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Longterm effects of endoscopic sphincterotomy on gall bladder motility

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Abstract

***Background*—Some of patients with an intact gall bladder develop acute cholecystitis or have gall bladder stone formation after endoscopic sphincterotomy. Endoscopic sphincterotomy may affect gall bladder motility.**

***Aims*—To prospectively evaluate longterm effect of endoscopic sphincterotomy on gall bladder motility.**

***Patients*—Thirty two patients with an intact gall bladder (15 with and 17 without gall bladder stones) who underwent endoscopic sphincterotomy for choledocholithiasis.**

***Methods*—Gall bladder function was examined before and at from seven days to five years after sphincterotomy. Gall bladder volume, at fasting and after caerulein administration, was determined by ultrasonography.**

***Results*—After endoscopic sphincterotomy, the enlarged orifice remained patent during a five year follow up period. One patient with gall bladder stones subsequently developed acute cholecystitis, the remaining being asymptomatic. In the patients before sphincterotomy, particularly in those with gall bladder stones, the gall bladder showed larger fasting volume and lower caerulein stimulated maximum contraction than normal controls. Throughout five years after sphincterotomy, fasting volume of the gall bladder decreased and its maximum contraction increased, regardless of gall bladder stones; significantly different from the values before sphincterotomy ($p<0.05$).**

***Conclusions*—Endoscopic sphincterotomy decreases fasting volume of the gall bladder and increases its contraction ability for a long period. These changes may rather decrease the risk of future acute cholecystitis or gall stone formation.**

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Keywords: endoscopic sphincterotomy, gall bladder motility, intact gall bladder.

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Endoscopic sphincterotomy (ES) is often performed for treatment of common bile duct stones in patients with the gall bladder in situ. Many of such patients, particularly elderly or frail patients who are considered unfit for surgery, have been followed up without cholecystectomy. It has been reported that, after ES, approximately 10% of patients with gall bladder stones subsequently undergo cholecystectomy for symptoms including acute cholecystitis.[1–6] Although nearly all patients with an acalculous gall bladder remain asymptomatic after ES,[2–6] some of these patients have formation of new gall bladder stones.[2] ES may change gall bladder motility. If so, the changes in gall bladder function may cause or affect development of acute cholecystitis and formation of gall bladder stones. However only a few studies on gall bladder function after surgical sphincterotomy or sphincteroplasty have been reported.[7–10] In this study, we prospectively evaluated longterm effects of ES on gall bladder motility in patients with the gall bladder in place.

Methods

A prospective series of 32 patients with an intact gall bladder who underwent ES for removal of common bile duct stones was studied. Patients who had cystic duct obstruction, the gall bladder filled with many or large stones, or gall bladder wall thickening more than 3 mm, on ultrasonography and endoscopic retrograde cholangiopancreatography (ERCP), were excluded from this series. Of the 32 patients, 17 did not have gall bladder stones (group A), and 15 had gall bladder stones (group B) (Table I). They had not undergone abdominal surgery, and did not have chronic pancreatitis or diabetes mellitus. ERCP showed common bile duct stones and gall bladder opacification in all the patients. Immediately after ERCP, they underwent ES to the upper margin of the papillary roof. The common bile duct stones were extracted by a Fogarty balloon or Dormia basket. They left the gall bladder in situ after ES.

ERCP was performed seven days and five years after ES to verify the complete clearance of the common bile duct stones and to determine common bile duct diameter and sphincterotomy length. The incision length was estimated by using a marked papillotome with the sphincterotomy wire close to the top.

The patients underwent gall bladder function test before ES (1–11 days before), and seven days (before follow up ERCP), three months, one year, and five years after ES. No patients received the function test during

TABLE I *Patient characteristics*

	Group A Without gall bladder stones (17 patients)	*Group B With gall bladder stones (15 patients)*
Age (y)	62·1 (41–73)	66·4 (45–76)
Sex (male/female)	7/10	6/9
Common bile duct stones		
Number	1·9 (1–7)	1·8 (1–6)
Size (mm)*	9·7 (5–24)	9·0 (5–21)
Classification		
Cholesterol stones	0	9
Calcium bilirubinate stones	17	6

*Size of common bile duct stones indicates diameter of the largest stone.

