anomalies, their recognition and management, is essential for the surgeon.

Addendum

Since completion of this manuscript, we have treated another patient with an unrecognized right dorsal caudal segmental duct injury sustained during cholecystectomy. Recovery was complicated due to inadequate drainage of intraperitoneal bile, but the biliary fistula eventually closed spontaneously. Postoperative x-ray films obtained by the injection of radiopaque solution through the biliary fistula suggested that the divided duct opened into the bed of the gallbladder.

J.S., a 37-year-old man, underwent cholecystectomy for cholelithiasis on August 20, 1974. Three weeks after an uncomplicated operation and an initial uneventful postoperative course, the right upper quadrant was reexplored because of pain. A massive subhepatic and subphrenic accumulation of bile was drained. Bile seemed to be coming out of the bed of the gallbladder. Thereafter, approximately 400 cc of bile was drained per day, but he continued to have normal-colored stools. On October 18, 1974, the following test results were obtained: Prothrombin time 100%, serum creatinine 1.1 mg/100 ml, total protein 9.2 gm/100 ml, albumin 4.65 gm/100 ml, cholesterol 151 mg/100 ml, glucose 103 mg/100 ml, total bilirubin 0.7 mg/100 ml, alkaline phosphatase 265 units, SGPT 150 units, SGOT 89 units, white blood cell count 8,300/cu mm, hematocrit 38.8%, hemoglobin 12.6 gm/100 ml. X-ray findings were as follows: A sinogram demonstrated a "pocket" of dye in the region of the gallbaldder fossa; the dye then filled a part of the intrahepatic ductal system in the region of the right dorsal caudal segment. No dye was seen to enter the extrahepatic biliary tract. Cleocin was given for 4 days following one episode of temperature elevation to 100.6 F on October 12, 1974. This febrile episode was associated with reduced biliary drainage from the fistula. At the time of the patient's admission to the UCLA Hospital on October 30, 1974, slight tenderness was present over the right costal margin. Biliary drainage had stopped. His temperature was 99 F, white blood cell 9,100/cu mm, total serum bilirubin 0.6 mg/100 ml, SGOT 183 units, and alkaline phosphatase 296 units. Stool and urine were normal in color. Attempted injection of the sinus tract did not disclose any communication with the biliary tree. Continued observation was recommended, and in the ensuing months, the patient has remained well without biliary drainage, chills, fever, or jaundice.

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Discussion

DR. FRANK G. MOODY (Salt Lake City, Utah): Drs. Longmire and Tompkins have presented with clarity approaches to problems which occur at or above the bifurcation of bile ducts. The principles they have enumerated are not far different from the ones we use for problems in the lower biliary tree, that is removal of debris and the establishment of free egress of bile especially when it's infected.

When you read the manuscript as I have, you'll try to second guess them on the cases that they present, but I assure you that you won't

improve on their results; I imagine you guessed that when you heard the presentation.

There are many personal preferences in managing problems of this type. For example, in patients who have congenital or adult cystic lesions that are stone formers, I think one should leave a large T-tube into the lower bile duct so he can retrieve, at intervals, stones which are often formed in these patients. Evacuation of the biliary tree in these patients is just not enough and I personally don't believe that the provision of a choledochoduodenostomy is going to handle this problem adequately.

In regard to strictures which occur in the hepatic duct that go into the bifurcation, and I must say this is the most common lesion I seem to encounter in my practice, I think the simplest way is to make an incision through the stricture from the hepatic duct up into the primary radicals and then place a Roux limb over this area.

As regards malignant lesions in this area, occasionally you can resect them. I believe they do report on two such cases. I had one such case. In this instance, the question is whether you should put both limbs of the biliary tree back in your Roux limb. Dr. Longmire and Dr. Tompkins have made very important contributions here because they tell us that you don't have to do this and I certainly agree with them. In terms of the majority of these lesions, however, you're lucky if you can establish drainage with the Roux limb. I prefer to do this by bringing it up to the left duct. If you divide the left branch of the portal vein, it gives you access to the radical large segment of the left ductal system that is in this area.

Now, I take issue with just one point because I don't know how to establish this and that is whether, in fact, you are dealing with an infected biliary tree, especially in these strictures that occur at the bifurcation because many of these patients have been on suppressive doses of antibiotics. At the time that you see them, they don't show frank signs of cholangitis. I would like to ask Dr. Tompkins to tell us how he establishes, either prior to or at the time of surgery, whether he's dealing with an infected biliary tree. Secondly, will just tying off the duct and allowing the lobe to atrophy lead to biliary cirrhosis?

Finally, do they have long enough followup on their patients to assure us that indeed it is not necessary to re-establish drainage in these ducts.

DR. THOMAS E. STARZL (Denver, Colorado): I would like to discuss just one aspect of Dr. Longmire's paper, namely the treatment of the small intrahepatic duct cell carcinomas that can obstruct the confluence of the right and left hepatic ducts.

