

# Hepatofugal Portal Blood Flow in Hepatic Cirrhosis

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A variety of indirect techniques has been claimed to provide evidence of spontaneous reversal of portal blood flow in hepatic cirrhosis but the existence of the phenomenon has been doubted by some who do not accept the validity of the indirect evidence. There are few reports of the demonstration of hepatofugal portal flow by selective hepatic arteriography, which is the only acceptable technique. We report three patients with histologically confirmed cirrhosis in whom hepatofugal portal blood flow was unequivocally demonstrated by arteriography, in whom no surgical portosystemic shunt had been performed and in whom there was no evidence of the Budd-Chiari Syndrome or hepatoma, situations accepted as associated with reversed portal blood flow. Theoretical considerations suggest that shunt surgery for bleeding esophageal varices should not be ruled out on the grounds of hepatofugal portal flow. However, end-to-side portacaval anastomosis and distal splenorenal shunt might predispose to the early redevelopment of esophageal varices when reversed portal flow is present. Side-to-side portacaval and conventional splenorenal shunts might be preferable in having less effect on hepatic parenchymal perfusion than when orthograde portal flow is the case.

**S**PONTANEOUS reversal of portal blood flow has been inferred in some patients with cirrhosis because of pressures recorded on the two sides of a clamp across the portal vein at operation and also because of visualisation of the portal vein on retrograde injection of contrast media via a wedged hepatic vein catheter.<sup>13-17</sup> The importance of such presumptive evidence of reversed flow is that it has been suggested to be useful in the selection of patients for surgery<sup>9,16,17</sup> and that reversed flow is said to affect the morbidity and mortality associated with shunt surgery during acute bleeding.<sup>3</sup> Doubt has been cast, however, on the validity of these and other indirect techniques in providing evidence of reversal of flow and on the very existence of the phenomenon in cirrhosis.<sup>6</sup> Selective hepatic arteriography is the most "physiological" technique for the demonstration of reversed flow in the portal vein and it is surprising that its widespread use has not led to more reports showing that the phenomenon occurs in cirrhosis though it is well demonstrated by this method in patients with the Budd-Chiari Syndrome,<sup>8,11</sup> hepatoma<sup>7</sup> and also after surgical porto-

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systemic shunts, both conventional splenorenal<sup>1</sup> and side-to-side portacaval.<sup>10</sup>

We report three patients with cirrhosis of the liver in whom hepatic arteriography unequivocally demonstrated hepatofugal blood flow in the portal vein.

## Materials and Methods

In a nine year period 94 patients with cirrhosis of the liver underwent hepatic arteriography for a variety of reasons (Table 1). From these, on careful assessment of serial films, three were found to have evidence of reversed portal flow.

Femoral artery puncture under local anesthesia was followed by catheterisation of the common or proper hepatic artery using an F7 polyethylene catheter. After injection of 20-30 ml of Conray 400 over three seconds serial exposures were taken at the rate of two per second for five seconds followed by one every two seconds for ten seconds.

**Case 1.** A 69-year-old alcoholic ex-barmaid with peripheral edema and ascites resistant to diuretics was investigated, after three weeks in hospital, with hepatic arteriography in pursuit of a possible hepatoma.

Hepatic arteriography with injection of 30 ml of Conray 400 showed the cork-screw appearance of hepatic artery branches often seen in cirrhosis. Hepatofugal flow into the portal vein mainstem was clearly shown by serial films, best demonstrated at seven seconds (Fig. 1).

During the course of her seven week admission her condition gradually deteriorated and she died in hepatic coma. Postmortem examination confirmed cirrhosis, but no hepatoma was found. The hepatic veins were shown to be patent. There was no histological evidence of the Budd-Chiari syndrome.

