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#### DISCUSSION

DR. JOHN TERBLANCHE (Cape Town, South Africa): I'm going to address myself mainly to the second half of this excellent paper which I enjoyed very much indeed.

(Slide) In doing so, I wish to make a plea to the members of the Association for the use of the U-tube, as depicted here. There are some technical differences since the last publication from our group of the use of this tube. We now use a long Argyle "Levine" type nasogastric tube. This is longer than the tube originally described and leaves you with long ends, which makes it easy to work with. We believe a firm tube is important. We have actually had a tumor constrict a Silastic tube and had to replace it for that reason. You will notice that we use only one hole above and one hole below the lesion. Bile drains through the tube and on into the duodenum. The U-tube does not produce an external biliary fistula.

(Slide) The tube is firmly fixed with a cross-piece, and I believe this is important and an advantage. We've actually had the problem of transhepatic tubes falling out, and this cross piece certainly holds the U-tube in place. In addition, when a transhepatic tube does fall out, if one doesn't replace it early, in our experience, it can be difficult to replace. This, I think, is a particular advantage of the U-tube procedure.

Recently, we have converted the U-tube to a circle O-tube, as soon as the patient is stable postoperatively. In other words, the two external limbs are joined together, and one has a completely closed system whereby the bile from either side will flow back into the patient without problems.

I would like to put the history of intubation of both benign and malignant strictures into perspective, as I believe this has not always been clearly defined. (The references will be published in *Surgery Annual*, Volume XI.) With regard to benign strictures, transhepatic intubation was first described by the two Mexican surgeons, Quijano and Munoz, in 1957 and 1959. Rodney Smith's classic paper in 1964, which was the first in the English literature, really started people using this technique for strictures.

As far as the U-tube's use in strictures is concerned, the first reports were in 1951 and 1959 by Goetze, the German surgeon, in the German literature. The most widely quoted paper is that of Saypol and Kurian in the American literature in 1969. However, Heydenrych, of South Africa, in a largely ignored paper, also described the use of the U-tube in biliary strictures in the same year in the American literature. Unlike Saypol, he had, in fact, already changed one of these tubes in a patient. I personally believe that a combination of the U-tube with Rodney Smith's mucosal graft procedure, as originally described by Goetze in 1951, has revolutionized our management of really high strictures. This makes the lesion very easy to handle technically.

With regard to bile duct carcinoma, the pioneering paper on dilatation and local intubation was, of course, published by Dr. Alte-

meier, of this society, in 1957. Transhepatic intubation was first described in the Uruguayan literature by Praderi in 1961, and he reported it in the English literature in 1974.

The U-tube procedure, as I have described it here today, was developed as a result of a problem in a patient in 1968, and used in two patients in 1969. In addition, Praderi and Uruguay described a similar technique in 1971.

(Slide) I want to update the published results from Groote Schuur Hospital, Cape Town. We had 26 cases of bile duct junction carcinoma between 1961 and 1972. The last 15 of these have been followed up to the present time. You will see that ten of these 15 patients survived for longer than one year. Two of them are alive and well at 6½ years, having had the U-tube procedure, together with 6000 rads of radiotherapy to the localized area of the tumor.

Four patients had radiotherapy and the U-tube procedure and a total of eight of this group had the U-tube procedure. We subsequently had an inexplicable gap of three years without any patients, but in recent patients we have used a combination of the U-tube and radiotherapy to the localized area. With this type of long-term survival, one just begins to wonder whether we aren't perhaps approaching cure by a very simple technique.

DR. WILLIAM P. LONGMIRE (Los Angeles, California): I would first like to compliment Drs. Cameron, Gayler, and Zuidema for the excellence of their presentation. They, more than anyone in this country, have emphasized the technique of transhepatic intubation in the management of strictures of the common bile duct, and all of us are indebted to Dr. Terblanche for clarifying the use of this transhepatic tube in malignant strictures.

I wish to speak primarily about the benign strictures.

(Slide) The techniques that have to be employed in the repair will vary depending upon the location of injury. In cases where there is a significant segment of dilated common bile duct, such as that seen in this slide, a mucosa-to-mucosa anastomosis with a T-tube stent, generally for one to three months, will suffice.

