TRANSJUGULAR APPROACH TO THE LIVER, BILIARY SYSTEM, AND PORTAL CIRCULATION*

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ABSTRACT:

More than five years of clinical and animal experience with the use of a transjugular approach to the liver, biliary system, and portal circulation is reviewed. It has been of clinical value in connection with hepatic manometry and venography, liver biopsy, and cholangiography. Satisfactory hepatic manometry and venography were achieved by the transjugular approach in all 47 cases where attempted; diagnostic liver specimens were obtained in 71 of 83 patients (86 percent); and cholangiography was successful in 48 of 52 patients with enlarged intrahepatic ducts (92 percent). No complications occurred with these studies. In animals, transjugular catheterization was used as a means for portal, mesenteric, and pancreatic venography. These procedures are ready for diagnostic clinical use. Therapeutic techniques explored in animals include intravascular tamponade of gastric coronary vein and the nonsurgical creation of intrahepatic portacaval shunts, both of promise in the future management of massive gastrointestinal bleeding from varices.

IN the transjugular (transvenous) approach, a catheter needle system introduced *via* the jugular vein is advanced through the right atrium into a hepatic vein. The catheter or the needle, or both, are then used for various diagnostic or therapeutic procedures relating to the liver, biliary system, and portal circulation (Fig. 1). The transjugular approach was introduced by Hanafee and Weiner[5,19] for cholangiography, and its clinical use was further extended to include liver biopsy,[10] dilatation of a biliary stricture,[6] and hepatic manometry and venography.[13] In animal experiments, it has been used for portal venography,[8] mesenteric venography,[4] pancreatic venography,[11] intravascular tamponade of the gastric coronary vein,[12] and the nonoperative creation of an intrahepatic portacaval shunt.[8,9] This review is based on our over five years of clinical and investigative experience with this approach and its applications.

TECHNIQUE

Procedures are performed in a roentgenologic suite equipped for television monitored fluoroscopy, serial filming, and EKG monitoring. A commercially available transjugular catheter needle set* includes a 45 cm long radiopaque Teflon catheter (3 mm o.d., 2.08 mm i.d.) and a 50 cm long needle (1.83 mm o.d., 1.40 mm i.d.). Both have slightly curved tips.

Clinical procedures are done using local anesthesia. A combination of sedatives (secobarbital, meperidine hydrochloride, or both) and atropine is used for premedication. For cholangiography, prophylactic antibiotics (usually 500 mg ampicillin by mouth four times daily) are also given for a day before and one or two days following the examination. An internal jugular vein, preferably the right, is used for catheter insertion in patients. The skin puncture site

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is high on the neck, 3–4 cm below the angle of the mandible.

Animal studies are done under general anesthesia and the right external jugular vein, exposed by cut-down, is used for catheter introduction.

The catheter is usually introduced over a guidewire into the right hepatic vein, although any major vein of the right or left lobe can be catheterized. Subsequent steps of the examination depend on the procedure(s) to be done; often several are performed at the same session.

HEPATIC MANOMETRY AND VENOGRAPHY

We consider the transjugular approach for hepatic manometry and venography as complementary to the transfemoral route. We use it in cases where a transfemoral approach is either technically not feasible or contraindicated by femoropelvic thrombosis, inferior vena caval anomaly, or obstruction. We also use it in patients where hepatic studies include simultaneous liver biopsy.

Hepatic manometry and venography are used to evaluate patients possibly having Budd-Chiari syndrome and even more often to assess cirrhotic patients being considered for portal decompressive surgery. Both manometry and venography are done with the catheter in a free and a wedged position. Free hepatic venography helps assess the stage and severity of the cirrhotic process[1,3,14] (Fig. 2*A*); wedged hepatic venography helps clarify hepatoportal hemodynamics and thereby aids in selecting the appropriate type of shunt[16,17] (Fig. 2*B*). The measurement of wedged and free hepatic pressures and those in the inferior vena cava and right atrium permits the diagnosis of portal hypertension as well as an assessment of its type and degree.[16,17]

