STRICTURES OF THE COMMON DUCT*

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Repair of strictures of the common duct still remains one of the most difficult problems in general surgery. Innumerable methods have been reported for the repair. Ordinarily, it would be desirable to adopt one of these methods as being superior to the others, but this is scarcely possible because the types of strictures vary so much. This variance in the type of strictures makes it desirable that the surgeon be acquainted with three or four types of repair.

ETIOLOGY OF STRICTURES

The majority of strictures of the common duct are *traumatic* in origin and are preceded by cholecystectomy. They are practically never encountered following cholecystostomy, and seldom indeed develop after choledochostomy. Excision of part of the duct, ligation by suture, or perforation of the duct by a suture represent common mechanisms in production of the lesion. In our series of 92 patients with stricture of the common duct, the cause was almost certainly operative trauma in 63 per cent of cases (see Table I).

In 20 per cent of our cases we have designated the cause as being *inflammatory*. Many of these are no doubt traumatic in origin. On many occasions, jaundice or other symptoms do not appear until three to six months have elapsed since cholecystectomy. On certain occasions it is possible that infection (with or without the development of a small abscess) develops in the right upper quadrant and involves the duct by contiguity, thus giving rise to a stricture. On other occasions, a portion of the duct may have been crushed by an artery forceps or pierced by a suture, thus accounting for the slow development of the stricture. On certain occasions a *collection of bile* may give rise to the stricture. It is well known that during cholecystectomy small aberrant bile ducts leading from the liver to the gallbladder may be damaged, and not ligated because of failure to observe them. A small amount of bile may accumulate in the upper abdomen because of this congenital anomaly. Bile also may accumulate in this area if the ligature around the stump of the cystic duct should slip off. Bile is extremely irritating, and even in the absence of bacteria produces peritonitis with marked inflammatory reaction. On many occasions we have observed a common duct with a normal and adequate lumen in the upper portion, but after repair of a stricture in the lower portion, have seen recurrence associated with progressive inflammatory destruction of the proximal portion. This has been described as "obliterative cholangitis," and has been observed by practically all surgeons making a study of common duct strictures. It is very possible that in the presence of a certain type of infection the inflammation may permeate the wall of the common duct and progressively destroy it by fibrosis. In our experience, when severe inflammation is present in the duct, recurrence is very apt to follow any type of repair.

There are two types of *pancreatitis* which may obstruct the common duct. One is localized pancreatitis of the head, and the other chronic diffuse sclerosing pancreatitis.

* Read before the Southern Surgical Association, Hollywood, Florida, December 5, 1950.

The first is a disease of relatively acute onset, lasting three to six months and usually followed by spontaneous recovery. The second is a chronic disease occurring gradually over a period of months, or years, and in its late stages is followed by nearly complete destruction of the pancreas with complications such as mild diabetes developing in the course of the disease. In very few patients will the pancreatitis progress to development of diabetes. None of our patients with obstruction of the terminal end of the duct, caused by localized pancreatitis of the head, are included in this report because drainage of the common duct is usually sufficient to relieve the symptoms and allow restoration of continuity of the duct.

TABLE I.—*Causes of Benign Strictures of the Common Bile Duct in Our Series of 92 Patients.*

	No. of Cases	Per Cent
1. Operative trauma..... (None following choledochostomy or gastrectomy)	61	66.3%
2. Inflammation..... (Some possibly related to trauma)	21	22.5%
3. Chronic pancreatitis.....	8	8.6%
4. Pancreatic or C. D. cyst.....	3	3.3%
Total.....	92	100 %

TYPES OF REPAIR

Regardless of the type of repair contemplated, the exposure will be the same with all types of operation. With few exceptions an enormous amount of adhesions will be encountered, due largely to the reaction of the tissues to bile draining from the wound and pooling in the right upper quadrant following the original operation (usually cholecystectomy). The duodenum and colon are separated from the liver by sharp dissection approaching the hilus of the liver from the antero-lateral direction. When structures are isolated in the hilus it is very helpful to identify them with a hypodermic needle and syringe before any structures are cut. If the common duct is missing the structure presenting in the floor of the wound will be the portal vein. Any bulging tissue at the hilus of the liver should be aspirated for identification. When isolating a common duct, careful technic with minimal trauma should be maintained, since rough handling of tissue encourages fibrosis in the healing process. Moreover, when a stump of common duct is found it should be mobilized only as far as needed in the anastomosis because extensive mobilization of the duct will detract from the blood supply which in most cases is already deficient. Search for the distal end of the duct is carried out as illustrated in Figure 1A.

