Experiences with Surgical Reconstruction of the Hepatic Ducts

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The majority of patients had had one or more attempts at reconstruction prior to referral to the author. The total number of operations directly related to biliary tract problems is given in Table 4. These figures include operations for complications, such as postoperative bleeding, which are not included in the case summaries.

Acute Trauma

The two patients with acute traumatic avulsion of hepatic ducts are sufficiently unusual to warrant brief reports.

Case Reports

S.B., a 2½-year-old white male, was admitted to the Oklahoma Children's Memorial Hospital 13 days after being hit by a truck. The patient had been admitted to another hospital where he was found to have skull and pelvic fractures, but no intrabdominal injury was recognized. He was discharged home but readmitted to a second hospital because of nausea and vomiting. On admission to OCMH the patient was a fussy, dehydrated child. Abdominal findings included slight distention but no tenderness. Initial laboratory findings included an hematocrit of 35% and bilirubin of 2.5 mg/dl with a direct of 1.2 mg/dl. Other laboratory values were within normal limits. The day after admission an abdominal tap was performed and grossly bile-stained fluid was obtained. Operation was performed the following morning and avulsion of a major duct just below the liver, thought to be the left hepatic duct, was found. A primary anastomosis between the ductal ends was carried out with interrupted sutures of -00000- arterial silk and a small silastic catheter threaded through a stab wound in the distal common duct through the anastomosis for decompression. The patient's postoperative course was uneventful. He pulled the silastic tube out approximately ten days after operation. He was reported as developing normally and with no difficulties attributable to the liver or biliary system eight years after the accident.

Clinic Material

Fifteen patients are included in this report. The lesions necessitating surgical reconstruction were acute trauma (Table 1), surgical trauma (Table 2) and neoplasms (Table 3). The technical objectives of excision of all fibrotic and inflammatory tissue, careful and accurate mucosa-to-mucosa anastomosis and minimization of foreign body response by selection of suture material and avoidance of stents have been consistently observed.
RECONSTRUCTION OF HEPATIC DUCTS

Table 1. Traumatic Avulsion of Hepatic Ducts

<table>
<thead>
<tr>
<th>Pt.</th>
<th>Age</th>
<th>Sex</th>
<th>Original Injury</th>
<th>Previous Operation</th>
<th>Operation</th>
<th>Subseq. Operation</th>
<th>Follow-Up</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. B.</td>
<td>2½</td>
<td>M</td>
<td>Hit by truck</td>
<td>None</td>
<td>End-to-end repair</td>
<td>None</td>
<td>8 yrs.</td>
<td>Exc.</td>
</tr>
<tr>
<td>D. W.</td>
<td>10</td>
<td>M</td>
<td>Fell on stake</td>
<td>Neg. laparotomy</td>
<td>End-to-end repair</td>
<td>7 yrs</td>
<td>2 mos.</td>
<td>Indef.</td>
</tr>
</tbody>
</table>

D.W., a 10-year-old white male was admitted to the Oklahoma Children's Memorial Hospital two weeks after falling out of a tree and landing on a stake which penetrated the right upper quadrant of the abdomen. Immediate laparotomy performed at another hospital revealed no intraabdominal injury. Approximately 12 days after injury he was found to have evidence of ascites. Paracentesis revealed gross bile and the patient was transferred for further treatment. On admission the patient appeared to be dehydrated but was not acutely ill. The abdomen was rounded and tender and there was evidence of ascites. The only abnormal laboratory findings were a bilirubin of 2.6 mg/dl with a direct of 1.3 mg/dl. Operation was carried out on the day of admission. Complete avulsion of the common hepatic duct just distal to the junction of the right and left hepatic ducts was found. Careful anastomosis between the two ends was performed with interrupted -00000- arterial silk sutures (Fig. 1). A small silastic catheter was placed through the anastomosis exiting lower in the common bile duct. The patient recovered uneventfully but shortly after discharge from the hospital had a single episode of cholangitis which responded rapidly to antibiotic therapy. The tube was removed approximately three weeks after the original operation (Fig. 2). This child was asymptomatic, with excellent growth and development, until seven years after the original operation at which time he became jaundiced. Physical examination was entirely normal and the only abnormal laboratory findings were a bilirubin of 6 mg/dl with a direct of 5 mg/dl and an elevated alkaline phosphatase. After a short period of observation the laboratory values did not change significantly and exploration was advised. At operation the left lobe of the liver was enlarged and exposure of the liver hilus was difficult. The site of the very high previous anastomosis was identified and resection carried upward to expose a reasonable left hepatic duct. No right hepatic duct was identified despite extensive dissection. A Roux loop of jejunum was prepared and used to anastomose to the left duct stump in an end-to-side fashion. The postoperative course was complicated by superficial wound infection and later

