Further Evaluation of Selective Decompression of Varices by Distal Splenorenal Shunt

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Clinical assessment of the patient and the evaluation of liver function provide useful data in predicting the mortality and morbidity following decompression of esophageal varices by portacaval shunts. However, these criteria are not sufficient because patients who are believed to have a good prognosis frequently develop hepatic encephalopathy and liver failure. Based on laboratory and clinical observations it was postulated that the preportacaval shunt hemodynamics of the portal system also profoundly influence the outcome of the operation.[1-4, 10, 11] The simplified thesis states that sudden diversion of normal or near normal hepatopetal portal blood flow by a portacaval shunt is detrimental to the liver. On the contrary, when portal blood flow to the liver has already been significantly reduced, diversion of the remainder is well tolerated.

Non-shunting procedures such as gastric devascularization, the interruption of portosystemic anastomoses by one method or another or ligation of varices are not productive of further liver damage but often fail to control bleeding permanently. Dissatisfaction with both non-shunting operations and portacaval shunts led to a new concept in the treatment of those patients having good hepatopetal portal blood flow. This operation seeks to decompress varices in the gastroesophageal area while maintaining hypertension in the remainder of the splanchnic system with consequent continued perfusion of the liver through the portal vein. Selective decompression of the gastroesophageal varices is by the transsplenic route through an anastomosis between the distal end of the splenic vein and the side of the left renal vein. The greater curvature of the stomach distal to the short gastric veins is devascularized. The gastrohepatic ligament is divided and the coronary vein ligated (Fig. 1).

In the initial report few patients had been observed for brief periods.[12] In this interim communication the series is brought up to date. Tentative answers can be given to some of the pertinent questions related to the procedure. Does the shunt remain patent? Are varices decompressed? Is recurrent hemorrhage a problem? Do patients develop encephalopathy?

Methods and Material

Six patients were reported initially. In four the distal shunt was successfully constructed. In one a shunt was not attempted and operation consisted of gastric devascularization and ligation of the splenic artery. This patient has rebled from gastroesophageal varices and is omitted from further consideration since a shunt was not attempted. In the sixth a shunt was unsuc-

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cessfully attempted and the stomach was devascularized with ligation of the splenic artery.

The entire series now consists of 15 patients. Preoperatively all patients were clinically evaluated, had liver function studies and assessment of splanchnic hemodynamics. All were judged to be reasonable operative risks and all had relatively good hepatopetal portal blood flow.

Results

Does the Shunt Remain Patent? All five surviving patients have had shunt patency demonstrated by splenoportography, by splenic artery catheterization with injection of contrast material and obtaining films during the venous phase of the examination or both (Figs. 2, 3). These examinations were carried out prior to discharge and have not been repeated although there is indirect evidence that the shunts have remained patent. It was possible to examine the shunt in three of the six patients who died. All were patent although a nonocclusive mural thrombus was present in one.

Are the Gastroesophageal Varices Decompressed? Do Varices Rebleed? In none of the patients has there been recurrent gastrointestinal hemorrhage. However, the observation period is short and varies from 183 to 739 days. Preoperatively all patients had gastrointestinal x-ray series that were interpreted as showing esophageal varices. In one the varices were small but are visualized on one of several examinations. Post-

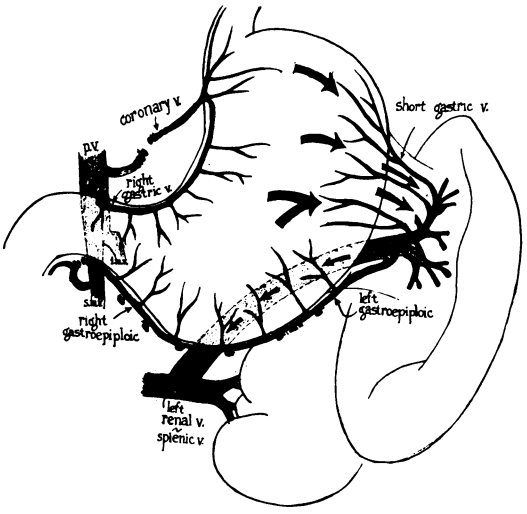

FIG. 1. Diagrammatic depiction of completed operation. Arrows indicate the direction of blood flow. Note end to side distal splenorenal anastomosis and ligation of the coronary vein. Blood from the inferior (i.m.v.) and superior (s.m.v.) mesenteric veins continue to perfuse the liver. (Reprinted by permission of Ann. Surg.[12])

