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SURGICAL ENDOSCOPY
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Early scheduled laparoscopic cholecystectomy following percutaneous transhepatic gallbladder drainage for patients with acute cholecystitis

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Abstract
Aim: The present study was conducted to evaluate the effectiveness of early scheduled laparoscopic cholecystectomy (LC) following percutaneous transhepatic gallbladder drainage (PTGBD) for patients with acute cholecystitis.
Patients and methods: 31 patients with acute cholecystitis were treated by early scheduled LC following PTGBD (group 1). These patients were compared with 9 patients treated by early LC without PTGBD (group 2) and with 12 patients treated by delayed LC following conservative therapy (group 3) for the success rate of intraoperative cholangiography, the conversion rate to open cholecystectomy, operative time, and hospital stay. Early scheduled LC following PTGBD was defined as scheduled LC when the patient's condition recovered and it was performed 1–7 days (mean: 4 days) after admission. The patients' age in group 1, 2, and 3 was 66 ± 13, 65 ± 10, and 64 ± 9 years, respectively, without significant difference. Most of the patients had additional diseases.
Results: The success rate of intraoperative cholangiography was 97% (30/31) in group 1, 67% (6/9) in group 2, and 67% (8/12) in group 3. The conversion rate to open cholecystectomy was 3% (1/31) in group 1, 33% (3/9) in group 2, and 33% (4/12) in group 3. The operative time for LC was 89 ± 33 min in group 1, 116 ± 24 min in group 2, and 135 ± 30 min in group 3. The mean hospital stay after LC was 9 ± 4 days in group 1, 9 ± 3 days in group 2, and 17 ± 7 days in group 3. In group 1, the success rate of intraoperative cholangiography was higher, the conversion rate to open cholecystectomy was lower, and operative time was shorter than in groups 2 and 3 with significant difference ($p < 0.05$, $p < 0.05$, and $p < 0.01$, respectively).
*Conclusion:*The findings of this study indicate that early scheduled LC following PTGBD is a safe and effective therapeutic option for patients with acute cholecystitis especially in elderly and complicated patients.

Key words: Laparoscopic cholecystectomy — Percutaneous transhepatic gallbladder drainage — Acute cholecystitis

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Laparoscopic cholecystectomy (LC) has been applied to acute cholecystitis with the development of surgeons' skill [2, 3, 9–11, 15, 16]. However, the usefulness of LC for acute cholecystitis has not yet been established because of technical difficulty and the timing of LC for acute cholecystitis is also still unsettled. Percutaneous transhepatic gallbladder drainage (PTGBD) has a good decompression ability for swollen gallbladders [15, 19, 20], however, the usefulness of PTGBD before LC has not yet been established. Here we report the usefulness of early scheduled LC following PTGBD for patients with acute cholecystitis.

Patients and methods

Between January 1998 and March 2002, 33 PTGBD were performed for all patients with acute cholecystitis. Two patients complicated with choledocholithiasis were treated by percutaneous papillary balloon dilatation [1] before LC, and they were excluded in this study. Early scheduled LC following PTGBD was performed on 31 patients with acute cholecystitis without choledocholithiasis (group 1). These patients were compared with 9 patients treated by early LC without PTGBD (group 2) and 12 patients treated by delayed LC following conservative therapy alone (group 3) between April 1995 and December 1997 for the success rate of intraoperative cholangiography, the conversion rate to open cholecystectomy, operative time, complication, and hospital stay. The patients in groups 1, 2, and 3 ranged in age from 44 to 86 years (66 ± 13 years), 55 to 81 years (65 ± 10 years), and 53 to 74 years (64 ± 9 years), respectively, without significant difference. The diagnosis of acute cholecystitis was established on the basis of acute upper abdominal pain with tenderness under the right costal margin, a fever of more than 37.5°C, leukocytosis, and

Table 1. Clinical characteristics of the three groups[a] on admission

Demographic data on admission	Group 1 (n = 31)	Group 2 (n = 9)	Group 3 (n = 12)
Age (yr)	67 ± 13	65 ± 10	64 ± 9
Sex (M/F)	10/21	3/6	4/8
Duration of acute symptoms ≤ 3 days	30	8	10
> 3 days	1	1	2
Fever more than 38°C	29	8	9
Jaundice	4	1	2
GB distension on US	31	9	12
GB wall thickening	25	8	8
GB st: Multiple	17	6	8
Single	10	2	4
None	4	1	0
WBC > 10,000/mm^3	27	8	11
T.bil > 2.0 mg/dl	4	1	2
GOT > 150 IU/liter	4	2	3

