Long Term Transhepatic Intubation for Hilar Hepatic Duct Strictures

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A technique for repairing benign high hilar hepatic duct strictures using transhepatic intubation with a large bore silastic stent is described. This procedure has been used in 10 patients. In 9 instances the stricture involved the common hepatic duct, and in one patient the right and left hepatic ducts. Nine of the strictures followed cholecystectomy; one followed the primary repair of a gun shot wound to the hepatic duct. Hepaticojejunostomies were created and the transhepatic silastic stent was left in place for 6 months in one patient, and for 12 months in 8 patients. In one patient the silastic stents are still in place. There have been no treatment failures. All patients are healthy and at full activity from one year, 3 months to 6 years, 6 months from the time of repair (average 3 years, 5 months). In the 9 patients whose stents have been removed, the serum bilirubin levels are normal. There have been no episodes of cholangitis following repair. This method of repair using long term transhepatic silastic stents is recommended for all high hilar hepatic duct strictures.

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BENIGN STRICTURES of the biliary tree continue to present a formidable surgical challenge. Repairs are difficult, the need for reoperation common, and long term results often disappointing. Particularly challenging are those strictures that occur high in the hepatic duct in the hilum of the liver. Identification of the ductal system at operation can be difficult, and because a satisfactory proximal biliary segment is often absent, a mucosa to mucosa anastomosis may be impossible. Over the past 7 years 10 patients with high hilar hepatic duct strictures have been treated at The Johns Hopkins Hospital. The surgical technique using transhepatic intubation with a large silastic stent and long term results in these 10 patients are presented.

Clinical Material

Between 1969 and 1974 10 patients, with high hepatic duct strictures were treated at The Johns Hopkins Hospital (Table 1). In 9 instances the stricture involved the common hepatic duct, and in one instance (Patient S.D.) both the right and left hepatic ducts were involved. Ages ranged from 19 years to 68 years, and averaged 36 years. Eight were women, and two were men. Seven patients were Caucasian and three were Negro. In 9 patients the stricture resulted from an injury at the time of cholecystectomy. Two of these 9 patients had undergone one prior attempt at repair, and one patient had undergone two prior repairs. In the tenth patient, the bile duct was transected by a gun shot wound. A primary end to end anastomosis was carried out, which subsequently strictured.

The interval between cholecystectomy and the development of jaundice in the 6 patients who had no prior attempt at repair varied from 2 weeks to 7 months. The interval between stricture repair and the development of jaundice in those 4 patients who had previously undergone an attempt at repair varied from 4 months to 29 months. At the time of admission for stricture repair the serum bilirubin varied in these 10 patients from 2.1 mg% to 19.3 mg%, and averaged 8.4 mg%.

Treatment

Prior to operation the anatomy of the biliary tree was defined by percutaneous transhepatic cholangiography in 5 patients (Fig. 1). Two patients had indwelling T tubes following previous repairs, and satisfactory definition of the stricture was obtained by T tube cholangiography. In one patient with an external biliary fistula, injection of the sinus tract resulted in satisfactory visualization of the bile ducts. In the last two patients cholangiography was performed intraoperatively at the time of repair.

