

# *Surgical Treatment of CBD Stones*

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**Abstract:**

With the current advances in laparoscopic and endoscopic surgery, common bile duct stones may be removed by endoscopic technique. But this technique is not available in most hospital in Thailand, so most Thai surgeons still have to confront with this problem frequently in their surgical practice.

There are several procedures to be considered after common bile duct exploration for common bile duct stones. Primary closure of the common bile duct, T-Tube drainage, Transduodenal sphincteroplasty, Supraduodenal choledochoduodenostomy and Roux-en-Y choledochojejunostomy are among the popular and useful procedures to deal with problems related to common bile duct exploration.

These procedures should not be considered as simple alternative or additional procedures because the indication for each is different, although with an area of overlap. The surgeons should select each procedure individually to best serve individual need of the patient and not to provide all patients with only one procedure for all circumstances.

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Surgical management of CBD stones continues to challenge the surgeons. The importance of clearing the ductal system of all stones cannot be underestimated, because when this is not done, complications of the residual stones often arise (Table 1). One of the controversy in biliary surgery is how to complete the operation when the CBD has been explored through a choledochotomy. This question is not easily answered because hard data are not available from prospective randomized trials to provide definite guidance. Most often this decision is a judgement call based on number of factors pertaining to the individual patient. The decision to add a biliary-enteric drainage to CBD exploration must take into account the increased risks of operative mortality and morbidity associated with the procedures compared with the risk of recurrent stones or other future biliary problems if the procedure is not done.

After common bile duct exploration for choledo-

cholithiasis, it can be dealt with in one of the following methods :

- Primary closure of the CBD,
- T-Tube drainage,
- Transduodenal sphincterotomy or sphincteroplasty,
- Supraduodenal choledochoduodenostomy,
- Choledochojejunostomy.

## **PRIMARY CLOSURE OF THE CBD VERSUS T-TUBE DRAINAGE**

Biliary drainage following CBD exploration has been a subject of controversy since JK Thornton reported the first successful CBD exploration in 1891 (Lancet)<sup>6</sup>.

After CBD exploration for stones, it is a common practice for surgeons to place a rubber T-tube into the CBD. Most surgeons consider the procedure to be

**Table 1** Results of conventional CBD exploration and intraoperative flexible choledochoscopy.

References	Year	Stone+ve Exploration	Number of retained stones	Percentage of retained stones
<b>Conventional CBD Exploration</b>				
LeQuesne et al <sup>1</sup>	1980	78	1	1.3
Stubbs&Blumgart <sup>2</sup>	1984	23	3	13.0
Jakimowicz et al <sup>3</sup>	1986	40	3	7.5
Neoptolemos et al <sup>4</sup>	1987	59	5	8.5
Sheridan et al <sup>5</sup>	1987	191	37	19.4
<b>Total</b>		<b>391</b>	<b>49</b>	<b>12.5</b>
<b>Intraoperative Flexible Choledocoscopy</b>				
Jakimowicz et al <sup>5</sup>	1986	238	5	2.1

both safe and useful. Problems with T-tube drainage can and do occasionally occur. In a recent large review of surgical bile duct stone, a 2.2 per cent complication rate was directly attributed to T-tube drainage<sup>4</sup>.

Historically, Richter and Buchbinder reported good result in 11 patients with primary closure of the CBD in 1919 (JAMA)<sup>7</sup>. At that time, many authorities such as W. Halsted 1923, William Mayo 1939, Pablo Mirizzi 1942 presented their series of patients in whom successful primary CBD closure was accomplished<sup>8</sup>.

They stressed four strict requirements for primary CBD closure; 1) patency of the ampulla of Vater, 2) complete removal of all CBD stones, 3) presence of normal pancreas (no pancreatitis), 4) meticulous suturing of the duct closure.

The dissatisfaction with T-Tube drainage at that time was largely secondary to two factors. First, the T-tube became easily occluded with precipitated bile and hence were nonfunctioning. Second, retained CBD stones were considered a surgical problems, whether a T-tube was in place or not.

The successful removal of retained CBD stones by percutaneous extraction techniques through the T-tube tract by Burhenne 1973, may be responsible for the popularity of T-tube drainage<sup>8</sup>.

Recently, primary closure of the CBD was used only in selected cases<sup>7-11</sup>. A cystic duct cholangiogram is repeated after the bile duct has been primarily closed. A closed suction drain is always positioned.<sup>11</sup>

#### *Proponents of primary closure of the CBD*

1. Most CBD explorations are uneventful after intraoperative choledochoscopy to exclude retained

stones or an edematous obstructed ampulla.