(Slide) This is an example of such a lesion in a 48-year-old man as seen by a transhepatic cholangiogram. His liver was removed and replaced with an orthotopic homograft 15 months ago. This is the specimen and this is an intravenous cholangiogram of the new duct system in which the duct reconstruction was with a cholecystojejunostomy to a Roux limb. We have treated three such patients with liver replacement. (Slide) The recipient I just described and this second 43-year-old patient, who is now nine months after operation for this lesion, have normal liver function and no evidence of recurrence. The third patients, who was 63 years old, died early postoperatively because of a technical error which I made during the transplant procedure.

It has begun to seem to us that small intrahepatic duct carcinomas may be a reasonable indication to perform total liver replacement in relatively young recipients. In contrast to the situation with large and nonresectable hepatomas, recurrence of the tumor has not occurred, at least so far. As Dr. Longmire showed us at the 1973 American Surgical Association meeting, autotransplantation of the lateral segment may be an attractive alternative approach in favorable cases. And in a few others, partial hepatectomy may be possible, as Dr. Longmire described in two cases today. In any event, trying for a cure instead of palliation in some of these patients is an appealing prospect that deserves further exploration.

DR. JOHN WILLIAM BRAASCH (Boston): It gives me a great pleasure to discuss this paper of Drs. Longmire and Tompkins, first of all because it is the most comprehensive treatment of the subject of segmental and lobar surgical disease of the liver available, and secondly, because this subject has been kind of a hobby of mine for quite awhile.

Not only is the etiology of the jaundice which occurs with fractional biliary outflow occlusion of interest but also, as the authors have emphasized, the practical application of these observations is very important.

To underline this importance is the case of a double traumatic stricture which required a double hepaticojejunostomy three years ago. The right anastomosis which I performed was two inches within the liver substance at that time and when she returned last week with cholangitis, I was determined to resect her right lobe since it didn't seem possible to establish a satisfactory right hepaticojejunostomy again. Unfortunately, this proved not to be feasible since the blood supply to the left lobe came mostly from the right hepatic artery on angiography. So, at surgery after dilating the left hepaticojejunostomy and being unable to locate the right duct, we left the right lobe in place having just read Drs. Longmire and Tompkins' manuscript the night before. Hopefully, this right lobe will quietly fade away as they have suggested.

Unfortunately, our previously published experience with 11 cases of only left hepaticojejunostomy in the course of stricture repair has not given too much support to this hope since in only three was the result satisfactory.

Now, in this present report, there are six cases which have a bearing on the problem of fractional obstruction jaundice. In three, the proof of obstruction was radiologic, on T-tube cholangiograms, and the patients were not jaundiced. In one, the proof was also radiologic and there was jaundice. That leaves two cases in which the proof of obstruction was surgical and each of these patients was not jaundiced. One had an obstructed right hepatic duct and another an obstructed posterior segmental duct.

There are many uncertainties in trying to evaluate these cases. Is a T-tube cholangiogram which fails to fill part of the biliary tree valid evidence for obstruction? Most often it is, but not always. Does a temperature elevation on one occasion mean that bile in an obstructed duct is infected? Is there an anomaly present such as is shown in this slide in which the posterior segmental duct crosses over and joins the left duct high up inside the liver? In this situation, part of the right lobe is drained by the left duct.

All of these unanswerable questions cloud valid assumptions but in spite of these problems, I would agree with the authors that probably development of jaundice in fractional obstruction depends on the presence or absence of infection and the amount of liver obstructed. My own preference is to emphasize the latter, but certainly the former is very important as they have shown. We only need to recall that appreciable degrees of jaundice can follow acute cholecystitis without physical common duct obstruction.

I have two other points to make. Both concern the treatment of segmental sepsis. (Slide) This is a barium cholangiogram of a patient who had a stricture repair previously. He had been having frequent chills and fever for several months and you will note that the anterior segmental ducts did not fill. Rather than risk a right hepatectomy in this elderly, politically sensitive case, a dilator was forced through the occluded duct to drain an abscess with subsequent relief of symptoms. This then is an alternative procedure to hepatectomy for segmental sepsis.

My second point concerns the management of segmental sepsis which occurs without known benign ductal obstruction. One must be sure that a neoplasm which should be included in the resection has not obstructed the duct draining the area of sepsis.

PROFESSOR MAURICE PAUL MERCADIER (Paris, France): As I have a very bad Quebec accent, I will try to speak in English in the same way! About the lesion of right or left hepatic duct, as with Dr. Longmire I usually put a ligature on the duct.

I am not sure it is possible to get it across when you have such a stricture at the region of the common duct. You have biliary cirrhosis on dilatations of the duct and I think it's quite exactly the same.

About the lesion with infection at the liver at the confluence of a duct, I don't like to perform an hepatectomy of the left hepatic turn.