Table 2. Surgical Injury

<table>
<thead>
<tr>
<th>Pt.</th>
<th>Age</th>
<th>Sex</th>
<th>Original Operation</th>
<th>Previous Reconstruction</th>
<th>Operation</th>
<th>Follow-Up</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. H.</td>
<td>39</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>1) Roux-en-Y</td>
<td>1) Hepaticocholejejunostomy (Kirtley)</td>
<td>16 mos.</td>
<td>Death from cholangitis with sepsis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Rev. of anastomosis</td>
<td>2) Revision</td>
<td>3 yrs</td>
<td></td>
</tr>
<tr>
<td>J. T.</td>
<td>31</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>1) Expl., T-tube</td>
<td>1) Hepaticocholejejunostomy</td>
<td>8 yrs</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Roux-en-Y</td>
<td>2) Splenorenal shunt</td>
<td>5 yrs</td>
<td>Excellent</td>
</tr>
<tr>
<td>D. W.</td>
<td>45</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>None</td>
<td>1) Rev. of hepaticocholejejunostomy</td>
<td>4½ yrs</td>
<td>Excellent</td>
</tr>
<tr>
<td>A. C.</td>
<td>61</td>
<td>M</td>
<td>Cholecystectomy</td>
<td>2) Revision</td>
<td>2) Hepaticocholejejunostomy</td>
<td>10 mos</td>
<td>Good</td>
</tr>
<tr>
<td>L. B.</td>
<td>55</td>
<td>M</td>
<td>Cholecystoduodenostomy</td>
<td>1) Cholecystocholejejunostomy</td>
<td>1) Resect. of stricture End-to-end duct repair</td>
<td>9 mos</td>
<td>Excellent</td>
</tr>
<tr>
<td>L. O.</td>
<td>54</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>2) Cholecystectomy</td>
<td>2) Resect. of stricture End-to-end duct repair</td>
<td>10 mos</td>
<td>Good</td>
</tr>
<tr>
<td>M. B.</td>
<td>71</td>
<td>F</td>
<td>Cholecystectomy</td>
<td>1) Reop., type unk.</td>
<td>1) Resect. of injured area End-to-end duct anastomosis</td>
<td>2½ yrs</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2) Reop., type unk.</td>
<td>2) Hepaticocholejejunostomy, Roux-en-Y</td>
<td>9 mos</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Reop., type unk.</td>
<td>3) Hepaticocholejejunostomy</td>
<td>9 mos</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4) Reop., type unk.</td>
<td>4) Hepaticocholejejunostomy</td>
<td>9 mos</td>
<td>Excellent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5) Duct-to-jejunal loop</td>
<td>5) Duct-to-jejunal loop</td>
<td>9 mos</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

*Age at referral to author.
†Follow-up interval from last operation to death or last information (November, 1973, in all cases)
by occult gastrointestinal bleeding. Liver chemistries returned to normal and the patient's early postoperative progress was satisfactory.

Surgical Injury

In eight patients, stricture of the biliary system resulted from surgical trauma (Table 2). The initial operation was cholecystectomy in six patients and in five of those the operating surgeon apparently did not realize that ductal injury had occurred. In one patient ductal injury was recognized and a choledocojejunostomy was performed. A patient who was explored for upper abdominal pain was thought to have an abnormally small common bile duct and a segment of urethral catheter was inserted into the duct as a stent. A cholecystostomy was also performed in this patient.

The interval between the original operation and the onset of obstructive signs or symptoms is given in Table 5. In most instances jaundice, with or without profuse biliary drainage, was noted in the early postoperative period suggesting that a ligature was the cause of obstruction, and this was found at operation in the two patients referred for initial reconstruction. In only one instance in which cholecystectomy was the original operation were symptoms delayed longer than a few days, and this information was obtained by history from the patient after several years and several operations.