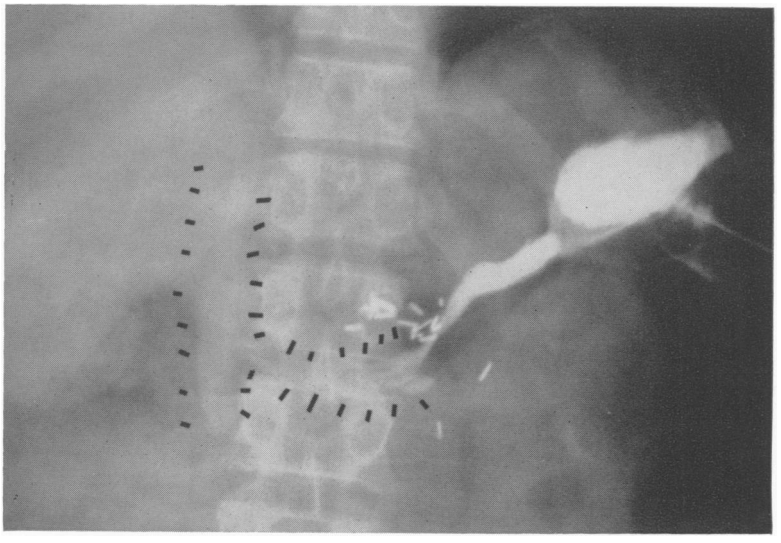

FIG. 2. Postoperative splenoportogram. Contrast material left the spleen by way of the splenic vein, flowed into the renal vein and inferior vena cava.

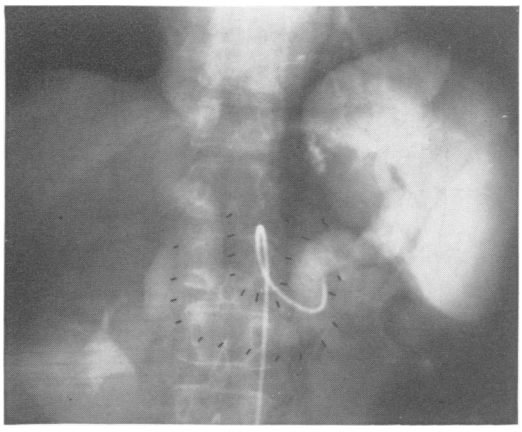

FIG. 3. Postoperative splenic artery angiography. On films obtained during the venous phase of selective splenic artery injection, the contrast material successively opacified the splenic vein, renal vein and inferior vena cava.

operative varices were not present in four of the patients (Fig. 4). In the fifth varices were present but considerably reduced in size and on a subsequent examination disappeared (Fig. 5). The single surviving patient who had an unsuccessful shunt with gastric devascularization and ligation of splenic artery continues to have large varices but has not rebled (Fig. 6).

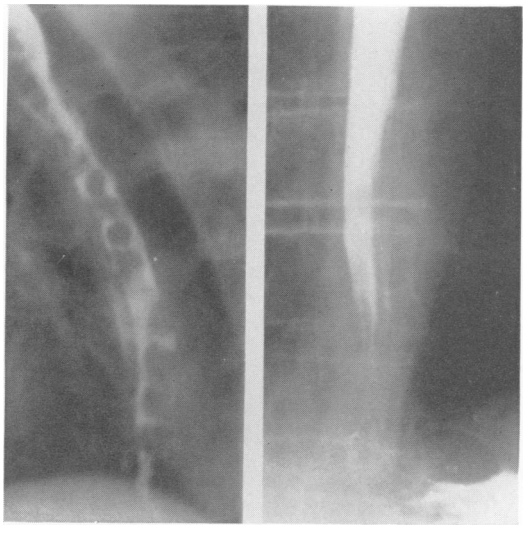

FIG. 4. Pre- and postoperative esophagrams. Large varices (left) were present preoperatively. Varices were not present when the examination (right) was repeated after operation.

