

A METHOD FOR REPEATEDLY SAMPLING THE BLOOD OF THE PORTAL VEIN IN HEALTHY ANIMALS.

By M. A. BLANKENHORN, M.D.

(From the Laboratories of The Rockefeller Institute for Medical Research, New York, and the Medical Research Laboratory of Lakeside Hospital, Cleveland.)

(Received for publication, July 1, 1926.)

A method to obtain samples of the blood of the portal vein at will would be of extreme value for the study of the phases of intestinal absorption and of liver problems not to mention others. The method here described was devised during the course of a study of the reabsorption of pigments of biliary origin for which the usual laboratory methods entailing laparotomy had proved inadequate. While this method does not permit sampling entirely at will, it does permit repeated tapping of the vein in the healthy and unanesthetized animal.

The plan pursued is to place a silver tube within the body of the animal. For weeks or months after the animal has recovered from the operation this tube will serve as a guide for a puncture of the portal vein.

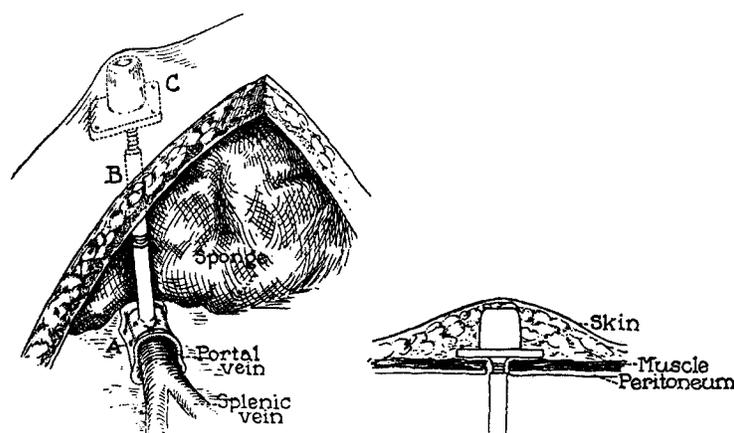
To be successful as a guide to tapping the portal vein the tube must be in contact with it at one end. The other end must be palpable beneath the skin and easily entered by a needle large enough for the withdrawal of blood. The device must be well tolerated by the animal and do no injury to the abdominal viscera.

Such a cannula was made of silver in the form illustrated in Text-fig. 1. For convenience in installing it was made in three parts.

A is a saddle-shaped plate which spans the portal vein and is held there by large silk threads. *C* is a plate with a nipple on it which is fastened into the abdominal wall near the costal margin so that it is covered only by skin. *B* is a hollow stem that connects *A* and *C* by screwing into both these parts when they are in place. This stem is fitted with a right hand screw on one end and a left hand screw at the other so that turning in the one direction engages both the end

pieces (*A* and *C*) and draws them closer together. This screw arrangement not only facilitates assembling the apparatus but regulates the length of the cannula so that it will fit dogs of various sizes.

In practice the details of operation to install the cannula are as follows: Under ether, a midline incision is made from the xyphosternum to one-third the distance to the pubis; self-retaining retractors are put in and wide retraction made. A sand bag under the lumbar spine increases the exposure and large moist sponges are packed into the abdomen to keep the intestines out of the field. The portal vein in the dog is retroperitoneal in about one-half its circumference so a small amount of dissection is required to permit the saddle *A* to span the vein without tension. When the dissection is done two very thick silk threads are passed entirely under the vein at the cephalic and caudal ends of the dissection. These threads are quite long and both ends of each are brought up and out of the inci-



TEXT-FIG. 1.

sion. Each thread is now put through a hole in the four corners of the plate and the plate, held by a hemostat, is lowered along the threads and into place. When it is in place the opposing threads are tied over the top of the saddle. These ligatures keep the saddle in place without compressing the vein at any point.

The plate carrying the nipple *C* must next go in. To guard against the infection that commonly develops around foreign bodies the skin must not be injured and the button must be out of the line of the main incision. To make a bed for the button, the right belly wall is everted as far as possible, with the retractor out. The end of the ninth costal cartilage is clipped off and an incision made from within outwards through the muscles in the line of the ribs, care being taken not to penetrate the skin. With the finger in this incision a pocket is made by blunt dissection of the subcutaneous fascia that will be large enough to contain the plate. When the bed is prepared the piece of silver is pushed through the muscle

incision and held by an assistant, while the operator closes the button-hole-like incision of the muscles with heavy mattress sutures of silk. It is imperative to have this repair so well done that there is no strain on any thread and that the plate retains its subcutaneous position.

