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ASPECTS OF TREATMENT*

Technique of transduodenal exploration of the common bile duct

Duodenoscopic appearances after biliary sphincterotomy

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Summary

A simple technique for performing biliary sphincterotomy is described. From an experience of 150 such operations this has been found to provide satisfactory access for exploring the biliary tree and makes T-tube drainage unnecessary. Duodenoscopic observation up to 9 years after the operation showed that the sphincteric region had healed without stenosis. Sphincteric activity had not been completely abolished.

Introduction

Transduodenal exploration of the common bile duct has been practised by many surgeons in Europe and South America since the late 19th century as an alternative to the more conventional supraduodenal approach. Recently this procedure has attracted attention in Britain[1-3]. Since 1959 150 such operations have been performed at this hospital. We report here a technique which has been found to be suitable and describe and illustrate the duodenoscopic appearances of the sphincter region after sphincterotomy. A clinical assessment of the long-term results of this operation is to be reported elsewhere[4].

Anatomy of the papillary region

A variety of different operations on the biliary sphincter have been described and to distinguish between them it is necessary to refer to the anatomy of the region (Fig. 1). The muscle fibres of the biliary sphincter (the sphincter choledochus) surround the lower end of the common bile duct in its course through the duodenal wall. This sphincter extends for about 2 mm outside the duodenum proximally, but its absolute length probably varies from person to person[5] since there are considerable individual differences in the length of the intramural segment of the bile duct (11–27 mm)[6]. A second sphincter, the sphincter pancreaticus, may surround

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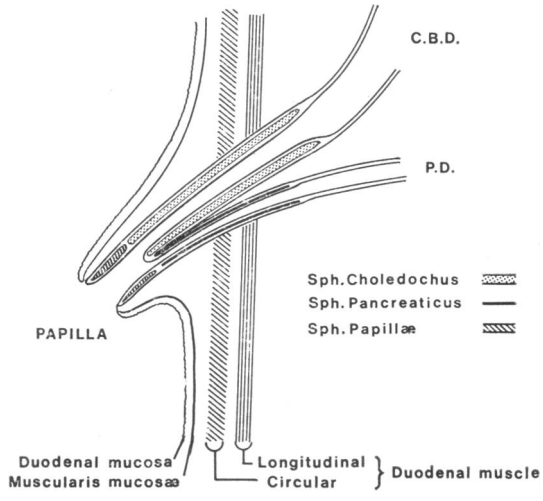

FIG. 1 *Anatomy of the sphincter of Oddi (after Tagliaferri et al.[8] and Kreilkamp and Boyden[9]). CBD = common bile duct. PD = pancreatic duct.*

the entrance of the pancreatic duct and a third, the common sphincter (or sphincter papillae), may be present at the apex of the duodenal papilla[7-9]. The occurrence of the last two sphincters is variable.

There has also been some confusion in the past over the terms used to describe different surgical procedures carried out on the papilla and sphincter, but agreement is now emerging (Fig. 2). Papillotomy and sphincterectomy have been tried but are said to be likely to be followed by stenosis. By papillotomy we mean division of the mucosa at the tip of the papilla and the common sphincter when present[8,10-12] and by sphincterotomy division of the papilla and the intramural part of the biliary sphincter[5,7,8,13-15]. When the mucosa of the bile duct and duodenum are then sutured the term sphincteroplasty is often used[7,16-18] and wedge resection of part of the papilla and sphincter musculature may be implied[7,13,15]. If such an incision divides all fibres of the biliary sphincter and therefore extends proximally beyond the duodenal wall, suture of the cut edges is obligatory in order to avoid leakage; it may then be called a total sphincteroplasty[7,17,19,20]. Although some surgeons use the term sphincterotomy to refer to an incision in the sphincter, the edges of which have been sutured[2,21-23], in this paper its use is restricted to the procedure described above without suturing.

Operative technique

Before operation liver function tests are carried out routinely and intravenous cholangiography if the plasma bilirubin level allows. Patients are given neomycin 500 mg 4-hourly for 24 hours in an attempt to sterilize the duodenal contents.

A right upper paramedian incision is made. Operative cholangiography is carried out if intravenous cholangiography has been unsatisfactory. The duodenum and the head of the pancreas are mobilized away from the inferior vena cava and genital vessels.