On the other hand, when the stricture lies high in the hepatic duct, as is so often the case, the mucosa of the intestine is frequently just approximated to the orifices of the ducts. In this circumstance, longterm stenting, as advocated by the authors, is certainly essential. Dr. Cameron indicated that in their series most of the repairs were of this variety. Many of these injuries occur when there is a confusing anomalous condition of the extrahepatic ducts, that leads the surgeon not only to put a clip across the duct or to traumatize it, but to actually excise a large segment of the extrahepatic system.

The principle of longterm stenting in difficult biliary anastomosis (and here I, too would like to digress a moment to mention some historical aspects, like those Dr. Terblanche has brought before us) was really first illuminated by Magoon and Claggett in 1958. They reported 12 cases from the Mayo Clinic in which Vitallium tubes had been inserted to stent a biliary-enteric anastomosis and had been in

place for periods lasting from one to eight years. These authors described how in many cases these tubes were simply placed up into the openings in the liver, with the jejunum approximated to the hilus about the tubes, and thus there was really no true biliary anastomosis.

However, when these tubes became occluded and were removed at some point from one to eight years after the original operation, they unexpectedly found a well formed anastomosis, lined with a normal-appearing mucosa. These observations suggested that such repairs might be considered as a two stage operation, first inserting a stent and then, when the stent became occluded, removing it at a second operation. They also demonstrated for the first time the value of longterm stenting.

I was somewhat surprised to discover, as Dr. Terblanche has mentioned, that Görtze probably first described the use of the transhepatic tube for bile duct stenosis in 1951. In 1937, a surgeon on the West Coast by the name of Hoag sutured the redundant gastric mucosa and submucosa, and in 1948 Cole sutured the jejunal mucosa and submucosa to the hilus of the liver over a stent.

(Slide) Experimentally, biliary diversion of bile into a Roux-en-Y jejunal limb is an ulcerogenic operation, as a number of investigators (including ourselves) have demonstrated. Here you can see in the dog's jejunum multiple ulcers that have developed after Roux-en-Y bile diversion. Acid production in a Heidenhain pouch may be increased by as much as 300% following the diversion of bile into a jejunal limb. There is, however, a considerable individual variation of acid increase in such animals, depending upon their normal, pre-experimental acid output.

We have found that in some of our patients with Roux-en-Y bile diversion, acid production has been stimulated. Because of our concern about the ulcerogenic potential of Roux-en-Y diversion, we have utilized a jejunal interposition type of operation.

(Slide) In our experiments with dogs that have responded with an elevated acid output to Roux-en-Y jejunal diversion of bile, we have found that division of the limb and insertion of the distal end of the jejunum into the duodenum cause the acid secretion to return to normal. Bile that returns through such an interposed jejunal segment to the duodenum will protect the patient against a potentially ulcerogenic operation, and at the same time it will prevent the reflux of duodenal contents up into the biliary system.

I have one final comment about bile duct reconstitution. We have two patients in our series in whom it is possible that the bile duct has reformed. In one, the original surgeon had stated that after inadvertently existing a large segment of the common duct, he had inserted one end of a T-tube into the proximal segment of duct and the other end into the distal portion of the duct. We left that T-tube in place for a period of three years, and when we reoperated on the patient to remove the tube, we unexpectedly discovered that the bile duct appeared essentially normal. The duct wall looked normal and it was lined with normal-appearing mucosa. Since removal of the T-tube, the reconstituted common bile duct has functioned satisfactorily for almost two years.

We have one other patient in our series who has a similar history and a third patient who is now under observation for a bile duct avulsion done a few months ago. Although such reconstitution has previously been reported both clinically and experimentally, it has never received serious consideration. I certainly would not advocate this procedure for regular use. In cases like the three we have described, where there was a traumatic avulsion or destruction, a T-tube has been utilized to bridge a duct defect at the time of the original operation as a life saving procedure.

I would like to compliment the authors once again for the excellence of their results and for the techniques they have advanced in this country.

DR. THOMAS TAYLOR WHITE (Seattle, Washington): We have had experience with 14 patients to date in which U-tubes have been placed to palliate carcinoma of the upper bile ducts or metastatic tumors to this area. We differ from Dr. Terblanche's approach in that we bring a Roux-en-Y loop up to this area, having attempted to resect the tumor first. While we have not used the Argyle catheter as he described, we have had the difficulty which

he described where the Silastic tube has become compressed and is difficult to change.