**Case 2.** A 53-year-old unemployed alcoholic who was admitted on several occasions with hepatic encephalopathy was suspected on one of these to have a hepatoma or metastases because of the appearances on liver scintiscan. Hepatic arteriography showed the right lobe to be grossly shrunken; retrograde opacification of the portal vein mainstem occurred at ten seconds after the injection of 25 ml of Conray 400. There was no evidence of tumor (Fig. 2). Three years later he died. Autopsy confirmed cirrhosis with patent

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TABLE 1. Indications for Hepatic Arteriography

| Indications for Hepatic Arteriography     | No. |
|---|-----|
| Acute bleeding from esophageal varices    | 27  |
| Recent bleeding from esophageal varices   | 19  |
| Chronic liver disease; suspected hepatoma | 18  |
| Cirrhosis with intractable ascites        | 15  |
| Reinvestigation after portosystemic shunt | 8   |
| Miscellaneous                             | 7   |
| Total                                     | 94  |

hepatic veins and the histological appearances did not suggest the Budd-Chiari syndrome. There was evidence of terminal small bowel infarction and infected ascites.

**Case 3.** A 19-year-old secretary presented with a two month history of anorexia, weight loss, jaundice and pruritus. She was shown to have esophageal varices. Endoscopic retrograde cholangiography suggested sclerosing cholangitis. Hepatic arteriography was performed to investigate the possibility of cholangiocarcinoma prior to surgery at which liver and common bile duct were biopsied and a T-tube inserted. Histology of the liver showed established cirrhosis with marked cholestasis and of the common bile duct showed densely sclerotic fibrous tissue compatible with sclerosing cholangitis. Neither clinically, at laparotomy or on liver biopsy was there anything to suggest the Budd-Chiari syndrome and she did not have ascites.

Hepatic arteriography showed reversed flow in the portal vein mainstem which was visualised at seven seconds after the injection of 30 ml Conray 400 (Fig. 3). There was no evidence of malignancy. Twelve months later she remained well with the T-tube still in place.

### Discussion

Moreno et al.<sup>6</sup> suggest that there are good physical explanations for the pressure differences recorded between the two sides of a clamp across the portal vein main stem and that such evidence is insufficient to support the conclusion that portal blood flow is reversed in direction. Similarly, retrograde injection into

hepatic veins and intraparenchymal deposition of contrast medium introduce an unphysiological increase in the resistance to orthograde venous inflow and may actually reverse the flow during the course of the injection.<sup>2,10,12</sup>

Selective hepatic arteriography would seem to be the method of choice in the demonstration of spontaneous reversal of portal blood flow, in that it least disturbs normal physiology, but there have been remarkably few well documented reports of such cases.

Of the six cases of Warren et al.<sup>16</sup> there was said to have been hepatic arteriographic evidence of reversed flow in two, though this was photographically documented in one case only and in this patient the diagnosis of cirrhosis was made without liver biopsy. Okuda et al.<sup>7</sup> reported five patients with hepatoma and one with cirrhosis in whom reversed portal flow was well demonstrated. Liver histology in the latter was not mentioned and, on the evidence presented, it would be difficult to exclude the possibility of a Budd-Chiari syndrome. L'Herminé et al.<sup>5</sup> found complete reversal of portal flow in five and partial (intrahepatic) only in ten cirrhotic patients, having excluded the Budd-Chiari syndrome by hepatic venography. In four of the five with reversed flow in the portal vein mainstem, large spontaneous portacaval anastomoses were demonstrated and in one there was a possible hepatoma.

Our three cases provide further evidence that reversed portal flow does occur in uncomplicated and unoperated cirrhosis. Reversal of portal blood flow in cirrhosis means that the resistance to outflow from the liver via the hepatic veins is so great that, despite the portal hypertension, inflow via the portal vein is prevented. Hepatic arterial blood leaves the