The surgeon supports the duodenum with the left hand and carefully palpates its medial wall with the tip of the left thumb in order to feel the papilla. In a few cases difficulty in locating the papilla may be encountered and the passage of a ureteric catheter into the cystic duct and thence through the sphincter has been helpful. Two stay sutures are placed in the duodenal wall so that a short transverse incision may be made between them exactly opposite the papilla (Fig. 3*a*). A Babcock's tissue forceps is then placed on the mucosa of the medial wall on the longitudinal fold just distal to the papilla at a point where damage to the pancreatic duct will be avoided. The papilla is then drawn into view (Fig. 3*b*) and its orifice negotiated with a lacrimal probe. A grooved dissector is then passed and its presence in the common bile duct confirmed by palpating the free border of the lesser omentum (Fig. 3*c*). It is essential to ensure that the instru-

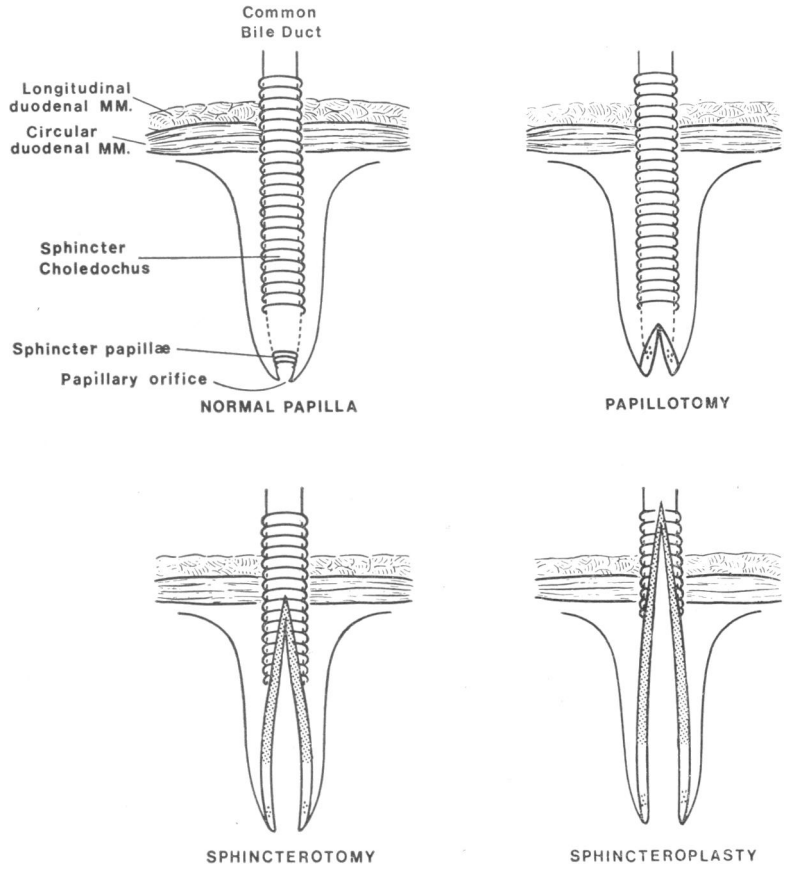

FIG. 2 *Showing the normal papilla and various operations that may be carried out when using the transduodenal approach to the common bile duct.*

ment does not lie in the pancreatic duct.

The sphincterotomy is made with Pott's angled scissors (Fig. 3*d*). The incision should be long enough to allow the blades of Desjardin's forceps to enter the common bile duct without difficulty. It must be limited to the intramural segment of the duct and must not extend outside the duodenal wall in the angle between it and the duct. Where the papilla is short and stunted an incision of 10 mm will suffice. Not infrequently it is longer than this and an incision of up to 18 mm may be required. Bleeding is seldom troublesome since the circumferential branches of the duodenal arteries are usually not divided. After removal of stones a sterile sucker is passed and both hepatic ducts and bile duct are sucked out.

The cut edges of the papilla and biliary sphincter are left unsutured and the duodenotomy is closed in its original transverse axis in two layers. The gallbladder is removed and the abdomen closed with drainage of the subhepatic space.