The basic question which I would like to ask about the instrumentation which has been used in Baltimore is whether or not this is a special, different kind of Dow-Corning Silastic tube. What we have been using is the 6 mm Silastic tubing which is used for hemodialysis, in which we punch several holes. Are the tubes used at Hopkins prepunched at the factory? Is there some reason why they can get the tubing in and out more easily than the rest of us?

We have had some difficulty with both changing the U-tube and attempting to place it by percutaneous route preoperatively as a method of reducing jaundice. Stig Bengmark told me yesterday that virtually all of the patients undergoing operations for obstructive jaundice in Lund have percutaneous tubes placed into the liver several weeks preoperatively in an attempt to repair a stricture or treat a carcinoma, after which the tubing is pushed through the narrowed area. He says that they have very little technical difficulty, but emphasizes that they take great care with sterile technique.

We have drained ten patients by a similar percutaneous approach.

(Slide) Here is a percutaneously placed catheter which has passed all the way into the duodenum. This was subsequently pulled back and replaced with a Silastic tube. We put a large ureteral catheter on the inside to give it stiffness before we finally got it down into the appropriate position.

(Slide) I would also like to show an instrument we have used in placing the U-tubes which is basically a 3 mm Bake's dilator which has a hole drilled in the end. You can suture the Silastic catheter to it, or tie the Silastic catheter around it. This makes passage of the tube much simpler for us in any case than trying to put Randall stone forceps up through the liver.

Last, I'd like to ask Dr. Cameron and Dr. Zuidema what they feel the advantage is of a single transhepatic tube, as opposed to a U-tube.

DR. THOMAS J. WHELAN (Honolulu, Hawaii): I want to congratulate Drs. Cameron, Gaylor, and Zuidema on their paper, and to thank them for forwarding their paper to me for study early enough to be able to do so.

Their results with benign stricture, as has already been pointed out, are excellent. I have only two questions about this aspect of the paper. First, apparently, in performing their transhepatic stenting procedure where mucosa-to-mucosa approximation is not possible, they do not try to produce a mucosa-lined stent from the jejunum, as Sir Rodney Smith has suggested. I should think that they must feel that this maneuver is not necessary in order to prevent restricting. I wish they would clarify this point for me.

Second, is there a comment in clarification of the increased incidence of seven benign strictures in the last year, whereas in the previous nine years there were only 18 cases? I presume that the people in the referring community realized that they have somebody who will take care of these difficult cases.

Most of my comments are confined, therefore, to the malignant strictures. We have recently reported 57 cases of bile duct cancer from Hawaii, of which 25 occurred in the common hepatic duct and its confluence. Fifty-eight per cent of our patients were Japanese. Although the population of Japanese to Caucasian in Hawaii is 1:1, bile duct cancer is 6:1 Japanese to Caucasian. The average survival of patients with lesions in this portion of the duct was eight months in our series. In only two of the 25 cases was resection and hepaticojejunostomy possible.

Since the series was concluded in 1975, we have placed three transhepatic U-tube Silastic stents with hepaticojejunostomy, and two of these patients are still alive without jaundice at one and a half to two years. There seems little choice, in our mind, between the transhepatic tube, as described by the authors, and the U-tube, either of which traverses and splints the stricture, allows drainage from the liver to the gastrointestinal tract, and can be changed, when occluded or partially occluded, without resorting to reoperation.

A U-tube additionally, however, can be cleaned out by advancing first one end of the tube to the skin, then the other, so as to expose

the holes and allow disobliteration of these holes of bile sludge. This is an office procedure. Cholangitis has not been produced by this procedure in a limited experience. The tube is cleansed with Betadine prior to pulling it back into place.

One late complication we saw with the U-tube was a subphrenic abscess which occurred one year postoperatively as a complication of a rupturing of the tract along the U-tube.

I'm encouraged by the suggestion that radiation therapy may prolong survival in these patients. We certainly are in need of adjunctive measures in management of these discouraging lesions, for which resection has little to offer in tumor control.

DR. JOHN WILLIAM BRAASCH (Boston, Massachusetts): To one who believes that the soul resides in the liver, the idea of skewering the liver with a tube leaves me a little queasy sometimes. However, I would agree that under certain circumstances this method of stenting anastomoses is preferable, especially in cases with very high lesions.