Five patients had undergone attempted reconstruction prior to referral and all five had had more than one such attempt. Three had had two such procedures, one had had three, and one had undergone five attempted reconstructive procedures (Table 5). A variety of reconstructive operations was required in those patients with a history of previous repair. In two instances an existing hepaticojejunostomy by Roux-en-Y Anastomosis was revised by resecting the previous anastomosis and adjacent scarring and performing a new anastomosis. In one patient, the proximal dissection necessary to expose relatively normal ductal tissue involved tunneling into the liver several centimeters and in this patient, hepaticocholedochojunction, as described by Kirtley, was performed.

This patient also had undergone five attempted reconstructive procedures (Table 5). A variety of reconstructive operations was required in those patients with a history of previous repair. In two instances an existing hepaticojejunostomy by Roux-en-Y Anastomosis was revised by resecting the previous anastomosis and adjacent scarring and performing a new anastomosis. In one patient, the proximal dissection necessary to expose relatively normal ductal tissue involved tunneling into the liver several centimeters and in this patient, hepaticocholedochojunction, as described by Kirtley, was performed.

![Diagram](image-url)
RECONSTRUCTION OF HEPATIC DUCTS

Fig. 2. Cholangiogram several days after original repair of hepatic duct avulsion (Patient D.W.). Good flow of contrast media with no evidence of narrowing.

formed. An attempt was made to fill the duct and suture it open but this was not technically satisfactory. This patient subsequently underwent two revisions of this anastomosis at approximately one-year intervals. She developed esophageal varices on the basis of biliary cirrhosis, underwent a splenorenal shunt and ultimately died of cholangitis and septicemia eight years after the original cholecystectomy. A patient whose original reconstructive procedure consisted of anastomosis of the common hepatic duct to a jejunal loop was treated by performing a new anastomosis to a Roux loop of jejunum. One patient with a very short stenotic area in a previous duct-to-duct anastomosis was revised by resecting the short segment and performing end-to-end anastomosis. Cholangitis recurred in this patient four months after the operation and, after several episodes of mild cholangitis, a second reconstruction was performed, again by excising a very short stricture and performing an end-to-end anastomosis with an initially satisfactory result.

Two patients were referred shortly after the original cholecystectomy. In one patient, operation was necessary at 18 days because of deepening jaundice without external drainage. The right and left hepatic ducts and the common duct had been individually ligated and an intervening Y segment apparently resected, leaving a sizable gap between the ends. Reconstruction was accomplished by suturing the two hepatic ducts together and performing an anastomosis between this ductal structure and a Roux limb of jejunum. Cholangitis recurred in this patient in two months and, after further episodes of cholangitis, reconstruction was carried out ten months after the first reconstruction by excising the scar tissue and performing a precise anastomosis to the same jejunal limb. The second patient was reoperated on eight days after cholecystectomy because of jaundice. Ligatures were present just proximal and distal to the cystic duct stump. This short segment was excised and end-to-end anastomosis carried out with a satisfactory postoperative course. The patient in whom a segment of catheter had been left in the common bile duct as a stent developed cholangitis two years after the original operation. At exploration the entire distal common duct was densely scarred, but a good common hepatic duct was present just distal to the junction of the right and left hepatic ducts. The duct was divided at this point and biliary-intestinal continuity established using a Roux limb of jejunum.

Neoplasia

Carcinoma of the right, left or common hepatic ducts was encountered in five patients. All five had been explored for obstructive jaundice prior to referral. Tumor was identified at the original operation in three and proven by biopsy in two. One patient is reported in detail.

Case Reports

T.M., a 44-year-old white female, was explored for obstructive jaundice of one month's duration. The gallbladder was empty and the common bile duct was small. The operating surgeon palpated a mass at the liver hilum and performed a needle biopsy of this mass which was reported as showing cholangiocarcinoma. The patient was referred for further treatment. At the time of admission to the University of Oklahoma Hospital, she was a well developed, well nourished, icteric female. Other than the jaundice, physical examination was not remarkable. Bilirubin was 16.5 mg/dl with a direct of 10 mg/dl. Other laboratory values were within normal limits. Percutaneous cholangiography revealed complete occlusion of the left hepatic duct and nearly complete occlusion of the right (Fig. 3). Exploration was carried out through a right thoraco-abdominal incision. Left hepatic lobectomy was accomplished; however, tumor extension in the hilum was close to the line of excision and it was necessary to divide the right hepatic duct after its division (Fig. 4). Reconstruction was carried out by suturing the two remaining right hepatic ducts together and performing an end-to-side anastomosis to a Roux limb of jejunum. The immediate postoperative course was satisfactory. The patient's jaundice cleared and she was discharged from the hospital. The patient developed jaundice two months after operation and at exploration was found to have a large, unresectable recurrence (Fig. 5). She was started on chemotherapy but died four months after the major resection.