End-to-End Anastomosis. When a local stricture is encountered, its excision and end-to-end anastomosis should yield good results in a very high percentage of cases. When part of the common duct is missing it is preferable to find the two ends of the duct and anastomose them if at all possible. Lahey[1] and Cattell[2] have been very successful in finding the two ends and strongly urge end-to-end anastomosis in place of any other type of operative procedure. Obviously, it will be necessary on many occasions to isolate the terminal end of the duct behind the duodenum. Lahey and Cattell advise mobilization of the duodenum and head of the pancreas and isolation of the duct by splitting the head of the pancreas. It should be added, however, that not all surgeons have been so fortunate in finding the terminal end of the common duct, and obtaining good results after it is found. One of the big difficulties with this type of operation is mobilization of the duodenum and head of the pancreas to an extent sufficient to allow end-to-end anastomosis without tension.

In performance of the anastomosis it is important that certain principles be heeded or followed. One row of sutures is adequate because in an end-to-end anastomosis, infection at the site of the suture line and danger of leak will be minimal. We use an interrupted mattress suture of 00000 silk,

being careful that it does not pierce the entire wall of the duct and project into the lumen; the presence of a non-absorbable suture in the lumen might lead to development of stones. Care should be taken not to take the suture too far from the edge and turn in a lot of duct, since this would no doubt encourage development of a stenosis or stricture. Before completion of the suture line, an opening should be made in the duct distal to the suture line and a T tube inserted to maintain decompression (see Fig. 1B). It must not be brought out through the suture line because of the tendency to increase the inflammation with subsequent fibrosis at the suture line. Opinions differ as to how long this T tube should be left in. Lahey and Cattell advise leaving them in place for several months before removal.

Lahey and Pyrtek[3] have recently surveyed the results in 229 patients with stricture subjected to follow up studies after operative repair. In 78 patients having an end-to-end anastomosis performed between 1940 and 1948, 60.2 per cent obtained good results after one operation and an additional 18 per cent obtained good results after a second operation; in this series the mortality rate was 3.9 per cent. In 27 patients having repair by anastomosing the proximal duct to the distal end after its dissection from the head of the pancreas, good results were attained in 73 per cent of the cases, counting six patients having good results

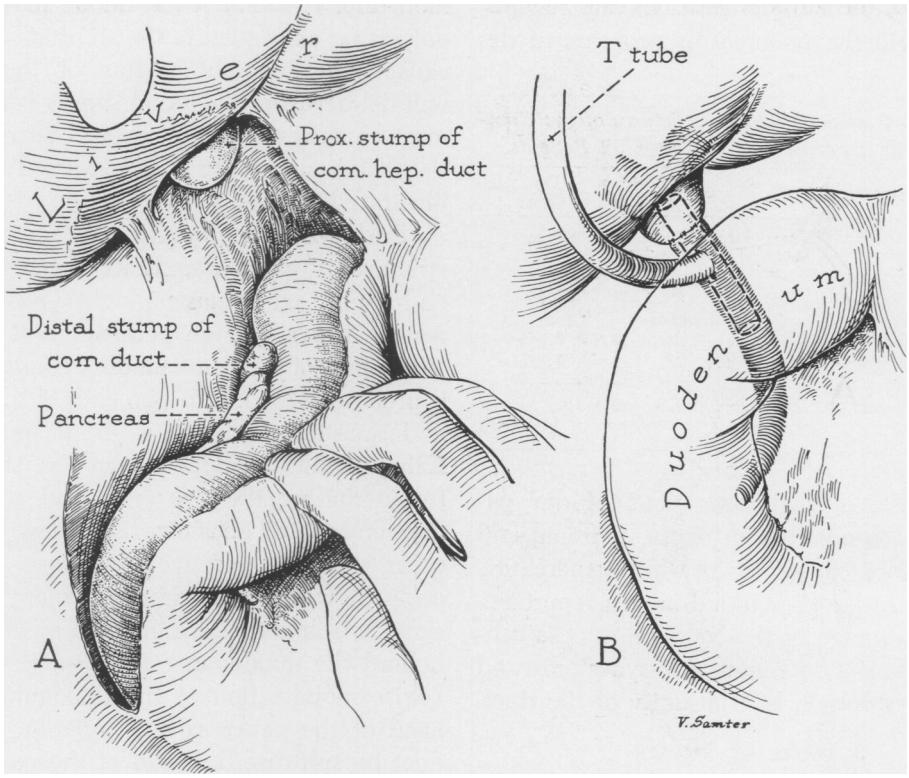

FIG. 1.—(A) In the search for the distal end of the common duct, the peritoneum on the lateral surface of the duodenum is incised and the duodenum rotated medially. (B) The duodenum must be mobilized sufficiently to bring the two ends of the duct together without tension. After the anastomosis is complete the T tube should be inserted for decompression, but it must not be brought out through the suture line.

following a secondary operation. In 185 patients operated between 1940 and 1948 by various types of technic, the procedure mortality rate was 4.4 per cent, and the patient mortality rate was 6.5 per cent.