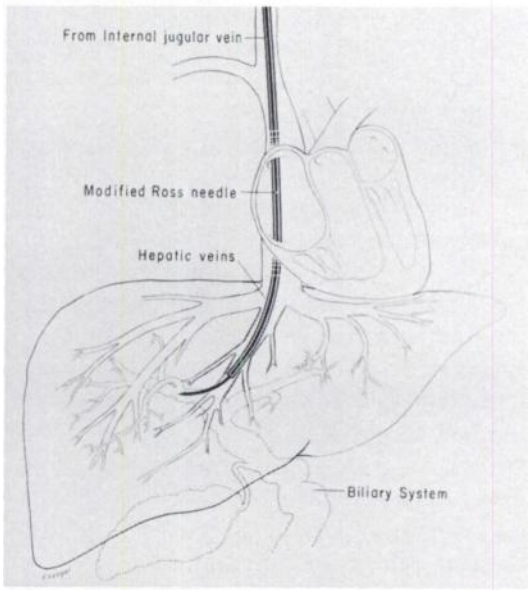

Fig. 1. Schematic drawing of the transjugular approach for cholangiography.

A wedged position of the catheter tip is easily achieved, using the transjugular approach. We occasionally introduce a smaller catheter of 1.8 mm o.d. through the Teflon catheter to extend its reach into small peripheral hepatic veins. Satisfactory hepatic manometry and venography were achieved by the transjugular approach in all 47 cases where attempted.

LIVER BIOPSY

We consider transjugular liver biopsy as complementary to the ordinary transperitoneal technique.[10] It is of particular value in patients with hemocoagulation defects, high grade obstructive jaundice, or in major ascites, where the transperitoneal route is unduly hazardous or contraindicated. Our biopsies are done under fluoroscopic control, employing suction from a syringe attached to the needle. In such cases, the catheter stays in the hepatic vein; only the needle punctures the liver parenchyma. It is usually advanced laterally about 2–4 cm into the parenchyma; several biopsies may be done in various directions from different veins. A crucial point in this technique is limiting suction to the time when the needle is in the liver parenchyma and thus keeping the obtained specimen in the needle. Undesired suction of the specimen into the syringe often results in tissue destruction.

In our series of 83 patients subjected to attempted liver biopsy by the transjugular approach, satisfactory specimens were ob-

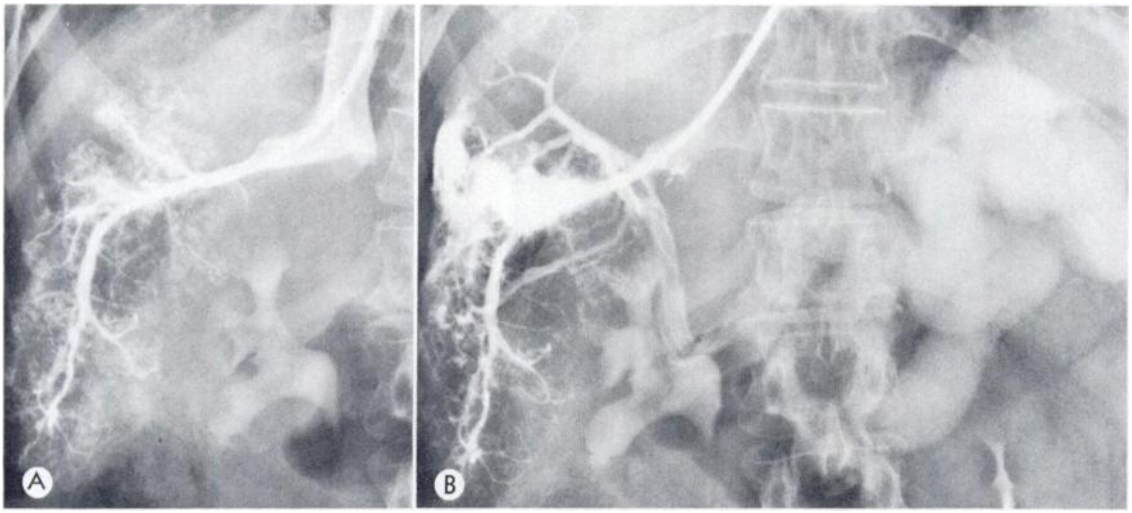

FIG. 2. Hepatic venography performed by the transjugular approach in a 53 year old man with advanced cirrhosis and large gastroesophageal varices. (*A*) Free hepatic venography shows advanced deformity of the hepatic venous system with irregular parenchymal filling. (*B*) Wedged hepatic venography visualizes the portal vein and large gastric varices by retrograde flow.

