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PORTAL AND SPLENIC VENOGRAPHY

BY

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[WITH SPECIAL PLATE]

Radiological demonstration of the portal vein is a useful investigation which materially assists in the surgical treatment of portal hypertension. Its purpose is to demonstrate the presence and nature of the main channels in the portal tree, especially the portal vein itself. Accuracy is essential, otherwise it will be misleading. Two methods of obtaining portal venograms are commonly practised. In the first, which may be referred to as splenic venography, 20–30 ml. of 70% diodone is injected into the substance of the spleen itself. In the second the dye is injected into a radicle of the portal vein after the abdomen has been opened. Both methods have their advantages and disadvantages, but neither can be depended upon to demonstrate more than half the portal tree. Much has been written on the subject recently; most articles stressing the value of one or other method. It is our purpose in this brief communication to emphasize that both are sometimes necessary in order that the portal vein may be completely delineated.

Splenic Venography

Splenic venography is carried out as a diagnostic method or as a preliminary to operation (Abeatici and Campi, 1951; Dreyer and Budtz-Olsen, 1952; Walker *et al.*, 1953; Atkinson *et al.*, 1955). It is performed under local analgesia or general anaesthesia, and provides information which may be a valuable guide to the nature of the disease process and to the type of operation required in the particular case. Discomfort is minimal if the injection is well conducted in a suitable patient. Unfortunately splenic injection is by no means foolproof, for the following reasons. It is difficult to inject the diodone accurately into a spleen which is not grossly enlarged. It is unsafe to puncture a spleen when the clotting power of the blood is reduced by a deficiency either of platelets or of prothrombin. Sometimes the spleen can be damaged with consequent haemorrhage, and a few deaths have occurred as a result of this accident (see, for example,

Gvozdanovic *et al.*, 1953; Reynolds *et al.*, 1955). We have often noticed a material perisplenic haematoma at laparotomy following splenic injection (see Cooper *et al.*, 1953). For some patients the investigation, when carried out under local analgesia, is an ordeal and should therefore be avoided. Lastly, venography by the splenic route is out of the question for patients whose spleen has been removed. We have had experience of 20 such "post-splenectomy bleeders."

Portal Venography

When the above contraindications to splenic venography apply to patients who have been selected for surgical treatment, the portal vein can be demonstrated only by the direct method. Apart from thus regarding it as an alternative technique, direct portal venography is applicable to all patients undergoing abdominal exploration for portal hypertension and allied diseases. It is the older and more elastic method, in that any suitable radicle of the portal vein can be used (Blakemore and Lord, 1945; de Sousa-Pereira *et al.*, 1949; Santy and Marion, 1951). It is far more certain to provide an accurate picture of the anatomy of the portal vein (Special Plate, Figs. 2 and 4), whether this vein is normal or not. A negative finding on splenic venography may mean nothing (Plate, Fig. 3), whereas such a finding on portal venography is proof that no portal vein exists. When this is the case the splenic vein is often delineated. It is not so important to show the splenic vein when a large and normal portal vein is present, because we usually prefer to use the portal vein for shunt operations. Portal venography is the safer method.

When it is our intention to demonstrate the trunk of the portal vein we use a jejunal vein for the injection. On other occasions we have used the left gastro-epiploic, left gastric, or even a branch of the splenic vein itself. The simplicity, speed, and safety of the method have recommended it to us (du Boulay and Green, 1954; Kemp Harper, 1955). However, it has two great disadvantages—it cannot be used until the abdomen has been opened and it does not usually demonstrate the splenic vein. It is less likely to show up the anastomotic vessels draining blood from the spleen. Lastly, an x-ray apparatus of high output is not usually available in the operating theatre, so that the number of serial radiographs of good quality which can be obtained from one injection is limited. When splenic venography is done in a department of diagnostic radiology, however, this limitation is less likely to apply.

In discussing the two methods, the haemodynamics of the blood flow must be considered in addition to details of technique.