Anastomosis of the Proximal Duct to Roux Y Arm of Jejunum. If the distal end of the common duct is destroyed or cannot be found, the authors consider anastomosis to be followed by significant infection at the suture line, we are not convinced now that a sphincter is necessary. If attempts to find the distal end of the duct are complicated by considerable bleeding and consumption of considerable time, we are inclined to resort to use of a Roux Y arm of jejunum as an artificial common duct. In this procedure the jejunum is transected about 15 inches

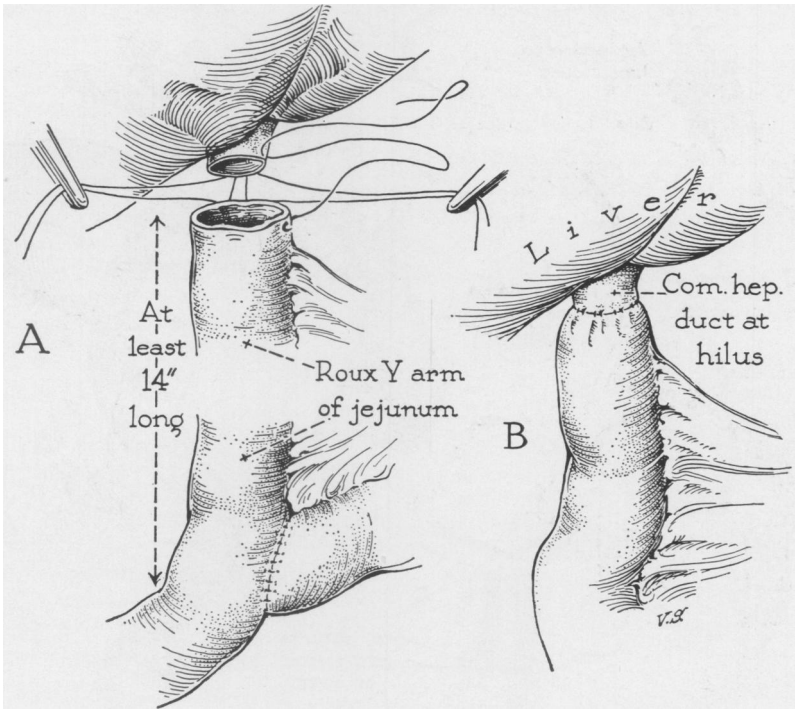

FIG. 2.—Repair of stricture by anastomosing the hilar duct to the end of a Roux Y arm of jejunum when the distal end of the duct cannot be found. (A) interrupted mattress sutures of fine silk are taken through the common duct and jejunum as illustrated. (B) Appearance of the suture line after all sutures are tied. The hilar duct is not always as large as shown. When it is smaller a smooth junction will not be achieved so readily.

of the proximal duct to a Roux Y arm of jejunum as the procedure of choice. Until a few years ago, the authors were of the opinion that it was extremely desirable to find the distal end of the common duct and thus preserve the function of the sphincter of Oddi. However, since use of a defunctionalized arm of jejunum, at least 14 inches in length, prevents regurgitation of food into the intrahepatic ducts, and does not appear from the ligament of Treitz, and the proximal arm of jejunum anastomosed to the distal arm about 12 to 15 inches from the severed end. An end-to-side procedure is chosen for this anastomosis, utilizing interrupted silk for the outside layer; continuous catgut may be used for the inside row, but an interrupted suture is less likely to result in obstruction of the stoma. The arm of jejunum is brought up through an opening in

the mesocolon posterior to the colon or is brought up anterior to the colon, depending upon the length of the mesentery of the jejunum (see Fig. 2).

tomosis in order to minimize the deposition of fibrous tissue in the healing process. It is actually helpful to have a frozen section of tissue from the duct to establish the pres-