I do have a few reservations in my own mind, perhaps, about what this large bore tube might do to some of the segmental ducts in the liver. We have seen segmental ductal obstruction cause problems, but apparently in this series of cases none were seen.

I would raise one small voice of caution in evaluating results in stricture repair until at least three years have gone by after stents have been removed. In a study about 15 years ago of some of our longterm followups, we found that three years seemed to be about the magic followup time.

I too came prepared with a history of transhepatic stents, and I find I have been outgunned by at least 20 years by these bibliophiles. I would like to point out one thing which has been omitted, a very nice study of Grindly's, reported in 1953, in which he looked into this matter of transhepatic stents in dogs. In the following year, 1954, occurred the first utilization of this technique in the United States in a stricture case by Clagett. I was a witness to the procedure on one end of a retractor.

DR. ANDRE VAN RIJ: I enjoyed this paper a great deal and am very impressed by the results. Dr. Walter J. Pories and I have also found this procedure particularly useful in malignant biliary stricture, particularly at the bifurcation of the common hepatic duct.

However, we have recently observed an interesting and unfortunate complication, which necessitated premature removal of the stent. This occurred in a 65-year-old man who had a malignant obstruction of the bifurcation which was associated with histological changes in the liver of acute cholangitis.

He was treated with a stent, but despite good drainage across the stent, the bilirubin would not fall below 14 mg%. He then went on and developed a persistent high fever, and *E. coli* was cultured from the bile. Intensive antibiotic therapy, which had been commenced prior to surgery, was continued, and subsequently we grew from the bile both *Serratia* and *Enterococci*.

Continuing with the antibiotic therapy, after 18 days, his clinical course continued to go downhill, and at this stage *Candida* was grown from the bile, and 10<sup>4</sup>/ml budding forms were seen. In addition

a positive serum serology for *Candida* was observed. Liver biopsy at that time showed a persistent acute cholangitis, but there were no mycelial forms.

It was only with the removal of the stent that his clinical course improved, and then it did so very markedly and promptly. His temperature fell, his bilirubin returned to normal, and he was discharged one week following removal of the stent.

At present, two months later, he remains unobstructed with a normal bilirubin.

The reason for bringing this complication to your attention is that, interestingly, *Candida* is uncommonly reported to appear in the biliary tree. Superinfection with *Candida*, however, is more common in debilitated patients and particularly with intensive antibiotic therapy. The presence of *Candida* has also been reported in association with central venous catheters and with prosthetic heart valves.

Here we have a group of patients undergoing the procedure described by Dr. Cameron who would also appear to be at a greater risk of such infections with the introduction of a foreign body. I would like to ask Dr. Cameron whether in his patients, bacteria were cultured from the bile when placing the stent and whether this had any effect on the morbidity associated with this procedure.

DR. JOHN L. CAMERON (Closing discussion): I think the number of individuals discussing this paper attests to the difficulties of management that still remain with biliary strictures.

In regard to the U-tube versus the straight tube with the distal end left in the Roux-en-Y loop, I think that's basically a matter of personal preference. However, I think patients prefer to have as few tube ends on their abdominal wall as possible. Particularly in malignant strictures, we feel both the right and the left duct should be intubated and that leaves you with four ends out on the abdominal wall if each is a U-tube. The only advantage of the U-tube that I know of is that it can be easily changed; but the straight tubes can be just as easily changed with a stylet with only one end out. Certainly a U-tube, I think, is just as satisfactory as a single tube.

In terms of the mucosal graft technique, we have not used that. Sir Rodney Smith has published his results, and using the mucosal graft technique and leaving a latex stent in for four months, he has good results in somewhere between 65 and 70% of his patients. We really think that the important aspects of our repair in benign strictures are the fact that a Silastic stent of large bore is used, and that it is left in for a period of 12 months. We have had virtually no failures with this technique. These tubes are produced commercially by Dow Corning. They are very thick walled and are non-compressible by tumor or any other natural means. They are much thicker than the tube shown in the picture by Dr. White, and I think it's really quite impossible to have these tubes compressed.

We have used percutaneous intrabiliary placement of a smaller, 3 mm catheter fairly routinely in these patients prior to surgery and used that catheter placement to withdraw our transhepatic stent during the operative procedure.

In answer to Dr. Braasch's question, the cholangiograms obtained through the transhepatic stents show all of the segmental branches beautifully. The multiple side holes, I think, avoid obstruction by these large-bore stents.