Gut, 1988, **29**, 1003–1006

Liver and biliary

Are duodenal diverticula associated with choledocholithiasis?

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SUMMARY **The results of 250 consecutive ERCP examinations were analysed in order to assess whether or not juxtapapillary duodenal diverticula are associated with choledocholithiasis. Cholangiography showed common bile duct stones in 71 patients of whom 25 (35%) had periampullary diverticula. Clear bile ducts were shown in 99, of whom only 12 had diverticula (12%) ($p<0.05$). After allowing for the differences in age between the two groups, patients with choledocholithiasis were 2·6 times (95% CI: 1·14–5·93) more likely to have a periampullary diverticulum than patients without choledocholithiasis. In the remaining 80 patients, cholangiography was either not successful or not indicated. Further clinical follow up and/or investigation have failed to reveal duct stones in any and only 10 (13%) of these 80 patients had diverticula. Overall, 47 patients had diverticula: 25 (53%) had duct stones, four may have had stones and 18 had none. Three or more years after cholecystectomy 59% of patients with duct stones had diverticula, while only 13% with clear ducts had them. These results show a significant association between periampullary duodenal diverticula and choledocholithiasis.**

The existence of duodenal diverticula has been known since the original description by Chomel in 1710,[1] and Morgagni's more detailed appraisal in 1762.[2] Post mortem studies have shown an incidence of 11–22%[3–5] yet they are less commonly seen at barium meal examinations and rarely appear to intrude into day to day clinical practice. We have examined the possibility that duodenal diverticula are associated with bile duct stones.

Methods

PATIENTS

The results of 250 consecutive ERCP examinations were analysed. The patients were of mean age 64 years, with a range of 14–95 and a male to female ratio of 1:1·3. In each case, the presence or absence of juxtapapillary duodenal diverticula was noted. In some patients cholangiography was not obtained as it was not technically possible or was not indicated, the examination primarily being undertaken in order to obtain a pancreatogram. In such cases the presence or absence of bile duct stones was based on subsequent investigations and clinical follow up. These included ultrasonography, intravenous cholangiography, percutaneous transhepatic cholangiography and cholecystectomy with or without common bile duct exploration.

Patients were subsequently divided into three groups: group I (n=71) in which bile duct stones were confirmed by ERC (n=60), operation (n=5, all within one week of duodenoscopy), or other radiological investigations (n=6); group II (n=99) in which bile duct stones were excluded by normal endoscopic cholangiography; group III (n=80) in which ERC was not technically possible or was not attempted.

STATISTICAL ANALYSIS

As there was a greater proportion of patients of a younger age in group II a test for association, adjusting for each decade of age, was done using logistic methods. Before this a test for homogeneity was carried out.

In order to investigate whether duodenal diverticula might have an effect on biliary drainage in

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Received for publication 12 February 1988.

Table 1 *Prevalence of duodenal diverticula in patients with choledocholithiasis (group I), without choledocholithiasis (group II) and when ERC was not obtained (group III)*

Age	Group I		Group II		Group III	
	DD Absent	DD Present	DD Absent	DD Present	DD Absent	DD Present
≤50	6	0	37	0	16	1
51–60	3	3	12	2	16	2
61–70	9	7	14	3	17	2
71–80	16	8	16	3	12	4
81–90	12	4	8	4	9	1
>90	0	3	0	0	0	0
Total	46	25	87	12	70	10
Prevalence of DD (%)	25/71 (35)		12/99 (12)		10/80 (13)	

DD = duodenal diverticula.

either the absence or the presence of duct stones, the diameter of the common bile duct was measured. Correction for radiographic magnification was made by reference to the diameter of the duodenoscope on the radiograph. Comparison was made between patients with and without diverticula in both groups I and II. Those patients who had undergone previous biliary surgery or had malignant biliary obstruction were excluded from this analysis.

Results

The prevalence of juxtapapillary diverticula in patients with choledocholithiasis was 35% whereas in patients without choledocholithiasis it was 12% (Table 1). Using a logistic model to adjust for the confounding effect of age, a test for association revealed that there is a significant difference between these two groups ($\chi^2 = 5{\cdot}434$, $p < 0{\cdot}05$). After adjustment for age, patients with duct stones were found to be 2·6 times as likely to have a duodenal diverticulum as those without stones (95% confidence limits 1·14–5·93).

The follow up of patients in group III was reviewed to assess whether duct stones might have been missed in this group. These patients were subdivided on the basis of their outcome as shown in Table 2. Gallbladder stones were proven in five of these patients and it is probable that at least one of the patients who had previously undergone cholecystectomy may have had duct stones before attempted ERC. Follow up for a mean period of 16 months of these patients and those in whom gall stones had been excluded by *x* ray examination did not, however, reveal new cases of stone disease or subsequent choledocholithiasis.