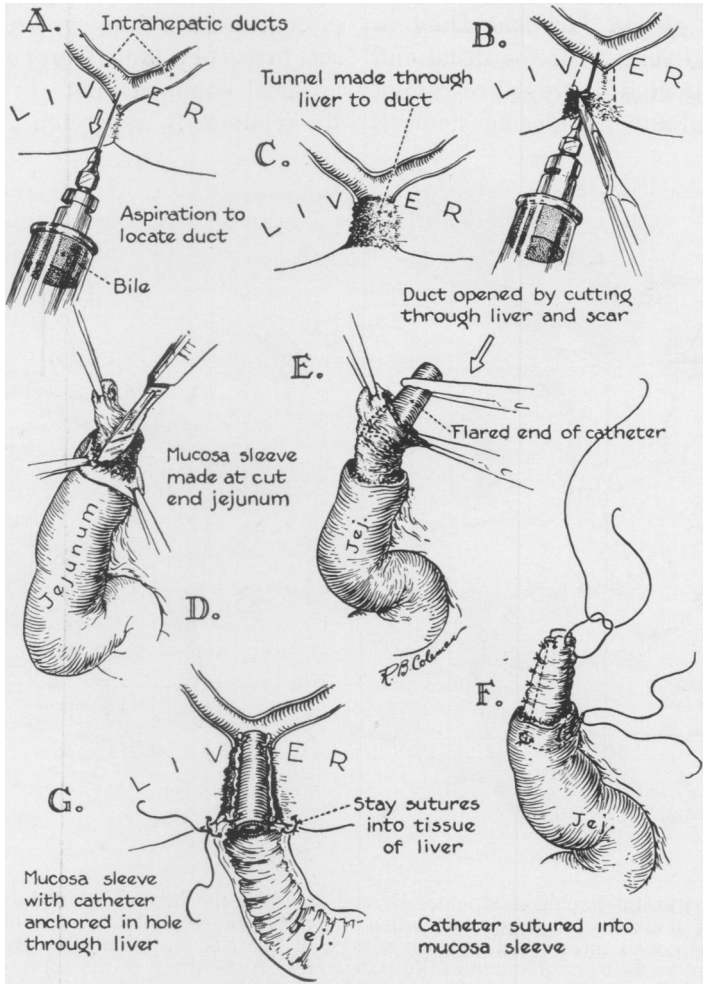

FIG. 3.—When there is no duct at the hilus but bile is obtained from an intrahepatic duct by aspiration of the liver with a needle and syringe, an opening should be made through the liver down to the duct. Rarely is this opening large enough to accept the entire end of the jejunum. When the opening is small we trim away the muscularis and serosa from the submucosa and insert the mucosa tip into the opening, hoping that it will adhere to the liver and act as a graft, thus preventing or minimizing stenosis. Some type of splint must be used to hold the submucosa against the liver. Instead of a short piece of rubber tube we have recently been inserting a T tube through an opening in the jejunum, extending one arm up into the liver. (After Cole in Canadian Medical Association Journal)

In repair with this method, and for that matter, any method, it is essential that all scar tissue be excised from the proximal arm of the duct being utilized in the anas-

ence of mucosa. We place about eight interrupted silk sutures between the end of the jejunum and the proximal end of the common duct. All of these are placed before

any are tied. Care is taken not to penetrate the entire thickness of the common duct. A mattress type of suture with fine silk is taken. A similar type of mattress suture is taken on the jejunal side so that when the suture is tied, mucosa can be brought to mucosa, but the suture does not penetrate the lumen of the duct or jejunum.

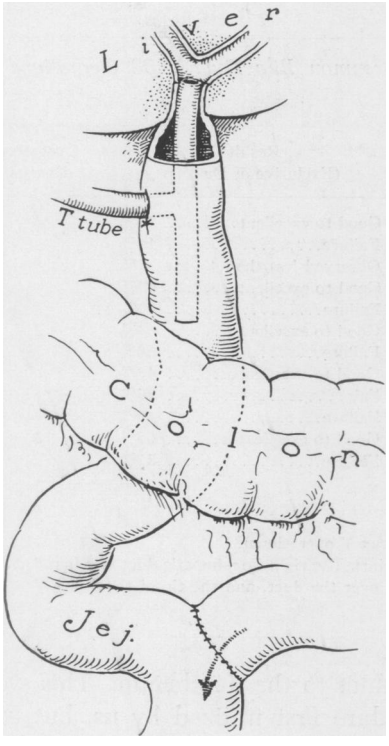

FIG. 4.—Diagrammatic sketch of completed operation when an opening must be made through liver tissue to find an intrahepatic duct.

We have found it helpful on some occasions to make an opening in the arm of jejunum an inch or two from the end, inserting a large catheter into the common duct at the hilus. Tying the sutures with the catheter in place minimizes the danger of obstruction to the lumen by infolding of excess tissue. On most occasions the catheter is removed when the suture line is completed. In our opinion, one suture line is adequate when a Roux Y arm of jejunum is used, because infection would be minimal when anastomosing a duct to a defunctionalized loop of intestine. However, we consider it essential, or at least desirable, to attach the end of the jejunum to the liver by several interrupted sutures to minimize leakage, and to prevent strain on the suture line by peristalsis or weight of the jejunal arm.

