A New Method for Portal Venography: Retrograde Hepatic Flushing.* (26395)

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Portal venographic studies have shown characteristic changes demonstrable in a variety of disease states and have been of great value in preoperative evaluation of patients undergoing portal surgery. All current methods of portal venography in the intact patient require either needle puncture of the spleen or liver, or laparotomy and exposure of branches of the portal system. Many authors, among them Cooper *et al.*(1), have cautioned that splenic injections are not without danger, and that they would hesitate to perform the procedure on any patient who could not tolerate splenectomy.

Suggestion of a new method of portal venography. It was proposed in this study to modify the methods of hepatic venography to enable visualization of the portal venous system. The first report on hepatic venography concerned work done in dogs in which 20 ml of dye was injected into hepatic veins(2). A balloon tip catheter was used, and it was reported that the entire hepatic venous system was filled through anastomotic channels, following injection into occluded right hepatic veins. Study of injection-corrosion casts of normal dog livers failed to reveal any such anastomotic channels. Comparison of the casts of dog livers (Fig. 1) and of known portal venograms in dogs with the photograph presented in the report suggested that the venous system demonstrated was not that of the hepatic veins but was that of the portal veins. It was thought that perhaps the force of injection of 20 ml of dye into an occluded hepatic branch was sufficient to overcome the intrasinusoidal pressure and thus resulted in filling of the portal venous system in a retrograde manner. A review of the later literature on hepatic venography revealed that Celis *et al.*(3) could not demonstrate the anastomotic channels previously reported. They did find filling of vessels, however, which were postulated to be small branches of the hepatic artery or portal vein filled against blood flow. Servello(4) noted briefly that among the "snags to be avoided" in hepatic venography was placement of the catheter too far peripherally, which resulted in filling of portal branches.

Method. Ten adult, mongrel dogs (10-25 kg) were used in this study. A No. 9 Cournand catheter was introduced into the exposed external jugular vein of an anesthetized dog (sodium ethyl barbituate (Nembutal); 30 mg/kg) and was guided into the hepatic veins under fluoroscopic control. The catheter was wedged into position peripherally and then pulled free about one cm. The position of the catheter was confirmed in some cases by a check of the free and wedged pressures. A rapid injection of 20 ml of 50% diatrizoate (Hypaque) was made. Serial x-rays were obtained using an automatic cassette changer and time of exposure was noted on the films by use of an automatic timer.

In certain cases portal venograms were obtained by operative exposure and cannulation of branches of the splenic veins, or by direct puncture of the portal vein. The latter procedure was possible in dogs in which a modification of the London cannula had been placed around the portal vein.

Dogs were sacrificed at intervals of less than one hour to 12 days after the injections. Autopsy was performed and sections of the liver obtained for histologic study. Injection-corrosion casts were made by the method of Hales *et al.*(5) in some cases.

Results. Study of a series of casts of the dog liver showed that the right lateral lobes received the first branch of the main portal

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FIG. 1. Cast of normal dog liver, portal and hepatic veins. Note modified London cannula in position on main portal vein and the branching pattern of the portal system. (#34)

vein. It was thought that retrograde injections of these lobes would cause the dye to flow into the main portal system and then be carried to the rest of the liver. Successful catheterization of the hepatic veins was accomplished in every case. It was noted that it was easier to gain access to the right sided hepatic veins, and that as predicted, the venograms obtained when the right lateral lobes were injected did fill the whole of the portal system. Retrograde injections through the veins of the left side of the liver resulted in less filling of the portal system. Serial films showed an initial phase of hepatic venous filling (Fig. 2a) followed by a phase of sinusoidal filling (Fig. 2b) and finally a phase of retrograde filling of the portal system of the rest of the liver (Fig. 2c). The entire portal system of the liver was well visualized save the portion of the lobe injected in which the sinusoidal filling obscured the portal channels. The dye was rapidly flushed away from site of injection and the rest of the portal system.

The portal venograms obtained by splenic vein catheterization and by direct portal vein puncture confirmed that the vessels demonstrated were indeed portal veins. Additional confirmation was obtained by comparison of the films with the injection-corrosion casts (Fig. 3).