TABLE II *ERCP findings*

			After ES	
		Before ES	*Seven days*	Five years
Group A	CBD diameter (mm)	15·4 (1·5)	13·7 (1·3)	11·0 (1·3)*
	Sphincterotomy length (mm)		11·7 (0·7)	7·7 (0·7)†
Group B	CBD diameter (mm)	14·0 (1·6)	12·2 (2·0)	10·2 (1·4)*
	Sphincterotomy length (mm)		10·4 (0·5)	7·1 (0·4)†

Group A consisted of 17 patients without gall bladder stones. Group B consisted of 15 patients with gall bladder stones. Results are expressed as the mean (SEM). Data for one patient of group B at five years after ES were omitted. Corresponding values were not significantly different between both groups. *Significantly different from the value before ES ($p<0·05$). †Significantly different from the value at seven days after ES ($p<0·05$). CBD=common bile duct.

acute cholecystitis, acute cholangitis or biliary colic. Any medication except for antibiotics was stopped 48 hours before the test. After an overnight fast, gall bladder motility was examined by ultrasonography (a 3·5-MHz transducer: SSA-250A or SAL-77A, Toshiba, Tokyo, Japan) between 8 am and 10 am. Gall bladder volume was calculated from longitudinal and transverse ultrasonographic transections of the gall bladder using the sum of cylinders method.[11] Gall bladder volume was measured before (0 minute, fasting volume) and at 10, 20, 30, 40, 50, and 60 minutes after intramuscular administration of 200 ng/kg of caerulein (Ceosunin, Kyowa Hakko Kogyo, Tokyo, Japan). No persons experienced abdominal pain during the test.

As controls, 10 healthy subjects with no evidence of pancreatobiliary disease or diabetes and normal ultrasonogram of the pancreatobiliary region were studied: four men and six women, 45–77 years (mean, 64·1). Patients and controls were matched for age and sex. These normal controls underwent gall bladder motility test without ES. Informed consent was obtained from all patients and healthy subjects.

All values are expressed as the mean (SEM). Results were analysed by means of Wilcoxon test. Differences were considered significant when $p<0·05$.

Results

ES and ERCP were performed without serious complications. On initial ERCP, the common bile duct stones were not different in number and diameter of the largest stone between group A and group B (Table I). All the extracted stones in group A were brown pigment stones composed of calcium bilirubinate, which were common in Japanese patients, particularly those with primary common bile duct stones (Table I). In group B, nine patients had cholesterol stones and six had brown pigment stones. ERCP confirmed complete clearance of the common bile duct stones seven days after ES in all the patients.

In group A, none of the patients experienced biliary colic, jaundice, cholecystitis or cholangitis during a five year follow up period. In group B, one patient with cholesterol stones underwent cholecystectomy for acute cholecystitis two years after ES. The patient was excluded from gall bladder motility test and ERCP at five years after ES. The remaining 14 were asymptomatic for five years although they still had gall bladder stones.

At five years after ES, ERCP confirmed the common bile duct clear of stones and the gall bladder opacified in all the 31 patients. On ERCP, diameter of the common bile duct before ES was not significantly different between group A and group B (Table II). After ES the diameter decreased; the difference was significant between the values before and at five years after ES in each group. The sphincterotomy length at five years after ES significantly decreased compared with that at seven days after ES (Table II). The incision length did not differ between both groups. No patients showed stricture of the papilla of Vater.