Is There Continued Perfusion of the Liver Through the Portal Vein? Preoperatively four of the surviving patients had hepatic blood flows (EHBF) estimated using radioactive colloidal gold.[6] By this method liver blood flow was normal in two patients and slightly reduced in two. All five had wedged hepatic venograms. In two there was little or no filling of the intrahepatic branches of the portal vein (Category 1), an indication of normal or mildly restricted portal venous flow to the liver. In three patients there was retrograde flow of the contrast material into intrahepatic branches of the portal vein with hepatopetal flow opacifying portal veins in adjacent lobules (Category 2). This signifies moderate restriction of hepatopetal portal blood flow. Four of the five patients had either indirect portograms or splenoportograms that were satisfactory for staging portal blood flow to the liver. In three there was near normal perfusion of the liver through the portal vein as manifested by the small amount of contrast material diverted from the liver through collateral channels and a prominent liver blush during the capillary phase of the examination (Stage 1). Using the same criteria portal blood flow was moderately reduced in two patients (Stage 2).[9] In summary, the five patients had either slightly or moderately restricted portal blood flow preoperatively.

Postoperatively EHBF decreased in all patients but because of altered splenic hemodynamics no significance can be attached to the change. All five patients had wedged hepatic venograms. In three there was considerable filling of intrahepatic portal vein branches similar to the pattern seen preoperatively in patients with severe restriction of portal blood flow (Category 3) (Fig. 7). In two patients contrast material flowed from the liver using the portal vein as an outflow tract (Category 4) (Fig. 8).

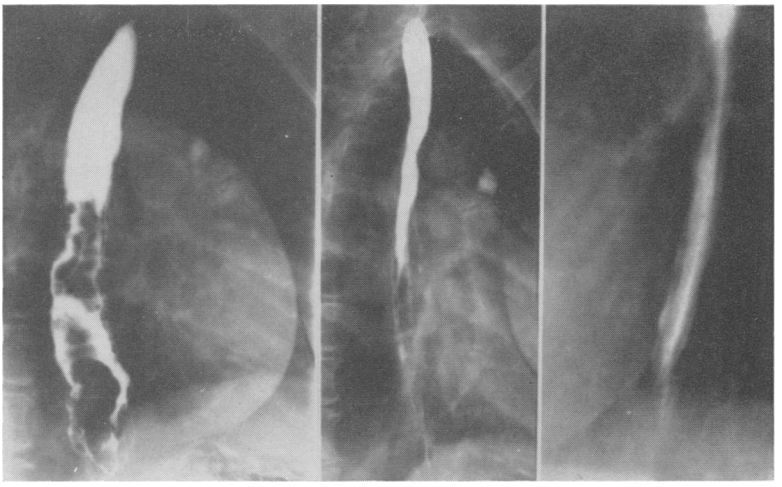

FIG. 5. Pre- and postoperative esophagrams. Huge varices present before operation (left) were much smaller but still present 20 days after operation (middle). At 360 days the varices had completely disappeared (right).

This picture is like that seen in spontaneous reversal of portal venous blood flow and following a side to side portacaval shunt.[8] On indirect portography contrast material reached the liver through the portal vein in three of the five patients, those classified as Category 3 (Fig. 9). In the other two the portal vein was not visualized but it is probable that in one of these the coronary vein was not ligated (Fig. 10). Postoperatively, then, three of five patients had some perfusion of the liver through the portal vein.