2. The advances in endoscopic sphincterotomy for treating patients with retained CBD stones have made the removal of retained stones possible without surgery.

3. There remain possible complications of T-tube drainage.

4. Patients with primary closure of the CBD have a short hospital stay, allow shorter operative time, have overall lower cost of hospitalization in many studies but patients with T-tube drainage need more nursing attention and feel uncomfortable while the drain is in place.

#### *The main reasons for the use of T-tube drainage*

1. To prevent bile leakage into the peritoneal cavity by decompression of the biliary tree. (T-tube allows spasm or edema of the sphincter to settle following the trauma of the exploration. It allows safe egress of bile in the event of a residual undetected bile duct stone obstruction. Without T-tube drainage, the obstruction might result in a build up of pressure in the CBD and leakage at or disruption of the closure of the duct.

2. Making postoperative cholangiography possible for diagnosis of retained stones.

3. If stones have been left, making their removal easier via T-tube tract for percutaneous extraction of retained stones.

#### *Complications of T-tube removal*

T-tube removal occasionally might well be associated with some hazards.

## 1. Bile peritonitis.

Various reasons can be suggested as why there may be leakage of bile into the peritoneal cavity after T-tube removal

### 1.1 Non irritant material T-tube

About 30 years ago, Winston et al (1965)<sup>12</sup> reported four cases of bile leakage and peritonitis with the use of Polyvinyl chloride T-tube.

Horgan et al (1984)<sup>13</sup> reported 15 cases with bile leakage following removal of T-tube. All cases used a new non-allergenic, non-irritant latex which was used to make Foley catheter.

Safe removal of T-tube depends on the irritant properties of the T-tube stimulating a reactive granulation tract around the tube. Thereby ensuring a temporary biliary cutaneous fistula which will normally close within a few days after T-tube removal. The introduction of latex rubber based material for T-tube manufacture resolved this problem, and such material remains the most common composition for T-tube in use today. Polyvinyl chloride T-tube is non or less irritant than latex rubber so that no tract is well formed. Furthermore, polyvinyl chloride hardened on contact with bile so that withdrawal of the tube is more likely to damage the CBD<sup>14</sup>.

### 1.2 Early removal of the T-tube

Corbett et al (1986)<sup>14</sup> presented three patients with bile peritonitis after removal of T-tube despite the use of a latex T-tube. The T-tubes were removed between 10-12 days after surgery. The authors believed that the early removal was contributory to peritonitis.

Gillete et al (1985)<sup>15</sup> also reported three cases that early removal before a wall-off tract formed was clearly the cause of bile peritonitis. Such cases are rarely recorded in the literature.

To prevent this complication, the T-tube should be in placed for at least 14 days, allowing the tract to mature before the T-tube is removed<sup>9</sup>.

### 1.3 Others possible causes

1.3.1 Two cases were reported to have bile peritonitis after T-tube removal associated with the use of steroids and one patient with Ehler-Danlos syndrome<sup>14</sup>. Steroid might diminish the inflammatory reaction around the T-tube and results in failure to form a wall-off tract around the T-tube. Another cause is ascites.

### 1.3.2 Residual stones or a stricture in the

distal CBD might raise intrabiliary pressure and increase the risk of leakage when the t-tube is removed.

#### *Incidence of bile peritonitis after T-tube removal*

Winston et al (1965)<sup>12</sup> cited reference to 2,000 CBD explorations using latex rubber T-tube without any bile leakage. But a survey by Corbett et al (1986)<sup>14</sup> calculated the risk of bile leakage and peritonitis each time a T-tube is removed to be 0.84% or one in every 119 CBD exploration. One quarter of the patients were managed conservatively but the majority (75%) required operation<sup>14</sup>.

Although bile peritonitis after removal of T-tube is uncommon, many surgeons will experience this complication at least once during their professional careers. It has almost certainly been under reported in the literature. In my own experience, I have seen three cases (one from early removal, one patient with ascites, one patient receiving steroids).

## 2. Adverse reaction

Eight patients from a total number of 105 patients who underwent T-tube removal had severe adverse reaction developed secondary to bacteremia from the presence of infected bile and possibly to minor trauma secondary to T-tube removal<sup>16</sup>. Within an average of 1-3 hours after T-tube removal, all of them were seen with severe RUQ pain associated with local tenderness and fever. All responded well to vigorous antibiotic treatment and none required surgical treatment.