It was found necessary to employ a rather large plate to guarantee a firm and permanent fixation to the parietal wall. The nipple upon the plate must also be of such size that the skin is lifted slightly by it, since otherwise the local swelling incident to the healing process may make it difficult to find. Two of the experiments recorded as failures were unsuccessful because the nipple could not be found with a needle even though the plate was firmly fixed.

With the two ends of the apparatus now in place an assistant grasps each with a hemostat to keep them in proper alignment while the operator screws in the connecting stem with his fingers, to what appears to be the proper length for an avoidance of tension when the animal is once more upon its feet. The abdomen is then closed in three layers with silk. The entire operation must be done with strict surgical care against infection for the retained foreign body predisposes to localized peritonitis or abscess.

When the animal is well recovered and the incision healed, which is usually within a week, the tappings can be begun. If the length of the stem of the silver tube is correct for the animal, and there is no strain on the vein or on the abdominal wall, the device is well tolerated, and the animal appears normal. If free from infection the skin fits flatly over the button. Such serum as may exude about the plate has free access to the abdomen and drains away.

The technique of tapping is as follows: The animal is placed on the left side, and the skin over the button is shaved and swabbed with iodine. A No. 17 lumbar puncture needle with stylette is thrust through the skin and down the cannula until close to the vein, when the stylette is withdrawn and a syringe attached on the needle. With suction made the needle is now advanced till it enters the vein, when blood flows into the syringe. The distance from skin to vein must already have been marked on the needle. It will be known from the length of the cannula as installed. A convenient aspirating apparatus is a 20 cc. Record syringe fitted with a rubber stopper and tube so that the operator can make suction with his mouth while manipulating the needle. It is well to have a little oxalate solution in the syringe and the needle, for clotting occurs very readily, partly on account of the length of the needle and partly because blood or serum may enter the needle from the cannula before the vein is entered. Precautions to guard against infecting the vein at the time of the tapping will prolong the usefulness of the device.

To employ a needle with stylette complicates the process of puncturing the vein and doubtless consumes time at a critical moment when clotting is most likely to occur, but on the other hand the stylette keeps the needle relatively free from the clotted lymph or fibrin that fills the lumen of the cannula. A further detail in construction of the cannula not shown in the illustration is the presence of minute holes in the walls of the cannula stem. These holes permit the escape of fluid or fibrin when a needle is thrust into the cannula.

Thus far the apparatus has been installed in thirteen dogs. Of seven instances in a series at Lakeside Hospital, Cleveland, three were successful, and from one to seven specimens of blood were obtained from each dog. One animal was tapped $7\frac{1}{2}$ months after operation. Of six instances studied at The Rockefeller Institute four were successful and two unsuccessful. The form of the apparatus pictured was developed during the course of work at the Institute.

The chief limitations of the method are referable to thrombosis of the vein. This is a result of the contact of metal with the vein, the continuous movement of the cannula upon it with the breathing, and the repeated trauma from the aspirations. The thrombus which gradually develops does not entirely obstruct the vein but tends to block the end of the needle while permitting blood to flow round about it.

It is probable that celluloid will prove better than silver as a material from which to make the cannula. This material is apparently better tolerated than silver and had a certain amount of flexibility, yielding to respiratory movements with less trauma to the vein. The most successful series of tappings were accomplished with a celluloid cannula, at the Lakeside Hospital. This cannula eventually came apart by some solvent working on its cemented joint.

It is highly probable that methods to sample blood from deep lying veins have been described but the writer is aware of but one such in the literature. London¹ described a method that involved intubation of the splenic vein with a glass tube which was continued through the abdominal wall with rubber and kept closed with a dressing. The success of his arrangement was not reported upon.

The writer is indebted to Dr. P. D. McMaster of The Rockefeller Institute and to Dr. Graham and Dr. Beck of the Department of Surgery of Lakeside Hospital for assistance in these experiments.

SUMMARY.

A method is described for repeatedly sampling the blood of the portal vein in healthy animals. The method has been employed in thirteen dogs with success in eight.

¹ London, E., *Quart. J. Exp. Physiol.*, 1923, suppl. 173.