Duodenoscopic findings after sphincterotomy

Eight women and 5 men aged between 37 and 73 years were examined with the Olympus JF Type B side-viewing duodenoscope 4 months to 9 years after transduodenal exploration of the common bile duct for stones or stenosis of the sphincter. The patients were

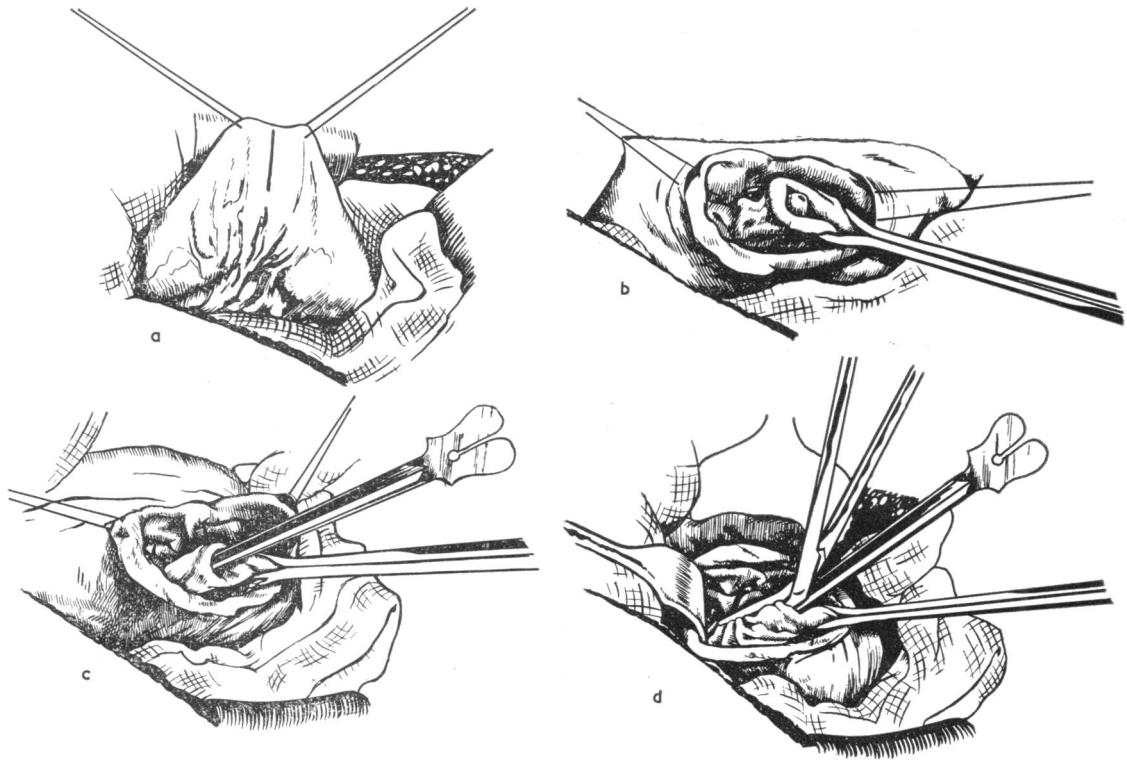

FIG. 3 *Operative technique of biliary sphincterotomy. (a) Transverse incision in the posterior part of the duodenal wall after mobilization. (b) Papilla drawn into duodenotomy incision. (c) Grooved dissector passed into common bile duct. (d) Sphincterotomy with Pott's angled scissors.*

asymptomatic and there was no evidence of pancreatic disease.

The technique used was similar to that described by Cotton *et al.*[24] The pharynx was anaesthetized with Cetocaine spray and the patient sedated with intravenous diazepam (5–25 mg). The instrument was passed into the duodenum. Duodenal motility was then inhibited with intravenous hyoscine-*N*-butyl bromide (20–40 mg). The papillary region was located on each occasion and on average the examination took 35 minutes; no ill effects were encountered.

The duodenoscopic appearances of the papillary region after sphincterotomy varied (see table). An estimate is given of the size of the orifices seen, based on a comparison with the known diameter of an endoscopic cannula (1.5 mm).