The effects of this procedure upon the liver were limited to small wedge-shaped regions at site of injection. Acutely, on occasion, small paravenous hemorrhages were noted, followed by leucocytic infiltration, coagulation necrosis, focal atrophy, and finally fibrosis. Total volume of liver tissue involved was considered to be equivalent to that lost

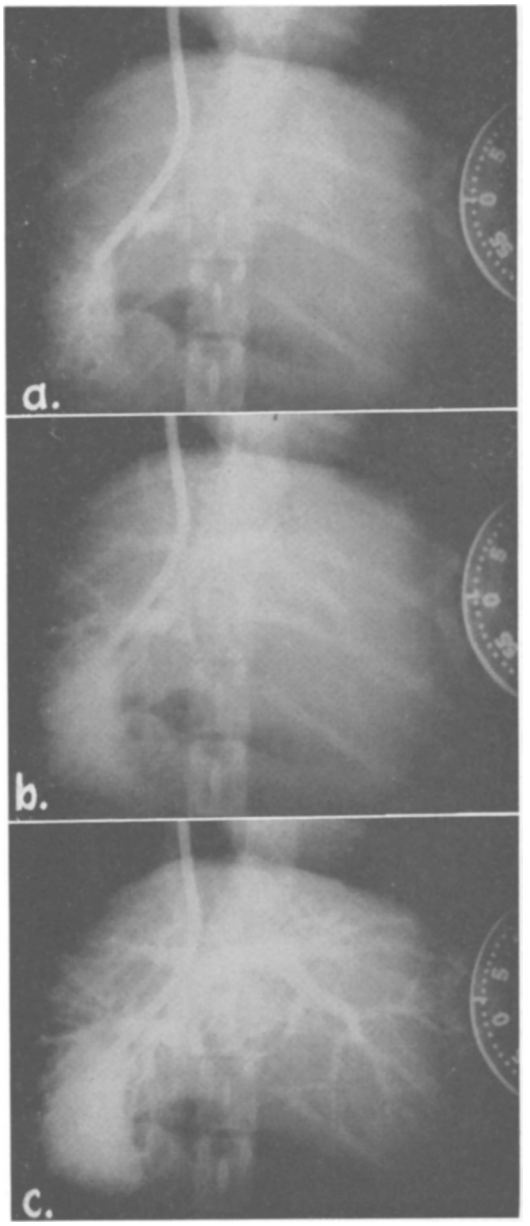

FIG. 2 a, b, c. Serial x-rays; note filling of sinusoids at catheter tip followed by progressive filling of the portal venous bed. (#25)

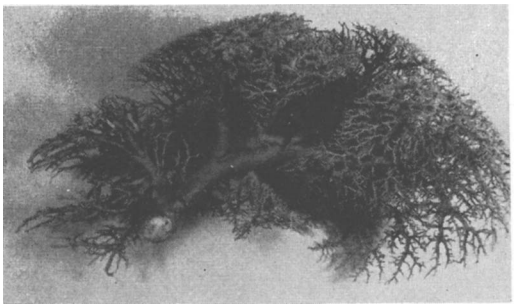

FIG. 3. Cast of portal system. (#25)

following needle puncture of the liver, with its attendant local hemorrhage. Some specimens showed no detectable changes at all.

Discussion. The proposed method for portal venography was easily performed and yielded excellent results. There was clear visualization of the entire portal system within the liver save a small section obscured by the sinusoidal filling at site of injection. The effects of the procedure upon the dog liver were studied both acutely and at intervals up to 12 days after the injections and showed minimal focal changes attributable to the procedure. Investigations are in progress in attempt to use this method of study in human patients.

Summary. A new method for portal venography by retrograde hepatic vein flushing was described. Application for the study of human cases is in progress.

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Susceptibility of Primary Cultures of Feline Renal Cells to Selected Viruses. (26396)

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Several workers have reported on the susceptibility of feline renal cell cultures to feline viruses(1-4). ECHO 10, ECMO(5), and herpes simplex(6) viruses have also been shown to be cytopathogenic in such cultures. Other human and bovine enteroviruses have been reported to be noninfective for feline renal cells(5). Since cultures of feline renal cells are a major cell type in this laboratory, their viral spectrum warranted an investigation. Twenty-four animal and human viruses were investigated for their ability to produce a cytopathogenic effect (CPE) with subsequent multiplication in primary cultures of feline renal cells. This paper reports our results.

Materials and methods. Primary cultures of feline renal cells were prepared by the trypsin digestion method described by Madin *et al.*(7). The growth medium was 0.5% lactalbumin hydrolysate in modified Hank's balanced salt solution with an addition of 10% lamb serum. The medium used at time of inoculation was lactalbumin hydrolysate containing 2% lamb serum. All media contained 500 units of penicillin and 500 μg of streptomycin per milliliter. Each of 4 renal culture tubes was inoculated with 0.1 ml of undiluted virus. When 70 to 80% of the cells were showing evidence of degeneration, 0.1 ml of fluid and cells was passed. In the absence of CPE, 0.1 ml of fluid and cells was transferred at 5- to 10-day intervals to new cell cultures. In all instances when CPE was absent the fluid was tested for virus by inoculation to susceptible cell cultures following 2 or more blind passages. No special attempts were made to adapt these viruses to