tained in 71 patients (86 percent). Specimens were usually 3–10 mm long and 1–1.2 mm in diameter (Fig. 3). Biopsy failures in 12 patients were due to failure to enter the internal jugular vein (one patient), to introduce the needle into hepatic veins which joined the inferior vena cava at an unusually sharp angle (one patient), to puncture a hard cirrhotic liver (two patients), and to obtain adequate material (eight patients). We have had no complications associated with liver biopsy.

CHOLANGIOGRAPHY

We consider transjugular cholangiography complementary to endoscopic retrograde cholangiography.[5,10,19] We use it in patients with obstructive jaundice, where the latter approach fails or gives insufficient information. In our hands, transjugular cholangiography has replaced the transperitoneal technique. Safety is one of the important reasons; the transjugular approach can be used even in patients with bleeding diathesis and ascites. Acute suppurative cholangitis is the principal contraindication.

FIG. 3. Liver biopsy performed by the transjugular approach in a 48 year old man with liver metastases from a pancreatic carcinoma.

In the conduct of this procedure, the catheter again stays in the hepatic vein and only the needle traverses the liver to enter the biliary system. Puncture is done under fluoroscopy, usually toward the hilum so as to favor entry into a major intrahepatic bile duct. Knowledge of the size and shape of the liver such as can be gained through prior angiography promotes the safety and success of this technique. Following puncture, the position of the needle is checked by a small test injection of contrast medium. After entry into a biliary duct has been effected, bile is aspirated and sufficient contrast medium injected to fill the entire ductal system. The needle is then withdrawn back into the catheter, which remains in the hepatic vein. Films are exposed during injection of contrast medium and after needle withdrawal.

Satisfactory visualization of the biliary system in our series of 76 patients was re-

lated to the size of intrahepatic ducts. Enlarged ducts were entered and visualized in 48 of 52 patients (92 percent) (Fig. 4). With normal ducts, a satisfactory study was obtained in only two of 24 patients (eight percent). We encountered no complications requiring surgery. At the time of elective surgery in 43 patients, neither blood nor bile was found in the abdominal cavity. In two of these patients, operated on one day after the study, some blood was found in the biliary system. Two patients had minor transient febrile reactions three to five hours after the study.

PORTAL VENOGRAPHY

Portal venography by the transjugular approach has been widely explored in animals and is ready for clinical use. Here, also, the intrahepatic portal circulation is entered by needle puncture from a hepatic vein. In dogs, the usual experimental subjects, the left portal branch provides the best puncture target because of its close relation to the intermediate hepatic vein and its straight course in line with that of the introduced catheter. Following puncture, a guidewire is introduced through the needle into the portal circulation and, thereafter, a Teflon catheter. With the needle and guidewire out, the catheter can be used for venography of any major trunk of the portal circulation. Excellent visualization of the portal vein, its intrahepatic portal branches, and its splenic and mesenteric tributaries is usually possible.[8] For the detailed study of peripheral mesenteric branches, a double-lumen balloon catheter can be introduced. After its inflation in the proximal superior mesenteric vein, the injection of contrast medium through the second lumen beyond the balloon provides detailed visualization of the mesenteric venous bed.[4] Selective filling of individual peripheral portal tributaries is easily ob-