It is noteworthy that all of these had positive bile culture but there was no sign of bile leakage.

There are two points of interest. First, pathologic changes on the biliary tree histology, biliary tract obstruction and CBD dilatation are key factors in provoking the development of adverse reaction, being associated with a high incidence of bile infection. Second, the aforementioned reaction were not associated with bile leak after T-tube removal but trauma of the CBD created after T-tube removal might initiate bacterial translocation and bacteremia in the presence of bile infection. Lygidakis<sup>16</sup> believed that in dealing with patients having advanced pathologic changes on the biliary tree (dilatation) and biliary infection, internal drainage should be recommended.

#### *Risk factors for surgical exploration of the CBD (Tables 2, 3)*

1. *Advanced age*<sup>17-20</sup> The higher rate of concomitant diseases in this group of patients is the principal

**Table 2** Mortality of biliary surgery for calculous disease.

	Year	Total cases	Cholecystectomy alone	cholecystectomy & CBD exploration
Mc Sherry et al <sup>21</sup>	1980	10,775	0.6	4.1
Doyle et al <sup>22</sup>	1982	4,000	1.8	6.6
Girard et al <sup>23</sup>	1988	7,436	0.36	1.3

**Table 3** Age related mortality in CBD exploration.<sup>23</sup>

Age (years)	Number of pts	Death (%)
< 50	356	0.3
50-70	333	2.1
> 70	130	2.3
<b>Total</b>	<b>819</b>	<b>1.3</b>

reason.

2. *Obstructive jaundice*.<sup>17</sup>

3. *Biliary sepsis*.<sup>19-20</sup> Patients with infected bile had higher mortality and morbidity rates than those with the sterile bile.

4. *Positive exploration for CBD stones*.<sup>18</sup> The negative exploration are usually accompanied by very low incidence of morbidity and mortality.

5. *Reoperation*.<sup>21</sup> Secondary CBD exploration was reported to carry a mortality rate twice that of primary CBD exploration.

### SPHINCTEROPLASTY

Mc.Burney in 1898 cited transduodenal removal of the CBD stones via sphincterotomy<sup>24</sup>. Jones SA<sup>24</sup> introduced sphincteroplasty in 1952. The anatomic and physiologic difference between sphincterotomy and sphincteroplasty have been emphasized.

**Sphincterotomy** : Division of the distal part of musculature surrounding the lower intraduodenal portion of the CBD. The sole purpose of this procedure is to remove an impacted stone and provide exploration of the duct from below.

Post operative T-tube cholangiography is indistinguishable from normal<sup>25-26</sup>.

**Sphincteroplasty** : Division of the entire length of the musculature surrounding the lower end of the CBD and this procedure extends outside the duodenal wall. This procedure not only allows thorough explo-

ration of the duct from below, but also give free drainage of bile through a wide opening (like an internal choledochoduodenostomy)<sup>26</sup>.

This technique has not, however, been believed to be more efficient by some authors and entails a greater risk of serious complications, especially pancreatitis<sup>27</sup>.

### Indications<sup>25-27</sup>

1. Patients with impacted distal CBD stones in a non-dilated duct (most common).
2. Patients with multiple CBD stones and surgeon had doubt about duct clearance without duct dilatation or minimal dilatation (8-12 mm. in diameter).
3. Patients with papillary stenosis (with or without impacted stone).

Papillary stenosis was diagnosed when intra-operative cholangiography showed limited passage of contrast into the duodenum ("mouse-tail") or when during operative exploration of the duct using Blake's dilators, a Fogarty catheter or choledochoscopy, the diameter of the papilla was noted to be less than 3 mm<sup>27</sup>.

### Advantages<sup>28-30</sup>

1. Provides dependent drainage of the CBD.
2. Direct visualization of the ampulla of Vater.
3. Avoids sump syndrome.
4. Facilitates removal of an impacted ampullary stone.

### Complications of sphincteroplasty (procedure - related)<sup>27,31</sup>

Bleeding	0.8 - 5 %
Pancreatitis	1.6 - 4.2 %

### Mortality

The mortality rates were influenced by<sup>34-35</sup>

1. Age of the patients. (most important factors)

Age	< 30 yrs	- mortality 0 %
	> 70 yrs	- mortality 6 %

## 2. General risk factors (DM, renal failure, jaundice)

Only 40 per cent of all operative deaths were attributable to sphincteroplasty specific complication. The operation itself caused a mortality rate of 0.9%<sup>34</sup>.