I think it's always possible to reach the confluence. You can do that below the liver at the level of the islets affecting the capsular. It is always possible, at least in my practice, to perform anastomosis, a large anastomosis with the left branch.

If you can reach the bile ducts from below, it's always possible to reach the confluence from the top from above.

You can perform two operations. They were described by Chaum-

peau in France and I have practiced some of them. You can do a midline incision at the level of the liver on the right side. Through the parenchyma you can reach the hylus on the confluence of the two ducts and perform an anastomosis, a large anastomosis, with the right hepatic duct especially with long hepatic duct.

Sometimes it's not necessary to do such an operation. You can remove the interior aspect of the fourth segment of the liver between the medium then on the ligament and you can reach exactly the confluence of the two hepatic ducts, the main hepatic ducts.

We have performed such operation very rarely, but quite often it's impossible to repair such a lesion with the left hepatic duct from below.

As the Chiari Disease, I think I was the first to perform a hepatic for Chiari Disease. I agree with you when you have dilatation on the right part of the liver, on the left part of the liver it's always possible to perform an hepatorrhaphy and I have performed a large right hepatorrhaphy in my first case.

But when you have dilatation on both sides, I have performed in a similar case, a second case of Chiari's Disease, I have performed exactly the same operation I described for a stricture, a midline incision on the left side of the median vein, the liver is opened just like a book and it's not bleeding not at all with a finger fracture of the parenchyma. It's very easy to control the collaterals of the median vein and you reach the confluence of the right bile duct by the left bile duct and you can perform a very large anastomosis with a Rouen-Y loop of jejunum.

I think it is very important always to have the long loop to avoid the reflux. To me that means 60 cm at least.

As for stenosis from a carcinoma, I think it is quite an operation to perform a liver transplant. In many cases, you see the patient when he is in very poor condition and I think it's quite an operation to perform a liver transplant for such disease. At least this is my experience.

DR. RONALD K. TOMPKINS (Closing discussion): Dr. Moody, we agree that the T-tube may be left in for irrigation of these multiple cystic areas. We would like to be able to get to them early enough so that we do not have such a large amount of sludge that it can't be removed and in those cases feel that a high duct-enteric anastomosis may prevent the stagnation and sludging.

We do have, at present, some patients with tubes in who need the irrigations for relief of sludge periodically.

You ask a very difficult question and that is how do we know if the biliary tract is infected? Most of us have seen patients with bacteria growing in the bile ducts and around the tubes quite frequently and yet the patients get along quite well. I would guess that the best answer is if the patient has signs and symptoms of cholangitis then we would say that this is a significant infection.

There is a difference, clinically, I think between a bacterobilia and an infected biliary tract and this is a very difficult clinical judgment in some cases.

The other difficult question you asked was whether tying off the duct causes biliary cirrhosis? We can't answer that on a controlled patient series basis, however we have one patient who is now about eight years following such an operation with normal liver function and no evidence of biliary cirrhosis.

Dr. Starzl, we're very interested in your three transplantations for bile duct carcinoma. I think that with the present dismal results of the treatment of bile duct carcinoma that such innovative attempts at therapy and cure are indicated and especially in experienced hands such as yours.

However, I would point out that the course of patients with bile duct carcinoma in many cases is a prolonged one and that 15 months followup is rather short for some of these. We look forward to further followup on your cases in the future.

Dr. Braasch, of course, is well known for his detailed studies in the area of segmental obstruction and damage to the liver. We appreciate his comments and have benefited by his experiments and experience.

We agree with him that the etiology of the jaundice in some of these patients is a mystery and I certainly hope that his latest patient continues to do well.

We feel that a T-tube cholangiogram done in the x-ray department is adequate because we can make use of gravity, turning the patient to various sides and fill the ductal segments.

The T-tube cholangiogram done on the operating table is not that accurate. We've had difficulties filling all the segments with both T-tube and cystic duct cholangiography in the operating room. This is not a problem in those institutions where movable tables and fluoroscopic equipment are available.

Dr. Braasch also asked if fever means cholangitis. I think we would answer that somewhat similarly to Dr. Moody's question.

We're quite happy in some of these difficult cases if the patient has only one, or perhaps two, episodes of fever in a year and this is manageable by antibiotics. We would agree that that is probably cholangitis but it does not necessarily warrant reoperation.

Professor Mercadier, we thank you very much for sharing with us your experience with the transhepatic exposition of the bile ducts. We have not used that procedure although we agree with you that a long Roux-Y limb is of value no matter how you drain the biliary tree. I think that your statement that it's almost always possible to perform an anastomosis to the left duct is quite right. We've found in other studies that the left hepatic duct is a long and unbranching segment beneath the liver for 3 or 4 cm in most specimens that we've looked at.

And, if one can gain access to that area through the scar and the other vascular adhesions, then I think an anastomosis is quite reasonable and in some of our cases we've shown that that's all that needs to be done, the right duct does not need to be hooked up if there's no infection behind that.