PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE 172, 397–399 (1983)

A New Technique for Hepatic Portal Sampling in the Conscious Dog (41577)

ANNA SIREK AND O. V. SIREK

Department of Physiology and Division of Teaching Laboratories, University of Toronto, Toronto, Ontario M5S 1A8, Canada

Abstract. A technique for implantation of a silastic catheter into the portal vein is described. The central end of the catheter is passed through a puncture hole into a tributary of the portal vein. The peripheral free end, occluded by a rubber membrane, is passed through the abdominal wall and buried under the skin. Once the catheter is in place it can be kept patent for several weeks. Injection of a substance and withdrawal of blood from the portal vein are carried out by percutaneous puncture of the rubber membrane, a virtually painless procedure that can be carried out in fully conscious nonrestrained dogs.

It is well recognized that the liver is the chief metabolic organ of the body and that it extracts nutrient substances as well as certain hormones which are transmitted to it from the splanchnic area through the portal venous blood. Thus, it may be desirable to measure the concentrations of certain constituents in portal blood before the concentrations are altered by the liver.

Although it is easy to obtain blood samples from a peripheral vein, sampling from the portal vein is beset with difficulties. If samples are withdrawn acutely, under anesthesia, the procedure is not physiological. If an indwelling catheter is placed into the portal vein, the free end, which must be exteriorized to permit flushing, is frequently chewed and destroyed by the animal even when covered by a protective jacket.

We are presenting in this report a successful method for hepatic portal venous sampling that we developed in the course of studying concentrations of pancreatic hormones in the prehepatic blood (1–4). We can implant catheters into the portal vein, keep them patent for several weeks, and thus withdraw repeated blood samples from fully conscious, nonanesthetized dogs.

Materials and Methods. Silastic medical grade tubing (Dow Corning Corp. Medical Products, Midland, Mich.) of inner diameter 0.03 and outer diameter 0.065 in, is cut into 50-cm lengths. The tubing is dipped into and flushed with 2% TDMAC–heparin (Tridodecyl Methyl Ammonium Chloride, Polysciences Incorp., Warrington, Pa.) and hung vertically to dry for 24 hr. The central end of the tubing is then tapered to a dull point and a loop of Silastic tubing with two retaining ears (Incath Ltd., Don Mills, Ontario, Canada) is placed 5–6 cm from the tip to mark the length which will be placed intravascularly. The peripheral end of the tubing is slipped over the Teflon end of an 18g Longdwell catheter (I.V. Catheter No. 6752, Beckton–Dickinson and Co., Rutherford, N.J.) (Fig. 1). The overlap of the Silastic tubing and the Teflon catheter is about 3 cm and is secured in place by two ligatures of 3-0 silk. Surgical sterilization is done using steam autoclave or ethylene oxide. If the latter is used, sterilization must be done at least 48 hr prior to actual use of the tubing. The sterilized tubing is filled with sterilized heparin–saline solution (1:10).

Under general anesthesia (Halothane, Ayerst Laboratories, Montreal, Quebec) a median laparotomy is performed and the central tip of the Silastic tubing is inserted into the portal vein either directly or via one of the following vessels: splenic vein, pancreaticoduodenal vein, superior mesenteric vein, or left colic vein. The vessel chosen for the site of entry of the tubing is cleared of adventitia and is lifted with the help of two retaining ligatures placed about 2–3 cm apart. The face of the vessel is pierced with a hypodermic needle, a catheter introducer (No. 6999, Beckton–Dickinson and Co., Rutherford, N.J.) is placed in the opening and then the pointed end of the tubing is slipped gently into the lumen in the direction of the portal vein. The tip of the tubing should be placed approximately half way between the point of entry

0037-9727/83 $1.50

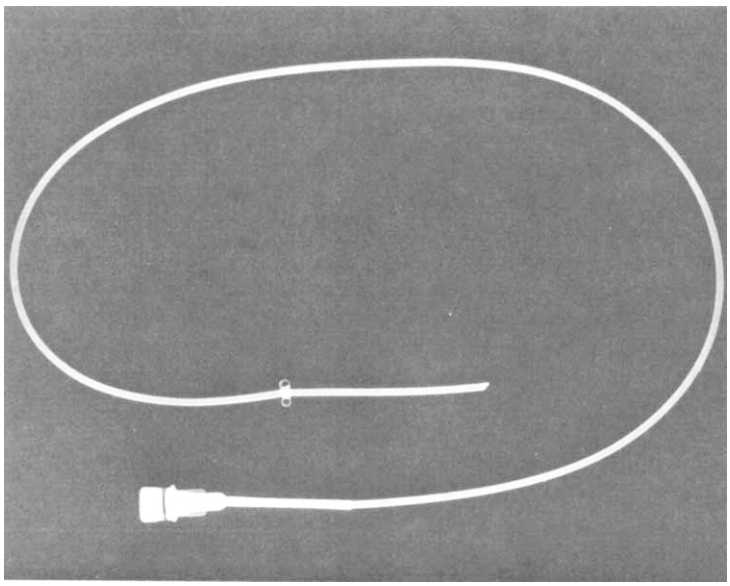

FIG. 1. Portal catheter prepared for insertion.

of the splenic vein into the portal vein and the liver. After the tip has been satisfactorily located in the vein, the Silastic loop is secured to the outside of the vessel with a ligature of 5-0 silk passed through the retaining ears (Fig. 2). There is no need to make a purse-string suture, because the wall of the vessel contracts around the Silastic tubing. We rarely encounter bleeding, but if it does occur, it can easily be stopped by the application of either gentle pressure or a piece of gelfoam (Upjohn Co., Kalamazoo, Mich.).