None of patients of group A had stones or sludge in the gall bladder on ultrasonography, before and after ES. All patients of group B had stones retained in the gall bladder on ultrasonography after ES. In five of 17 patients of group A and seven of 15 of group B, ultrasonography showed a 3–5 mm thickening of gall bladder wall after ES. Before ES, fasting volume of the gall bladder was larger in patients with choledocholithiasis (23·7 (1·5) ml in group A and 25·7 (1·8) ml in group B) than in normal controls (21·5 (1·4 ml)); significantly different between group B and normal controls (Fig 1A, 2). Patients with choledocholithiasis showed a maximum decrease in gall bladder volume at 40 minutes after caerulein injection, as did normal controls (Fig 1A). Maximum contraction in patients with choledocholithiasis (68 (2)% in group A and 59 (4)% in group B) was significantly lower than that in controls (78 (2)%) (Fig 3). Maximum contraction in group B was significantly lower than that in group A.

After ES, fasting volume significantly decreased and reached a plateau at three month after ES in both groups; 16·2–18·8 ml in group A, and 17·7–20·4 ml in group B (Fig 2). The gall bladder showed maximum contraction at 20–30 minutes after caerulein administration (Fig 1B). In both groups, maximum contraction significantly increased after ES, reaching a plateau at three months; 76–82% in group A, and 65–72% in group B (Fig 3). However, the contraction ability in group B was not restored to the level of normal controls.

Discussion

In this study, fasting volume of the gall bladder decreased and its maximum contraction increased for five years after ES. Enlarged opening of the common bile duct into the duodenum remained patent during the same period. None of patients with an acalculous gall bladder and 6·7% of those with gall bladder stones developed acute cholecystitis after ES.

After ES, a retained gall bladder sometimes develops acute cholecystitis or has gall stone formation.[1–6] Gall bladder related illness after ES may be caused by bactobilia,[12] or changes in bile composition[7–13] or gall bladder motility.

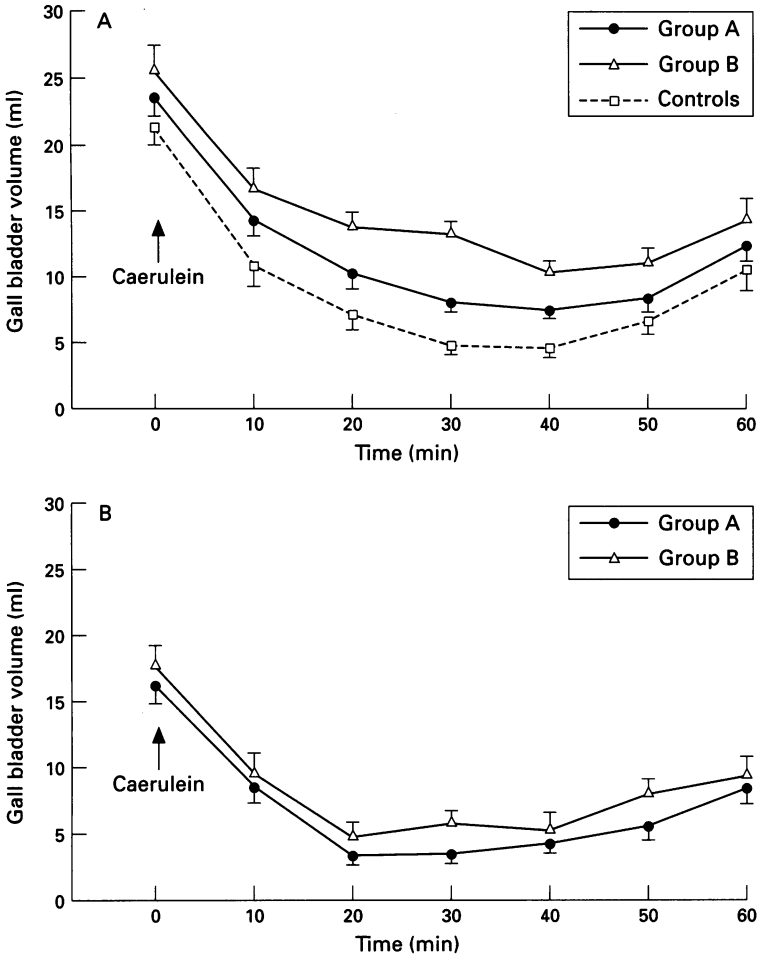

Figure 1: Gall bladder volume after caerulein administration in patients with choledocholithiasis (group A and group B) and normal controls. Group A consisted of 17 patients without gall bladder stones. Group B consisted of 15 patients with gall bladder stones. The results are expressed as the mean (SEM). (A) Before ES: In each group and controls, all the values after caerulein administration were significantly different from the value before administration ($p<0·01$). (B) Five years after ES: In each group, all the values after caerulein administration were significantly different from the value before administration ($p<0·01$).