A comparison of this mortality rates with that occurring after endoscopic sphincterotomy, (mortality rates of 1%)<sup>36</sup> demonstrates that the mortality rate itself is almost equal for both procedures (Table 4). The difference is that the surgical sphincterotomy is a combination of cholecystectomy, choledochotomy and sphincterotomy.

Almost all patients with post operative cholangitis had papillary stenosis<sup>27</sup>.

The results of many series<sup>27,33</sup> are similar in that more than 70-80 % of patients are asymptomatic at least 5 years after surgery (Table 5).

### Treatment of cholangitis after sphincteroplasty<sup>27</sup>

1. Endoscopic sphincterotomy (successful 50%)
2. Choledochoduodenostomy

**Table 4** Mortality following sphincteroplasty.

Reference	Year	Patients	Mortality (%)
Jones SA <sup>30</sup>	1978	312	1
Lygidakis NJ <sup>32</sup>	1982	40	5
Nardi et al <sup>31</sup>	1983	95	4.2
Baker et al <sup>33</sup>	1987	56	5.3
Sellner et al <sup>34</sup>	1988	1,200	3.7
Ramirez et al <sup>27</sup>	1994	135	1.5

**Table 5** Long term results following sphincteroplasty.

Reference	Year	Patients	F.U. (yrs)	Cholangitis (%)
Baker et al <sup>33</sup>	1987	41	7	3.3
Ramirez et al <sup>27</sup>	1994	101	5.6	5.9

### Importance for the Surgeons

- To make the decision as soon as possible in the course of the operation, rather than after prolonged fruitless attempts to remove an impacted stones. There is an evidence that prolonged instrumentation of the duct prior to performing sphincteroplasty would add complications to the procedure.

- To decide between choledochoduodenostomy and sphincteroplasty before performing a duodenotomy, because the incision must be placed differently for the two procedures.

- Gentle handing of the tissue and clear identification of the pancreatic duct.

### TRANSDUODENAL CBD EXPLORATION AFTER SPHINCTEROPLASTY WITHOUT CHOLEDODCHOTOMY (TCDE/S)

This technique has been popularized in Great Britain over the past two decades by Peel et al 1974<sup>37</sup> as a safe and potentially more effective alternative to supraduodenal CBD exploration (Table 6).

Standard supraduodenal CBD exploration can be technically difficult in small duct exploration and is associated with a significant risk of ductal injury or late stricture. Instrumentation of the middle part of the small CBD introduce additional risk of longitudinal ductal tear and posterior wall perforation and ductal transection<sup>38-39</sup>. Extensive dissection of small duct may also devascularized the duct and result in stricture formation<sup>38</sup>.

**Technique:** After cholecystectomy, duodenum was mobilized by a standard kocherization. A biliary Fogaty catheter was inserted through the cystic duct into the duodenum, inflated the balloon and withdraw snugly against the ampulla. Duodenotomy (localizing the ampulla by palpating the balloon) and sphincteroplasty could be performed with subsequent stone removal (using biliary Fogaty, scoops, Randall stone forceps, irrigation with red rubber catheter, cholangioscope).

**Table 6** TCDE/S without choledochotomy.

Reference	Year	Patients	Mortality	Pancreatitis	Duodenal fistula
Strom & Stone <sup>24</sup>	1982	123	2.4%	0%	1.6%
Ratych RE <sup>38</sup>	1991	28	0%	10%	0%

### Advantage

1. Avoid blind instrumentation of the distal CBD.
2. No choledochotomy, obviate the use of T-tube.
3. Alternative for CBD exploration in small CBD.

### CHOLEDOCHODUODENOSTOMY

Choledochoduodenostomy was first described more than 100 years ago by Reidel in 1888<sup>25,40</sup>. His patient died 9 hours postoperatively. Sprengel in 1890, published the first successful side-to-side Choledochoduodenostomy in a patient with CBD stone in Germany and gave the procedure its name<sup>25,40-42</sup>.

This procedure was first popularized in continental Europe and South America. However, American and British surgeons particularly remained rather reluctant initially. The main reason against this procedure was the overemphasis of the sump syndrome and ascending cholangitis.

