, intraoperative cholangiography

0.001). Bile leakage was diagnosed as continuous drainage of bile from the dissected area during LC in six patients; as persistent drainage of bile-stained fluid from the drainage tube in nine patients; and as a subhepatic bile collection found 2 weeks post-LC in one patient who did not have drainage tubes placed. The time that elapsed before the detection of bile leakage in the former nine patients ranged from a few hours to 2 days after LC. The etiological classifications and respective management strategies were as follows.

Cystic Duct Stump Leakage Due to Unsecured Closure (n = 3; Strasberg A Injury)[13]

During the initial part of our study, two patients were treated by direct re-exploration without ERCP to enable earlier correction of possible major injury. One patient underwent exploratory laparotomy and one underwent laparoscopic investigation, but leakage from an unsecured cystic duct stump occurred in both. We sutured the leaking stump in one patient and utilized an endo-loop in the other. Based on the experience gained from these two patients, ERCP is now routinely performed in all patients with bile leakage post-LC to identify the source of the leak. The third patient with cystic duct stump leakage was diagnosed using ERCP. Given that the leakage was well drained through an indwelling subhepatic drain during LC, management consisted simply of observation, and the leakage sealed spontaneously after 4 days. The improper ligation of the cystic duct stump in these three patients was due to severe inflammatory changes in the gallbladder, which made precise dissection of the cystic duct difficult during LC.

Retained CBD Stone (n = 1)

Bile leakage was noted 2 days after LC in one patient and immediate ERCP revealed a retained CBD stone with contrast medium leaking through the stump of the cystic duct. We reviewed the videotape of the LC and determined that the cystic duct was well secured after the routine endo-clip ligation. The dislodgement of the clip was therefore attributed to increased CBD pressure caused by retention of the CBD stone. Laparotomy with choledocholithotomy and T-tube choledochotomy were performed.

Common Bile Duct Injury (n = 10)

There were ten patients with CBD injury, six of whom had CBD transection injury (Strasberg E injury); determined intraoperatively in three and post-LC by ERCP in three. Laparotomy and Roux-en-Y choledochojejunostomy were performed in these six patients. The other four patients had partial CBD injury (Strasberg D injury) detected intraoperatively in two and postoperatively using ERCP in two. One of the two patients with intraoperatively determined bile leakage required conversion to open surgery, but the other one underwent laparoscopic T-tube choledochotomy. Endoscopic retrograde cholangiopancreatography was done to locate the source of the bile leakage in the two postoperatively diagnosed patients, both of whom were treated with expectant therapy as the leakage had been externally drained using a subhepatic drainage tube. The leakage sealed 4 and 6 weeks later, respectively.

Leakage from an Accessory Duct on the Liver Bed (Strasberg A Injury; n = 1)

Endo-clip ligation of the small accessory ductule was performed during LC in one patient.

Unknown Origin (n = 1)

The last patient, who had undergone an elective LC, experienced persistent right upper quadrant abdominal discomfort for 2 weeks postoperatively. A subhepatic fluid collection was identified by abdominal sonography, which was confirmed to be bile by laparoscopic exploration. No further bile leak occurred postirrigation, and the source of the leakage was not identified. Laparoscopic drainage of the subhepatic area was successfully carried out.

All patients in this study recovered uneventfully during their hospitalization, with follow-up ranging from 2 to 8 years. One of the six patients who underwent CBD transection experienced an episode of cholangitis due to stenosis of the anastomosis.

Discussion

Bile leakage after LC has been widely reported and comprehensively discussed in the literature.[18,19] Lee et al. reviewed 179 cases of bile leakage, and concluded that most were manifestations of bile duct injury or other technical complications of LC.[20] In 1989, Rayter et al. reported performing ^{99m}Tc-labeled hepatic dimethyliminodiacetic acid scanning to detect bile leaks.[19] Fujii et al. later recommended prompt ERCP to confirm the origin of bile leakage, using endoscopic nasobiliary tube drainage (ENBD) to extract the bile.[15] We prefer immediate ERCP to identify the source of bile leakage. Etiological classification can be determined from these findings, whereby appropriate corrective procedures may be promptly implemented and unnecessary procedures avoided.