In five patients we have been unable to find a duct at the hilus, but with a syringe and needle have found an intrahepatic duct to the right of the hilus at a depth of one to one and three quarters inches. On these occasions we have cut out a cone-shaped piece of liver over the duct and inserted the tip of a Roux Y arm of jejunum into the opening connecting with the duct. Usually it will be necessary to trim away serosa and muscularis from the tip of the jejunum to make it small enough to insert into the opening without danger of obstructing the opening (see Fig. 3). In three of these five patients, such large vessels were found with the needle and syringe adjacent to the duct that we were reluctant to attempt cutting the duct. Utilizing information we discovered previously, that puncturing intrahepatic ducts near the surface several times with a needle usually resulted in creation of a fistulous opening, we punctured the duct ten to 20 times with a needle and inserted the tip of jejunum, anchoring it deep in the opening, so that the mucosal portion of the tip of jejunum would act as a graft and minimize production of a stricture. A T tube (or rubber tube splint) must be inserted in the end of the jejunum an inch or two from the anastomotic line, with the superior arm (of the T tube) in the opening of the liver to compress the jejunum against the walls of the opening and encourage the jejunum to adhere to the liver (see Fig. 4). If this procedure is performed, it is probable that the tube should be left in place several months. Obviously, the operation just described cannot be expected to yield a high percentage of good results, but when no duct can be found there may be no other

procedure available. The Longmire method might be considered, but in at least many of these cases where no duct can be found at the hilus, it may be assumed that the junction of the right and left duct is obliterated by the sclerosing process; on such occasions, cutting across the left lobe of liver would drain only the remaining stump of the left duct, and not the right.

rate, etc., in the patients of our series treated by this and other methods will be discussed under "Results."

Choledochoduodenostomy. One of the first procedures to be adopted fairly widely in the repair of common duct strictures, after discovery that transplantation of a fistulous tract was followed by poor results, was the anastomosis of the proximal common duct to the duodenum. This was the procedure first utilized by us, but our results were so unsatisfactory that we changed to other methods. However, we wish to emphasize that some surgeons utilize this type of operation and prefer it to others.

TABLE II.—*Summary of Results in Repair of Strictures of Common Bile Duct (108 Operations in 92 Patients).*

Type of Operation	Number Operations	Results (Exclusive of Deaths)		Operative Deaths
1. Hilar duct to Roux Y arm jejunum	57	Good to excellent	73%	2
		Failure	19%	
		Observed less than 1 year	7%	
2. Intrahepatic duct to mucosal flap jejunum* (Modified Hoag operation)	5	Good to excellent	60%	
		Failure	40%	
3. Repair local stricture	10	Good to excellent	62%	2
		Failure	38%	
4. Hilar duct to duodenum	10	Good to excellent	40%	
		Fair	20%	
		Failure	40%	
5. Miscellaneous types of operations	26	Good to excellent	65%	3
		Failure	35%	
Total	108			7

Operative mortality rate 6.8% (3.5% for those having Roux Y operations).

* In this group of 5 cases the duct could not be found at the hilus. The right intrahepatic duct was found with an aspirating needle, a cone-shaped piece of liver resected over the duct, and the tip of the Roux Y arm of jejunum inserted (see text and Fig. 3).

In previous years we have utilized vitallium tubes, rubber catheters, and rubber tubes as splints to support the suture line following anastomosis of the duct to the Roux Y arm of jejunum. However, we have seen such extensive thickening and fibrosis in ducts with rubber tubes implanted several months previously, that we are beginning to question the wisdom of using them to support the suture line when anastomosing the hilar duct to a Roux Y arm of jejunum. Accordingly, we have not utilized a splint in the last several cases, except as described, and as shown in Figure 3. Preliminary data suggest that results following use of no splint (except in cases such as shown in Figure 3) are superior to those with a splint. The percentage of failure, mortality

In reality, choledochoduodenostomy is about the simplest type of repair for a stricture of the common duct if the two ends are not readily available for end-to-end anastomosis. After the stump of proximal duct is found at the hilus and isolated, the duodenum is mobilized and brought up to approximate the duct. An opening is made in the duodenum and an outer row of interrupted fine silk sutures taken posteriorly. Interrupted fine catgut is used for the inside row; this inside row of sutures goes through

all layers of the duct and duodenum. After the inside layer is completed, the remainder of the sutures of interrupted silk are taken for the outside layer. To relieve tension on the suture line the duodenum is anchored to the liver by three or four fine interrupted sutures. Walters,[4] who uses this method of repair fairly consistently, recommends no splint for the anatomic line if the duct is large, and a Mayo-Sullivan rubber tube with a double flange, if the duct is small.

As stated previously, our results with choledochoduodenostomy have been relatively poor, inasmuch as only four of ten patients sustained good results. However, the series is so small that any figures on results would not be very valid. Walters[4] favors this operation over any other and has reported its use in 118 cases with good results in 70 to 75 per cent of cases. During the years 1940 to 1948 Walters reported a patient mortality rate of 3.4 per cent and a procedure mortality rate of 2.6 per cent in 88 cases, most of whom were operated by the choledochoduodenostomy technic. In the period 1924 to 1939 inclusive, he reported a mortality rate of ten per cent in 98 cases, thus demonstrating a sharp improvement in mortality rate during recent years.