In 3 patients the orifice of the common bile duct appeared as a small oval hole or crescent from which jets of bile issued intermittently (Fig. 4*b*). In the interval the orifice was closed and reflux of bile was not observed.

In 4 patients the orifice of the common bile duct was larger and circular. Complete closure occurred when the duodenum contracted, but when it was relaxed the orifice remained patent. When duodenal motility was inhibited with hyoscine-*N*-butyl bro-

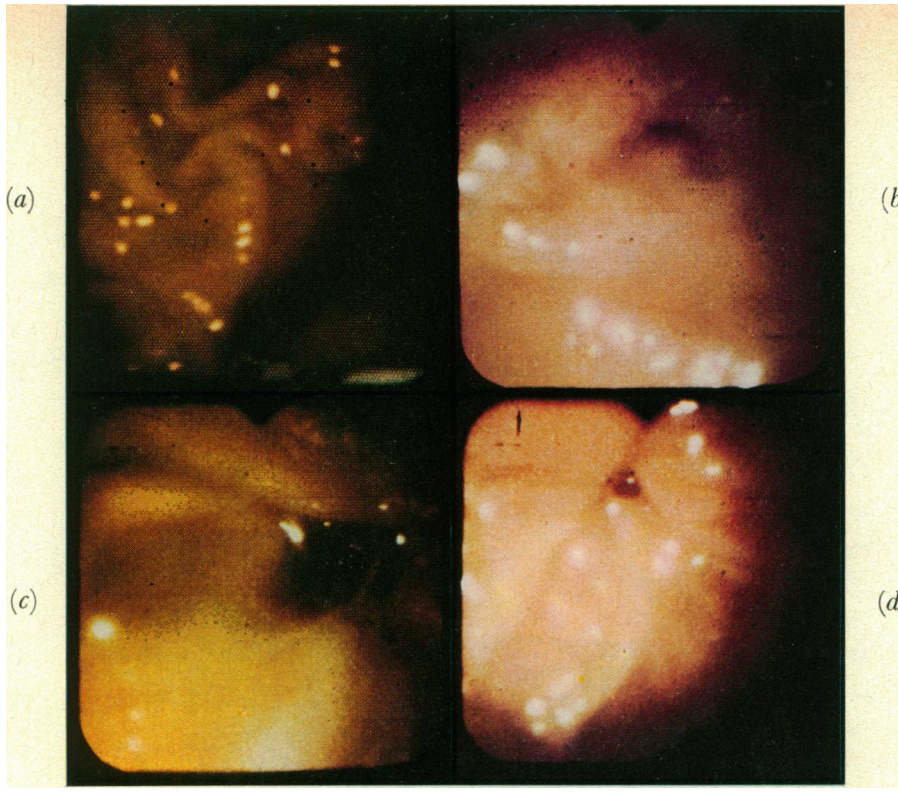

FIG. 4 *Endoscopic appearance of the papillary region. (a) Normal papilla. (b) After sphincterotomy; 4 mm orifice. (c) After sphincterotomy; 10 mm open. (d) After sphincterotomy; 10 mm closed.*

