

PORTACAVAL ANASTOMOSIS: A REPORT ON FOURTEEN CASES*

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THE operation of portacaval anastomosis for the relief of portal hypertension has been performed in fourteen patients. In four of the cases the site of the portal bed obstruction was extrahepatic. In the ten remaining cases the site of the portal obstruction was intrahepatic due to portal cirrhosis of the liver. There were two operative deaths, both cirrhosis cases; one occurred a few hours after operation and the other four days following operation.

Splenectomy and left nephrectomy with anastomosis of the splenic vein to the stump of the left renal vein has been performed six times, one, employing the Carrel suture technique and in the remaining five cases the non-suture technique was employed, using vitallium tubes. In a case of a nine year old boy with cavernomatous transformation of the portal vein who had previously had a splenectomy, the stump of the splenic vein was isolated and anastomosed to the vena cava, end to side, employing the suture technique. In the remaining seven of the fourteen cases, the portal vein was anastomosed to the vena cava, end to side (Eck fistula) using the non-suture technique with vitallium tubes.

Whereas the follow up results in the four cases of portal hypertension due to extrahepatic portal block have not been ideal, the operation appears to have been distinctly beneficial in three of the four cases. It is true that three of the four cases have had episodes of bleeding since operation, but in general the bleeding episodes have not been as severe or as frequent as before operation. No case has had hematemesis as was the rule before operation. We now have a follow up of one and one-half years on a sixteen year old girl who, for years before operation had had massive hematemesis followed by tarry stools of two weeks duration. During the year prior to operation the attacks occurred at

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approximately six month intervals. Whereas, since the performance of a spleno-renal shunt one and one-half years ago there have been only two bleeding episodes, one of which was so slight as to be considered negligible and in neither was there hematemesis. A follow up letter from the patient dated January 9, 1946, states there has been no bleeding since March 1945 (nearly a year). She states further that her general health is much improved, has more energy and does not tire easily.

An esophagram made one year following operation on this girl, when compared with an x-ray taken before operation, revealed a marked reduction in the size of the esophageal varices. It is reasonable that this evidence of reduced pressure in the portal system so lessens the strain upon the esophageal vessels as to permit the strengthening processes within the vein walls an opportunity to become effective against erosion or sudden rupture.

This patient had an obstructive lesion (cavernomatous transformation) of the portal vein. One cannot in such case of portal vein obstruction expect the splenic vein, when used to effect a portacaval shunt, to reduce the portal pressure to anywhere near a normal figure. It must be remembered that the splenic vein handles normally only approximately 40 per cent of the total volume blood flow of the portal system. As a matter of fact, opening the spleno-renal shunt at operation in this case reduced the pressure in the superior mesenteric vein from 390 mm. of water to 290 mm. of water—a reduction of 100 mm. in portal bed pressure. Although this is far from the normal figure of 100 mm. of water, it is a great stride in the right direction for this girl and, it may mean just sufficient reduction in portal pressure to change her future from the certainty of a lethal bleeding episode.

The amelioration of the viciousness and frequency of bleeding episodes in this girl and others commends the procedure of portacaval shunt to further trial upon a group of otherwise hopeless cases. Cases of extrahepatic portal block, e.g., cavernomatous transformation of the portal vein, are unsuitable for the establishment of Eck fistulae. An attempt to do so, using a vein graft to bridge the distance from the foreshortened portal vein to the vena cava accounted for our one total failure in the group of four cases of portal hypertension due to extrahepatic portal bed block.

Because of the greater size of the portal vein, its anastomosis to the vena cava (Eck fistula) will shunt a far greater volume of blood than

a spleno-renal anastomosis, which, in effect makes the Eck fistula a more efficient shunt for the lowering of portal pressure. For the above reason and the fact that Eck fistula operations seem to be better tolerated than spleno-renal vein anastomoses we now prefer its use in cases of cirrhosis of the liver.

Of the eight cases of cirrhosis of the liver followed postoperatively four had splenectomy, left nephrectomy with anastomosis of the splenic vein to the renal vein stump and four had anastomosis of the portal vein to the vena cava (Eck fistula).

The indications for portacaval shunt are clear cut in cases of portal hypertension when due to extrahepatic portal bed block. Whereas, in cases of cirrhosis of the liver the problem is more complex. No one disputes the physical facts of the blood pressure lowering effect of a portacaval shunt in the presence of portal hypertension but all insist upon a careful evaluation of the factors that establish the necessity of doing such an operation in an individual case of cirrhosis and when to do it.