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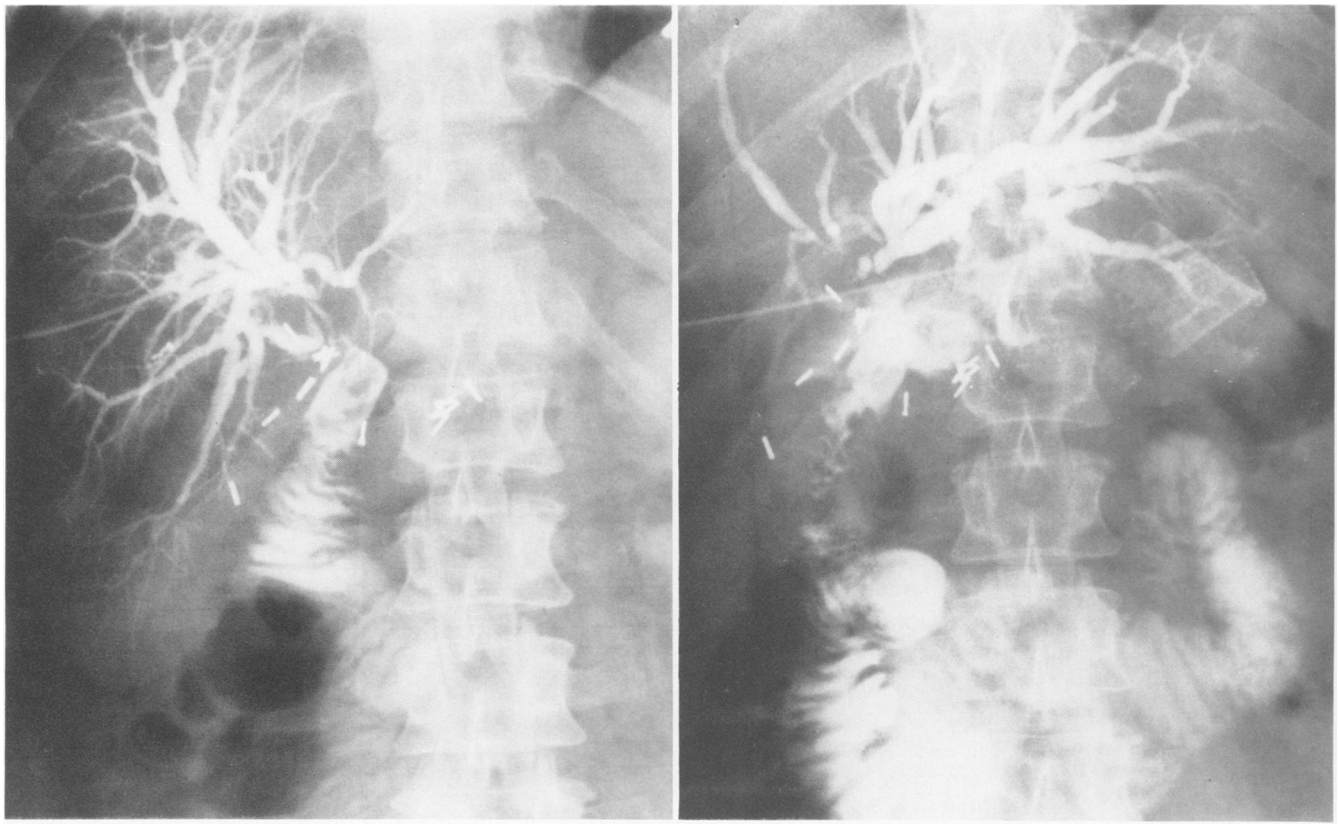
TABLE 1. *Ten Patients With Hilar Hepatic Duct Strictures*

Patient	Age, Race,* Sex	Etiology	Prior Repair	Admission Bilirubin mg%
E.N. #41 66 10	34, N, F	Surg Trauma	one	7.1
R.G. #148 65 12	68, C, M	Surg Trauma	no	2.8
L.T. #152 19 43	19, N, F	Surg Trauma	no	3.9
S.D. #155 99 49	50, C, F	Surg Trauma	two	7.7
J.B. #137 70 54	24, C, F	Surg Trauma	one	17.4
A.V. #147 37 55	35, C, F	Surg Trauma	no	12.8
T.W. #131 40 59	19, N, M	Gun Shot Wound	one	4.0
B.T. #146 37 65	29, C, F	Surg Trauma	no	2.1
J.L. #144 53 90	36, C, F	Surg Trauma	no	6.9
G.S. #143 20 94	43, C, F	Surg Trauma	no	19.3

* C—Caucasian; N—Negro.

Surgical repair involved identification and dissection of a proximal hepatic duct remnant. In each instance this was found high in the hilum of the liver, often within the liver parenchyma (Fig. 2). In no instance was a segment of normal proximal duct obtained that would allow a mucosa to mucosa anastomosis. Once the biliary tree was identified, an acutely curved Randall stone forceps was placed into the intraparenchymal hepatic duct, usually the right, and advanced superiorly and anteriorly into the anterior segmental duct until it approached within 1 cm of Glisson's capsule. At this point the liver was incised with a scalpel and the tip of the stone forceps extended through the surface (Fig. 3). A silastic stent 60 cm in length and 1 cm in outside diameter was tied to the end of the stone forceps. Multiple holes had been placed in the silastic tube throughout half its length (Fig. 4), and the end containing the holes was drawn down through the liver and out the hilum. The opposite end of the stent, protruding from the anterior superior surface of the right lobe of the liver, was brought out through a stab wound in the right upper quadrant onto the anterior abdominal wall. A Roux-en-Y jejunal loop was then constructed



FIGS. 1a and b. Preoperative percutaneous transhepatic cholangiogram. This study required inserting the cholangiogram needle first into the right hepatic duct (a), and then into the left hepatic duct (b) to visualize the entire biliary tree. The patient (S.D.) had a stricture at the bifurcation and the right and left ducts did not communicate. Having this information prior to surgery was of great importance.