Left hepatic lobectomy was employed in one additional patient

<table>
<thead>
<tr>
<th>Table 5. Surgical Injury</th>
</tr>
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<tbody>
<tr>
<td>Patient</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>N. H.</td>
</tr>
<tr>
<td>J. T.</td>
</tr>
<tr>
<td>D. W.</td>
</tr>
<tr>
<td>C. S.</td>
</tr>
<tr>
<td>A. C.</td>
</tr>
<tr>
<td>L. B.</td>
</tr>
<tr>
<td>L. O.</td>
</tr>
<tr>
<td>M. B.</td>
</tr>
</tbody>
</table>
result eight years after repair. The second patient was free of any symptoms of biliary obstruction after the immediate postoperative period for over seven years when he became jaundiced. Reoperation was successful in restoring biliary-intestinal continuity, but followup is too short to term the procedure a success.

One of eight patients treated after surgical injury of the biliary system died as a result of the injury. This patient had multiple attempts at biliary tract reconstruction undergoing a total of eight related surgical procedures. The remaining patients are doing well without evidence of biliary obstruction. One patient is listed as having a good result because he has had a single episode of fever and, by history, dark urine. Serum bilirubin and alkaline phosphatase were normal during this episode. Five of the seven have had no symptoms suggestive of biliary obstruction for more than two years and four are asymptomatic more than four years after their last operation.

Four of five patients with primary carcinoma of the bile ducts are dead. The patient still living had placement of a silastic tube through unresectable carcinoma and subsequent irradiation of the liver hilum. She is free

but tumor tissue was left near the right hepatic veins. The initial palliative result was good. In one patient, found at operation to have carcinoma of the ductal system at the level of insertion of the cystic duct, the tumor was found to extend upward to a point below the junction of the right and left hepatic ducts and the ductal system was divided at this point and just above the duodenum. Reconstruction was carried out using end-to-side anastomosis to a Roux limb of jejunum with an uneventful early course. Unresectable carcinoma involving both right and left lobes of the liver was treated in one patient by dilating the left ductal system and inserting a silastic splint through the tumor stricture and suturing this in place. The right duct could not be located. This resulted in disappearance of jaundice, and the tumor mass, which was marked at operation with metal clips, was treated by irradiation therapy.

A final patient in the carcinoma group was a 58-year-old-man who had undergone three operations for “sclerosing cholangitis.” These operations covered a period of two years and the patient was referred to the author for re-exploration for recurrent biliary obstruction. He was found to have abdominal carcinomatosis and died approximately ten days after this procedure. This was the only early postoperative death in the 15 patients. At autopsy there was no gross tumor mass in the hepatic duct remnants, but microscopic sections showed nests of adenocarcinoma cells in the duct walls.

Results

The status of each patient at the time of this report is listed in Tables 1, 2, and 3. Of two patients requiring biliary reconstruction after acute trauma, one has a good

FIG. 4. Specimen from Patient T.M. Tumor mass is visible projecting from cut surface of total left lobectomy.
Discussion

Complete division of major hepatic ducts by trauma has been infrequently reported, and a variety of surgical procedures has been suggested as treatment. Simple drainage may be sufficient for partial division but seems unlikely to be successful for complete disruption. Sewell reported ligation of a major hepatic duct with a very satisfactory postoperative course. Primary repair of the duct by suture anastomosis has obvious advantages and appeal. A few instances of successful primary repair have been reported and one of the two cases described herein can be included. The occurrence of stricture seven years after apparently successful repair is alarming and illustrates the unique vulnerability of biliary anastomoses to continuing contracture. This has been recognized for years but has not been completely explained.