Forty seven of the 250 patients were noted to have duodenal diverticula (mean age 74 years, male to female ratio 1:2). Of these, 25 (53%) had proven bile duct stones and four (8%) were thought possibly to have passed stones just before the examination. The latter group comprised patients presenting with either obstructive jaundice or recurrent pancreatitis, three of whom had gall bladder stones, the fourth having undergone cholecystectomy three months previously. Seven patients with juxtapapillary duodenal diverticula had a malignant biliary obstruction and the same number had normal bile ducts at ERC without clinical or radiological evidence of gall stones. In the remaining four patients with duodenal diverticula, cholangiography was not achieved. Three of these patients had neither clinical nor radiological evidence of gall stones, while the fourth presented with obstructive jaundice but was subsequently lost to follow up.

The greatest excess of duodenal diverticula occurred in patients who underwent ERCP three or more years after cholecystectomy. Any stones seen at this stage were deemed to represent recurrent disease rather than stones overlooked at the first operation. There were 25 patients in this group, who underwent ERCP an average of 10 years after cholecystectomy (range 3–23). Ten of the 17 patients (59%) with recurrent stones had juxtapapillary duodenal diverticula. By comparison, only one of the 8 patients

Table 2 *Follow up results of patients in whom ERC was not obtained (group III)*

	Patients (n)	Duodenal diverticula (n)
Gall bladder stones confirmed	5	0
Previous cholecystectomy, duct stones not shown radiographically	8	1
Gall stones excluded by:		
x ray examination	28	2
Subsequent operation for malignant biliary obstruction	24	3
Subsequent operation for other pathology	8	3
Lost to follow-up	7	1
Total	80	10

Table 3 *Common bile duct diameters in patients with duct stones (group I) and without duct stones (group II)*

	Group I		Group II	
	DD Absent	DD Present	DD Absent	DD Present
Patients (n)	17	8	24	7
Mean duct diameter (mm)	13·9	16·5	7·7	10·4
1 standard deviation	4·6	10·0	1·9	3·9

DD = duodenal diverticula.

(13%) with normal ducts had a diverticulum (χ^2= 3·04, p>0·05).

Results from the measurement of common bile duct diameters are shown in Table 3. Comparison of mean duct diameters within each separate group revealed a greater mean diameter in the presence of diverticula even in the absence of duct stones. These differences were not, however, statistically significant.

Discussion

Barium meal studies report a prevalence for duodenal diverticula of about 1%,[6,7] but we have found that, in the absence of duct stones, 12% of patients have juxtapapillary diverticula. Although we have studied a group of patients selected because of the likelihood of biliary or pancreatic pathology, the frequency of diverticula in our two 'control' groups is very similar to that reported in autopsy series.[3,4] Presumably the comparatively low prevalence of diverticula reported in standard barium meals is caused by lack of distension of the second part of the duodenum.

There is a striking contrast in the group of patients who have bile duct stones, 35% of whom have duodenal diverticula. This rises to 59% three or more years after a previous cholecystectomy. In addition, when a juxtapapillary duodenal diverticulum is seen at duodenoscopy there is a greater than 50% chance of a bile duct stone being present.

The figures emphasise the significant association of the two abnormalities but they do not shed light on the possibility that one causes the other. Different studies have, however, suggested that juxtapapillary diverticula may be the cause of bile duct calculi and the following pathogenetic sequence has been postulated by Lotveit.[8] Manometric data have suggested that the pressure within the sphincter of Oddi may be decreased in association with a duodenal diverticulum.[9] Such a decrease might allow reflux of gut organisms for a stagnant diverticulum and bacterial derived B-glucuronidase would then deconjugate bile pigments.[8] This could lead to the formation of pigment stones, explaining the relative excess of pigment stones observed in patients with duodenal diverticula.[10] It would also explain the excess of brown pigment, duct stones which account for 70% of stones found 10 or more months after cholecystectomy.[11] Lotveit[8] and later Eggert[12] lent support to this hypothesis when they reported that in association with juxtapapillary diverticula bowel organisms can be cultured from the bile duct in over 80% of cases.

There seems convincing evidence that the presence of bowel organisms in common bile duct bile is associated with duct stones and also diverticula. That diverticula cause these abnormalities seems likely, because the incidence of both positive bile cultures and duct stones decreases as the distance of the diverticulum from the ampulla increases.[12] Whether the diverticulum induces these alterations by allowing excessive reflux through the sphincter of Oddi seems less well proven. Despite the manometric data of Lotveit[9] that sphincter pressure is reduced in association with diverticula, functional stasis within the bile duct may still exist, predisposing to infection of a stagnant system rather than an incompetent one. Formation of pigment stones might then occur by the mechanisms mentioned. If stasis lies behind the mechanism of stone formation then it is logical that relief would be accomplished by endoscopic sphincterotomy, as is generally the case. Support for this explanation would be the observation that mean common bile duct diameter is increased in the presence of duodenal diverticula. Although this is true in this study, the results are not statistically significant. It requires a much larger number of cases and preferably stratification for age and the presence of gall bladder stones to answer this question.

An abstract of this study to be published in the Bristol *Medico-Chirurgical Journal* after presentation of the work at the British Society of Gastroenterology, March 1987. The authors acknowledge Miss Bickel for help with statistical analysis and Mrs Clifford for her secretarial assistance.

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