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RE-ENTRANT CANNULA AND AUTOMATIC SAMPLING FOR BILE STUDY IN THE PRERUMINANT CALF

J. LEFAIVRE, C. DARDILLAT, M. DEBARRE and P. THIVEND

Laboratoire de la Digestion des Ruminants, INRA, Centre de Recherches Zootechniques et Vétérinaires de Theix, 63110 Beaumont, France

Up to now, the use of biliary cannula has mostly followed the principle of sampling from the biliary duct and direct reintroduction to the intestinal lumen. Some authors (Stanbridge and Mortimer, 1968; Laplace and Ouaissi, 1977) have tried using re-entrant cannula to the bile duct, but to our knowledge, in sampling and reintroduction procedures, no one has considered the possible role of the Oddi sphincter in duodenal bile flow. To counter this, we proposed using a reentrant cannula and an assisted biliary circulation procedure which maintains the normal functioning of the biliary system and allows a continuous study of secretion.

Cannula insertion

The cannula is made up of 2 polyvinylchloride catheters (internal diameter 3.0 mm, external diameter 4.5 mm) inserted in opposite directions into the bile duct in which a slit was made between the duodeno-sphincteral area and the hepato-cystic junction, (fig. 1). A silk thread was threaded under the duct and knotted around each catheter behind a collar placed at the end of the catheter to stop the duct receding.

This ligature allowed each catheter to be firmly connected to the bile duct. The upper end of the cannula must be kept away from the hepato-cystic junction to avoid occlusion of either the hepatic or the cystic duct. The lower catheter must not enter the area around the Oddi sphincter.

After inserting the cannula, a cotton tape (4 mm wide) was knotted around the part of the duct between the two catheters to ensure total diversion of the bile into the cannula (fig. 1). Two other tapes were threaded under the duct, each tying it firmly to one branch of the cannula.

Once the two catheters are in place, the upper branch, opened and slightly lowered, should have bile flowing from it. Elsewhere, physiological serum, administered gently by syringe into the lower catheter should reach the duodenum and if the catheter is behind the Oddi sphincter, no liquid should be recovered when the plunger of the syringe is pulled back slightly. The two catheters were then led out of the animal in a silicone tube.

During sampling, regular checks by injecting a coloured substance into the lower catheter and watching for no reappearance of the marker from the upper catheter ensured that there was no contact between the upper and lower branches.
Sampling apparatus (fig. 2)

Theory

A closed circuit, consisting of a water pressure gauge (M) and a peristaltic pump (P) set up parallel, using the difference in pressure between the sampling catheter (A) and the reintroduction catheter (B) was used. Any difference in level between A and B was detected by an electrical contact (C) at the pressure gauge. The difference was immediately counteracted by the pump. A series of short bursts of pump activity, controlled simply by the electrical contact, ensured a bile flow theoretically identical to that in a non-sectioned duct. Variations in level between a\textsubscript{1} and b\textsubscript{1} should be as small as possible so as not to disturb bile secretion. Variations of less than a few millimetres in water can be regarded as negligible considering the pressure usually exerted by bile flow.

Practice

Because of the tensio-active properties of bile which made it difficult to install an electrical contact there, we used a two stage system by which the two ends of the reentrant cannula were linked to the water pressure gauge by an air-filled tube (fig. 2). Two electrodes E\textsubscript{1} and E\textsubscript{2} were immersed in a U-shaped tube filled with physiological serum. One of the electrodes was an injection needle, the other a metal wire. Two three-way taps (R\textsubscript{1} and R\textsubscript{2}) were installed to balance the four liquid levels (a\textsubscript{1}, b\textsubscript{1}, a\textsubscript{2}, b\textsubscript{2}) before sampling began.

The peristaltic pump used was multi-tubed and thus enabled a certain percentage of bile to be drawn off continuously for analyses. Bile flow was measured using a tube (T\textsubscript{1}) of exactly the same dimensions as that for sampling (T\textsubscript{1}) and the two ends of which were immersed in measuring vessels. Under these conditions, measurements of bile flow and continuous representative sampling can be undertaken with minimal surveillance for periods of 24-36 hours.

Application

The entire cannulating and sampling procedure was carried out experimentally on 24 preruminant calves. Two calves died as a result of surgery and 4 were excluded 22, 26, 27 and 56 days after operating because of irregular func-
tinning of the cannula. 18 calves could be used to study biliary secretion. From 13 of them, quantitative results were obtained for an average period of 32 ± 10 days after which the bile duct healed over the area where it had been obstructed. In the 5 other calves, one of the two catheters was accidentally detached after 5, 20, 24 and 62 days.

The combination of reentrant cannula with flow measuring apparatus enables bile flow to keep its physiological characteristics: the propulsive system (vesicular and hepatic contractions, biliary peristalsis) and flow inhibitors (Oddi’s sphincter, enduodenal pressure) remain intact. Initial results (Debarre et al., 1979) indicate that biliary secretion in the preruminant calf is greater than that in other animals but to our knowledge there are no precise published data for the calf from which we could compare our results which those obtained with different cannula.

References