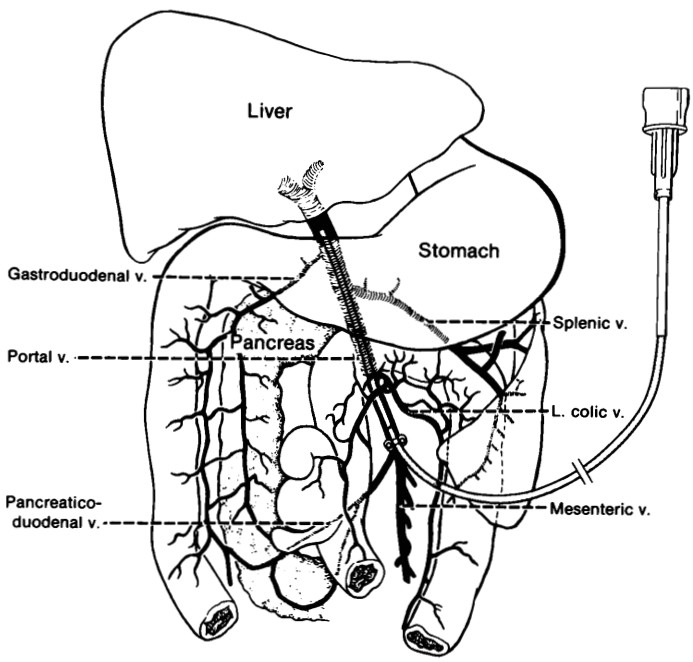

FIG. 2. Anatomical position of the indwelling portal catheter.

The next step is to pass the peripheral end of the catheter across the abdominal wall to the outside. A small incision is made in the skin on one flank of the animal, the abdominal wall is bluntly penetrated with a pointed curved hemostat and the peripheral end of the catheter is caught between the jaws of the instrument and pulled through the incision. A generous length of tubing is left in the abdominal cavity so that movement of the intestines and vessels will not cause tightening of the tubing. The Silastic tubing is covered by the omentum and the laparotomy wound is closed. The free end of the catheter is then tunneled in a wide loop under the skin; this usually required three small incisions. When the peripheral end is pulled out through the last incision in the skin, the open end of the 18g Longdwell needle is covered with a rubber membrane (the rubber cap from a plastic intravenous bag has proven quite satisfactory) which is securely tied in place with two ligatures of 3-0 silk. After this, the capped end of the tubing is buried in a subcutaneous pocket at the costal margin and incisions are sutured. They usually heal within a week and stitches can then be removed. Catheters placed by this technique are well tolerated and there is no need to use dog jackets.

Discussion. Proper and secure placement of the tip of the catheter determines the success of the operation and it is therefore important to follow the above-described procedure rigorously. If the tip is placed too close to the liver, the catheter can work its way up into the liver and become obstructed. If the tip is placed far below the entry of the splenic vein into the portal vein, sampling could miss the venous return from the splenic end of the pancreas. When the portal vein is cannulated via the splenic vein the tip of the catheter may find its way into the left gastric vein, or if cannulation is through the superior mesenteric vein, the tip may end up in the left colic vein. If problems occur, only fluoroscopy with contrast material can determine the actual position of the tip of the catheter.

Since the tubing and its capped peripheral end cause no discomfort to the animal, we can easily and frequently check the flow through the catheter by percutaneous puncture (21g needle) of the rubber membrane and subsequent flushing with heparin–saline solution. At the time of an actual experiment, a 21g butterfly needle (Venisystems, Abbott Ireland, Ltd., Sligo, Rep. of Ireland) is inserted percutaneously across the membrane and this provides continuous, unhampered access to portal vein blood.

The catheter will remain open for several weeks, allowing repeated experiments involving serial samplings to be performed. One can thus study prehepatic concentrations of various constituents ranging from components of the enterohepatic bile circulation to amino acid profiles following ingestion of selected nutrients. We are using the technique with continuous success in time series studies of the secretion of pancreatic hormones.

This work was supported by a grant from Denison Mines, Ltd. of Toronto. The authors are indebted to Mr. Timothy Butland for skilled technical assistance and to Mrs. Stephanie Meredith for expert secretarial help.

1. Sirek A, Vranic M, Sirek OV, Vigas M, Policova Z. The effect of growth hormone on acute glucagon and insulin release. Amer J Physiol **6** (Endocrinol, Metab):E107–E112, 1979.
2. Vanhelder WP, Sirek A, Sirek OV, Norwich KH, Policova Z, Vanhelder T. Diurnal episodic pattern of insulin secretion in the dog. Diabetes **29**:326–328, 1980.
3. Sirek A, Vanhelder WP, Sirek OV, Norwich KH. Pulsatile pattern of basal insulin secretion in the dog. In: Irsigler K, Dunz KN, Owens DR, Regal H, eds. New Approaches to Insulin Therapy. Proceedings of the 2nd Vienna-Lainz Diabetes Symposium, Vienna, MTP Press Ltd, pp191–197, 1980.
4. Vaitkus P. The immediate effects of a pulse injection of growth hormone on glucose homeostasis. MSc Thesis, University of Toronto, May 1982.

Received October 4, 1982. P.S.E.B.M. 1983, Vol. 172.