Strasberg et al. identified retained CBD stones etiologically as type A injury, presenting as a leaking cystic

duct stump;[13] however, it seems more reasonable to categorize retained CBD stones as the etiology of bile leakage rather than bile duct injury. Deziel et al. reviewed 77 604 LCs, noting 223 cases (0.29%) of postoperative bile leakage.[21] The incidence in our series was identical (0.29%) . We also confirmed that the incidence of bile leakage after emergency LC for acute cholecystitis (1.37%) was higher than that after elective LC (0.09%). To lower the incidence of bile leakage and retained CBD stones, it is important to perform preoperative image studies such as ERCP or IOC. We performed preoperative ERCP in 286 (19%) of our first 1 500 LCs, and found a coexisting CBD stone in 107 patients (endoscopic sphincterotomy in 72 and laparoscopic common bile duct exploration (LCBDE) in 35). Intraoperative cholangiography was performed in 120 patients, 7 of whom were found to have CBD stones. Intraoperative cholangiography was performed mainly for failed preoperative ERCP or when a cystic duct stone or unexpected dilatation of the CBD was found intraoperatively. Although routine ERCP or IOC can reduce the incidence of postoperative retained CBD stones, neither strategy is cost-effective or complication-free, and both have a significant failure rate and false-positive/negative rate. Our policy is to perform ERCP or IOC selectively, when a dilated CBD is found by sonography or if the serum enzyme level is elevated. This policy has resulted in an acceptably low rate of bile leakage (0.29%) and retained CBD stones (1.5%).

Deziel et al. reported identifying the site of leakage in 107 patients; as arising from the cystic duct in 57, the gallbladder fossa in 24, the CBD or hepatic duct in 18, an aberrant bile duct in 7, and the liver biopsy site in 1.[21] Retained CBD stones were also found in 3 patients with cystic duct leaks. In our study, etiological analysis proved useful for establishing guidelines and deciding on the most appropriate management once leakage occurred.

Immediate ERCP will always show the exact leakage site; however, prompt laparoscopic re-exploration with IOC, which offers an immediate opportunity to directly visualize the site and extent of the bile leakage, can serve as an alternative procedure, although this may prove difficult in some situations. Furthermore, given the limited number of patients, it is difficult to evaluate the efficiency of ERCP combined with therapeutic endoscopic procedures, second-look laparoscopy with IOC, and other laparoscopic procedures for the management of post-LC leakage.

In the present study, the single case of a retained CBD stone resulting in cystic duct stump leakage was proven by ERCP, and laparotomy was subsequently performed to remove the CBD stone. The most suitable management of a retained CBD stone with cystic duct stump leakage remains controversial, in relation to the relative value of EPT and ENBD compared with LCBDE.[22,23] Our team has gained much experience of performing LCBDE, which may prove to be the procedure of choice for managing this situation because it provides direct visualization of the relevant anatomy, allowing both evaluation of the leaking stump and stone removal using intraoperative choledochoscopy, in a single session.[24,25] Although transcystic duct stone removal with C-tube drainage is a good alternative,[26,27] we have not had experience with this procedure as we usually perform laparoscopic CBD exploration through an anterior choledochotomy. In fact, we have performed LCBDE in 82 patients with gallstones and CBD stones, and also for a retained CBD stone post-LC. The retained CBD stone was removed via choledochotomy using a 4.2-mm choledochoscopy, leaving an indwelling T-tube. The involvement of the retained CBD stone in the etiology of bile leakage after LC is re-emphasized.

There were ten cases of bile duct injury in this series, consisting of four partial and six transection CBD injuries. Based on our experience with removal of the T-tube via choledochotomy postlaparotomy or laparoscopic CBD exploration, it is probable that a partial CBD injury will close spontaneously if the bile is adequately drained; however, spontaneous closure takes as long as 6–8 weeks. Thus, ENBD and other surgical procedures may be superior because of the reduced recovery time.

In this series, bile leakage was identified after CBD transection in six patients, during LC in three, and post-LC in three. All were treated with laparotomy and Roux-en-Y choledochojejunal anastomosis. Although end-to-end anastomosis over a T-tube is recommended for CBD transections if the inflammatory change is not severe and there is no tissue loss,[28] our experience[29] favors Roux-en-Y choledochojejunostomy over end-to-end anastomosis because of the lower rate of restenosis after long-term follow-up. It is interesting to note that two patients in whom CBD transection was identified post-LC were excluded from this study because the main clinical presentations were severe abdominal pain and jaundice, without evidence of bile leakage. Thus, there were at least two different clinical manifestations for CBD transection post-LC, namely, bile leakage and obstructive jaundice, depending on whether the proximal CBD remained securely closed. This is also why we emphasize the clinical distinction between bile duct injury and bile leakage.

In conclusion, when bile leakage is diagnosed after LC, it is important to consider how the leakage has arisen. Given the wide variety of available treatments, ranging from a few days of observation to advanced biliary enteric bypass surgery, the etiology of the leakage should be definitely determined before any intervention takes place, thereby minimizing unnecessary

exploration. Many factors need to be assessed when deciding upon the most suitable management of bile leakage, including the surgeon's experience, availability of an endoscopist, cost-effectiveness, equipment requirements, and length of admission and follow-up. With the exception of CBD transection, which necessitates an extended open procedure, as laparoscopic management is not feasible, all other types of bile leakage may be treated more conservatively by observation, percutaneous transhepatic cholangiography, endoscopic procedures such as ENBD or endoscopic papillotomy, or repeating laparoscopic procedures.

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