Repair of surgical injury to the hepatic ductal system has been a problem since shortly after the first successful cholecystectomy. A variety of reconstructive techniques has been described and employed, but none has gained universal acceptance. The principal areas of controversy at present concern the choice of duct-to-duct or duct-to-enteric anastomosis and the advisability of the use of long-term stents for anastomoses. Duct-to-duct anastomosis was advocated by Cattell and Braasch and this large experience was influential in persuading surgeons to search for the distal ductal system and perform primary anastomosis between the proximal and distal duct ends. Reports of major series by Walters et al. and Cole et al. showing improved results with duct-to-enteric anastomoses and, more recently, the disappointing results reported by Longmire in duct-to-duct anastomoses have led to a decline in the popularity of duct-to-duct anastomosis. It is suggested that the primary duct-to-duct anastomosis be performed only when very short segments of stricture are involved. The only failure of a reconstructive operation for stricture performed under favorable circumstances in the author's experience was with a duct-to-duct anastomosis. Duct-to-enteric reconstructions involve the use of either duodenum or jejunum (usually as a Roux-en-Y anastomosis). Anastomosis of the biliary system directly to the duodenum was popularized by Walters et al. and, more recently, supported by Aust and associates and Hertzer and associates. The duodenal operation is simpler than the jejunal in that less anastomoses are necessary and it does preserve the presence of biliary contents in the duodenum. Biliary tract reconstruction by anastomosis to the jejunum in a Roux-en-Y fashion was originally advocated as a means of avoiding reflux and, therefore, cholangitis. It is now generally accepted that cholangitis is almost invariably due to obstruction and that reflux is relatively unimportant. Nevertheless, the jejunal anastomosis has distinct advantages. The Roux limb can be made long enough so that the anastomosis is under no tension and is mobile enough that anatomic accuracy in performing the anastomosis is simplified. The presence of a Roux loop repair greatly facilitates subsequent exposure if an additional operation is necessary and this is a possibility in any biliary tract reconstruction. Finally, use of the Roux limb avoids the possibility of a lateral duodenal fistula which can result from a mishap with duodenal anastomoses. For these reasons, the authors have rou-
tinely employed hepatojunostomy by Roux-en-Y anastomosis when a biliary-enteric operation is selected. Intraoperative cholangiography is often very useful in defining anatomical relationships (Fig. 6).

The use of stents to decompress the proximal biliary tree and to maintain patency of anastomoses by preventing scar contracture has been almost routine until the last decade despite the suggestion by Cole et al.\(^5\) that tubes might increase the inflammatory response and therefore increase the scarring and contraction. Warren et al.\(^25\) support the use of stents with a very large experience and state that the best results were in patients in whom stents were left in place for 18 months to two years. The value of stents is also suggested by the experience of Lane et al.\(^10\) Clinical and experimental evidence indicating that splints are not necessary for successful biliary anastomoses has been presented by Madden.\(^19\)

Decreasing reliance on tubes has been mentioned by others.\(^1\) Stents have not been used in the author's experience, but repeated strictures in the patient having a Kirtley operation and follow-up of a sizable series of similar operations performed by Kirtley and his associates\(^10\) suggest that a stent might be helpful in those situations in which accurate mucosa-to-mucosa anastomosis is not technically possible.\(^5\)

It is probable that adherence to details in the performance of biliary anastomosis is even more important than the type of reconstructive procedure which is selected. There is usually little option in timing reconstructive procedures, but when biliary obstruction or mishap is recognized in the postoperative period (usually within three to five days), immediate reoperation is technically easier than if the procedure is delayed longer than one week. There is no convincing evidence that the success rate is higher but this seems to be a reasonable assumption. In the performance of biliary anastomoses, preliminary resection of all scar and inflammatory tissue is exceedingly important. The bile-stained lumen of a biliary fistulous tract may have the gross appearance of mucosa but have no mucosal elements. If there is any doubt, frozen sections of the areas to be used for anastomosis can be utilized to prove the presence of a mucosal lining.\(^2\) The author prefers an accurate, one layer, interrupted suture technique using very fine, inert sutures. The current choice is polypropylene. An external drain is used, but internal drainage and stents are not employed if an accurate mucosa-to-mucosa anastomosis has been achieved. Plastic procedures for revision of strictures have been mentioned frequently.\(^2,7,12\) Usually the degree of scarring precludes success of such procedures but when a mucosa-covered diaphragmatic stricture is encountered, as described by Way and Dunphy,\(^27\) longitudinal incision and transverse closure is appealing.

Recurrent stricture after reconstruction is usually manifested by cholangitis and ordinarily occurs within two years of the operation. Way and Dunphy\(^27\) have stated that a patient, two years after reconstruction without evidence of obstruction, has a 90% chance of permanent freedom from biliary obstruction.

