

of more milk by circulating prolactin and other hormones. Milk ejected into ducts is believed to be gradually reabsorbed into the circulation, and some may flow back into the alveoli. These local effects of oxytocin on the mammary gland are believed to account for its ability to maintain mammary secretion in postpartum rats after litter removal.

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A Modified Bile Return System in the Dog.* (25433)

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Steatorrhea in bile fistula dogs was reduced substantially following hourly return of the dogs' own bile to the duodenum(1). The steatorrhea was greater when bile was returned every 4 to 8 hours, even though total cholic acid returned was the same. Thus, it appears that bile must be in the intestine nearly continuously to effect normal fat absorption. However, complete correction of the steatorrhea of bile deprivation by continuous return of bile has not been demonstrated. A modified Rous-McMaster bile fistula preparation(2) is described in this report, permitting free entry of bile to the duodenum, and restoration of normal fecal fat levels following bile deprivation.

Methods. Duodenal and gall bladder cannulas were prepared for implantation with Tygon tubing (1/16" wall, 1/4" and 5/16" O.D. respectively, overall length approximately 12" each). Two Tygon collars (Fig. 1; a,b) and an abdominal wall brace (c,d) were cemented on each cannula with Tygon paint. The cannulas were then coated with a silicone preparation (Siliclad, Clay Adams,

Inc.) to minimize bile sedimentation on the inner wall. Sterilization was accomplished by soaking in benzalkonium chloride (Zephiran, Winthrop Stearns, Inc.). Clogging of the duodenal cannula tip with intestinal contents was obviated by placing 1½" slits bilaterally in the intraduodenal segment (e). The surgical procedure was carried out aseptically on mongrel female dogs weighing 9 to 18 kg with due regard for the requirements of proper animal care. The common duct was ligated and sectioned. The cannulas were anchored with a double row of purse string sutures and brought through stab incisions in the right abdominal wall (Fig. 1). The bile cannula extended into the base of the gall bladder about ½" (f), in a line with the cystic duct. A male luer fitting (g) and a stethoscope fitting (h) were inserted. During bile collection periods the duodenal cannula was capped and bile was drained into a rubber balloon. During bile return periods the 2 cannulas were connected to reestablish the enterohepatic biliary circuit. A many-tailed binder covered the cannulas. A balloon bag was pinned to the binder during collection periods. 30-50 ml of isotonic saline was in-

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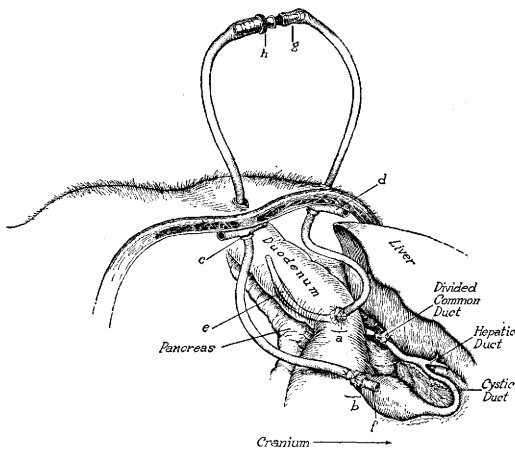


FIG. 1. Schematic representation of cannulas implanted in duodenum and gall bladder.

jected through the duodenal cannula every morning and evening to assure its patency. Test meals, fed once daily, starting approximately one week after operation, were completely consumed. They consisted of 300 g of canned dog food (Friskies, Carnation Co.) and 2 g of brewers yeast, to which varying amounts of oleic acid or triolein were added (Table I). Feces were collected and refrigerated for the last 3-5 days of 5-7 day test periods. Fecal fat excretion was then estimated on duplicate aliquots of the total blended fecal sample as the petroleum ether soluble material extracted in 7 hours(3).

Results. The experiments summarized in Table I were carried out on 2 groups of ani-

mals: on dogs which it is assumed suffered no bile deprivation since the gall bladder and duodenal cannulas were joined at time of operation and remained connected during the subsequent month of tests; and, on dogs following one to three 5-7 day bile deprivation periods. None of these animals became visibly jaundiced during these tests.

Inasmuch as large doses of oleic acid are poorly tolerated even by normal dogs(4), the slight but significant increase in level of fecal fat when 25 g of oleic acid was fed is not surprising. However, on all other regimes no significant difference in fat excretion between normal and operated animals occurred. This suggests that fat absorption was essentially normal in these operated animals.