Has Encephalopathy Been a Problem Postoperatively? None of the five successfully shunted patients restrict protein intake and none have any clinical manifestations of hepatic encephalopathy. Protein tolerance tests * have been done on normal individuals, on patients with cirrhosis before or after portacaval shunts and on the five patients who have survived distal splenorenal shunt (Fig. 11). In almost all instances two protein tolerance tests were done on each individual and some had serial tests. For each hour there are statistically significant differences between normal individuals and preoperative cir-

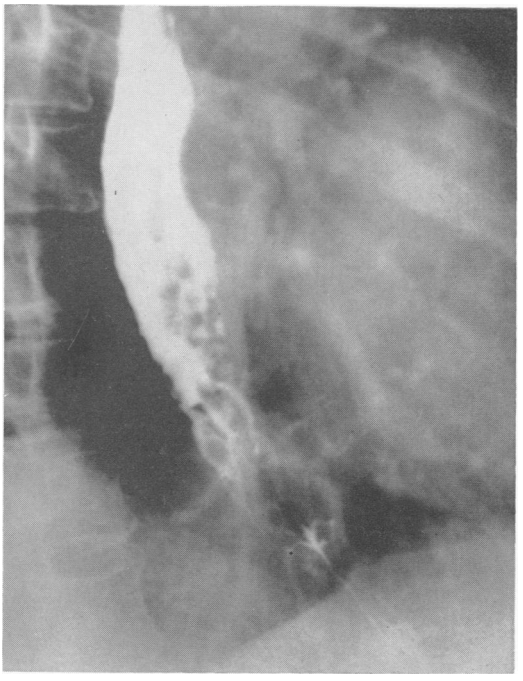

FIG. 6. Postoperative esophagram. Varices were undiminished following gastric devascularization and ligation of the splenic artery and vein but without a distal splenorenal shunt.

* The patient fasts for 12 hours, a baseline venous blood sample is taken and the patient is given a 50 Gm. protein meal in the form of lean steak, this being the largest meal that patients will consistently consume at one time. Venous blood samples are obtained at 1, 2, 3, 4 and 5 hours. An "omega" sample is obtained between 6 and 7 hours. Ammonia levels are determined using a modification of the technic described by Nathan and Rodkey.[5]

FIG. 7a. Preoperative wedged hepatic venogram. With the catheter wedged in an hepatic vein contrast material was injected and refluxed into branches of the portal vein, an indication of moderately restricted hepatopetal portal blood flow.

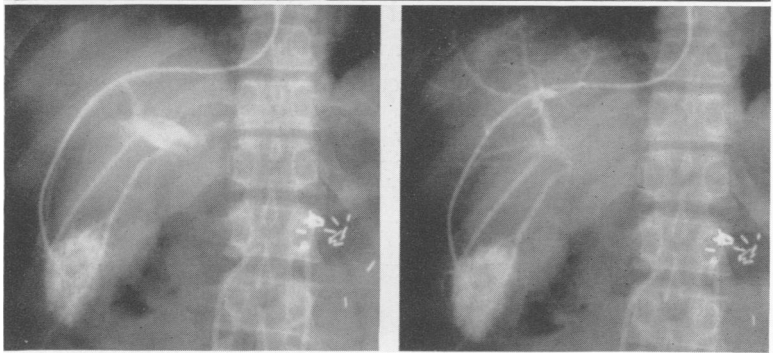

FIG. 7b. Postoperative wedged hepatic venogram. The examination was repeated on the same patient. In early films (left) contrast material partially filled the main right intrahepatic portal vein and on later films (right) opacified other branches of the portal vein, indicating continued but severely restricted perfusion of the liver through the portal vein (Fig. 9).

rhotics as well as between preoperative cirrhotics and those having a portacaval shunt. There is no statistical difference between preoperative cirrhotic patients and those having a distal splenorenal shunt.

How is "Hypersplenism" Affected by the Operation? No patients had symptoms that could be ascribed to hypersplenism preoperatively and none developed after operation. Before operation the lowest platelet count was 80,000/m^3 although all five were lower than 250,000/m^3. The lowest white blood cell count was 1,350/m^3 and three were below 5,000/m^3. Postoperatively there were minor changes but none of the platelet counts became normal. The lowest white blood cell count was 2,900/m^3. Four patients had liver scans pre- and postoperatively using radioactive colloidal gold. In each instance the measured size of the spleen decreased and there was less uptake of the isotope by the organ after operation (Fig. 12).

How Have the Patients Fared Clinically? All patients are pursuing their former activities. One, a housewife, complains of undue fatigue, a symptom she experienced prior to operation. Two continue to consume large quantities of alcohol. One of these has had a cerebrovascular accident with subsequent convulsions that are controlled by medication. One of the remaining two continues to have domestic difficulties.