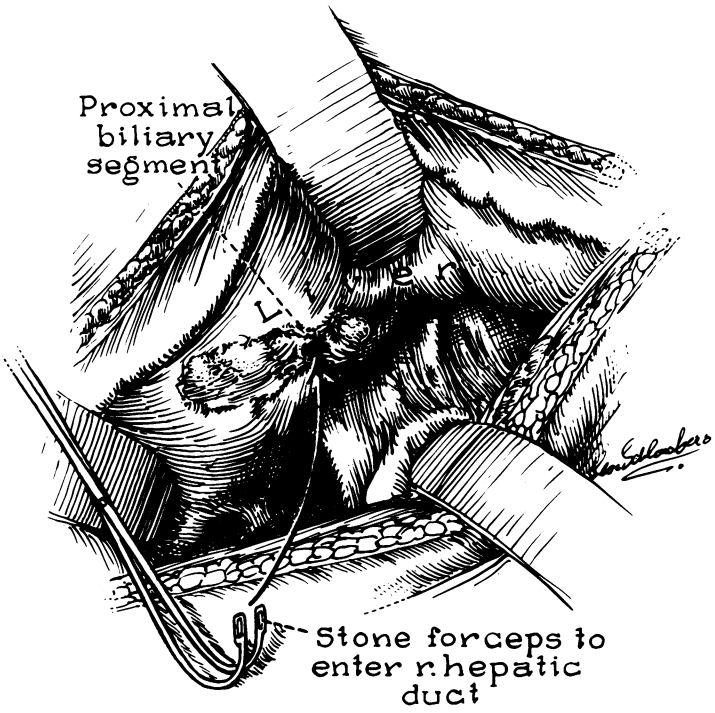


FIG. 2. The bifurcation of the hepatic duct has been identified as it enters liver parenchyma. Good mucosa generally is not present circumferentially in these high strictures. For passage of the transhepatic stent, acutely curved stone forceps are used.

and placed in the hilum of the liver (Fig. 5). The silastic stent was introduced into the side of the Roux-en-Y loop through a stab wound. The side of the jejunal loop was then sutured to the hilum of the liver using one or two layers of non-absorbable suture material. The hepaticojejunostomy was carried out using full thickness of the jejunum, and hepatic duct, liver capsule, or any other tissue available in the hilum. Two Penrose drains were left in the area of the anastomosis, and two additional drains were left in the area where the silastic stent penetrated through the anterior superior surface of the liver. In the patient with strictures of both the right and left hepatic ducts, a silastic stent was placed in the main left hepatic duct. The main right hepatic duct could not be identified. What probably was the anterior segmental branch of the right hepatic duct was identified and cannulated with a second silastic stent. Operative time varied from 4 hours and 15 minutes to 10 hours and 15 minutes, and averaged just over 7 hours. Most of the operative time was spent in locating and dissecting out the proximal biliary segment. Once the biliary tree was located, insertion of the transhepatic stent and anastomosis of the Roux-en-Y proceeded rapidly.

Following surgery the silastic tube was left open and connected to a bile bag. When a postoperative cholangiogram revealed the anastomosis to be healed, the silastic tube was clamped. Once a day thereafter until the stent was removed the tube was irrigated with 20 ml of saline. In one patient with silastic tube was removed 6 months following repair; in 8 patients the tubes were left in place for 1 year. In the one patient with silastic stents in both the left and right hepatic ducts, the stents remain in place 15 months following repair. In several patients the silastic stents were replaced during the year following surgery when they became partially occluded with biliary sludge. This was performed in the outpatient clinic under fluoroscopic control by first passing a guide wire down the lumen of the silastic stent into the Roux-en-Y jejunal loop. The stent was then removed leaving the guide wire in place. The new tube was then easily slipped in place over the guide wire (Fig. 6).

Results

All 10 patients developed biliary cutaneous fistulas following surgery. In each patient bile leaked for several days from the surface of the liver at the exit site of the silastic stent. In addition, most patients initially leaked a small amount of bile from the site of the hepaticojejunostomy. In all 10 patients the transhepatic silastic stent was left to dependent drainage until bile drainage along the Penrose drains ceased, and a transhepatic tube cholangiogram revealed the biliary tree to be sealed. All biliary fistulas closed with 3 weeks. Two patients developed a subhepatic abscess following repair and re-