Carcinoma of the extrahepatic biliary system is uncommon but not rare.\(^19\) The fact that these tumors produce a very distressing clinical picture (progressive obstructive jaundice, pruritis, anorexia, etc.) and the observation that many tumors remain localized for long periods of time have led to an aggressive surgical attitude towards these lesions.\(^17\) Technical procedures for excision of the entire extrahepatic ductal system and extended resection of either hepatic lobe have been developed.

Longmire\(^15\) has suggested further technical extensions for use in resecting lesions of the hepatic ductal system. The actual experience reported to date, however, is discouraging despite occasional reasonable results.\(^7,9,12,28\)

Since, in most instances, there has been a fairly long delay before the diagnosis of carcinoma is suspected, it
is possible that increased awareness and earlier diagnosis may result in increasingly successful surgical resections. Reasonable palliation can often be obtained, but unfortunately, this is usually not of long duration. When surgical resection and, therefore, any possibility of cure is not possible, the insertion of a permanent tube into the ductal system, bypassing or stenting the obstructed segment, also affords reasonable palliation.\(^8\) As Altemeier et al.\(^1\) have reported, sclerosing carcinoma of the biliary system may be a very confusing entity and should be considered whenever the diagnosis of sclerosing cholangitis is entertained. This lesion is often slower growing than other tumors in the area. Prompt diagnosis and aggressive treatment may yield improved results.

**References**


**Discussion**

Da HARWELL WILSON (Memphis): I think all of us would agree that the mucuso-to-mucosa anastomosis is definitely preferable when this can be achieved. With reference to the stent, I think that if we are sure of a mucosa-to-mucosa anastomosis, we would agree it is not always necessary, although in a few cases where we have been able to do a duct-to-duct mucosal anastomosis, we have used the stent, bringing the stent out through an opening either above or below the site of anastomosis.

As Dr. Williams mentioned, I think surgery of this type, while being indicated less frequently than previously, is still going to be necessary in certain cases for a long period of time, and it's important that we have in our armamentarium a number of different techniques, or at least be quite familiar with these in the event they are needed, even though the need for the alternate methods may arise infrequently.

All of us would agree that duct-to-duct anastomosis is best, perhaps, if we do it; but frequently, whether due to trauma or to injury occurring in the operating room, sufficient amount of duct to permit end-to-end anastomosis is frequently non-existent.

On the other hand, the Roux-en-Y anastomosis to the common duct or hepatic ducts has been advocated as a method of avoiding cholangitis and ascending infection. In our experience, I believe that anastomosis of the proximal ducts to the duodenum, where mucosa-to-mucosa can be carried out, gives just as good a result; and actually, it seems that we do not have the problem of ascending infection and cholangitis as long as there is not stricture present.

This has been a controversial issue, and before this Association there have been, at times, people who would advocate the avoidance of infection by the ascending route by always using the Roux-en-Y. Dr. Waltman Walters of this Association, at previous meetings has frequently referred to his extensive experience at the Mayo Clinic with anastomosis of the duct to the duodenum reporting excellent results. I think that both methods work very well.
I think also that, while certain methods may be the best in the hands of a given individual because of his personal experience, there are other times when a different method may be lifesaving. We owe a great tribute to Dr. Longmire for the method of intrahepatic choledochojuenostomy, which most of us, except Dr. Longmire, refer to as the Longmire operation, because this has been lifesaving for a number of individuals.

I also think the method of Mr. Rodney Smith, of London may be very helpful. This is the ingenious method of dilating the stenosed area in the hilum of the liver, passing a flexible gallstone forceps up through the dome of the liver, and then drawing down a Levin tube, attaching this to the mucosa of a Roux-Y, and, as Mr. Smith states, accomplishing mucosa-to-mucosa anastomosis without sutures, by drawing this mucosa up into the hepatic portion of the liver.

Dr. Kenneth W. Warren (Boston): The method Dr. Williams has employed certainly has merit, and the results for traumatic strictures secondary to operation indicate that this is a meritorious procedure.

Having treated considerable number of these patients, we have seen a broader spectrum of the pathology. This experience has convinced us there is no single operation, and we must individualize the procedure. One must be prepared to use a variety of stents.

It is very easy to avoid a stent if the caliber of the duct above is good. Essentially, what you find at the hilus of the liver determines the ultimate result. As Dr. Wilson has said, certainly there is a place for transcatheter intubation, both by pulling up the mucosa, as he described, and Rodney Smith has used, and also for putting a U tube right through the liver where it can be changed. This is for patients who have stricture of the intrahepatic ducts.