Over the past 20-30 years, however, publications about choledochoduodenostomy have appeared with increasing frequency in the British and American Journals. Capper (1961)<sup>43</sup> in the UK and Madden (1970)<sup>44</sup> in the USA had produced excellent results of choledochoduodenostomy. From the results obtained in most of reported series, at present time, choledochoduodenostomy is a well accepted operation.

### Indications

1. Multiple CBD stones or sludge in a dilated duct.<sup>26,31</sup>
2. When complete clearance of duct cannot be ensured, particularly in the presence of acute cholangitis<sup>45</sup>
3. Primary common bile ductstones.<sup>26,46</sup> Whether as a primary or secondary operation (for recurrent stone).
4. Retained or residual stones.<sup>26,46</sup> In reoperation for residual stones, one or more stones may be left behind in 2.9-33 per cent of the explored duct and reoperations on the biliary system carry high mortality and morbidity.<sup>25,46-47</sup>
5. Impacted distal CBD stones.<sup>26,48</sup> No postoperative pancreatitis has been reported following choledochoduodenostomy. Vigorous attempts at manual removal of this stone in a dilated duct are hazardous. This blind maneuver would have a higher risk of

producing a "false passage" perforation of the wall of the intrapancreatic portion of the CBD or of traumatizing the pancreas which can lead to severe acute pancreatitis.

Choledochoduodenostomy should be reserved for an impacted distal CBD stone in a non dilated duct or when acute pancreatitis is present at surgery.

### Contraindications

1. Non dilated CBD.
2. Difficulty in mobilization of duodenum.
3. Significant duodenal edema or inflammation.

The presence of duodenal edema, whether due to acute cholecystitis with secondary duodenal inflammation or due to active duodenal ulcer, should be considered contraindication. The edematous, inflamed duodenum holds suture poorly and may be a risk for anastomotic disruption. An inflamed CBD does not present a problem<sup>26,48</sup> and previous Billroth II gastrectomy is not a contraindication.

### Advantages

1. Technically easier and faster to perform than sphincteroplasty or Roux-en-Y choledochojejunostomy. This was particularly important when dealing with elderly or debilitated patients.<sup>49-51</sup>
2. It appears to be more physiologically appropriate in that bile is entering the duodenum rather than jejunum.<sup>46,52</sup>
3. It permits easy access to further endoscopic evaluation or treatment if necessary.<sup>46,49</sup>

### Disadvantages

1. The necessity for making a duodenal anastomosis, with all the attendant risk of leak and serious side duodenal fistula.
2. Sump syndrome.
3. Recurrent cholangitis.
4. Duodenogastric reflux.

### Two basic technical criteria

1. A dilated CBD.
2. A wide stoma.

Kraus (1980)<sup>53</sup> reported the first study attempted to determine the correlation between the size of the CBD and subsequent cholangitis. He suggested that other procedure than choledochoduodenostomy should be considered when CBD is less than 1.6 cm.

The results of several studies have shown that size of the CBD and of the stoma are of critical importance in obtaining good long term results (Table 7). The optimal size of the CBD and stoma varied in many series.

The CBD should be at least 12 mm<sup>27,44,51,54-56</sup>, 14 mm<sup>26</sup>, 16 mm<sup>27,41,53,57-58</sup> or 25 mm<sup>52</sup> in diameter to allow the construction of a choledochoduodenostomy stoma at least 14 mm<sup>17,25,41,53,58</sup>, 20 mm<sup>29</sup>, 25 mm<sup>26,40,42,46,51,54</sup>

### *Mortality and Morbidity*

The significant drawbacks to choledochoduodenostomy are the risks of cholangitis, sump syndrome and alkaline reflux cholangitis (Tables 7,8).

### **CHOLANGITIS**

In the past it was believed that reflux of duodenal contents into the biliary tract was the presumed cause