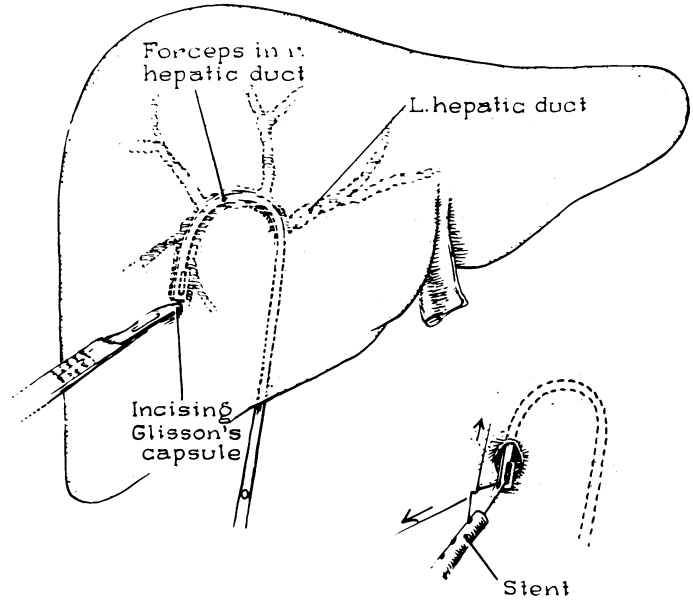


FIG. 3. The acutely curved Randall stone forceps are passed into the anterior segment of the right hepatic duct and can be brought to within one or two centimeters of Glisson's capsule. The capsule is then incised, the silastic stent sutured to the forceps, and the stent pulled through the liver into the porta.

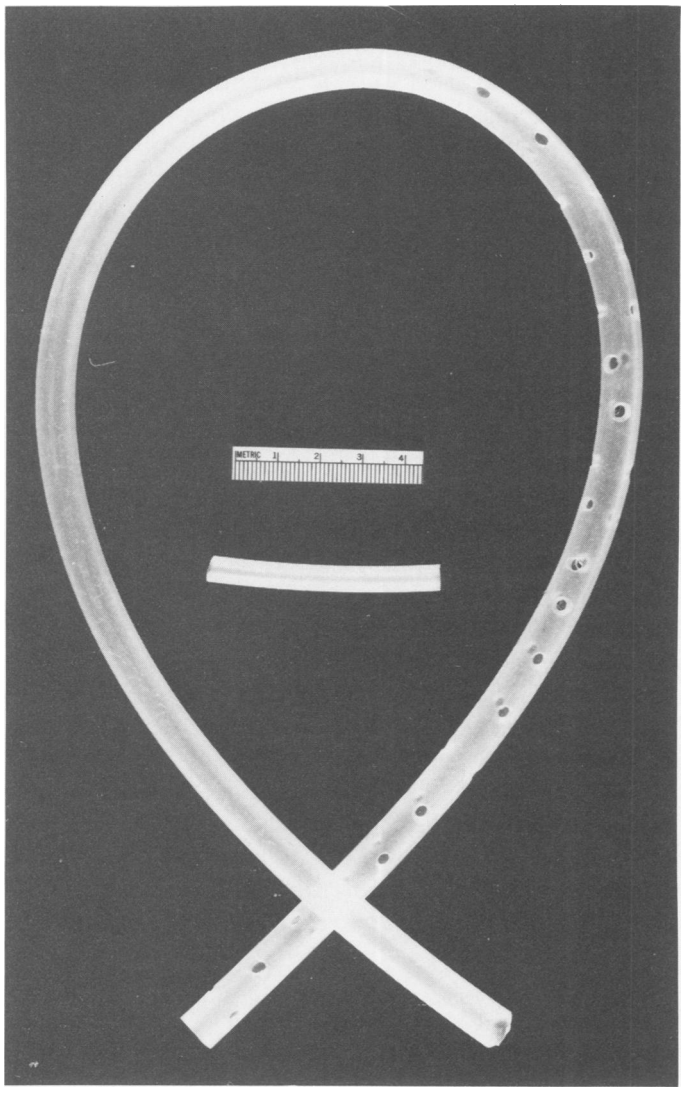


FIG. 4. The silastic stent is 60 cm in length and 1 cm in diameter. Multiple holes are placed in the distal portion of the tube. If the ductal system will not accept the large tube, a smaller 6 mm stent is used.

quired operative drainage. A third patient remained febrile for 10 days following surgery, but his temperature returned to normal with antibiotics. There were no operative deaths among these 10 patients, and no late deaths have occurred.