"Streamlining" and Diversion of Portal Blood

Radio-opaque solutions injected into the spleen will delineate only vessels or parts of vessels which drain off splenic blood. It has been recognized for very many years that "streamlining" is a phenomenon commonly encountered in the portal vein (McIndoe and Counseller, 1927; Helps and McDonald, 1954). It has often been suggested that in some animals blood coming from the spleen and inferior mesenteric vein travels more to the left lobe of the liver than to the right, while blood from the right colon and small intestine travels to the right lobe of the liver. We have on many occasions been able to demonstrate "streamlining" in the portal vein giving preferential supply to the right lobe of the liver, but good filling of the left lobe of the liver from splenic injection has not often been an outstanding feature. Sometimes "streamlining" has prevented diodone from fully delineating the portal vein, and has thus given a false picture easy to confuse with partial thrombosis (Hunt, 1956).

When intra- or extra-hepatic obstruction is present, blood is diverted through other channels into the systemic circulation. Blood from the spleen and from the stomach seems to be the first to be side-tracked up oesophageal varices or back through the veins of Retzius into the retropancreatic, paracolic, and para-splenic veins. The diaphragmatic veins may also play a large part in this diversion of portal blood.

On three occasions recently diodone injected into the spleen has failed to reach a normally patent portal vein, having been totally diverted. (For an example see Special Plate, Fig. 3.) In such circumstances it is possible to build up a picture of the portal tree only by using both methods one after the other as required, thereby filling the complementary parts of the portal system.

Serial Radiography

In all methods of angiography in which radio-opaque material is injected into a flowing stream of blood an accurate representation is more likely to be obtained by multiplicity of pictures—the method of serial radiography. The greater the number of exposures made—that is, the more cinematographic the technique—the more complete will be the picture of the system being investigated. In the portal tree, however, multiplying photographs is not going to alter “streamlining” or diversion of portal blood along adventitious channels. Leger (1955) attempts to circumvent the misrepresentation due to these causes by the injection of a large quantity of contrast medium and the taking of many serial films, but even he illustrates a case in which this method failed to prevent a misdiagnosis of portal thrombosis.

Combined Splenic and Portal Venography

Our own experience of portal venography dates back to early 1949. In every case of portal hypertension that has been operated upon since that date the portal tree has been investigated radiologically. Other cases of splenic disease have been similarly investigated. We have used the method as a technical aid to operation rather than as a diagnostic procedure. Altogether we have more than 40 percutaneous splenic venograms and nearly 150 portal venograms available for study. On about 15 occasions both methods were carried out. We have arrived emphatically at the conclusion that in certain cases a combination of the two methods is the best way of obtaining accurate information (Rousselot, 1953).

The decision whether or not to operate is arrived at on clinical, biochemical, and radiological assessment. The patient is anesthetized and placed on the operating table in such a position that venograms can be obtained by both methods. The patient's arms are folded across the upper chest and fixed so that they do not interfere with the operation or with serial radiography (Hunt *et al.*, 1956). The skin over the spleen is sterilized and 20–30 ml. of 70% diodone is injected directly into the spleen by the most convenient route (proportionately smaller quantities are used for children). If the spleen is very large, this is usually done through the abdominal wall; if not very large, through a convenient intercostal space. The anaesthetist maintains absolute apnoea during the course of the investigation, so that damage to the spleen is minimal and there is no risk of capsular tear. The films are developed during the next few minutes while the field of operation is being sterilized and the final arrangements for operation made. They are thus available in time to guide the surgeon in placing the incision. Sometimes the portal vein is clearly demonstrated and there is no need for further radiological investigation. If the portal vein is indistinct or appears to be absent, portal venography is performed after the abdomen has been opened. We use a standard mobile x-ray apparatus and take two pictures, one at the exact finish of the injection of diodone and another 1½ seconds later (du Boulay and Green, 1954). In addition, we usually estimate the speed of flow in the portal or the splenic vein, using the method described by Hunt (1954), and this sometimes provides information of great value.