[a] Group 1: cases treated with early scheduled laparoscopic cholecystectomy (LC) following percutaneous transhepatic gallbladder drainage (PTGBD); group 2: cases treated with early LC without PTGBD; group 3: cases treated with delayed LC following conservative therapy

Table 2. Additional diseases of the three groups[a] on admission

Additional disease	Group 1 (n = 31)	Group 2 (n = 9)	Group 3 (n = 12)
Bronchial asthma	1	0	0
Bronchitis	1	2	1
Pneumonia	0	0	1
Sick sinus syndrome	1	0	0
Congestive heart failure	1	0	0
Hypertension	4	2	2
Cerebral infarction	1	0	1
Diabetes mellitus	1	1	1
Gastric ulcer	1	1	1
Hemorrhagic gastritis	1	1	0
Duodenal ulcer	1	0	0
Erosive duodenitis	1	0	0
Acute pancreatitis	1	0	1
Liver cirrhosis	2	0	0

[a] Group 1: cases treated with early scheduled laparoscopic cholecystectomy (LC) following percutaneous transhepatic gallbladder drainage (PTGBD); group 2: cases treated with early LC without PTGBD; group 3: cases treated with delayed LC following conservative therapy

ultrasonographic findings. Ultrasonography on admission revealed distension of the gallbladder in all patients of the three groups. Gallbladder wall thickening was found in 25 patients of group 1, 8 patients of group 2, and 8 patients of group 3. The number of gallstones was multiple in 17 patients, single in 10, and acalculous in 4 of group 1. The number of gallstones was multiple in 6 patients, single in 2, and acalculous in 1 of group 2. The number of gallstones was multiple in 8 patients and single in 4 of group 3. Duration of acute symptoms before admission is shown in Table 1 and additional diseases in the three groups are listed in Table 2. There were no significant differences among the three groups.

Emergent LC was avoided in all patients because of age and poor general condition. In groups 2 and 3, only conservative therapy including fasting, intravenous drip infusion, and antibiotics administration was performed before LC. Ultrasound-guided PTGBD was added on admission in group 1. After recovery from symptoms of acute cholecystitis such as abdominal pain or fever, preoperative cholangiography through the PTGBD tube was performed for 1–5 days after PTGBD. Early scheduled LC was defined as scheduled LC 1–7 days (mean: 4 days) after admission. Delayed scheduled LC following conservative therapy was defined as scheduled LC performed more than 7 days after admission.

The intraoperative fluoroscopic imaging C-arm system used was an Opescope WHA 50N (Shimadzu, Tokyo, Japan). Intraoperative cholangiography through the PTGBD tube was tried before separating the cystic duct in all cases in group 1. LC was performed according to the laparoscopic subtotal cholecystectomy with cholecystomucoclasis reported by Michalowski et al. [12]. The gallbladder was opened around the PTGBD tube and the gallbladder tissue around the tube was left. The other gallbladder tissue was extracted using a specimen bag. After removal of the PTGBD tube, the residual gallbladder mucosa was cauterized with the argon plasma coagulator (APC300, Erbe, Germany). When the inflammation of the Calot's triangle was hard, the cystic duct was separated after repeated intraoperative cholangiography through the PTGBD tube and confirmation of no abnormal anatomy. In groups 2 and 3, intraoperative transcystic cholangiography was routinely tried. After removal of the gallbladder, the peritoneal cavity was irrigated with 500 ml of warm saline and the Morison's space was drained routinely with a soft drain inserted through the right flank trocar site.

The results are given as mean ± SD. The significance of differences was tested using a Student's t test or a χ^2 test. P values < 0.05 were considered statistically significant.