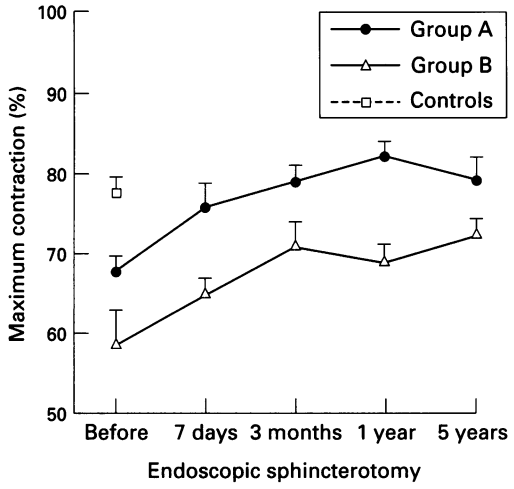

Figure 3: Maximum gall bladder contraction evoked by caerulein administration before and after ES. Data for one patient of group B at five years after ES were omitted. The results are expressed as the mean (SEM). The values before ES were significantly different between group A and controls ($p<0·05$), between group B and controls ($p<0·01$), and between group A and group B ($p<0·05$). In each group, the values after ES were significantly different from the value before ES ($p<0·05$).

In dogs[7–10] and prairie dogs,[2] surgical sphincterotomy or sphincteroplasty reduced fasting gall bladder volume and increased gall bladder emptying. This was explained mainly by reduced pressure of the common bile duct. However, these experimental studies referred to only short-term effects of sphincterotomy. Additionally gall bladder motility after ES has never been studied in clinical cases.

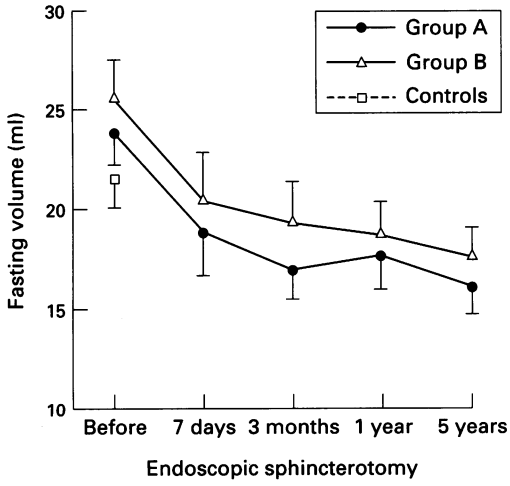

Figure 2: Fasting gall bladder volume before and after ES. The results are expressed as the mean (SEM). Data for one patient of group B at five years after ES were omitted. The values before ES were significantly different between group B and controls ($p<0·05$). In each group, the values after ES were significantly different from the value before ES; at seven days, three months, and one year after ES, $p<0·05$: at five years, $p<0·01$.

This study demonstrated that, before ES, patients with choledocholithiasis, even those with an acalculous gall bladder, showed increased fasting volume and decreased maximum contraction of the gall bladder compared with normal controls. These changes might result from bile statis by common bile duct stones as well as impairment of the gall bladder itself.

Throughout the five years after ES, the gall bladder showed lower fasting volume and higher contraction ability than before ES. This improvement was observed even in patients with gall bladder stones who had no or mild cholecystitis. ES affected gall bladder function probably because of free bile flow from the common bile duct to the duodenum due to decreased resistance of the terminal common bile duct and clearance of common bile duct stones. Moreover the diameter of the common bile duct decreased after ES probably for the same reasons. These changes in gall bladder motility after ES lasted as long as sphincterotomy remained patent. A mild thickening of the gall bladder wall after ES seemed to be caused partly by reduced fasting volume of the gall bladder.