Followup in these 10 patients has ranged from one year and 3 months to 6 years and 6 months, and averages 3 years and 5 months (Table 2). No patient has required reoperation. There have been no instances of cholangitis. The serum bilirubin is normal in 9 of the 10 patients. The patient with strictures of both right and left hepatic ducts with two transhepatic silastic stents still in place, has a serum bilirubin of 4.0 mg/100 ml. The serum alkaline phosphatase remains elevated in 5 patients, and is normal or near normal in the remaining 5. The serum transaminases are mildly elevated in two patients, and in the normal range in the remaining 8 patients. All have resumed normal lives and are not limited in any way. One patient still has two transhepatic silastic stents in place and irrigates both tubes daily. Her activities are otherwise normal. Her silastic stents have been replaced as an outpatient on two occasions.

Discussion

Prior to performing the surgical repair of a benign stricture of the biliary tree, two options have to be dealt with. First, to what should the proximal biliary segment be anastomosed, and second, should the anastomosis be stented for a long period. In the past there have been strong advocates for anastomosing the proximal biliary segment to the distal common duct.[1] This often requires a tedious search for the distal segment since it is usually small and can be difficult to localize. In addition, once found there always is a wide disparity between the diameters of the two segments. Finally, the anastomosis will on occasion be performed under tension since a considerable length of duct usually has to be sacrificed to obtain normal tissue for repair. Others have advocated anastomosing the proximal biliary segment to the duodenum.[2,8] This eliminates the search for the distal biliary segment and any possible disparity in size when perform-

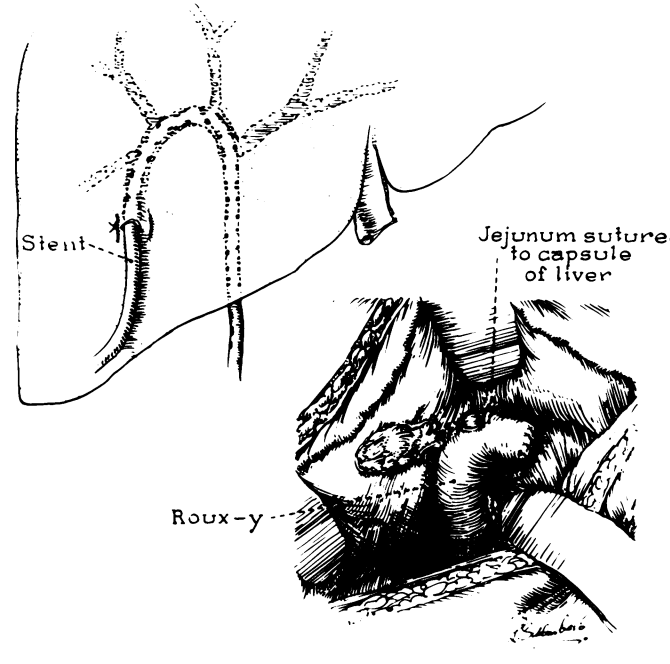


FIG. 5. A horizontal mattres suture is placed around the exit site of the silastic stent on the surface of the liver. The jejunal loop is tacked up to Glisson's capsule, or whatever tissue is available, and the silastic stent is placed into the jejunal loop through a stab wound.

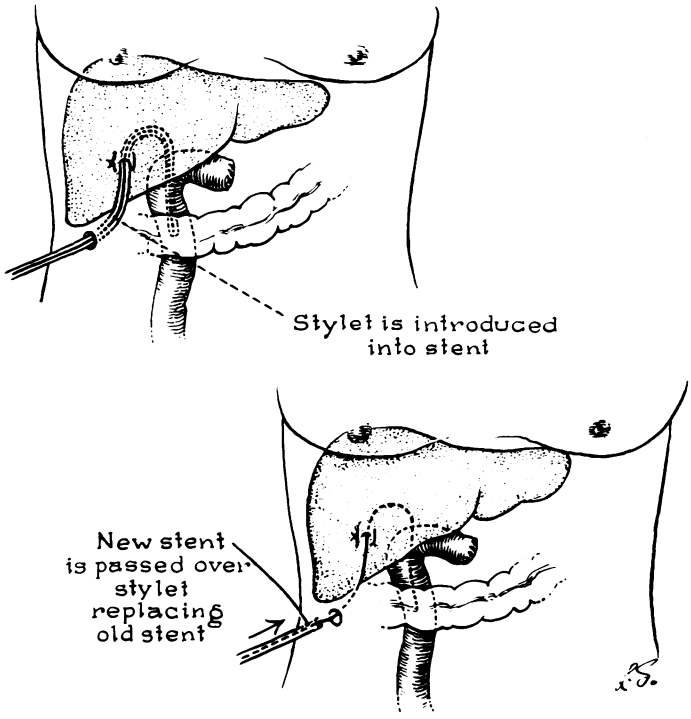


FIG. 6. If the silastic stent becomes partially occluded with biliary sludge, it can be changed by first passing a flexible guide wire through the stent into the jejunal loop under fluoroscopic control. The old stent is removed leaving the guide wire in place. A new stent is then easily inserted over the guide wire.