**Table 7** Long term results of choledochoduodenostomy.

Reference	Year	No. of Pts.	F.U. yrs.	Cholangitis	Sump Syndrome
Madden et al <sup>44</sup>	1970	100	NA	NA	0
Degenshein et al <sup>42</sup>	1974	117	9	11	0
Kraus MA <sup>53</sup>	1980	68	NA	2.8	NA
Lygidakis NJ <sup>62</sup>	1981	342	9	0	0
Cubillos et al <sup>41</sup>	1985	125	NA	1.6	0
Huguier et al <sup>49</sup>	1985	75	6.7	2.7	0
Baker et al <sup>33</sup>	1987	125	7	3.3	2.8
Schein & Gliedman <sup>51</sup>	1987	200	5	NA	0
Escudero-Fabre et al <sup>58</sup>	1991	40	12.1	0	0
Deutsch et al <sup>48</sup>	1991	126	NA	1.5	2.4
Rat et al <sup>61</sup>	1993	43	4	8	0
Panis et al <sup>57</sup>	1993	58	2.4	10.3	5.2
Ramirez et al <sup>27</sup>	1994	225	5.6	4.7	0
Mihmanli et al <sup>63</sup>	1996	24	5	0	0
		<b>1,678</b>	<b>2.4-9</b>	<b>0-11</b>	<b>0-5.2</b>

**Table 8** Mortality and morbidity of choledochoduodenostomy.

Reference	Year	No. of Pts.	Mortality (%)	Morbidity (%)
Madden et al <sup>44</sup>	1970	1,255	2.7	NA
(Collective series)	1929-1969			
Berlatzky <sup>46</sup>	1981	709	2.5	NA
(Collective series)	1970-79			
Mosegaard et al <sup>59</sup>	1982	49	4	NA
Gaskill et al <sup>60</sup>	1982	71	2.8	30
Lygidakis NJ <sup>45</sup>	1982	342	0	NA
AI media et al <sup>40</sup>	1984	70	1.4	7.1
Huguier et al <sup>49</sup>	1985	77	2.6	NA
Cubillos et al <sup>41</sup>	1985	125	3.2	42.4
Baker et al <sup>33</sup>	1987	190	5.3	11.6
Escudero-Fabre et al <sup>58</sup>	1991	64	6	28
Deutsch et al <sup>48</sup>	1991	126	4	17
Rat et al <sup>61</sup>	1993	43	6	15
Ramirez et al <sup>27</sup>	1994	225	1.8	21.3
		<b>3,346</b>	<b>0-6</b>	<b>7-42</b>

of ascending cholangitis.<sup>60</sup>

Madden (1970)<sup>44</sup> showed experimentally that even biliary-colonic anastomosis failed to produce ascending cholangitis in dogs if the anastomosis is wide enough.

The important consideration is not that the duodenal contents get up into the biliary tree but that they should be passed freely back into the GI tract. Most surgeons stressed the need for a large anastomosis and agreed that "the more barium the better" from barium study. The terms "ascending" and "reflux" cholangitis are misnomer. Cholangitis is caused by obstruction from narrowing stoma, therefore, it should be referred to as "obstructed" or "descending" cholangitis.<sup>52</sup> A corollary of this would be "no obstruction, no cholangitis".<sup>41</sup>

Reflux from the duodenum into the biliary tree may lead to some derangement of hepatic function tests but this is not clinically significant.<sup>33</sup>

Matthews et al 1993<sup>64</sup> suggested five etiologic factors contributing to recurrent cholangitis.

1. Anastomotic stenosis (usually < 5 mm).
2. Intrahepatic stricture.
3. Intrahepatic stones.
4. Improper constructed or oriented enteric conduit.
5. Conditions predisposing to either abnormal intestinal flora or bacterial overgrowth in the biliary tree such as silk suture exposed in the bile duct lumen, duodenal diverticulum.

#### *Treatment of cholangitis after choledochoduodenostomy*

##### **- Non operative treatment**

1. Endoscopic sphincterotomy is the treatment of choice
2. Endoscopic enlargement of the choledochoduodenostomy stoma.

Blair III in 1985<sup>65</sup> first described endoscopic enlargement of choledochoduodenostomy stoma. He presented good results in 4 cases treated by diathermy enlargement of the stoma to about 1 cm with a standard sphincterotome.

Angioplasty-type balloon catheters are being used via the percutaneous transhepatic route to dilate biliary anastomosis.<sup>66</sup> Similar balloons are now available for endoscopic use<sup>67</sup>, which should simplify treatment of recurrent stenosis in patients who are poor surgical risk.

##### **- Reoperation**

1. To make a wider choledochoduodenostomy stoma.
2. Roux-en-Y choledochojejunostomy.

#### *Prevention of cholangitis*

A stoma of adequate size and a good opposition of mucosa of the CBD to that of the duodenum are the best prophylaxis for stenosis and cholangitis.<sup>41,49,51,53</sup>

#### **SUMP SYNDROME (BLIND SAC SYNDROME)<sup>40</sup>**

The sump syndrome has been recognized as a long term sequela reported with side-to-side choledochoduodenostomy or choledochojejunostomy. Biliary sump syndrome is a rare but embarrassing problem.