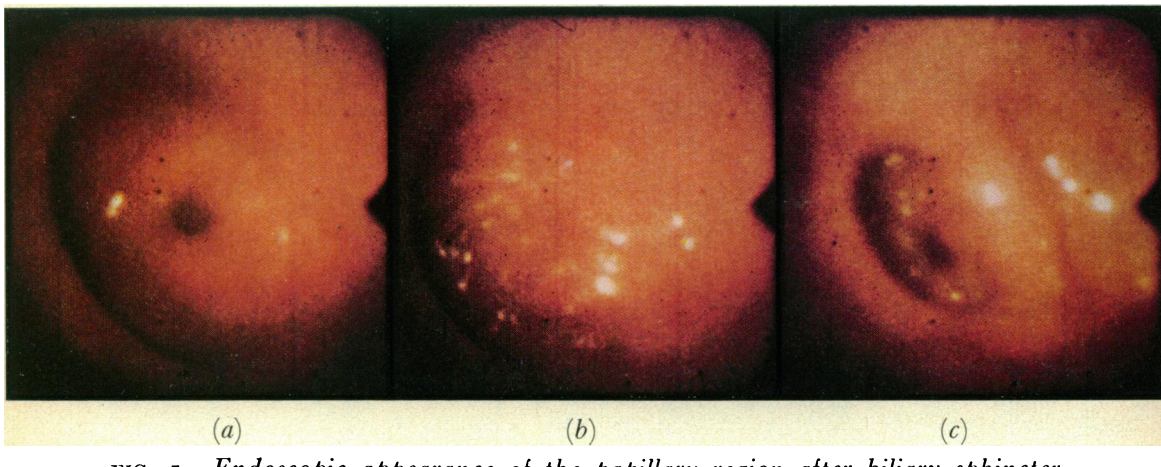

FIG. 5 *Endoscopic appearance of the papillary region after biliary sphincterotomy; orifice 15 mm. (a) The orifice of the pancreatic duct is seen open in the centre of the saucer-shaped depression and the bile duct as a slit on the left. (b) Closure of pancreatic duct orifice after the discharge of pancreatic juice. (c) The rim of the depression (biliary sphincter) contracts but the pancreatic duct orifice remains open.*

Endoscopic findings following transduodenal sphincterotomy (13 patients)

Fig. No.	*Patient*	*Sex*	*Age (years)*	*Postop. interval*	*Orifice*		*Bile*	
					Size (mm)	*Closure*	*Flow*	*Reflux*
4*b*	D.J.	F	61	6 years	4	Complete	Intermittent	No
	F.J.	F	56	1 year	4	Complete	Intermittent	No
	T.C.	F	55	4 months	3	Complete	Intermittent	No
4*c, d*	M.F.	F	57	7 years	8	Incomplete	Continuous	Yes
	A.D.	M	62	9 years	8	Complete	Continuous	Yes
	I.S.	F	51	1 year	10	Incomplete	Continuous	Yes
	W.Wc.	M	61	2 years	9	Incomplete	Continuous	Yes
5	J.T.	M	55	5 years	15	Incomplete	Continuous	Yes
	V.V.	F	59	2 years	12	Incomplete	Continuous	Yes
	W.Wi.	M	73	1 year	16	Incomplete	Continuous	Yes
	D.D.	F	58	7 months	12	Incomplete	Continuous	Yes
	A.G.	F	37	5 months	12	Incomplete	Continuous	Yes
	J.N.	M	64	5 months	15	Incomplete	Continuous	Yes

mide, contraction of the orifice was still seen to occur, but complete closure was achieved in only one patient (Fig. 4*c* and *d*). Bile entered the duodenum in a continuous trickle and reflux of bile was observed in all patients. The opening of the pancreatic duct was identified just distal to the bile duct orifice in one patient.

In the remaining 6 patients the papilla was converted into a saucer-shaped depression or groove (Fig. 5*a*), with the bile duct entering at the proximal end; the pancreatic duct orifice was identified in the floor of the depression in 2 patients. In some cases duodenal contraction could achieve complete closure of the common bile duct orifice. Bile flowed continuously into the duodenum, and reflux occurred in all patients. In one patient contractions of the orifice of the pancreatic duct occurred independently of contraction of the biliary opening and of the duodenum as a whole (Fig. 5*b* and *c*). In 2 patients the margins of the groove were surrounded by several frond-like projections.

Discussion

Techniques for transduodenal exploration of the common bile duct have been described by several authors, some of whom recommend an incision of predetermined length, defined in millimetres[5,15,17,25-27]. Since the length of the intramural segment of the common bile duct varies[6], such an incision cannot be expected to divide the same amount of sphincter muscle on each occasion[5]. Others vary the length of the incision in each individual according to the pathological lesion present[11,18,19,23,28]. In our view the purpose of the sphincterotomy is to permit exploration of the biliary tree, so the length of the incision need be only such as to allow the introduction of the instruments used to carry this out. Some authors[16,18-20,26] advise occasional or routine extension of the incision proximally in order to divide all the sphincteric muscle, but we have not found this necessary.

It has been claimed that there is a risk of stenosis developing after sphincterotomy and that this may be avoided by suturing the edges (sphincteroplasty)[21,29-34]. Duodenoscopy has been used in the assessment of the stoma following choledochoduodenostomy[35].