ing the anastomosis. However, when dealing with a high hilar stricture, using the duodenum can make the anastomosis technically difficult and even result in tension on the suture line. Also, if the anastomosis leaks following repair, as it often does, in addition to a biliary fistula a duodenal fistula results. Using a defunctionalized Roux-en-Y jejunal loop eliminates the disadvantages of both the proximal biliary segment to distal common duct anastomosis, and the proximal biliary segment to duodenum anastomosis. The loop can be easily placed without tension in the hilum of the liver, and an end of biliary segment to side of jejunal loop anastomosis carried out without fear of tension or disparity of size. If a biliary leak occurs following repair, the enteric component of the fistula is of no consequence. Also, if the patient ever requires reoperation the area of the anastomosis can be more easily and safely approached. In using a Roux-en-Y loop the bile is diverted down stream in the small bowel and the risk of a duodenal ulcer is theoretically somewhat increased. However, the risk of a significantly shortened life expectancy is so high if a satisfactory biliary repair is not obtained, that the possibility of increased risk of peptic ulcer disease is secondary.

Whether or not to stent an anastomosis after repair of a benign biliary stricture remains controversial. There are proponents for long term stenting,[3,9,10] and those who feel a stent should be used only for a short period or not at all.[5,12] In performing a biliary tree to bowel anastomosis with good mucosal to mucosal approximation, as one does for instance after a pancreaticoduodenectomy for tumor, long term stenting is certainly not indicated or necessary. One might choose to insert a stent for short term decompression in case the anastomosis leaks initially, but many surgeons feel even short term stenting is not necessary. In repairing high hilar hepatic duct strictures, however, a completely different situation exists. In none of the 10 patients presented in this series was a proximal biliary segment available that contained reasonably normal mucosa around its entire circumference. In most instances the Roux-en-Y jejunal loop had to be tacked up to Glisson's capsule in the area that the silastic stent exited from duct and hepatic parenchyma, and good mucosal to mucosal approximation was not possible. Under these circumstances, long term stenting is mandatory. In the present series of patients the operative procedure created an internal biliary fistula between the biliary tree and a jejunal loop. Only after the scar tissue, which inevitably forms under such circumstances, has matured and contracted can one safely remove the stent. Using a large bore stent of silastic, which is known for its low tissue reactivity, may allow wound maturation to take place more rapidly and with less inflammatory response, and thereby de-

TABLE 2. *Most Recent Liver Chemistries in Ten Patients Following Stricture Repair*

Patient	Interval Since Repair (months)	Bili-rubin (mg%)	Alk. Phos. (Int. U.)	SGOT (Int. U.)	SGPT (Int. U.)
E.N. #41 66 10	42	0.3	595	50	40
R.G. #148 65 12	37	0.2	34	13	9
L.T. #152 19 43	17	0.7	109	24	13
S.D. #155 99 49	15	4.0*	339	47	24
J.B. #137 70 54	47	0.2	42	20	20
A.V. #147 37 55	39	0.5	34	14	17
T.W. #131 40 59	78	0.8	110	22	
B.T. #146 37 65	39	0.2	51	29	24
J.L. #144 53 90	47	0.2	19	9	9
G.S. #143 20 94	51	0.8	29	11	7

* Two transhepatic stents remain in place.

crease the chance of late contracture. Surgeons from the Lahey Clinic have probably had more experience with biliary strictures than any clinic in the world. Their data clearly indicate that the longer one leaves a stent in place following repair, the more likely the repair will be successful.[10] A sizeable experience with stricture repair has also been gained at the Mayo Clinic, and they also advise long term stenting.[6]

The method of transhepatic stenting used in this series was first reported by Smith.[7] It allows one to firmly fix the stent so that migration is not possible, something we have seen with conventional T tubes. In addition, with the aid of a guide wire these stents can easily and quickly be changed as an outpatient procedure. Others have brought the distal limb of the stent out the jejunal loop and abdominal wall, creating a U tube to facilitate changing the tube. This clearly is not necessary as tube changes can easily and safely be made as above. Smith recommended rubber tubes be used, but we have found silastic to be superior. The silastic stents are very nonreactive, and biliary sludge accumulates on them much more slowly than on rubber tubes. On occasion we have seen silastic stents remain in place for up to a year without accumulating significant debris. Initial concern with the possibility of bleeding from liver parenchyma when the stent is brought out through the anterior superior surface of the right lobe has been unfounded, and we have had no instances of significant bleeding. Cholangiography postoperatively is easily performed by placing the patient in the steep Trendelenberg position (Fig. 7). This technique of stenting with transhepatic silastic tubes has also been used in our hospital with success for malignant biliary strictures.