Intrahepatic Cholangiojejunostomy. Longmire and Sanford[5] have reported a new type of procedure in which they amputate the left lobe of the liver, isolate a large duct and anastomose it to an opening in the side of a Roux Y arm of jejunum after the mucosa-to-mucosa technic. They have utilized this method in four cases with fairly good results in all four. Other authors have reported success with this method, but we have not been so successful. In one of our patients, an anastomosis was performed successfully, but a few months later a stricture developed. In a second patient upon whom we utilized this method, we cut across the left lobe, but could not find a duct large enough to admit a moderate sized probe. A previous attempt to find a duct at the hilus was unsuccessful. In this patient the liver was enormously enlarged and slightly fibrosed, due presumably to portal thrombosis. This enlargement and fibrosis had compressed the ducts, perhaps in a manner so consistently noted in infants, with congenital stenosis of the bile ducts.

RESULTS

Our series consists of 108 operations on 92 patients. An anastomosis between the hilar duct and end of a Roux Y arm of jejunum was performed on 57 occasions. Only 50 of these had been performed longer than one year previously; good to excellent results were obtained in 73 per cent of this group (see Table II). We had two postoperative deaths in this group of operations, constituting a mortality rate of 3.5 per cent.

On five occasions a duct could not be found at the hilus, but one was found with a needle and syringe to the right of the hilus at a depth varying from one to two inches. As described previously, an opening was made in the liver over this duct and the end of the Roux Y arm of jejunum anchored in the opening over a rubber catheter or T tube. Admittedly this is a desperate method in a desperate situation, but two of the five cases sustained good results. Without it nothing would have been possible unless a Longmire procedure could have been utilized.

On ten occasions we performed an end-to-end anastomosis. Theoretically this procedure should be associated with the lowest mortality of all methods, but we lost two of these ten in the postoperative period. Results in the eight survivors might be considered fairly good insofar as 63 per cent were classified as good. This corresponds closely to the experience of Lahey and Pyrtek, who reported 60.2 per cent good results in 44 cases so operated, and good results in 78 per cent, counting secondary operations performed in some of them. However, Walters reports only 50 per cent good results with this procedure.

On ten occasions we performed anastomosis between the stump of the common duct and the duodenum. Although none of these ten patients died in the postoperative period, only four were classified as having good results. This is the procedure preferred by Walters, who reports 70 to 75 per cent good results with it. As indicated previously, this series of ten cases is too small upon which to draw valid conclusions.

On 26 occasions miscellaneous types of operations were performed with three deaths. In this group, 65 per cent were classified as having good to excellent results. In a few of these patients simple procedures such as removal of a suture from the common duct, dissection of scar from the duct, or minor plastic procedures were performed. Inclusion of such patients in this group maintains the results at a fairly satisfactory figure which otherwise could be bad because some of our early cases with unsatisfactory results following use of a loop of jejunum (instead of a Roux Y arm of jejunum) were included in this group.

There were seven postoperative deaths in our entire series, constituting an over all procedure mortality of 6.8 per cent. In 57 operations anastomosing the hilar duct to a Roux Y arm of jejunum there were two postoperative deaths, constituting a procedure mortality rate of 3.5 per cent. The cause of death in the seven fatalities was massive hemorrhage from portal hypertension in two, hepato-renal failure in two, bile peritonitis with multiple intraperitoneal abscesses in one, abscess of the right lobe of the liver in one, and acute hepatitis in one. In the last patient just mentioned, a Mikulicz type of repair was performed for a short stricture, and a T tube inserted with one arm extending through the sphincter of Oddi. Large quantities of duodenal contents regurgitated through the T tube and presumably went up into the liver. Evidence of sepsis, primarily of the acute hepatitis type, developed and she died with multiple liver abscesses. Since this unfortunate experience we no longer use a long armed T tube, although we admit conclusions should not be drawn from one case.

DISCUSSION

It must be emphasized continuously that the vast majority of strictures of the common duct are secondary to operative trauma. To avoid errors of operative technic in biliary surgery certain precautions must be borne in mind at all times. These have been discussed in detail in a previous publication.[6]

It is well known that *early repair* of accidental trauma to the common duct is highly desirable; results should be best in patients so treated. In most cases it is possible to make the diagnosis of accidental occlusion of the common duct because of development of jaundice or a biliary fistula 48 to 72 hours after cholecystectomy. True enough, not all patients developing a biliary fistula two or three days after operation have had injury to the common duct; slippage of the ligature from the cystic duct or drainage of bile from severed accessory hepatic ducts may result in drainage of bile from the wound in the immediate postoperative period. Fortunately, in these conditions the flow of bile always stops spontaneously in ten to 20 days. Differentiation of these complications from accidental occlusion of the duct is usually fairly accurately made in four to eight days by the absence of bile in the stool of patients with occlusion of the common duct and presence of bile in patients with the other complications just mentioned.