What is the Mortality of the Operation? Fifteen patients have undergone operation. Eight died during the immediate postoperative period. There have been no subse-

quent deaths. In four of the patients the shunt was attempted unsuccessfully. In two the distance between renal and splenic veins was too great. One had an end-to-side portacaval shunt and survived. The other was treated by gastric devascularization and splenectomy and died after rebleeding from gastroesophageal varices. The other two unsuccessful shunts were the result of technical errors. Both had gastric devascularization. One survived; in the other a vein graft thrombosed in spite of heparinization and the patient died of intraperitoneal bleeding.

TABLE 1. *Experience with Distal Spleno-Renal Shunts and Gastric Devascularization*

Attempted Procedures			15
Unsuccessful		4	
Living	2		
Dead	2		
Successful		11	
Living	5		
Dead	6		

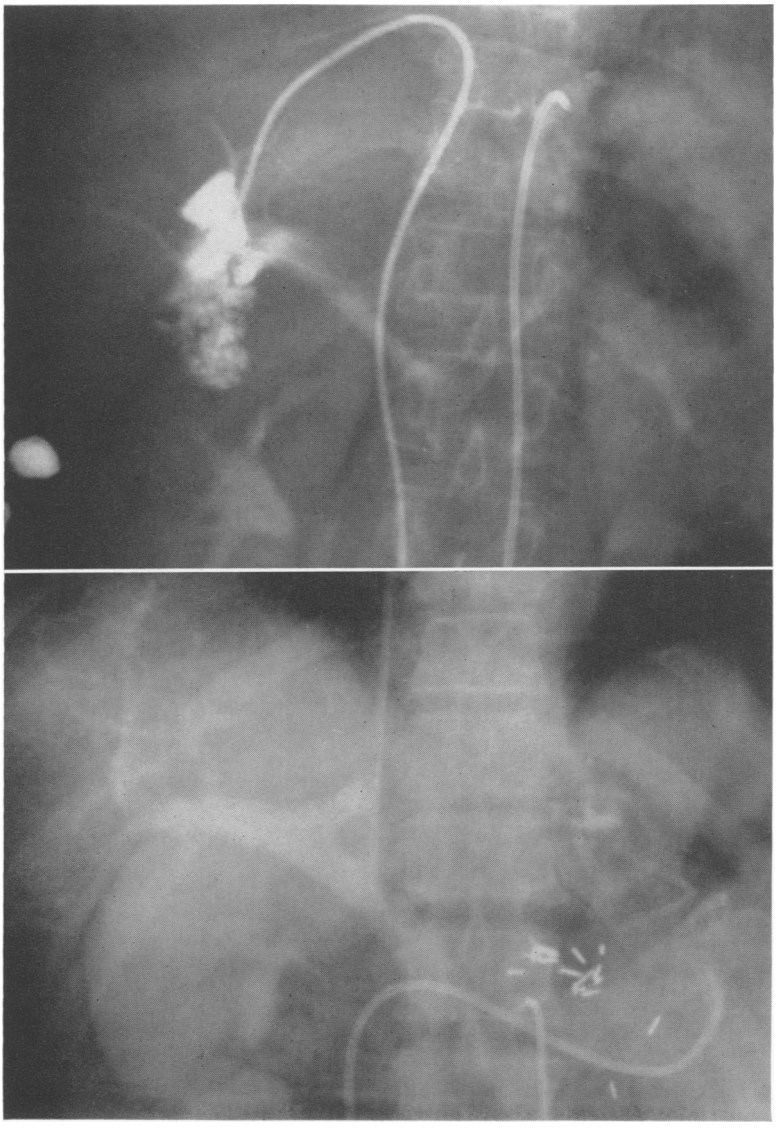

FIG. 8. Postoperative wedged hepatic venogram. The portal vein is opacified as an outflow tract indicating that portal blood no longer perfused the liver in this patient. Contrast material fills the coronary vein at its junction with the portal vein, providing evidence that the coronary vein was not ligated (Fig. 10).