A sump (a pit or well) develops in the distal non functioning limb of the CBD. This distal CBD segment acts as a blind end diverticulum or as a siphon where lithogenic bile, GI contents and debris accumulate.

The mechanism proposed is that undigestible food materials enter the biliary system via the anastomosis and become impacted in the distal blind pouch of the CBD. As the material build up it gradually forms a nidus for bacterial growth and sometime recurrent stones. When this material reaches a mass large enough to block or partially block the anastomosis, cholangitis supervenes. Occasionally impaction of the distal sump also has caused pancreatitis.<sup>68</sup> Other rare problem due to bacterial proliferation in the sump leading to deconjugation of bile salts and presenting as steatorrhea and malabsorption.<sup>40,43</sup>

The presence of food debris in the blind segment seems frequent, without any symptoms, provided that a large choledochoduodenostomy has been performed. Akiyama (1980)<sup>69</sup> noted food debris distally in 4 of 15 patients with choledochoduodenostomy who underwent endoscopy annually. There were no symptoms of cholangitis in any of these patients. It is important to note that all of these patients had a large stoma size.

There is a general lack of agreement as to the criteria for the diagnosis of sump syndrome. The complex symptoms compose of cholangitis or pancreatitis with food debris in the distal CBD segment and stoma narrowing. Few cases have been clearly documented.

## Treatment

### - Non operative Treatment

1. Endoscopic sphincterotomy is the treatment of choice. This technique has been reported to provide distal bile duct drainage of the sump but cannot be used in patients with long strictures of the distal CBD. Debris or stones were extracted by basket entrapment or an occlusion balloon through the ampulla of Vater after endoscopic sphincterotomy.<sup>68,70-74</sup>

2. The material can be extracted directly through the stoma, if patent, by endoscopic cannulation of the anastomosis.<sup>70</sup>

3. Endoscopic lavage through the ERCP catheter into the ampulla of Vater.<sup>72</sup> The stones or debris were irrigated from the distal CBD and emerged from the choledochoduodenostomy stoma.

### - Reoperation

Mathews et al (1993)<sup>64</sup> preferred to perform a Roux-en-Y choledochojjunostomy to permanently eliminate the sump. They<sup>64</sup> did not believe that endoscopic treatment can completely remove the thick, infected debris that is often densely adhere to the wall of the inflamed distal CBD.

## DUODENOGASTRIC REFLUX

An unregulated bile flow into the duodenum, as might be expected after any procedure abolishing the sphincter action<sup>75</sup>, could be reasonable explanation for this abnormal reflux which was found endoscopically in 12-60 per cent<sup>40,63,69</sup>.

Is choledochoduodenostomy a significant cause of duodenogastric reflux? Paper from Spain in 1994<sup>76</sup> evaluated duodenogastric reflux in 4 groups of patients. Group I-healthy or control, Group II-patients who had symptomatic cholecystectomy, Group III-patients who had symptomatic choledochoduodenostomy and Group IV-patients who had symptomatic choledochoduodenostomy (dyspeptic symptoms). Duodenogastric reflux was quantified using continuous intravenous infusion of 99mTc-HIDA and subsequently determining its concentration in gastric juice. The results showed that all of the patients who underwent operation, whatever the technique used, had high reflux rates than those in control group. But group IV had highest reflux rates. This results suggested that duodenogastric reflux must be involved in the genesis

of these dyspeptic symptoms.

### *Post operative evaluations for choledochoduodenostomy patients.*

1. All patients should have air in the biliary tree from plain abdominal x-ray.

2. An UGI series should show prompt filling of the biliary tree, and complete emptying should occur by 12 hours and no later than 24 hours.<sup>26,51</sup>

3. HIDA scan. With a proper functioning stoma, the biliary tree will empty in 45 minutes.<sup>26</sup>

4. ERCP assessment of the patency of the choledochoduodenostomy and biliary tree.

Because of the concern about long term results in patients with choledochoduodenostomy, particularly with reference to the occurrence of cholangitis, sump syndrome and duodenogastric reflux. The prevalent thinking among surgeons has been that choledochoduodenostomy should be performed only in the elderly patient and high risk patient and should be avoided in younger patients, who have a life-expectancy of 10 years or more.<sup>45</sup>

Later, it has also been recommended for use in the younger patients since a more aggressive therapy may be indicated in their often more aggressive lithogenic diathesis, and good long term results of many studies have been documented.<sup>40,57-58</sup>

### *Important factors*

1. The decision to do this operation must be made before the duodenum is opened.<sup>42</sup>

2. Choledochotomy should be performed as low as possible.<sup>29,46</sup>

- Avoid long blind pouch of the distal CBD.