Numerous points in operative technic are extremely important in the results following operative repair of stricture. It is just as important, in fact more important than in the average operation, that extreme gentleness be used; particularly is it essential not to handle structures at the site of anastomosis roughly, since operative trauma increases scar formation and the stenotic process. All scar should be excised at the

ends of the common duct to minimize scar formation at the suture line. When the stump of common duct at the hilus is short, there is a great temptation to leave every millimeter of tissue. However, leaving scar tissue on the end of the duct is unwise conservation; it is far better to excise the scar even though the duct is short, and obtain enough duct for an anastomosis by excising small portions of liver tissue to facilitate the performance of the anastomosis. In many cases where considerable inflammation is present it will be difficult to determine just where the junction is between mucous membrane and scar tissue. On a few occasions we have resorted to frozen sections and have found them helpful in determining how much to trim from the end of the duct.

The amount of inflammation in the duct and its size are very important factors in the ultimate results following repair. In general, the outcome is particularly favorable if the duct is long, the lumen large, and the wall thin; on the contrary, the outcome is unfavorable if the duct is short, the lumen small and the walls thickened—particularly if acute or subacute inflammation is present. We are so convinced of the unfavorable effects of inflammation on repair that we have almost universally adopted the plan of giving intensive chemotherapy to every patient for a few days preoperatively.

Six or seven of our patients have had splenomegaly and other evidence of portal hypertension; most of these have had bleeding from esophageal varices. On two occasions a spleno-renal shunt was performed in order to control the hemorrhage. The results of repair of stricture under such circumstances are unfavorable because of the marked inflammation usually present. The cause of the portal hypertension is usually either portal vein thrombosis or biliary cirrhosis. Although a few of these patients have died, we have had an autopsy on only one case. Therefore, we are unable to give any data on the comparative incidence of the two complications.

Originally we were of the opinion that the sphincter of Oddi was an extremely important organ. Our experience during the past several years indicates that the sphincter is by no means essential, although we contend the terminal end of the common duct should be found, if possible, so that the sphincter mechanism might be preserved. When a Roux Y arm of jejunum is anastomosed to the hilar duct and then utilized as an artificial common duct no regurgitation of food will take place if at least 12 inches of jejunum intervene between the duct and intestinal anastomosis. We feel that regurgitation of food up into the intrahepatic ducts is undesirable, although by no means will it always result in development of infection. By far the majority of patients with attacks of chills and fever (suppurative cholangitis) developing after operative repair of a fistula have a recurrence of the stricture as the cause of the infection. However, we do have evidence that regurgitation can produce infection of the suppurative cholangitis type. For example, in our early work on repair of strictures we anastomized the hilar duct to a loop of jejunum in five cases. Four of these had a satisfactory result for a time but later developed chills and fever. Roentgen ray examination with barium showed that barium would reflux up into the intrahepatic ducts even though we had performed an entero-enterostomy proximal to the ductal anastomosis. Severance of the proximal duct resulted in complete cessation of symptoms in two of three cases and marked improvement in the third.

The question as to use of splints to support the suture line postoperatively for a period of time is a controversial one. We have seen such severe inflammation of the common duct with great thickening and fibrosis surrounding a rubber tube placed in the duct months previously as a splint, that we are inclined to believe the deleterious effects of a splint may outweigh the advantages. We are inclined to believe that if an

anastomosis between the hilar duct and end of a Roux Y arm of jejunum is performed with proper technic, a splint is not needed, unless the patient has had an incontrollable suppurative cholangitis. In such a case (*i.e.* suppurative cholangitis) it would appear desirable to insert a T tube through an opening in the end of the jejunum one to two inches from the anastomotic line with one arm extending up past the stoma. We are now inclined to remove this T tube at the end of three weeks to minimize inflammatory reaction from the rubber. However, in the few patients in whom we found a duct only to the right of the hilus and had to make a hole in the liver to establish continuity with the end of the jejunum, it is probably desirable to leave the tube in place for several months.

When a duct has been repaired by an end-to-end suture, some sort of decompression would appear necessary to protect the suture line against the resistance of the sphincter of Oddi, which may at times be considerable. A T tube would appear the most desirable type of splint and method of decompression, although on a few occasions we have used a McArthur rubber tube, threaded past the sphincter of Oddi and anchored with a suture to the exterior. When the anchoring suture is cut, the tube will be passed. The tube is made by cutting a piece of desired length from a rubber catheter.

We have abandoned the use of the vitallium tube for several reasons. As stated, we doubt that a splint is needed in the average case in which the hilar duct is anastomosed to the end of a Roux Y arm of jejunum. In an end-to-end anastomosis utilizing proximal and distal common duct, a type of support must be used which can be removed, since one cannot depend on passage of a tube through the sphincter of Oddi unless it protrudes into the lumen of the duodenum as is the case with the McArthur tube. Although it has been shown quite conclusively that vitallium is very inert from the standpoint of tissue reaction, we know from experience that if vitallium tubes are left in a bile duct for any prolonged length of time, they will become plugged with bile precipitate, but with no greater frequency than a rubber tube.