In the experiment summarized in Table II bile was collected for a 5-7 day period, followed by one, two, or three 5-7 periods of bile return on each diet. In all of these dogs fecal fat excretion was within normal limits (Table I) within 12 days after rejoining the cannulas. This means that steatorrhea in bile fistula dogs can be corrected by returning their own bile continuously.

Discussion. Fecal fat excretion was normal in operated dogs as long as 10 weeks after surgery (Table II). Thus, for studies requiring only periodic collection or sampling of bile this simple continuous return system might well keep animals in better condition than when no bile is recirculated, or when it is re-

TABLE I. Fecal Fat Excretion in Normal Dogs and in Dogs Circulating Their Bile through the Cannula System.

Food intake/day	Fecal excretion/day			
	Normal		Operated	
	No. of dogs	Total fat (g), mean $\pm$ S.D.	No. of dogs	Total fat (g), mean $\pm$ S.D.
Without previous bile deprivation				
Control diet (300 g)*	9†	1.0 $\pm$.9	5	1.0 $\pm$ 1.0
Plus 25 g oleic acid	4	1.0 $\pm$.2	2	3.0 $\pm$ 1.2§
" 50 g "	6	5.6 $\pm$ 2.7	2	6.4 $\pm$ 3.5
" 50 g triolein	7	1.7 $\pm$.6	3	1.1 $\pm$.5
Following previous bile deprivation‡				
Control diet (300 g)*	9†	1.0 $\pm$.9	4	1.0 $\pm$.3
Plus 10 g oleic acid	6	1.7 $\pm$ 1.3	3	1.1 $\pm$.4
" 25 g triolein	4	1.9 $\pm$.8	3	.8 $\pm$.2

* 10 g fat.

† These controls are the same series.

‡ These animals are the same as reported in Table II.

§ Group comparison: Operated *vs* normal dogs fed the same diet, .02 < p < .05.

TABLE II. Time Course for Correction of Steatorrhea in 6 Bile Fistula Dogs.

Fecal excretion, g total fat/day										
Control diet (10 g fat)				Plus 25 g triolein			Plus 10 g oleic acid			
Bile fistula	Bile return period*			Bile fistula	Bile return period*		Bile fistula	Bile return period*		
	1	2	3		1	2		1	2	3
11.5	1.0									
12.6	6.9	1.6	.8							
10.2	1.4			29.3	10.0	.7				
8.6	9.1	.9		25.0	5.0	1.0	15.0	3.0	1.3	1.8
				15.8	1.9	.8	13.0	4.1	1.0	.7
							21.7	11.6	1.4	

* Bile return period 1: 2- 7 days after reconnecting cannulas.

Idem

2: 7-12

3: 12-17

Idem

"

turned by stomach tube or other discontinuous technics. This system does not yet appear to be useful for more than 3 months. In many of the operated animals the gall bladder wall around the cannula eroded after this period, followed by leakage of bile and peritonitis. However, the animals exhibited surprising resistance to liver infections. While slight cholangitis was evident, histological sections revealed significant lesions of the liver parenchyma only in 3 dogs. In these 3 animals some evidence of hepatitis was present.

Summary. Eleven bile fistula dogs, with common bile duct sectioned, were permitted to recirculate their bile by periodically joining together polyvinyl cannulas fixed in the duodenum and gall bladder and brought outside through stab incisions. In 6 of these dogs, fed varying amounts of triolein or oleic acid,

steatorrhea was corrected completely within 12 days after rejoining the cannulas. In 5 other dogs fed similar diets, but not subjected to prior bile deprivation, fecal fat excretion was within normal limits for period up to 30 days. These results show that the steatorrhea of bile deprivation can be corrected by continuous bile return.

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Effect of Dietary Calcium and Phosphorus Levels on Body Burdens of Ingested Radiostrontium.* (25434)

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Entry of radioactive strontium into the biosphere is one of the important consequences of fallout from nuclear explosions and much

study has been given to interrelationships in the progression of fallout strontium and natural calcium through the food chain to human population. Details of comparative behavior of strontium and calcium in various species (under normal conditions and also during pregnancy and lactation) have been worked out and many of the findings con-

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