All 10 patients presented in this series have done well. With an average followup of well over 3 years, there has not been a failure. No instances of cholangitis have occurred. Even though no length of symptom free followup guarantees that a patient will not restricture, the majority who are asymptomatic for 2 years following repair will never again have difficulties.[11] Close followup of all 10 patients continues in our hospital. Nine of the 10 patients have had their silastic stents removed. The bilirubin is normal in all 9. Only the patient with strictures of both right and left hepatic ducts, and with two silastic stents still in place, remains chemically jaundiced. She is now 15 months post surgery and we plan to leave the stents in place permanently because of the technical problems associated with repair. This patient has all of the left hepatic duct drained, and part of the right hepatic duct. Since patients ordinarily require only 50% of their liver parenchyma to completely clear serum bilirubin,[4] theoretically she should not be jaundiced. It is possible, however, that she incurred enough liver injury during the prior two attempts at repair that she no longer is able to clear bilirubin with the amount of liver being drained. Nevertheless, she is totally asymptomatic and living a normal unlimited life. The success obtained in these 10 patients with this technique of long term transhepatic stenting with a large bore silastic tube and the ease with which the repair can be carried out after the proximal biliary segment is identified, leads us to recommend this approach for all high hilar hepatic duct strictures.

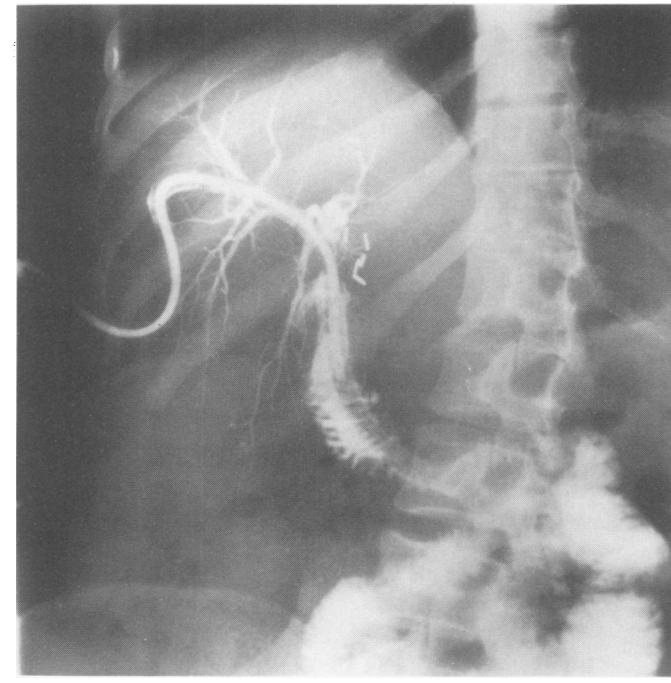


FIG. 7. A postoperative cholangiogram obtained by injecting the transhepatic silastic stent in a patient (L.T.) who previously had undergone repair of a high hilar hepatic duct stricture. Note that with the multiple side holes in the stent, there are no signs of obstruction of hepatic duct branches by the stent.

Addendum

Patient T.W. recently returned with a serum bilirubin of 3 mg %, 6 years and 9 months after his repair. A transhepatic cholangiogram revealed a stricture of his left hepatic duct. A transhepatic stent was easily reinserted through his Roux-en-Y loop. His bilirubin is now normal and it is planned to leave the stent in place for 12 months.

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Discussion

Dr. Kenneth W. Warren (Boston): I think this is a very excellent presentation of one method of repairing high hilar strictures of the common duct and the hepatic duct. As a matter of fact, most of the strictures that we see are high. Usually we can identify the lining of the duct, even if the duct should then divide above the bifurcation. But one must bear in mind that individualization, both in the choice of an operation and in the choice of a stent, is really the hallmark of repair of common duct strictures.

We agree that the use of a transhepatic straight tube has several advantages, as pointed out by Dr. Zuidema. First of all, you can get x-rays, if you wish. They are usually not necessary if the patient is having no symptoms. You can irrigate the tube, and, most importantly, as I think Dr. Zuidema would agree, this tube can be changed. Now, we've used several of these, and we use it almost routinely in inoperable carcinoma of the bile ducts at the hilus, and frequently, as shown in one of his cases, we use bilateral transhepatic intubation.