SUMMARY

In a study of 92 patients with stricture of the common duct encountered by us during the last 13 years, we noted that in at least 63 per cent the cause was obviously operative trauma. An additional number of those designated as being caused by inflammation are no doubt caused by trauma likewise. In our experience with several different types of operative procedures we have finally adopted as our procedure of choice, the method of anastomosing the hilar duct to a Roux Y arm of jejunum when the distal end of the duct cannot be found. When the distal end of the common duct can be found, an end-to-end anastomosis should be performed between the two ends of the duct.

Our results in 57 patients in whom we anastomosed the duct to a Roux Y arm of jejunum were good to excellent in 73 per cent. The procedure mortality rate was 3.5 for this group. For the entire series the procedure mortality rate was 6.8 per cent.

We have seen so much reaction in the common duct to rubber tubes left in place for a considerable length of time that we are doubting the wisdom of using a splint of the rubber type as routine to support a suture line when the proximal duct is anastomosed to intestine. In an end-to-end anastomosis between the two ends of the common duct, some type of decompression must be maintained in order to protect the suture line against the resistance of the sphincter of Oddi; for this purpose a T tube is probably preferable.

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DISCUSSION.—DR. WALTMAN WALTERS, Rochester, Minn.: I profited by Dr. Cole's paper very much. I think the more surgeons who become interested in this subject, probably the fewer strictures will occur, especially if one has to struggle over them for hours to try to get, as he says, an anastomosis of the duct to the duct or the proximal duct to the intestine. I would like to comment on one or two things I thought I heard Dr. Cole say which I am sure he did not mean, and I do so only because I think that we should recognize the fact that transplantation of the external biliary fistulous tract by Drs. Hugh Williams, Frank Lahey and others, including myself, was never thought to be a particularly scientific, practical or enduring procedure in treatment of extensive strictures. You agree with that, don't you, Dr. Lahey?

Many years ago I transplanted fistulous tracts in five cases and had two successes; interestingly enough one of the patients went for 19 years without serious symptoms of biliary obstruction. I re-operated on that patient and the obstruction was not due to contracture of the entire fisulous tract, contrary to my expectation, but it was due to contracture at the point of anastomosis at the end of the tract to the duodenum. This was repaired; another stricture developed later and Dr. T. C. Douglass of Chicago, whom many of you know, operated on this patient again and performed a splendid operation. He excised the stricture of the right hepatic duct and made a ductal anastomosis. So far as I know the patient has been well since that time. So I should like to correct what Dr. Cole said as follows: 20 to 25 years ago transplantation of external biliary fistulas was used occasionally in cases of extensive stricture of the extrahepatic bile passages. Such has not been the case for the past 15 years. From 1914 on, anastomosis of the duct to the duodenum (as first successfully done by W. J. Mayo), and anastomosis of duct to duct were more frequently used procedures and the ones which gave the best results.

I agree with Dr. Cole in that it does not make a great deal of difference whether the duct is anastomosed to the duodenum or to the jejunum, provided there is not infection in the wall of the duct or within the liver. As he said, if you have a large duct without much infection in it and you make an accurate anastomosis of any type, except of the end of the duct to the end of the duct, which I am prejudiced against, the result is usually good. I do not like anastomosis of the end of the duct to the end of the duct because of the concentric contracture which occurs at the site of the anastomosis. Some years ago Dr. Truman Blocker suggested to me that one of the principles of plastic surgery be applied, and a triangular anastomosis be used between the ducts instead of a circular one. Unfortunately, in the cases on which I have operated, so little proximal or distal portion of the duct remains that a triangular flap anastomosis can seldom be used. If the pancreatic portion of the common bile duct is dissected, a stricture is almost certain to develop at that lower part of the duct; at least that has been my experience. In my experience the best procedure has been the anastomosis of the duct to the duodenum.* I have obtained excellent results in from 75 to 80 per cent of such cases. The result depends on whether sufficient duct remains above the stricture to permit an accurate anastomosis to the duodenum and on the amount of infection in the wall of the duct, its size, and whether there were calculi in the intrahepatic portion of the duct. In contrast to this, excellent results have followed anastomosis of the ends of the duct in only 52 to 55 per cent of my cases.

In some of Dr. Cole's groups, there are too few cases—tens and fives—to give reliable percentages. I think these groups should be discarded when results of different types of operation are being contrasted on a percentage basis. It is inadvisable to make any end-to-end anastomosis of a duct over a tube when the tube must stay in place for any length of time, because infection results

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* Walters, Waltman: Physiologic Studies in Cases of Strictures of the Common Bile Duct. Ann. Surg., **130**: 448, 1949.