Recent advances in the medical therapy of portal cirrhosis of the liver have established the fact that a percentage of these cases can be improved both clinically and by laboratory tests for the measure of liver function. The above facts automatically eliminate then all cases of cirrhosis for surgical consideration who have not had a thorough trial on the medical regime except those cases whose lives are threatened by hemorrhage and, even in the latter group, good judgment must be exercised as to the optimum time to operate. Whereas portal hypertension is the basic causal factor of hemorrhage in cirrhosis cases it is important to remember that a high prothrombin time, itself a sign of severe liver damage, may incite and prolong hemorrhage. Such cases are obviously poorer operative risks, but failing an energetic conservative regime, operation does offer a chance for life. Three of our eight cases fell into the above group. All three went through the shunt operation successfully but two of the three cases had a stormy convalescence. It is true that each case has had one bleeding episode over follow up periods of two years three months, one year and one year respectively, but in no instance was there vomiting of blood during these episodes as had occurred invariably before operation. Furthermore the post-operative bleeding episodes were limited to the passage of two or three tarry stools whereas before operation bleeding would persist for several

TABLE I—PROTEINS*

Name	Age	Sex	Findings	Type of Shunt	Preoperative			Postoperative		
					T.P.	Alb.	Glo.	T.P.	Alb.	Glo.
1. Duncan	27	M	Cirrhosis Esophageal Varices	Spleno- renal	6.6	2.9	3.7	7.1	3.6	3.9
2. Box 777262	46	F	Cirrhosis Esophageal Varices Ascites	Portal vein to Vena cava (Eck Fistula)	7.8	4.3	3.5	5.6	3.4	2.2
					8.1	3.9	4.2	6.6	4.1	2.5
					8.0	4.1	3.9	6.1	3.8	2.4
3. Pahuci 690444	5	F	Cirrhosis Esophageal Varices Ascites	Spleno- renal	8.2	4.5	3.7	7.4	3.5	3.9
								7.2	3.7	3.5
								7.2	4.1	3.1
								7.3	3.8	3.5
4. Schein- garten 557450	28	M	Cirrhosis Esophageal Varices Ascites	Portal vein to Vena cava (Eck Fistula)	8.5	3.3	5.2	6.9	2.6	4.3
								7.1	2.4	4.7
								7.9	2.2	5.7
								8.8	(1.5)	6.3
								6.2	2.2	4.7
			7.4		5.1					
5. Cocozela 754188	42	M	Cirrhosis Esophageal Varices Ascites	Spleno- renal	7.5	3.5	4	6.2	2.5	3.7
								6.8	2.6	4.2
								6.5	2.6	3.9
6. Mooney 536889	56	M	Cirrhosis Esophageal Varices Ascites	Spleno- renal	5.7	3.2	2.5	6.4	3.7	2.7
					7.1	3.8	3.3	7.2	4.1	3.1
					6.4	3.5	2.9	5.8	3.1	2.7
								6.5	3.6	2.8
7. Long 783972	49	M	Cirrhosis Esophageal Varices Ascites	Portal vein to Vena cava	5.3	2.3	3.0	5.9	3.6	2.3
								5.4	2.6	2.8
								5.7	3.1	2.6
8. Iacoletti 784905	58	M	Cirrhosis Esophageal Varices Ascites	Portal vein to Vena cava	5.2	2.9	2.3	4.5	2.5	2.0
								4.9	2.3	2.4
								4.7	2.9	2.0
								5.0	1.9	3.1
								5.0	2.0	3.0
								5.0	2.2	2.8
								6.2	3.0	3.2
								5.0	2.4	2.6

* Proteins expressed in %.

weeks. In fact in two of the three cases at the time of operation the patients had been bleeding for one month each and, in spite of transfusions, the hemoglobin wavered in the twenties in one and the low forties in the other.

Spleno-renal anastomoses using 6 and 8 mm. tubes respectively were done in two of the three cases. In the third case a vein graft using the superficial femoral vein was used to join the portal vein to the vena cava. The objectionable use of a vein graft was necessary in this case on account of tissue edema. Because of the small size of the superficial femoral vein in comparison with the portal vein we feel that this particular shunt was capable of handling no more blood than the spleno-renal anastomoses performed in the other two cases. This was further borne out by the fact that the portal vein pressure fell to only 390 mm. of water upon opening the anastomosis. We now know that all three of these cases should have had a shunt operation comparable to the full size of the portal vein—namely a direct end to side anastomosis of the portal vein to the vena cava. It is of interest that in a year's follow up on a fourth case of cirrhosis who preoperatively had bled less severely, there have been no postoperative bleeding episodes. In this case the portal vein was anastomosed end to side with the vena cava using a 12 mm. vitallium tube. Furthermore x-rays of the esophageal varices done before and six months after operation revealed a marked reduction in the size of the varices postoperatively.