One of the stents that we like best is a modification of the Cattell Y tube where I put it a vulcanized, solid core onto this Y and bring it out either through the jejunum or the common duct in the rare instances in which we do end-to-end repair. Thus, we are able to remove it without reoperation.

In reviewing the records of a large number of patients who have had indwelling Y tubes—the Cattell Y tube—the longer these stents stayed in without producing symptoms (these stents were left in until cholangitis developed requiring a secondary operation for their removal) the better the result. Three years seemed to be the magic number. A good result was obtained in 86 per cent if the stents stayed on for that length of time without producing symptoms. After that, the results were scattered, and the patients were some of those patients, some of the stents staying in as long as 20 years. The longer the stents remained in place without symptoms, the better the result.

The modification of the Y tube presents one problem. Patients can see the external limb, and they want the tube removed. We have used this modified tube now for about five years and think it is eminently applicable to many of these strictures. We also have used the Rodney Smith mucosal graft with our modified Y tube, and by pushing this Y segment up into the ducts, the mucosal bridge is well above the stricture.

So, I make a plea. One has to individualize the surgical treatment and one has to be prepared even to improvise at the time of operation.

Dr. Frank Glenn (New York): I wish to take this opportunity to re-emphasize the unpredictability of a bile duct either anastomosed to bile duct or to any structure. It appears that stricture due to scar tissue in the bile duct wall may be scant or exuberant. The type of anastomosis and suture material seems to make little difference.

This slide is a cholangiogram (O. R.) of an 18-year-old female in whom I had repaired a right hepatic duct by end-to-end anastomosis and a divided common duct by choledochojuenostomy (Roux Y tube). Eighteen months later her alkaline phosphatase became elevated and then her bilirubin. At operation this choledochojuenostomy reveals a stricture of the duct to duct anastomosis of the right hepatic and stricture of the choledochojejunal anastomosis with calculi proximal to it. These were corrected. The patient had had a T tube stent from the right hepatic to and through the choledochojejunal anastomosis for several months and then removed. At present, over a year after the second repair, her alkaline phosphatase is slightly elevated and her bilirubin normal.

Dr. Robert Zeppa (Miami): My primary purpose is to bring to the attention of the membership a particularly pernicious mechanism for the development of common duct stricture, and this is the forcing in of the smallest T-tube during the course of resection for liver injury. As you know, this was a procedure in vogue for the therapy of liver injuries, and we have seen one particularly horrendous problem with a young man who required an extensive debridement lobectomy, and subsequently developed stricture in a common duct that at the time of the liver injury measured only 3 mm in diameter, and some very poor judgment was used in putting in that T-tube. The smallest T-tube that they could fit was the smallest size available in the hospital.

Dr. William P. Longmire, Jr. (Los Angeles): In regard to the part of the alimentary tract that one should use for the reconstruction, may I say that for many years we have favored the use of a Roux-en-Y jejunal limb for a choledochojuenostomy; however, it should be pointed out that in a recent review conducted by Dr. Michael McArthur of about 90 of these cases at our institution, 10 per cent had developed peptic ulcers, and between 25 and 30 per cent had peptic ulcer symptoms. Experimentally, one can markedly increase the gastric acid output by creating a choledochojejunal anastomosis.

This finding has cooled our enthusiasm somewhat for the use of choledochojuenostomy. There is one time, however, when use of the jejunum is indicated, and that is in cases of repair with a very small thin-walled duct as seen at the time of an extensive primary bile duct injury. These may leak, and if the duct has been anastomosed to the duodenum, then one is dealing with a duodenal fistula. In such early cases we have always preferred to use the jejunum, if available.

Dr. Erle E. Peacock, Jr. (Tucson): The problem in reconstructing the common bile duct is not just one of rebuilding a conduit. All of the currently available operative procedures will do that. An additional problem, as I see it, is contraction of the scar days and weeks after the conduit has been constructed.

A cell which seems to make a major contribution to scar contraction has been identified. It is myofibroblast. A specific inhibitor of myofibroblast action also has been identified. It is tacrine, a drug which ureologists have used in the past to prevent bladder contraction. Tacrine is available across a drugstore counter and it would seem to me that, although not a whiff of evidence is available now that it would work in tubular organs, it is time to start evaluating such agents as adjuncts to reconstitutive surgery of tubular organs.