The dual approach to the radiological demonstration of the portal tree, when it has been possible, has not so far failed us. To illustrate our thesis we have selected the radiographs obtained in two patients with cirrhosis of the liver who were operated upon for massive recurrent haematemesis from oesophageal and gastric varices. The splenic venogram in Case 1 (Special Plate, Fig. 1), shows a well-filled splenic vein and diversion of splenic blood up the left gastric vein. The portal vein and its main branches is no more than out-

lined by the diodone—a good example of laminar flow which could easily be mistaken for thrombosis. The portal venogram (Plate, Fig. 2), on the other hand, demonstrates that the portal vein is normal and suitable for porta-caval anastomosis, which was duly constructed without difficulty. In the splenic venogram from Case 2 (Plate, Fig. 3), the dye can be seen to have been injected well into the substance of the spleen. There is no real splenic vein, but there are two large channels draining the blood into an enormous mass of gastric varices. Fig. 3 B shows that this blood percolates away from these varices into retropancreatic channels which communicate with the inferior vena cava, which is distinctly though faintly shown. Drainage of the portal into the systemic system can thus be seen, and yet the patient suffered from massive haemorrhages. It was evident that all splenic and much gastric blood was being diverted away from the portal vein, and that further venography would be necessary once the abdomen had been opened. In Fig. 4 of the Special Plate are reproduced the pictures obtained by portal venography. Traces of the dye from the splenic injection still remain within the spleen. The portal vein is beautifully shown together with the left gastric vein draining blood back into the same mass of varices as demonstrated by splenic venography. On studying the four radiographs it was adjudged that the oesophageal and gastric varices would be most directly decompressed if a porta-caval anastomosis could be successfully constructed. This was therefore done, and the patient has had no further haemorrhage.

For some years we have considered a natural development of the double method by connecting splenic and jejunal needles to a single syringe containing the diodone and obtaining venograms by both methods simultaneously. Unfortunately it is complicated and time-consuming, and adds to the risks of technical fault in that it is necessary to watch two needle-points instead of one. We therefore prefer the simpler methods as described above.

Summary and Conclusions

Radiological demonstration of the portal tree is a valuable method of investigation. It can be achieved by the injection of contrast medium into one or other, or both, of the two main radicles of the system: into the spleen to delineate the flow of splenic blood, which may be partially or completely diverted from the portal vein; or into a jejunal vein to delineate the flow of mesenteric blood to the portal vein itself. The former may be carried out pre-operatively, the latter must be done at operation. It is often essential to perform both before a composite and complete picture of the portal blood flow can be obtained. The laminar flow of blood in such veins may also give rise to deceptive appearances which should be guarded against by using both methods.

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FIG. 1.—Case 1 (cirrhosis). Splenic venogram. (Cf. Fig. 2.) A. Diversion of most of diodone up through gastric and oesophageal varices, with portal vein outlined but not filled. B. $1\frac{1}{2}$ seconds later; shows only one side of portal vein—an example of stream-lining. (Gall-stones also present.)

FIG. 2.—Case 1 (cirrhosis). Double portal venogram complementary to Fig. 1 (diodone of splenic venogram showing as pyelogram). Well-filled portal vein and less diversion; splenic vein not filled.

FIG. 3.—Case 2 (cirrhosis). Splenic venography by injecting 20 ml. 70% diodone into substance of spleen percutaneously before operation. All dye is being diverted by way of large cluster of gastric varices into retroperitoneal veins which drain into inferior vena cava.

FIG. 4.—Case 2 (cirrhosis). Portal venography on same patient as Fig. 3, after abdomen opened, by injecting 25 ml. diodone into radicle of jejunal vein. Almost all dye, admixed with blood in superior mesenteric vein, passes either to liver via a normal portal vein or to same clump of gastric varices by way of enlarged left gastric vein.