OBSERVATIONS FROM A STUDY OF THE COMPARATIVE ANATOMY OF THE EXTRAHEPATIC BILIARY TRACT

STEWART C. THOMSON

Loyola University School of Medicine, Chicago, Illinois

ABSTRACT

For the student in zoology who is looking forward to a medical career, a study of the comparative anatomy of the biliary tract should prove an aid to the fuller comprehension of anomalies he will later observe in the dissection laboratory, in the operating room and at the autopsy table.

Historical Survey.—A brief survey of some of the contributions to the knowledge of the comparative anatomy of the extrahepatic biliary tract, although very incomplete, shows that interest in the extrahepatic biliary tract has been evidenced since earliest times. Some of these contributions are considered in the full length manuscript.

Summary of Observations. — In the studies which are summarized in this paper, observations were made as completely as the condition of the specimen or the amount of the material allowed. Almost all of the specimens were obtained through the courtesy of the staff of the Field Museum of Natural History and the many kindnesses of the staff are gratefully acknowledged. A full report which includes most of these dissections has been published by the Field Museum of Natural History (1).

Altogether, 111 animals were studied. These represented twelve orders and fifty-two species. The data obtained are summarized under seven distinct but related topics.

1. The presence or absence of the gall bladder.—In fifty-two species of Mammalia, a gall bladder was absent in only eight—the whale (*Balaenoptera physalus*), the zebra (*Equus burchelli*), the horse (*Equus caballus*), the dassie (*Procavia sp.*), the white-tailed deer (*Odocoileus virginianus*), the brown rat (*Rattus norvegicus*), the pocket-gopher (*Geomys bursarius*) and the rice-rat (*Oryzomys meridensis*).

In Hyracoidea, Perissodactyla and Cetacea the gall bladder was absent. In Rodentia, as in Artiodactyla, there was variability among the species. In Marsupialia, Primates, Edentata, Carnivora, Insectivora and Chiroptera, a gall bladder was present in all specimens studied. In the one specimen of Sirenia (*Trichechus latirostris*), there was a gall bladder. The variability among the Rodentia was of particular interest.

2. The character of the wall of the gall bladder was determined only by its opacity and by palpation of the structure. It showed much variability. In Chiroptera and in Insectivora the wall was thin; it was firm in Marsupialia and Artiodactyla; it was strong and thick in Carnivora and the Primates. In Rodentia it was variable, e.g., thin in the guinea-pig (*Cavia porcellus*) and the house mouse (*Mus musculus*), but firm and thick in the African porcupine (*Hystrix cristata*).

3. The relationship of the gall bladder to the liver varied between and within orders. In Marsupialia, with the exception of the opossum (*didelphis mesamericana*) it was loosely adherent to the liver. In the flying phalanger (*Petaurus norfolcensis*), the viscus was loosely lodged in its fossa; in the Tasmanian devil (*Sarcophilus harrisii*) the gall bladder was loosely attached to the liver by a peritoneal fold for two-thirds of its length. A short peritoneal fold which connected the gall bladder to the liver was seen in the Chiroptera studied. The loose attachment to the liver was observed in Primates. In the Carnivora, particularly deep fossae were seen in the binturong (*Arctitis binturong*) and the dog (*Canis familiaris*). In the black bear (*Ursus americanus*), the gall bladder was loosely attached to the liver. In Rodentia, the variability was again marked.