FIG. 9. Postoperative superior mesenteric angiography. Contrast material was injected into the selectively catheterized superior mesenteric artery. On the venous phase of the examination the portal vein and its intrahepatic branches are well opacified indicating hepatopetal portal blood flow. The patient is the same as in Figure 7.

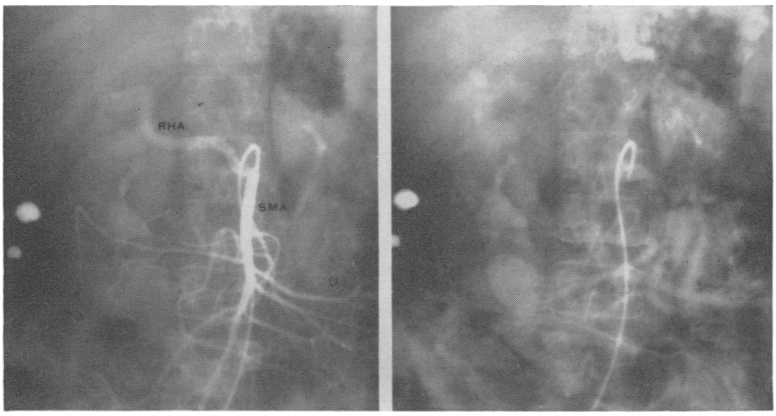

FIG. 10. Postoperative superior mesenteric angiography. The superior mesenteric artery (SMA) was selectively catheterized. Part of the contrast material was dissipated into the right hepatic artery (RHA) (left). On the venous phase of the examination the portal vein was never opacified providing additional evidence of lack of liver perfusion through the portal vein. The patient is the same as in Figure 8.

Of the 11 patients having successful distal splenorenal shunts and gastric devascularization, six died. In five the primary cause of death was liver failure. In two this was associated with upper gastrointestinal bleeding and in a third with intraperitoneal and upper gastrointestinal hemorrhage. A fourth patient had infected ascites. In none of the three patients was the bleeding believed to be from varices. The sixth patient had a bowel injury and died of peritonitis (Table 1).

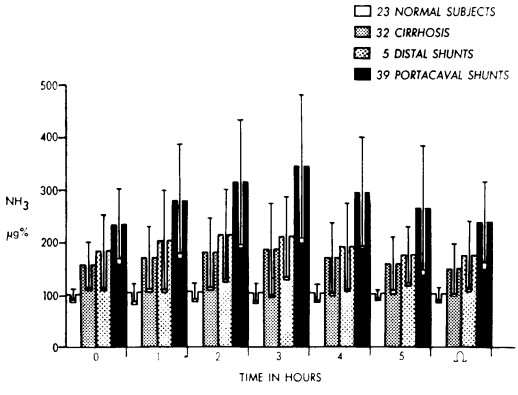

FIG. 11. Protein tolerance tests on normal individuals, patients with cirrhosis of the liver, patients with cirrhosis after a portacaval shunt and on cirrhotics after a distal splenorenal shunt. There was no statistically significant difference in ammonia levels for any time period between preoperative patients with cirrhosis and the cirrhotic patients who had distal splenorenal shunts. However, the difference between these two groups and the portacaval shunt group was highly significant ($p < 0.02$ to $P < 0.001$).

Retrospectively Was It Possible to Separate Those Patients Who Survived from Those Who Died? On the basis of clinical evaluation there appeared to be no difference. Two patients had urgent operations, one survived and one died. Because almost all patients developed ascites postoperatively this was investigated as a factor. The presence or absence of recent ascites did not seem to influence the outcome. Scrutiny of liver function tests did not provide a criterion for separating individual patients although the average serum glutamic oxalacetic transaminase and alkaline phosphatase levels were higher in the patients who died than in those who survived. Since all patients had relatively good hepatopetal portal blood flow analysis of the preoperative portal hemodynamics was unrewarding. Only four of the patients had preoperative determinations of cardiac output so that there are not enough data to investigate this possibility.[7] However, in the single survivor the cardiac index was at the upper limit of normal preoperatively and was unchanged after operation. Of the three patients who died, the cardiac index was normal in one, slightly elevated in the second and significantly elevated in the third. Because intraperitoneal bleeding, the result of uncompressed hypertension in a portion of the splanchnic bed, has been a problem the degree of portal hypertension

was compared between the survivors and non-survivors. The difference was not significant. Almost all patients had liver biopsies at the time of operation. It appears that this may be a helpful criterion. These relatively few biopsies were reviewed as "unknowns." Those patients with "active" liver disease died. Those with "inactive" disease survived.

