A fistula for measurement of bile flow and composition in the dog

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Many types of biliary fistula have been created for the study of biliary secretion in the experimental animal. Most of these interfere considerably with normal physiological function, either by bypassing the sphincter of Oddi, or more commonly by failing to maintain the enterohepatic circulation of bile. Thureborn (1963) has shown that interruption of the enterohepatic circulation alters the volume and composition of liver bile. Moreover the enterohepatic circulation is modified by the activity of the gall bladder and the sphincter of Oddi. The apparatus which we have used in the dog is easy to construct, causes minimal interference with normal biliary mechanics, and has proved successful in studies of bile flow and composition.

THE APPARATUS

A T-tube and a cannula are the two principal items.

A double-barrelled T-tube, suitable for use in the dog, can be made conveniently from two lengths of translucent vinyl tubing of 2.0 mm internal diameter, which are drawn through two side-holes in a short length of identical tubing, temporarily softened in acetone (Fig. 1). The T-tube is introduced into the common duct in the usual way, and a non-absorbable ligature is then passed around the common duct, and tied firmly over the non-conducting splint of the T. This prevents leakage of bile along the common duct around the circumference of the vinyl tubing. The choledochotomy incision is then closed around the long limbs of the T-tube, which are passed through a sheet of omentum and led to the cannula.

FIG. 1. The double-barrelled T-tube.

A

B

FIG. 2. A Longitudinal section of cannula.
B The complete cannula.

The cannula, which is introduced through a stab incision in the right flank, consists of a hollow stainless steel cylinder of 1 inch diameter, closed at each end and traversed by two narrow stainless steel tubes of 2.0 mm internal diameter (Fig. 2). The inner end of the cylinder is fixed intraperitoneally by an integral perforated flange, and a similar adjustable flange is slipped over the external end of the cylinder to rest comfortably against the abdominal wall. This is secured in position with locking screws. Internally the twin traversing tubes are connected to the long limbs of the T-tube by a taper collet device. Externally the twin tubes can be united by a circular perspex block containing a drilled channel which fits snugly over the ends of the metal tubes to form a continuous pathway for the bile. A Neoprene washer is interposed between the perspex block and the body of the cannula, and when not in use, the external end of the cannula is covered by a stainless steel cap which screws onto the body. During observation periods the cap and block are removed, and a flowmeter with a sampling device can be attached, or a combined flowmeter and manometer may be used.

Experience with this apparatus shows no alteration in liver function tests in dogs kept up to four months. Infection may occur but can be controlled by sterile precautions and appropriate antibiotics where necessary.

COMMENT

This simple apparatus adapts the principle used in the experiments of Rous and McMaster (1923), but avoids the long intraabdominal tubes, incorporates a reliable method of cannulation of the common duct, and provides a secure external access point. The apparatus avoids interference with the sphincter of Oddi such as occurs with the modified Thomas

cannula technique as used by Marshall, Moreno, and Brodie (1964). It also overcomes the risks of ascending infection which are a drawback of the choledochoduodenal fistula used by Kocour and Ivy (1938). The transparenchymal technique introduced by Grindlay, Eberle, and Walters (1953) is an ingenious method to obtain pressure readings, but is unsuitable for flow or composition studies as no provision is made for return of bile to the duodenum. Jonson (1963) in the use of his external two-part common duct fistula overcomes the absence of a return limb by collecting fistula bile, and refeeding it at intervals by mouth. Interruption of the enterohepatic circulation using the present method occurs only temporarily and minimally during sampling procedures. It is superior to previous methods for experiments on the biliary system.

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