4. The duodenal papilla showed variability, not only as to its presence or abscence, but also as to its size. It was

TABLE I.—RELATION OF PANCREATIC AND BILE DUCTS*

Species	*Type A*	*Type B*	*Type C*	*Gall-bladder*
Tree-kangaroo *(Dendrolagus matschiei)*	+			+
Wallaby *(Macropus sp.)*	+			+
Flying phalanger *(Petaurus norfolcensis)*	+			+
Tasmanian devil *(Sarcophilus harrissii)*	+			+
Mexican opossum *(Didelphis mesamericana)*	+			+
Orangutan *(Pongo pygmaeus)*	+			+
Chimpanzee *(Pan satyrus)*	+			+
Macaque *(Macaca mulatta)*	+			+
Marmoset *(Tamarin ursulus)*	+			+
Red Uakari *(Cacajao rubicundus)*	+			+
Dog *(Canis familiaris)*	+			+
Cat *(Felis domestica)*	+			+
Little panda *(Ailurus fulgens)*				+
Binturong *(Arctitis binturong)*			+	+
Armadillo *(Dasypus novemcinctus)*	+		+	+
Sheep *(Ovis aries)*				+
Cow *(Bos taurus)*			+	+
Pig *(Sus scrofa domestica)*		+		+
Florida Manatee *(Trichechus latirostris)*		+		+
Dassie *(Procavia sp.)*		+		+
Zebra *(Equus burchelli)*	+			0
Horse *(Equus caballus)*	+			0
African porcupine *(Hystrix cristata)*	+			0
Guinea pig *(Cavia porcellus)*		+		+
Striped ground squirrel *(Citellus tridecemlineatus)*		+		+
House mouse *(Mus musculus)*		+		+
Brown rat *(Rattus norvegicus)*			+	+
Rabbit *(Oryctolagus cuniculus)*			+	0
Rice-rat *(Oryzomys meridensis)*		+		+
			+	0

* Key: Type A—Ducts course together to duodenal wall; Type B—Ducts enter duodenum separately at variable distance from each other; Type C—Pancreatic duct joins bile duct at distance from opening of the latter into duodenum.

prominent in the black bear (*Ursus americanus*) in which a gall bladder was present. It was equally prominent in the zebra (*Equus burchelli*) in which there was no gall bladder. It was not present in the binturong (*Arctitis binturong*) which had a gall bladder, nor in the dassie (*Procavia sp.*) in which there was no gall bladder. The duodenal papilla varied within an order as to its presence and size, e.g., in the bear (*Ursus americanus*) and the dog (*Canis familiaris*); it was absent in the binturong (*Arctitis binturong*).

5. The distance of the opening of the bile duct from the pylorus was markedly variable. In two species of Rodentia, the African porcupine (*Hystrix cristata*) and the guinea pig (*Cavia porcellus*) it was nearest to the pylorus. Both of these species possessed gall bladders. In two species of Artiodactyla in which the gall bladder was present, a marked difference was observed. In the domestic cow (*Bos taurus*) the opening was 62 cm. caudad to the pylorus, but in the pig (*Sus scrofa domestica*) it was 3.4 cm. Naturally the question arises as to the comparative length of the small intestine in these species. The ratio of the length of the small intestine of the former to that of the latter is approximately 3 to 1.

6. The relationship of the common bile duct or the common hepatic duct (when there is no gall bladder) with the pancreatic duct was of great interest to Mann and his co-workers (2) and they made studies of this relationship in laboratory and common domestic animals. These relationships in the specimens examined in the series here reported are summarized in table 1.

It was observed that the type of relationship did not correspond with the presence or absence of the gall bladder. Again there was particular variability among the Rodentia, e.g., the guinea pig (*Cavia porcellus*) was in type B; the brown rat (*Rattus norvegicus*) was in Type C. It should be noted that in the seven species in which the ducts entered the duodenum separately at variable distances from each other (type B), a gall bladder was present in each species.

7. Other observations. Hepato-cystic ducts which drain from the liver into the side of the gall bladder or into the cystic duct along its course have been observed in various vertebrates. In this series they were particularly observed in the cow (*Bos taurus*). They were injected with gelatin and dissected carefully in order definitely to establish their existence. The surgical importance of hepatocystic ducts, when present in man, lends added significance to these structures when encountered in zoological studies.

One of the interesting observations which were made in this study concerned the dassie or hyrax. The author has previously reviewed several reports of investigations on the viscera of hyrax and reported his findings (3).

REFERENCES

1. Thomson, S. C. 1940. Studies of the anatomy of the extrahepatic biliary tract in mammalia. Zool. Ser., Field Mus. Nat Hist., vol. 22. pp. 415-430.
2. Mann, F. C., J. P. Foster and S. D. Brimhall. 1920. The relation of the common bile duct to the pancreatic duct in common domestic and laboratory animals. J. Lab. and Clin. Med., vol. 5, pp. 203-206.
3. Thomson, S. C. 1938. The extrahepatic biliary tract of the hyrax. Anat. Rec., vol. 72, pp. 445-449.