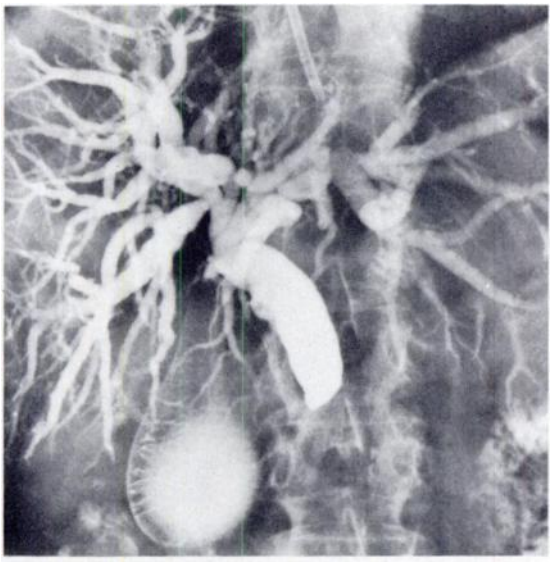

Fig. 4. Transjugular cholangiogram in a 63 year old woman with pancreatic carcinoma causing subtotal obstruction of the distal common bile duct.

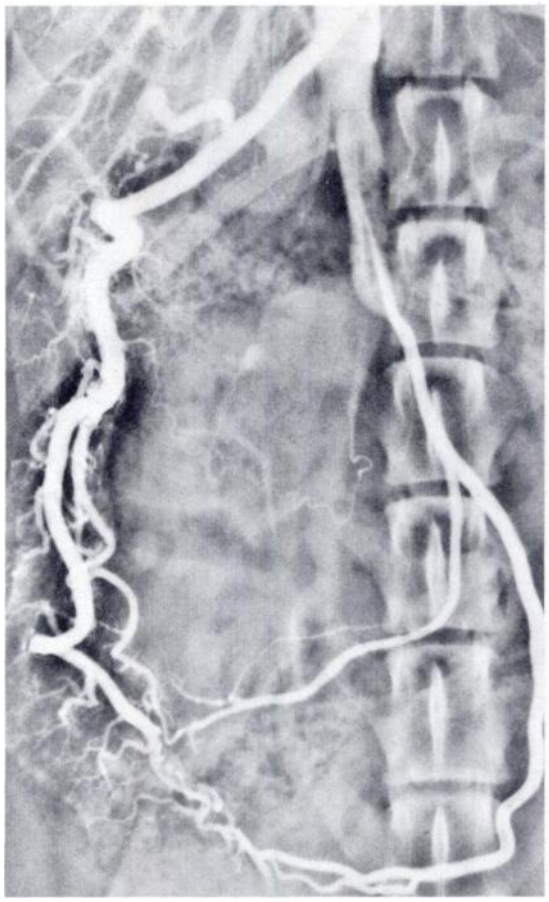

Fig. 5. Selective retrograde pancreaticoduodenal venogram performed in a dog by the transjugular approach with good visualization of duodenal and pancreatic veins.