Discussion

The concept of selective decompression of gastroesophageal varices while maintaining hepatopetal portal flow seems to be valid. The method using the trans-splenic route with isolation of the viscera in the left upper quadrant of the abdomen from the remaining viscera draining into the splanchnic bed remains theoretically sound.

Practically, the shunts have been proved to function during the immediate postoperative period and presumably continue to do so because varices have remained decompressed. By angiographic technics it was found that three of five patients had hepatopetal portal blood flow during the early postoperative period. These studies have not been repeated but the relatively low non-peaked blood ammonia curves obtained during serial protein tolerance tests may be indirect evidence of continued perfusion of the liver by portal blood. More importantly, ammonia levels obtained during protein tolerance tests in cirrhotics after distal splenorenal shunts were not significantly higher than in the unoperated patients with cirrhosis. In the group that had portacaval shunts the ammonia levels were significantly higher for each time period ($p < 0.02$–< 0.001).

The mortality, perhaps spuriously high because of few patients, has been such that widespread use of the procedure cannot be recommended. Because of the promising aspects of the operation investigation in this institution will continue. As in the past the operation will be performed only on those patients who have been found to have good hepatopetal portal blood flow preoperatively. Selection of patients will be more stringent in that liver function tests will more nearly approach normal and preoperative needle biopsy of the liver will be a prerequisite. If there is evidence of "active" liver disease the patient will be excluded. Certain changes in operative technic are contemplated to minimize the troublesome postoperative bleeding that occurs from retroperitoneal dissection both in isolating the left renal vein and in ligating the coronary vein because portal pressure remains high except in the area that is selectively decompressed.

Summary

Selective trans-splenic decompression of gastroesophageal varices has been successful in five patients.

At the time of hospital discharge all shunts were found to be patent by angiographic technics. Of great importance is the complete disappearance of varices in

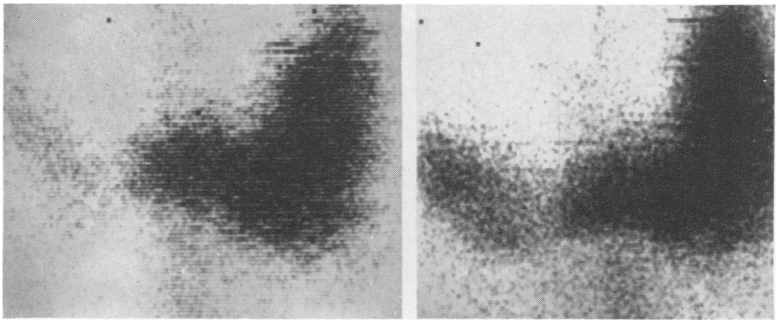

FIG. 12. Pre- and postoperative liver scan. Preoperatively there was considerable uptake of Au^{198} in the slightly enlarged spleen (left). After operation the spleen decreased in size and Au^{198} uptake was much less.

all patients and there has been no rebleeding during observation periods ranging from 183 to 739 days.

In three of the five surviving patients portal vein blood continued to perfuse the liver during the early observation period as seen on films during the venous phase of superior mesenteric arteriograms.

Protein tolerance studies reveal a marked difference between the selective shunts and the portacaval shunts. There has been no encephalopathy and no protein restriction in any selective shunt patient and clinically all patients have done well.

The operation has been attempted on 15 patients, eight of whom died. In four patients the shunt was not completed, twice because of technical errors and twice because of the distance between the mobilized splenic and renal veins. Two of these four patients survived and two died. Of 11 patients in whom the operation was carried out, six died. Because of the high mortality the procedure cannot be recommended except in centers studying this problem.

Acknowledgment

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