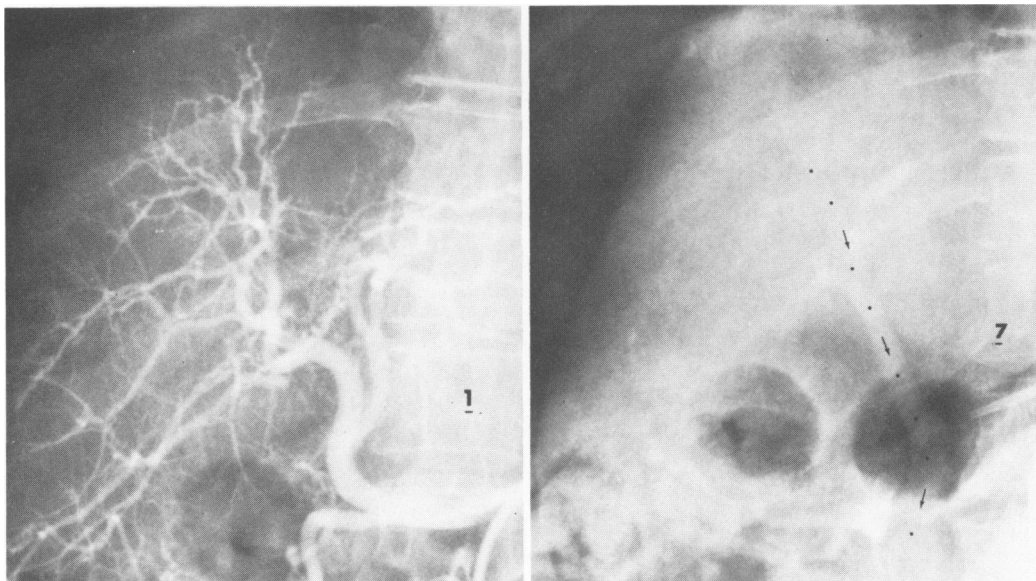


FIG. 1a and b. Case 1. (a, left) One second after injection of contrast. Corkscrew appearance of hepatic arterial branches characteristic of cirrhosis. (b, right) Seven seconds after injection of contrast. Hepatofugal flow into portal vein mainstem (arrowed).

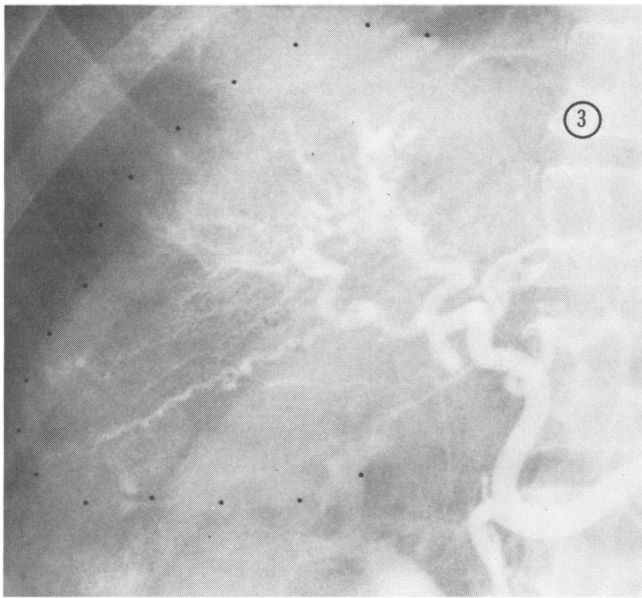


FIG. 2a. Case 2. Three seconds after injection of contrast. Shrunken right lobe with corkscrew arterial branches.