Ascites: Excessive peritoneal fluid was found at operation in seven of the eight cases of cirrhosis followed postoperatively. There was no reaccumulation of fluid in three cases after operation. Two cases required paracentesis once and twice respectively. Whereas, in the remaining two cases paracenteses were performed over increasing intervals for a period of two months in one and perhaps five more months in the other.

A study of portal pressure readings taken at operation before and after opening the shunt when correlated with pre- and postoperative protein values, as these factors relate to the formation of ascites, would be highly informative. Unfortunately, often due to the exigencies of the operation, our portal pressure readings are far from complete. The protein values before and after operation in the eight cases of cirrhosis were as shown in Table I.

A summary of the protein values before and after the formation of portacaval shunts in eight cases of cirrhosis of the liver is as follows: In one case, having esophageal varices but no ascites, there was a significant rise in total proteins and albumin following operation. In two other cases there was a slight rise in total proteins and albumin follow-

TABLE II—BROMSULPHALEIN TEST
Percentage of Dye Excreted After 30 Minutes

<i>Name</i>	<i>Preoperative</i>	<i>Postoperative</i>
Pahuci 690444	10%	5% 10% 8%
Duncan 767177	70%	38%
Cocozelo 754188	60% (S.B. 1.5 mg. %)	65% (S.B. 2.5 mg. %)
Box 777262	45%	10% 30% 20%
Scheingarten 557450	42%	40%
Mooney 536889	20% (S.B. 3.5 mg. %)	22% (S.B. 1.0 mg. %) 25% 35% 27%
Iacoletti 784905	35% (S.B. 4 mg. %)	35% (S.B. 3 mg. %) 20% (S.B. 3 mg. %) 27% (S.B. 3 mg. %) 61% No jaundice 55% No jaundice 39%

ing operation whereas in the remaining five cases there was a slight fall.

The role of portal hypertension and low proteins as causal factors in the formation of ascites in cases of portal cirrhosis of the liver has long been known. Therefore the relief of ascites following the establishment of portacaval shunts in the above seven cases of cirrhosis having evidence of severe portal hypertension (esophageal varices) is not unexpected. The relative importance of the portal hypertensive factor in the cause and perpetuation of ascites is well demonstrated however in the five cases whose proteins failed to rise to preoperative levels following the establishment of portacaval shunts for the relief of portal hypertension. Whereas in all of the cases operated upon by us there was evidence of severe portal hypertension such is not the case in all cases of cirrhosis of the liver. There are some cases of cirrhosis with ascites due primarily to lowered proteins, a result of liver damage

in which the portal vein radicals have been relatively little constricted by fibrosis.

Bromsulphalein liver function tests were performed before and after the establishment of portacaval shunts in seven of the eight cases of cirrhosis followed postoperatively (Table II).

A summary of the results of this liver function test is as follows: In four of the seven cases bromsulphalein retention decreased following operation, namely, 2 per cent, 32 per cent, 25 per cent and 2 per cent respectively. Whereas in three of the cases there was a slight rise in bromsulphalein following operation, namely 5 per cent, 7 per cent and 4 per cent respectively.

We realize that the number of cases is too small to make these findings of statistical significance; however, it so happened that in all three cases showing increased retention of bromsulphalein following operation jaundice was present when the tests were made—both before and after operation. All chemists familiar with the bromsulphalein liver function test are in agreement that the presence of an elevated serum bilirubin so complicates the quantitative determination of bromsulphalein in the blood as to vitiate the accuracy of the test. In view of the above facts then, should we discard the three cases in which the accuracy of the bromsulphalein tests was compromised by the presence of an elevated serum bilirubin, the evidence favors improvement in this liver function test following the establishment of portacaval shunts.

Unfortunately we cannot present an array of figures concerning other liver function tests before and after the establishment of portacaval shunts in these eight cases (Table III). The results were at least encouraging in the two cases having hippuric acid excretion tests before and after operation.

The behavior of the cephalin flocculation test is interesting.

The usual decrease in the prothrombin time following the establishment of portacaval shunts is informative to the extent to which the change may be attributable to improvement in liver function.

Two of the eight cases of cirrhosis followed postoperatively have died. One, the five year old child whose postoperative course was complicated by polycystic disease of the kidney and chronic nephritis, finally succumbed to uremia two years and three months following a spleno-renal anastomosis. At autopsy the splenic vein was found to have undergone fibrotic occlusion at the anastomosis site. This occurrence

TABLE III—HIPURIC ACID LIVER FUNCTION TEST
(Normal Secretion One or More Grams Per Hour)

<i>Name</i>	<i>Preoperative</i>	<i>Postoperative</i>
Long 783972	0.62 grams 1 hr.	0.82 grams 1 hr
Scheingarten 557450	0.8 grams 1 hr.	1.1 grams 1 hr. 1.5 grams 1 hr.
		1.3