Results

PTGBD was technically successful in all patients. Complication of PTGBD did not occur. Preopreative cholangiography through PTGBD tube was not obtained because of an obstruction of the cystic duct in only one patient. Fistula formation around the PTGBD tube was not completed at the time of LC for 31 patients. Moderate to severe adhesion around the gallbladder was observed in all cases; however, the adhesion could be dissected with careful manipulation. Intraoperative cholangiography through the PTGBD tube could be

Table 3. Comparison of the clinical results of the three groups[a]

	Group 1 ($n = 31$)	Group 2 ($n = 9$)	Group 3 ($n = 12$)
Success rate of intraoperative cholangiography	97% (30)[a,b]	67% (6)[a]	67% (8)[b]
Intraoperative complications			
Uncontrollable bleeding	0% (0)	22% (2)	8% (1)
Biliary injury	0% (0)	0% (0)	0% (0)
Conversion rate to open cholecystectomy	3% (1)[c,d]	33% (3)[c]	33% (4)[d]
Operative time of LC (min)	84 ± 31[e,f]	116 ± 24[e]	135 ± 30[f]
Hospital stay (days)			
Overall	15 ± 7[g]	14 ± 6[h]	25 ± 9[g,h]
Post LC	9 ± 4[I]	9 ± 3[j]	17 ± 7[i,j]

[a] Group 1: cases treated with early scheduled laparoscopic cholecystectomy (LC) following percutaneous transhepatic gallbladder drainage (PTGBD); group 2: cases treated with early LC without PTGBD; group 3: cases treated with delayed LC following conservative therapy
[a,b,c,d,g,h,i,j] $p < 0.05$, [e,f] $p < 0.01$

performed in 30 patients of group 1. In the remaining 1 patient, it could not be performed because of cystic duct stones, so transcystic cholangiography was performed after removal of the cystic duct stones. Intraoperative transcystic cholangiography could be performed in 6 patients of group 2 and 8 patients of group 3. But it could not be performed in the remaining 3 patients of group 2 and 4 patients of group 3. Only 1 patient in group 1 was converted to open cholecystectomy because of a super intense Calot's triangle, which was caused by the patient's delayed arrival at our hospital 5 days after the onset of her illness. In the remaining 30 patients of group 1, LC succeeded. One of group 2 and 3 of group 3 patients converted to open cholecystectomy because of an intense Calot's triangle. Two of group 2 and one of group 3 patients converted because of uncontrollable bleeding and needed blood transfusion. The conversion rate to open cholecystectomy was 3% (1/31) in group 1, 33% (3/9) in group 2, and 33% (4/12) in group 3. The operative time for LC was 89 ± 33 min in group 1, 116 ± 24 min in group 2, and 135 ± 30 min in group 3. In group 1, the success rate of intraoperative cholangiography was higher, the conversion rate to open cholecystectomy was lower, and operative time was shorter than in groups 2 and 3 with significant difference ($p < 0.05$, $p < 0.05$, and $p < 0.01$, respectively). Intraoperative uncontrollable bleeding did not occur in group 1. Intraoperative biliary injury did not occur in the three groups. Postoperative wound infection occurred in two patients in group 1, one in group 2 and two in group 3. A transient biliary leakage occurred in one patient in group 3. The mortality rate was 0% in the 3 groups.

The mean hospital stay after LC was 9 ± 4 days in group 1, 9 ± 3 days in group 2, and 17 ± 7 days in group 3. The mean overall hospital stay was 15 ± 7 days in group 1, 14 ± 6 days in group 2, and 25 ± 9 days in group 3. In group 1, the mean hospital stay after LC and overall hospital stay were shorter than those in group 3 with significant difference ($p < 0.05$, respectively), but not shorter than those in group 2 (Table 3).

Discussion

Acute cholecystitis had been considered a contraindication of LC in the beginnings of LC [4, 17]. With the development of technical skill and laparoscopic instruments, the number of surgical teams which first apply LC for acute cholecystitis is increasing. However, the conversion rate to open cholecystectomy is still high [2, 3, 9–11, 15, 16] and there are still some problems to be solved, such as the timing of LC and the timing of conversion.