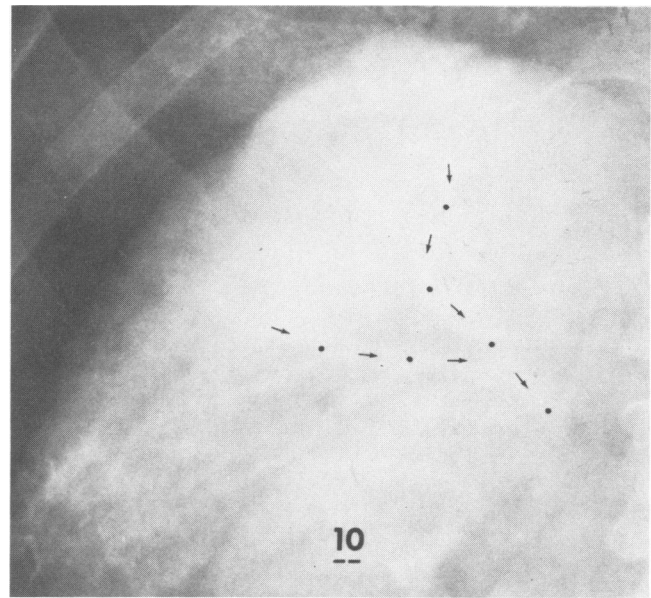


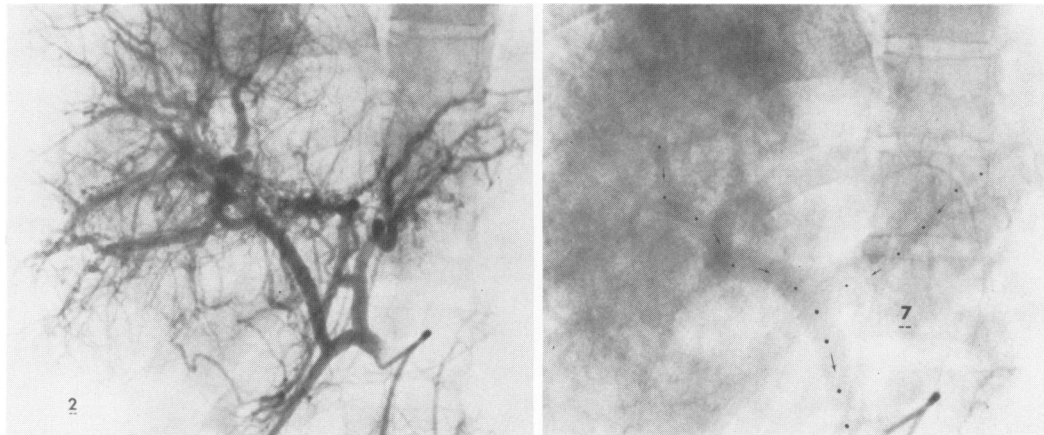
FIG. 2b. Case 2. Ten seconds after injection of contrast. Retrograde flow into portal vein mainstem (arrowed).

liver via the portal system. The likelihood that this state of affairs correlates with an increased risk of the development of encephalopathy during bleeding from varices or after survival from shunt operations is debatable.<sup>3</sup> It is easy to imagine, however, that hepatofugal flow might occur during active bleeding which "decompressed" the portal system when this had not previously been the case; hepatopetal flow might then be re-established when bleeding stopped. None of the three patients reported here was bleeding at the time of arteriography, however, and reversed flow was not demonstrable in any of the 27 cases who were examined during an episode of acute bleeding.

It could be argued that the demonstration of reversed portal flow in cirrhosis in the absence of encephalopathy shows that the hepatic parenchymal cells are tolerating deprivation of portal blood and indicates

that liver blood flow would not be diminished by surgical shunting and thus such operations to prevent further bleeding should not be ruled out. Furthermore it could be argued that the type of shunt chosen might be influenced by the presence of reversed flow. An end-to-side portacaval procedure would leave the hepatic end of the portal vein as a high pressure region favoring the redevelopment of esophageal varices and side to side portacaval and conventional splenorenal shunts might have less effect on hepatic parenchymal perfusion than in patients with orthograde portal flow. The theoretical advantage, in this regard, of the distal splenorenal shunt<sup>18</sup> might be out-weighted when there is hepatofugal flow by the greater likelihood of recurrence of the varices after this form of surgery. When hepatopetal flow is demonstrated, however, this is perhaps the method of choice in the treatment of bleeding

FIGS. 3a and b. Case 3. (a, left) Subtraction films two seconds after injection of contrast. (b, right) Seven seconds after injection of contrast. Subtraction shows reversed flow from right and left lobes into portal vein mainstem (arrowed).



esophageal varices.<sup>4</sup> These theoretical considerations would, however, need to be tested by empirical observation.

Three patients with cirrhosis were demonstrated to have spontaneous reversal of portal blood flow on hepatic arteriography. It is suggested that such a finding may not necessarily indicate a poor prognosis in the event of bleeding from esophageal varices, that such patients should not be debarred from shunt operations on this ground alone, but that the choice of operation may be influenced by this finding.