Post-sphincterotomy changes in gall bladder function may affect development of gall bladder complications or fate of gall stones. ES improves gall bladder bile stasis in patients with or without gall bladder stones, as shown in this study. Surgical sphincterotomy is known to prevent gall stone formation in prairie dogs[2] and to facilitate spontaneous passage of glass beads from the gall bladder in dogs.[10] ES would enhance emptying of crystals and small stones before larger stones are formed. A few patients are reported in whom pre-existing gall bladder

stones have disappeared after ES.[2-5] These changes in gall bladder motility may also prevent acute cholecystitis after ES.

ES decreases fasting volume of the gall bladder and increases its contraction ability for a long period. These changes in gall bladder motility may decrease the risk of future acute cholecystitis or gall stone formation after ES.

1 Cotton PB, Vallon AG. Duodenoscopic sphincterotomy for removal of bile duct stones in patients with gallbladders. *Surgery* 1982; **91:** 628–30.
2 Tanaka M, Ikeda S, Yoshimoto H, Matsumoto S. The long-term fate of the gallbladder after endoscopic sphincterotomy: complete follow-up study of 122 patients. *Am J Surg* 1987; **154:** 505–9.
3 Davidson BR, Neoptolemos JP, Carr-Locke DL. Endoscopic sphincterotomy for common bile duct calculi in patients with gall bladder in situ considered unfit for surgery. *Gut* 1988; **29:** 114–20.
4 Siegel JH, Safrany L, Ben-Zvi JS, Pullano WE, Cooperman A, Stenzel M, *et al.* Duodenoscopic sphincterotomy in patients with gallbladders in situ: report of a series of 1272 patients. *Am J Gastroenterol* 1988; **83:** 1255–8.
5 Rosseland AR, Solhaug JH. Primary endoscopic papillotomy (EPT) in patients with stones in the common bile duct and the gallbladder in situ: a 5–8-year follow-up study. *World J Surg* 1988; **12:** 111–6.
6 Hill J, Martin DF, Tweedle DEF. Risks of leaving the gallbladder in situ after endoscopic sphincterotomy for bile duct stones. *Br J Surg* 1991; **78:** 554–7.
7 Cohn MS, Schwartz SI, Faloon WW, Adames TJ. Effect of sphincteroplasty on gallbladder function and bile composition. *Ann Surg* 1979; **189:** 317–21.
8 Hutton SW, Sievert CE Jr, Vennes JA, Duane WC. The effect of sphincterotomy on gallstone formation in the praire dog. *Gastroenterology* 1981; **81:** 66–7.
9 Hutton SW, Sievert CE Jr, Vennes JA, Duane WC. Inhibition of gallstone formation by sphincterotomy in the prairie dog: reversal by atropine. *Gastroenterology* 1982; **82:** 1308–13.
10 Hutton SW, Sievert CE Jr, Vennes JA, Shaver RBI, Duane WC. Spontaneous passage of glass beads from the canine gallbladder: facilitation by sphincterotomy. *Gastroenterology* 1988; **94:** 1031–5.
11 Everson GT, Braverman DZ, Johnson ML, Kern F. A critical evaluation of real-time ultrasonography for the study of gallbladder volume and contraction. *Gastroenterology* 1980; **79:** 40–6.
12 Gregg JA, Girolami PD, Carr-Locke DL. Effects of sphincteroplasty and endoscopic sphincterotomy on the bacteriologic characteristics of the common bile duct. *Am J Surg* 1985; **149:** 668–71.
13 Sauerbruch T, Stellaard F, Paumgartner G. Effect of endoscopic sphincterotomy on bile acid pool size and bile lipid composition in man. *Digestion* 198; **27:** 87–92.