It seemed that it might also prove informative in examining the orifice of the bile duct after sphincterotomy. We have found two reports[24,36] of this examination having been used in sphincterotomized patients. Cotton *et al.*[24] examined 2 patients and found that the duct orifice was patulous in one but congested and scarred in another. The findings in our 13 sphincterotomized patients, however, were that the sphincter region had healed without scarring and the orifice of the bile duct remained patent without the edges having been stitched. We have other evidence from a much larger group of patients that this is so[4].

It seems likely that the variability in the endoscopic appearance of the sphincteric region was due to the differing length of sphincterotomy made. A small incision dividing the fibres of the common sphincter and a few of the lower fibres of the sphincter choledochus preserved much of the functional activity of the biliary sphincter itself; bile was delivered into the duodenum as a jet and reflux was not observed. After a longer incision which divided most of the muscle of the biliary sphincter the cut edges retracted to form a hole or groove. In these circumstances bile flowed into the duodenum in a continuous trickle and refluxed at times. That such a sphincterotomy did not, however, completely divide the biliary sphincter seems likely since intermittent closure of the bile duct opening could still be seen at endoscopy. We have no evidence that the size of the stoma prejudiced the clinical result[4] or that small stomas were commoner in patients with the longest follow-up.

Intravenous hyoscine-*N*-butyl bromide in doses of 20–40 mg effectively inhibited duodenal motility for 5–15 minutes. During this inhibition contractions of the muscle around the biliary orifice still occurred, suggesting that this region is more resistant to anticholinergic drugs than the rest of the duodenum.

The orifice of the pancreatic duct when identified was seen to contract at regular intervals, independently of the remaining fibres of the biliary sphincter and of the duodenal contractions. This suggests that the biliary and pancreatic sphincters may act independently within the muscular complex of the papillary region.

Pancreatitis following sphincterotomy has been reported from countries where the disease is more prevalent than here[37-42]. In our experience the incidence of this complication is no higher than with other methods of exploring the biliary tract. We would not, however, advise the transduodenal approach in patients with a past history of the disease.

An advantage of using the transduodenal route for exploring the bile ducts is that an incision in the bile duct itself, blind instrumentation of its lower end, and subsequent T-tube drainage are avoided. Complications of blind dilatation of the sphincter and papilla include the creation of a false passage and the development of a fibrous stricture[43-47]. On occasion T-tube drainage may be followed by cholangitis, fistula, and stricture formation[48-51]. Where a second exploration of the biliary tree is indicated this method has the additional advantage that the supraduodenal dissection is unnecessary.

The following may therefore be regarded as absolute indications for transduodenal exploration of the common bile duct: (1) stone impacted at the sphincter; (2) stricture at the sphincter; and (3) re-exploration.

While the transduodenal approach may be used as the routine method of exploring the common bile duct, it is contraindicated in the following circumstances: (1) when large faceted stones are locked in the duct; (2) when there is a single large stone which does not pass down to the sphincter; and (3) when there is a previous history of

pancreatitis.

Exploration of the biliary tree by this technique without routine postexploratory cholangiography gives a low recurrence rate for stone. There has been one known recurrence amongst 82 cases followed for up to 12 years[4]. If, however, radiological studies are desired these may be obtained by inserting a small Foley catheter through the divided sphincter into the lower end of the duct[52].

We gratefully acknowledge the assistance of Miss J Abbott, medical artist.

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CORRECTION

Mr W G Everett writes: 'My attention has been drawn to a point of detail in my article "Sutures, incisions, and anastomoses" published in the July issue of the *Annals* (vol. 55, p. 31) which was incorrect.

'In the last paragraph on p. 32, under "Durability of suture material", I stated: "The durability of different non-absorbable suture materials has been investigated by implanting sutures into animal tissues. It was found that silk, linen thread, Teflon, and cotton had no strength at all after 6 months, and even multifilament nylon had lost 80% of its strength after a year."

'While this statement is correct for silk, linen thread, and cotton, Teflon loses only approximately 10% of its original strength after a year (Catchpole, B N, and Winn, S A (1960) *Lancet,* 2, 236). In view of the widespread use of Teflon in many branches of surgery I think that it is important that my original inaccurate statement should be corrected.'