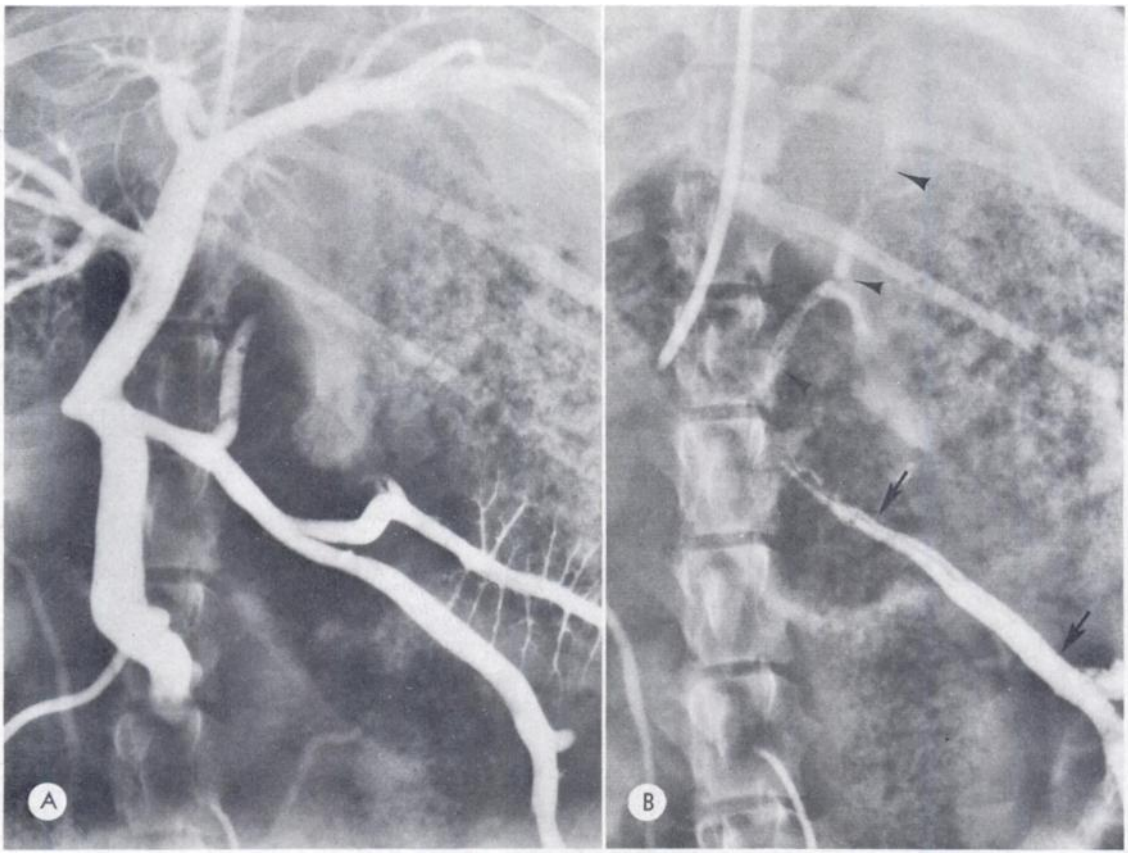

FIG. 6. Isobutyl 2-cyanoacrylate "cast" occlusion of the left gastric and splenic veins in a dog by the transjugular approach. (*A*) Control retrograde portal venogram. (*B*) Plain abdominal roentgenogram after venous occlusion reveals opaque isobutyl 2-cyanoacrylate "cast plugs" in the left gastric (arrowheads) and splenic veins (arrows).

tained with a small catheter coaxially introduced through the Teflon catheter, a technique permitting selective retrograde pancreatic venography[11] (Fig. 5).

INTRAVASCULAR TAMPONADE OF THE GASTRIC CORONARY VEIN

Transportal tamponade of the gastric coronary vein using a transjugular approach has been developed in dogs as a method of promise for the emergency, nonoperative management of bleeding from gastroesophageal varices.[12] Portal entry that was used for venography and a coaxially introduced catheter were used to catheterize the gastric coronary vein. Temporary intravascular tamponade of the gastric coronary vein was achieved, using various types of balloon catheters. The injection of a rapidly polymerizing tissue adhesive, isobutyl 2-cyanoacrylate, enabled its prompt, selective, and definitive obliteration. Polymer casts were used to obliterate long segments of large veins such as the splenic (Fig. 6).

INTRAHEPATIC PORTACAVAL SHUNT

A method for the nonoperative creation of intrahepatic portacaval shunts has been explored in normal dogs.[8,9] Following transjugular entry into the portal circulation, the transhepatic puncture tract in the liver was dilated to a diameter of 6 mm by a system of coaxial dilating catheters, similar to that used for angioplasty of arteriosclerotic obstructions.[4] A short length of tubing was then slipped over the catheters and left in place in the liver, to form a

sleeve graft connecting the portal and inferior caval veins. Such shunts have stayed open for six to twelve days (Fig. 7). After percutaneous retrieval of the shunt which was in place for less than five days, the fistulous tract closed rapidly. In animals in which the shunt was in place for two weeks, a portacaval fistula persisted for 24 to 48 hours.