- No tension.

3. Extensive mobilization of the duodenum.<sup>29,46</sup>  
- No tension.

4. Meticulous one layer anastomosis and good mucosal opposition.<sup>49,55,57,61</sup>

5. Slip a finger into the duodenotomy to palpate the ampulla.<sup>42</sup>

- No overlooked ampullary tumor.

## ROUX-EN-Y CHOLEDUCHOJEJUNOSTOMY

This procedure is less frequently reported in the literatures<sup>57</sup>, but many surgeons have favored this diversion procedure of the biliary system.<sup>29,57,61</sup>

### Indications

1. Same as choledochoduodenostomy, even the size of the CBD is not large enough for choledochoduodenostomy.
2. The duodenum can not be utilized for choledochoduodenostomy (duodenal ulcer, scarred, obstructed, cannot be mobilized).
3. Prior choledochoduodenostomy.
4. Intrahepatic duct stones, which often require drainage that offer access to the biliary tract post-operatively.

### Advantages

1. A defunctionalized, isoperistaltic intestinal segment to reduce reflux from the intestine.
2. A low tension anastomosis, which can be created at the hilum of the liver.
3. The possibility of doing side anastomosis in difficult situations where the bile duct cannot be mobilized with still reduce the chance of reflux.
4. No sump syndrome (end to side anastomosis)
5. No serious biliary fistula. If there is leakage of bile, the drain is left in place as long as necessary. Almost all such biliary fistulae close within 2-3 weeks.<sup>52</sup>

### Disadvantages

1. Require two anastomoses and take more time to perform.
2. Precludes endoscopic evaluation and treatment if necessary.
3. Less physiologic.<sup>77</sup> It does not provide normal mixing of the bile with the food that leave the stomach. Theoretic disadvantage of the bile being emptied into the proximal jejunum rather than the duodenum have frequently been raised, as have concerned regarding reabsorption of the bile salts within the Roux-en-Y limb. Kaiwara & Suzuki (1978)<sup>78</sup> showed in dogs that diversion of bile from the duodenum decreased pancreatic exocrine secretion with a Roux-en-Y reconstruction but not with choledochoduodenostomy.

4. Peptic ulcer.<sup>79-81</sup> The frequency of peptic ulcer disease after this procedure has varied among series. The proposed mechanism for ulcer production is two fold. First, there is diversion of the alkaline bile from the proximal duodenum into the jejunum, leaving the gastric acid unneutralized in the proximal duodenum. Second, there is experimental<sup>79</sup> and clinical<sup>80-81</sup> evi-

**Table 9** Long term results of choledochoduodenostomy and Roux-en-Y choledochoenterostomy

	Choledocho- duodenostomy	Roux-en-Y Choledochojejunostomy
Patients	64	66
Mortality	6.2%	1.5%
Morbidity	18%	13%
Mean Hospitalization	20 days	22 days
Long term F.U.	no significant difference (Cholangitis)	

dence that this procedure results in increased gastric acid production.<sup>52,57</sup>

While other series<sup>82-83</sup> have failed to identify an increased frequency of peptic ulcer disease after this procedure.

### Long term results

Cholangitis was noted in 7-10% of these patients<sup>29,57</sup>, and was the results of rather the presence of residual intrahepatic duct stones than stenosis of the anastomosis.<sup>52-57</sup>

Panis et al 1993<sup>57</sup> presented the first randomized study comparing choledochoduodenostomy and Roux-en-Y choledochojejunostomy in the treatment for CBD stones. This study confirmed the good long terms results of both procedures (Table 9).

### CONCLUSIONS

"Fit the operation to the needs of the patients and not the patients to one operation", Madden JL 1985.

There is no significant difference in the morbidity and mortality rate of the sphincteroplasty, Choledochoduodenostomy and Roux-en-Y choledochojejunostomy. All procedures give excellent long term results. These operations should not be considered simple alternative or additional procedures but that the indication for each are different, although with an area of overlap. Choledochoduodenostomy and sphincteroplasty are complimentary rather than competitive.

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