In the dissection of a hard Calot's triangle in delayed LC for acute cholecystitis, many surgeons feel difficulty and anxiety about LC. Biliary injury by LC is the most severe complication which should be avoided. We believe that intraoperative cholangiography is essential to avoid biliary injury. However, transcystic intraoperative cholangiography is difficult and the operative time is longer in acute cholecystitis. Intraoperative cholangiography through the PTGBD tube is a clue to solving this problem. There have been some arguments for the use of PTGBD before LC. Kim et al. [8] reported that the conversion rate to open cholecystectomy and the morbidity rate in LC after 72 hr of admission following PTGBD vs non-PTGBD in patients with acute cholecystitis was 15% (4/27) vs 23% (3/13) and 15% (4/27) vs 15% (2/13), respectively. They concluded that PTGBD did not significantly improve the outcome of LC for acute cholecystitis. On the other hand, Tseng et al. [18] reported the usefulness of PTGBD before LC for acute cholecystitis. They reported that the complications related to PTGBD were bile leakage after tract dilatation noted in 2 patients (1.4%), and 20 (14%) patients had pain at the puncture site. However, the conversion rate to open cholecystectomy was 27% (32/117) in LC with a mean of 4 days after PTGBD. Mo et al. [13] reported that the conversion rate in LC 2 to 5 days after PTGBD was 0% (0/7). Watanabe et al. [20] reported that the conversion rate to open cholecystectomy in delayed LC with a mean of 34 days after PTGBD for acute cholecystitis was 0% (0/14). Patterson et al. [15] reported that the conversion rate in LC with a mean of 36 days after PTGBD was 31% (4/13). Thus, the necessity of PTGBD before LC for acute cholecystitis has not yet been established.

Other previous reports indicated that an early LC within 4 days of the onset of symptoms decreased the major complications and conversion rates [5]. However, surgeons cannot control the duration between the onset and the patient's arrival. Most of our patients were

elderly and complicated. In elderly and complicated patients of acute cholecystitis, it often takes more than 4 days to improve their general condition. Furthermore, some authors reported that both mortality and morbidity rates were higher in emergency surgery than in elective surgery, especially in elderly patients [6, 7, 14]. Scheduled elective surgery can provide enough time to assess and improve their condition more than emergency surgery.

In our study, early LC without PTGBD could shorten the hospital stay, but could not improve the success rate of intraoperative cholangiography compared with delayed LC. To improve the success rate of intraoperative cholangiography and to make LC easier, we applied early scheduled elective LC following PTGBD defined as scheduled LC 1–7 days (mean: 4 days) after admission.

PTGBD is a safe, easy, and effective technique for acute cholecystitis, which can decompress the swollen gallbladder and lead to a patient's early recovery. Preoperative cholangiography through the PTGBD tube can provide information on the relationship of the cystic duct, bile duct, and stone. Intraoperative cholangiography through the PTGBD tube was also easy, which contributed to avoiding biliary injury. In our study, the PTGBD tube provided the safety of LC and contributed to lowering the conversion rate to open cholecystectomy in performing LC for acute cholecystitis compared with other reports [3, 9–11]. Percutaneous gallbladder aspiration can decompress the swollen gallbladder, but it cannot lead to intraoperative cholangiography. Early scheduled LC following PTGBD significantly shortened the operative time and overall hospital stay. The average overall hospital stay in group 1 was 15 ± 7 days. In Japan, elderly patients tend to stay longer in hospital because most expenses for hospitalization are paid by the Japanese socialized medical insurance system. The length of hospitalization after LC in Europe and America is much shorter than that in Japan. Shortening of the length of hospitalization after LC might be possible from the medical point of view; however, it was not acceptable for Japanese elderly patients in poor general condition and their families under the Japanese medical socialized insurance system. Therefore, the length of hospital stay of our patients cannot compare with that reported by others in Europe and America.

When performing LC, the insertion of a PTGBD tube did not result in intraabdominal adhesions severe enough to contraindicate the use of LC. The complications associated with early scheduled LC following PTGBD were minor. However, shortening the period of PTGBD tube means incompleteness of fistular formation around the PTGBD tube. As a complication, one of the previously reported patients experienced pneumothorax which was caused by lack of fistular formation around the PTGBD tube which passed through the pleural cavity [20]. We have never experienced such a complication until now. Only one patient in group 1, who came to our hospital 5 days after the onset of her illness, was converted to open cholecystectomy because of a super intense Calot's triangle. We also believe that we should not persist in LC when the anatomy of a Calot's triangle is unclear even with the help of PTGBD. We agree with Hashizume's opinion [5] that the conversion to laparotomy is considered to be a good surgical option.

We conclude that early scheduled LC following PTGBD can be a safe and useful therapeutic option for acute cholecystitis, especially in elderly and complicated patients.

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