CEPHALIN FLOCCULATION TEST

	<i>Preoperative</i>	<i>Postoperative</i>
1.	4+	0
2.	3+	2+ .5
		1.25+
3.	4+	0
4.	1+ 1+	0 0 0 0
		0
5.	3+	2+ 3+ 0 2+
		1.75+
Iacoletti 784905	Negative	4 +

PROTHROMBIN TIME

Those cases with elevated prothrombin times usually have returned to normal.

in our first case was not altogether unexpected because it was noted at the completion of the operation that the splenic vein was sharply angulated over the edge of the vitallium tube. Our attempt to relieve this angulation by stay sutures was not essentially successful. The occurrence of angulation at the spleno-renal junction has been largely avoided in subsequent cases by mobilization of a longer segment of splenic vein. This can usually be done by the painstaking ligation of numerous pan-

creatic branches. Even so in one case tissue edema was so extensive as to necessitate the use of a vein graft to bridge the space between the splenic and renal veins.

Though complete fibrotic occlusion of the anastomosis was noted at autopsy no doctor familiar with this child's preoperative and post-operative course (and there were many) but would attest to her remarkable clinical improvement following operation. Attempts at controlling an episode of bleeding that had recurred almost daily over a period in excess of a month had definitely proven a losing game in this child, until the situation of extremis was reversed following operation. Considering the progressive improvement this child made over the year following operation in comparison with the steady downhill course during the year preceding operation is convincing evidence that the spleno-renal shunt was delivering a good volume of blood over the period. And, it is my opinion that the fibrotic narrowing of the anastomosis progressed at a very slow rate with at no time the sudden intervention of thrombus. Furthermore, there is no evidence of the latter upon careful examination of the specimen.

Infra red photographs to show superficial collateral vessels over the abdomen taken three weeks after and fourteen months after operation would support the above conclusion.

The second to die of the eight cases of cirrhosis followed post-operatively lived for one year following the establishment of a spleno-renal shunt. This forty-two year old man had a very bad cirrhosis—the present illness going back months beginning with loss in weight, strength and appetite; jaundice and ascites supervened. There was reversal of the A/G ratio and a 4 plus cephalin flocculation test. Following operation the man gradually gained strength and was finally able to work part time. The ascites never recurred following discharge from the hospital.

Our last follow up on this patient was some three months before the onset of his last illness. We understand the onset of his last illness was sudden with a fever and some abdominal discomfort; he arrived at another hospital with a temperature of 104° F. His course was rapidly downhill; he became stuporous shortly after admission. His exitus a few days later was punctuated by an episode of hemorrhage. We have just recently received the pathological specimen in this case and have not completed the study of the liver. The spleno-renal anastomosis was

found to be patent in the specimen though, due to the considerably larger renal vein, the walls were somewhat fluted bordering the junction with the splenic vein. However, union between the splenic and renal veins was firm. There was no thickening of the vein walls or other evidence of irritation by the vitallium tube. The intima was everywhere intact. No thrombus was present and within the vitallium tube there was full freedom of space for blood flow.

It is obvious from the specimen that the spleno-renal shunt in this case was capable of handling a considerable volume of blood though, no doubt, not nearly so much as an Eck fistula. It would appear from the high fever this man had upon entering the hospital that he may have had some kind of infection or toxemia. At any rate rapid failure of the liver, as no doubt this man had, can in a matter of a few hours so affect prothrombin as to constitute a tremendous factor in the inciting of hemorrhage in a patient proven to have esophageal varices. It is a matter of interest that our operative notes reveal this man's portal pressure as exceeding 500 mm. of water—the highest by 50 mm. of any case so far recorded by us. These facts would argue for the choice of Eck fistula (portal vein to vena cava) anastomosis in this man though it is unlikely that the difference would have been adequate to meet the onslaught of a rapidly mounting prothrombin time—a terminal event.

Summary: A report of fourteen cases in which portacaval shunts were established was presented. The technique, indications for operation and the type of portacaval shunt to be employed were discussed. The role of the portacaval shunt in ameliorating the severity and frequency of hemorrhage in cases of portal hypertension was illustrated.

The influence of the portacaval shunt on ascites was emphasized.

Blood protein levels before and after the establishment of portacaval shunts in eight cases of cirrhosis of the liver were reported.

Bromsulphalein excretion figures before and after operation were presented. Finally, the effect of the portacaval shunt on hippuric acid excretion, cephalin flocculation and the prothrombin time in cases of cirrhosis was discussed.

Conclusions: The number of cases has been too small and the data accumulated insufficient to draw sweeping conclusions. Of one thing we are sure, however, and that is that unless the operation is carried out with infinite care as to details (and there are many) the chances of the portacaval shunt remaining patent are practically nil.