For my own part, the high strictures in the hilus of the liver are usually repaired by using a modified Y-tube stent with the mucosal bridge, and even if you cannot identify—which we usually can—the lining of the duct, by placing this properly and by making the bridge sufficiently wide, one can insinuate the mucosa up into these two ducts.

Or if you are going to use the method with the straight transhepatic tube, as most of you know, Rodney Smith recently has used a different type of mucosal graft, pulling it up into the liver, into one duct or the other, and I'm sure that this has a great deal of merit.

So I think this is a wonderful experience that has been reported here today, and as Dr. Sandblom mentioned, you're going to have to follow these patients for many years, because we have seen strictures occur ten, 15, 20 years after an excellent repair and a long-term result.

As far as the modified Y-tube remaining in place without symptoms, practically all of them will remain in place without evidence of cholangitis for a year; so that this is a method that Dr. Zuidema has reported, it has merit, and I shall follow with great interest the long-term results.

Dr. H. William Scott, Jr. (Nashville): Dr. Zuidema knows very well that Dr. William Halsted was greatly opposed to the use of stents, or any form of inlying tube, in biliary anastomoses, but I don't believe Dr. Halsted dealt with the terrible fibrotic strictures that are currently under discussion. As Dr. Warren has pointed out, a great deal of the experience with the repair of biliary strictures that we have had in this country has derived from the experience of his former chiefs, the late Frank Lahey and Richard Cattell, at the Lahey Clinic. We have also learned much from the late Arthur Allen at the Mass. General, Dr. Waltman Walters at the Mayo Clinic, and Warren Cole, who is currently here in this audience.

(Slide) Dr. John Sawyers a few years ago presented to this Association the experience that our group in Nashville had at that time with the use of Dr. James Kirtley's fishmouth method of handling the scarred, fibrotic proximal hepatic duct with Roux Y jejunostomy. Only three patients had a stent. This shows the artist's illustration of the surgeon's dilemma as it seemed to us at the time, whether to use a stent or not. And our meager evidence certainly supports the contention that Dr. Zuidema's more powerful evidence brings about.

There were five recurrent strictures in nineteen patients without a stent, and in three patients who had a stent no strictures occurred.

I'd just like to ask if Dr. Zuidema would tell us whether Dr. Rodney Smith's extensive experience with the use of transhepatic stenting has been accompanied by much in the way of complications. One worries, of course, about traumatic hemobilia, which we heard Dr. Sandblom talk about this morning, and one also wonders about the incidence of stress ulcer with biliary diversion. I didn't notice any stress ulcers in the complications listed by Dr. Zuidema. I wondered if he used any particular method of preventing stress ulcers, such as routine use of antacids in the postoperative period.

And, finally, I wish he would say a bit more about the management of patients, antibiotics, irrigations, how to prevent the complications of infection with an in-lying tube.

Dr. Frank C. Spencer (New York City): Dr. Rodney Smith has been referred to several times, and I thought it would be of interest to the organization to describe some of our visits at St. George's with Sir Rodney last September.

I was quite overwhelmed by the extent of his experience, his absence of complications, and his impressive movie. He cites experiences with about a thousand patients with common duct strictures over the past 20 years and the uses of his mucosal tube technique. He is free to admit that he does not have good long-term followup, but the short-term followup, in terms of morbidity, mortality, and the like, is extremely small. I came away with the very simple question of "Why in the world, as we both speak English, aren't we using it more?"

So I rise with hearty support of Dr. Zuidema's position. And, if you will note, in his presentation, quite strikingly, all ten of their cases developed temporary leaks that healed in the majority.

A striking feature of Sir Rodney's technique is that he forms his mucosal tube, places the stent as described, anchors it to the tube with one stitch, and pulls it up over the stricture, with no stitches whatever, except one or two to anchor it to the hilum of the liver, treating it like an onlay graft.

I think that's probably the difference from the technique that Dr. Kirtley was so innovative with in Nashville, in that he sewed it around the hilum of the liver, but could not get mucosal-to-mucosal apposition, hoping that the scar tissue would bridge. But by tying the mucosal tube to the stent and tugging it upward, it's actually implanted like a skin graft.

As many have said, you must have long-term courses. I think there is no question from the abundance of data that we have been far behind in this technique, or adopting it for awkward problems, to lessen morbidity, and, ideally, for the patient with malignant stricture, who is certainly the candidate for permanent intubation with this technique for as long as they live. I hope papers like Dr. Zuidema's will do much to popularize it in this country. Thank you very much.

Dr. Jonathan E. Rhoads (Philadelphia): We attempted a slightly different approach several years ago with a patient who had had five