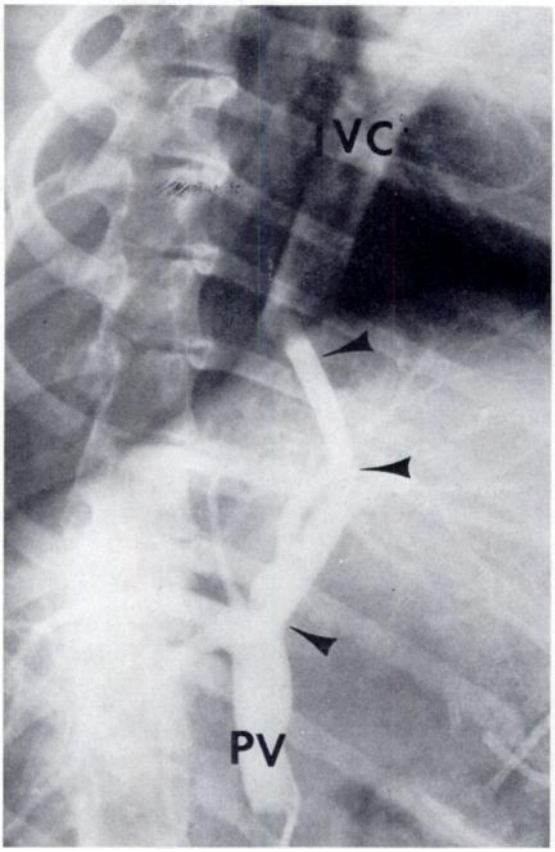

Fig. 7. Portal venogram in a dog with an intrahepatic portacaval shunt created by the transjugular approach. A short tubing (arrowheads) drains part of flow from the portal vein (PV) into the inferior vena cava (IVC).

DISCUSSION

The transjugular approach to liver parenchyma, bile ducts, and the portal circulation involves somewhat elaborate techniques; however, it has considerable diagnostic and therapeutic potential. Skilled professional and technical personnel experienced in angiographic techniques are essential, as are specially equipped roentgenologic facilities. Among its advantages are safety and the opportunity of achieving several diagnostic and therapeutic objectives through a single procedure. Since transperitoneal passage and puncture of the liver capsule are eliminated, cholangiography and liver biopsy can be done even in patients with hemocoagulation defects, ascites, or high grade obstructive jaundice without risk of hemoperitoneum or bile peritonitis. Combined studies such as cholangiography and liver biopsy or manometric and venographic examinations with liver biopsy give complex information about hepatobiliary diseases and their secondary hemodynamic changes, thereby favoring an informed decision as to the need for and type of surgery.

Diagnostic and therapeutic procedures explored in animal experiments are now ready for use in selected patients. Portal venography can help in the preoperative work-up of patients undergoing decompression surgery or in the evaluation of operability in hepatic or pancreatic tumors, where simpler procedures fail to give sufficient information. Pancreatic venography can help in the early diagnosis of pancreatic carcinoma. Portal catheterization also offers an important clinical and research tool for collecting venous blood samples from individual portal tributaries for various laboratory studies.

The application of intravascular tamponade to gastroesophageal varices and the creation of intrahepatic portacaval shunts may be of therapeutic value in otherwise unmanageable massive gastrointestinal bleeding from varices. The transperitoneal transhepatic route has already been used to control such bleeding by obliteration of varices.[7,18] We consider the transjugular, transvenous route preferable to the transperitoneal because of greater safety and the opportunity to effect portal decompression by an intrahepatic portacaval shunt. However, before the sleeve shunt technique explored in animals becomes clinically applicable, more research

will be needed, especially in achieving continuing shunt patency. Research should also be directed to other possible means for transhepatic shunting such as the creation of a direct portovenous fistula by simple dilatation of the transhepatic puncture tract (which might remain patent in the cirrhotic liver with portal hypertension), or the formation of a neovascular lumen around a temporary shunt, techniques which have been successfully applied in the clinical management of arteriosclerotic obstructions.[2,15]

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