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MASTER

TEMPORAL SEPARATION OF SURGERY FROM
OBSERVATION IN THE STUDY OF BILIARY PHYSIOLOGY *

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ABSTRACT

Since surgical stress affects the regulation of body constitution by the liver and the pancreas, the necessity is stated for temporal separation of surgery from observation in physiological studies of the intra-abdominal tributaries to the gastrointestinal tract.

Two methods for such temporal separation are described. The first permits willful, repeated, reproducible obstruction and release of the common bile duct. The second allows repeated exteriorization and reconstitution of bile flow. Both apply to the non-stressed, unanesthetized nondepleted rat.

INTRODUCTION

Both surgical stress and shock are known to affect the physiology of hepatic and pancreatic function (1). This was reflected convincingly in recent studies of the homeostasis of an essential constituent, manganese (2,3). Furthermore depletion of bile, pancreatic juice or both has been known to distort not only the function of the intra-abdominal tributaries to the gastrointestinal tract, but also the constitution of the body itself (4-7). The development of simple and effective methods permitting the avoidance of stress and depletion was desirable since it was difficult to adapt methodology published by others.

The present paper records two methods found to be exceedingly satisfactory in this laboratory. The first facilitates the immediate, repeated obstruction of the biliary tract and the release of the obstruction at any time suitable to the investigator. The second method applies to the willful, reversible exteriorization of the bile flow. Both pertain to the intact, unanesthetized rat.

BILIARY OBSTRUCTION

Materials:

The instrument depicted on Figure 1 is constructed as follows: A. surgical steel wire size 0 (Ethicon Inc.) about 12 cm in length is shaped as shown in the insert. This is introduced into a polyethylene tube gauge 190 about 3 cm long, the edges of which are heat-polished to avoid tearing of either the bile duct or of the tube itself.

Procedure:

The shaved skin of the anesthetized rat is cut parallel to and 1 cm below the right costal margin over a distance of 3 cm. The fascia, muscles and

peritoneum are incised next. The duodenum is exteriorized and its posterior surface is exposed. One of the wire's tips is inserted around the upper 1/3 of the common bile duct. Thereafter, both tips are passed through the lumen of the polyethylene tube. At this point, the bile duct rests freely within the wire loop (Fig. 1B). The latter has a greater radius than the polyethylene tube so that only a strong pull on the wire will obstruct the bile duct. Such a pull will flatten the tube, while compressing the bile duct at three points. Thereafter, a simple push of the wire will suffice to bring upon complete restitution of bile flow. To insure the eventual success of these maneuvers, it is desirable to test them visually at operation. The optimal distances for the pulled and pushed positions of the wire are marked by two sharp notches as shown in Figure 1A. Subsequently, the instrument is bent so that the subcutaneous tip of the tube underlies the skin without distortion of either the bile duct or other intra-abdominal structures (Fig. 1B). This bending is critical because it guarantees against inadvertent twisting of the instrument, which might otherwise result in jaundice. The wires are bent alongside the polyethylene tube and the tube is anchored to the fascia. The peritoneum, muscles and fascia are sutured en masse with 00 silk and the skin is closed with discontinuous sutures.

After the animal's complete recovery, the tip of the tube may be readily exposed by simple dehesion of the skin without anesthesia. The ends of the wire are straightened, pulled up to the notch, the wires are folded along the tube at the level of the notch and tied to the tube with silk to prevent accidental unfolding. The maneuver obstructs the bile duct. The procedure can be reversed and repeated if necessary, permitting the willful imposition of obstructive jaundice, the recovery thereof and the reimposition of jaundice later. If adhered to strictly, this technique carries negligible probability of failure.

EXTERIORIZATION OF BILE FLOW

Materials:

Catheters are constructed of polyethylene tubing; approximately 10 cm lengths of No. 10 gauge are used for rats weighing less than 200 gms and about 15 cm long segments of No. 50 gauge for larger animals. The catheter flares out to produce both an olive and a tip, if the tubing is approached cautiously but steadily to a small candle flame under imperceptible tension. The tip is cut to produce a bevel (Fig. 2).

Operation:

The shaved skin and the linea alba are transected from the origin of the xiphoid to the midabdomen under general ether anesthesia. Two silk sutures are inserted through the xiphoid cartilage in order to immobilize later the subcutaneous loop of the biliary catheter. A purse-string suture is sewn through the anterior superior portion of the duodenal serosa, to secure the duodenal end of the catheter. The latter may be provided with an olive, depending upon whether one plans to remove it later or to leave it in situ permanently. The mid-portion of the duodenum is then laid gently over the left margin of the incision thus exposing the bile duct without significant evisceration (Fig. 2). A curved 5" Halsted mosquito clamp is applied in order to immobilize the distal end of the duct. A suture, to be tied later, is placed around the upper third of the duct by means of a No. 5/0 atraumatic needle and silk thread (insert Fig. 2). The anterior wall of the bile duct is cut halfway across by means of curved iris scissors at a point 1 or 2 mm distally to the suture surrounding the duct. This cut provides the bile duct automatically with a small flap (Fig. 2), which renders the entrance of the tip of the catheter into the lumen almost automatic.

After the olive passes above the suture, the latter is tied securely over the duct and catheter. A second suture is placed around the catheter to secure it at a distal point. The clamp is released and the catheter is positioned to describe two loops: one intra-abdominal, the other subcutaneous. Both are secured on the xiphoid process.

The duodenal wall is perforated with the curved scissors at the center of the purse string suture. The distal end of the catheter is inserted into the duodenal lumen, the purse strings are drawn and tied first around the catheter and then to one of the xiphoid sutures.

The peritoneum and the muscles are closed in one layer with discontinuous silk sutures. The duodenal portion of the catheter is marked with a Flashdry ink marker. The loop is introduced under the skin which is then closed with discontinuous silk sutures. This procedure requires about 30 minutes of one operator's time.

A few days or weeks later the animal is placed in a Bollman cage (8). It is now easy to exteriorize the subcutaneous loop of the catheter by dehis-
cing the incision in the unanesthetized animal, which causes little distress. For subsequent acute experimentation, the duodenal end of the catheter may be pulled out to permit sequential collections of bile by spontaneous flow. For chronic observations, the loop of the catheter is cut, the bile is sampled, and the two segments of the catheter are connected by a fitting rubber tube.

When the steps described above are strictly adhered to, this procedure results in negligible experimental failure.

DISCUSSION

The procedures described in this paper are useful both in the study of biliary physiology and experimental obstructive jaundice. The necessity in

our own laboratory for these procedures prompted their development almost de novo. Since it is possible that this need also exists in the laboratories of other investigators, they have been described in detail. No effort is made to compare the methods described herein with those of others (5,6 and 9-15).

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LEGENDS

- Figure I.
- A. Components of the instrument for the obstruction of the common bile duct.
 - B. Construction and position of instrument around the duct.
 - C. Pulled wire results in flattening of the tube and compression of the bile duct. Ends of wire are folded. (see text).

Figure II. Schema of relative positions of viscera, catheter, clamp and sutures.

Insert: Detail of inserted biliary catheter about to be secured. (see text).

FIGURE 1

FIGURE 2