### References

1. Boijssen, E. and Ekman, C. A.: Angiography in Portal Hypertension. *J. Cardivasc. Surg.*, 6:3, 1965.
2. Burchell, A. R., Moreno, A. H., Panke, W. F. and Rousselot, L. M.: Some Limitations of Splenic Portography. I. Incidence, Hemodynamics and Surgical Implications, of the Non-visualised Portal Vein. *Ann. Surg.*, 162:981, 1965.
3. Charters, A. C., Chandler, J. G., Condon, J. K., et al.: Spontaneous Reversal of Portal Flow in Patients with Bleeding Varices Treated by Emergency Portacaval Shunt. *Am. J. Surg.*, 127:25, 1974.
4. Galambos, J. T., Warren, W. D., Rudman, D. et al.: Selective and Total Shunts in the Treatment of Bleeding Varices—A Randomised Controlled Trial. *N. Engl. J. Med.*, 295:1089, 1976.
5. L'Herminé, C., Paris, J. C., Villoutreix, H. et al.: L'Inversion Spontanée du Courant Porte Intra-hépatique au cours des Cirrhoses. Etude Angiographique de 15 Observations. *J. Radiol. Electrol. Med. Nucl.*, 56:491, 1975.
6. Moreno, A. H., Burchell, A. R., Reddy, R. V., et al.: Spontaneous Reversal of Portal Blood Flow: The Case For and Against Its Occurrence in Patients with Cirrhosis of the Liver. *Ann. Surg.*, 181:346, 1975.
7. Okuda, K., Moriyama, M., Yasumoto, M., et al.: Roentgenologic Demonstration of Spontaneous Reversal of Portal Blood Flow in Cirrhosis and Primary Carcinoma of the Liver. *Radiology*, 119:419, 1973.
8. Pollard, J. J., and Nebesar, R. A.: Altered Hemodynamics of the Budd-Chiari Syndrome Demonstrated by Selective Hepatic and Selective Splenic Angiography. *Radiology*, 89: 236, 1967.
9. Price, J. B., Voorhees, A. G. and Britton, R. C.: Operative Hemodynamic Studies in Portal Hypertension. Significance and Limitations. *Arch. Surg.*, 95:843, 1967.
10. Rousselot, L. M. and Burchell, A. R.: Splenic and arterial portography and hemodynamics in portal hypertension. *In Schiff, L. (ed.), Diseases of the Liver. 4th edition. Philadelphia, J. B. Lippincott, 1974.*
11. Ruzicka, F. F. and Rossi, P.: Arterial Portography: Patterns of Venous Flow. *Radiology*, 92:777, 1969.
12. Smith, G. W.: An Assessment of Validity of Pre-operative Hemodynamic Studies in Portal Hypertension. *Surgery*, 74: 130, 1973.
13. Viamonte, M., Warren, W. D., Fomon, J. J. and Martinez, L. O.: Angiographic Investigations in Portal Hypertension. *Surg. Gynecol. Obstet.*, 128:37, 1970.
14. Warren, W. D. and Muller, W. H.: A Clarification of Some Hemodynamic Changes in Cirrhosis and their Surgical Significance. *Ann. Surg.*, 150:413, 1959.
15. Warren, W. D., Fomon, J. J., Viamonte, M. and Zeppa, R.: The Pre-operative Assessment of Portal Hypertension. *Ann. Surg.*, 165:999, 1967.
16. Warren, W. D., Fomon, J. J., Viamonte, M. et al.: Spontaneous Reversal of Portal Venous Blood Flow in Cirrhosis. *Surg. Gynecol. Obstet.*, 126:315, 1968.
17. Warren, W. D., Restrepo, J. E., Respass, J. C. and Muller, W. H.: The Importance of Hemodynamic Studies in Management of Portal Hypertension. *Ann. Surg.*, 158:387, 1963.
18. Warren, W. D., Zeppa, R. and Fomon, J. J.: Selective Trans-splenic Decompression of Gastroesophageal Varices by Distal Spleno-renal Shunt. *Ann. Surg.* 166:437, 1967.