Anatomical Variations of the Extrahepatic Ducts in Dogs: Knowledge for Surgical Procedures

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Abstract. Variations of the hepatic duct terminal were examined in 50 cadavers of mixed-breed dogs. The hepatic duct was formed by 4 major tributaries in 70% of the dogs and by 3 tributaries in 30% of the dogs. The order of hepatic duct termination, proximal to the gallbladder, was as follows: the duct from the right medial lobe, then the quadrate, then the common duct from the right lateral and caudate lobes. The number and distribution of the extrahepatic ducts vary among individual dogs [3, 4, 10]. Disorders of the gallbladder and bile duct are relatively uncommon in dogs [5, 7]. However, biliary tract diseases have recently become more prevalent [11]. For gallbladder necrosis, rupture, infection and stone, cholecystectomy is the surgical treatment of choice [8]. In cholecystectomy, the cystic duct is sufficiently left to prevent ligature on the hepatic duct, which enters the CBD near the entrance of the cystic duct. Ligation of the hepatic duct results in icterus and elevated levels of alkaline phosphatase [2, 6].

Anatomical information regarding canine biliary drainage has been reported by Sleight and Thomford [10] and has been cited in recent clinical textbooks [1, 8] as well as a journal article [9]. However, this anatomical information requires supplementation to facilitate safe and efficient surgical procedures. To shorten the operative periods and/or to apply laparoscopic operation for cholecystectomy, one must have information on the typical length of this duct and which extrahepatic duct is nearest to the gallbladder. Our purpose in this study was to obtain detailed anatomical information about extrahepatic duct terminations and the cystic duct, as this information can be used to make preoperative diagnoses for biliary diseases.

The carcasses of 50 normal mix-breed dogs euthanized by carbon dioxide inhalation, with body weights of 5 to 25 kg (24 males and 26 females), were obtained from the Department of Life Environment of Tottori Prefecture. The liver and part of the duodenum were removed, and the bile duct, gallbladder and hepatic ducts were perfused with saline through a catheter inserted into the major duodenal papilla. Barium sulfate was injected through the catheter until the gallbladder was filled with the contrast medium, and the opening of the major duodenal papilla was sutured closed. X-ray images (40 kV, 3.0 mAs; KXO-80F, Toshiba Medical Systems Corporation, Tokyo, Japan) were taken with caudocephalocranial views of all hepatic lobes, the gallbladder and part of the duodenum. The bile and extrahepatic ducts were dissected free of surrounding tissues in order to evaluate the anatomical construction.

Because the neck of the gallbladder is tapered [3], the length of the cystic duct is not described in any books or papers we have cited. In this examination, the borders between the gallbladder and the cystic duct were not detected clearly except in 5 dogs. To estimate the length of the cystic duct, a virtual line was hypothesized as the intersection of a perpendicular line through the base of the fissure between the quadrate and left medial lobes to the long axis of the quadrate lobe. The vertical distance between the virtual line and the terminal point of the most proximal hepatic duct was taken as the length of cystic duct (Fig. 1).

Three to 4 hepatic ducts united to form bile ducts (Fig. 2). From the 50 cadavers, the terminations of the hepatic ducts were classified into 2 types (Fig. 3). In all examined dogs, the hepatic duct from the right medial lobe independently joined the CBD, and the ducts from right lateral and caudate lobes were united on the right side. On the left side, there were 2 separate hepatic ducts terminating in the CBD in 70% of the dogs, 1 from the quadrate lobe and another formed by the merging of the ducts from the left lateral and left medial lobes. In the other 30%, there was only one left hepatic duct.
that terminated in the CBD, formed by the joining of ducts from the quadrate, left lateral and left medial lobes.

The order of the termination of the hepatic ducts proximal to the gallbladder was also classified into 2 types (Fig. 4). In most of the dogs (90%), the hepatic duct from the right medial lobe was the most proximal followed by the quadrate lobe. In only 10% of the dogs, the end of the duct from the quadrate lobe terminated in the CBD more proximal than the end of the duct from the right medial lobe.

The estimated length of the cystic duct ranged from 4 to 24 mm (11.2 ± 6.4 mm); it was less than 5 mm in 12% of dogs (body weight 5–11.5 kg), 5–14.9 mm in 60% of dogs (5–25 kg) and 15–24 mm in 28% of dogs (7–16.5 kg). Regression analysis showed that there was no significant correlation between the length and body weight (p<0.01). In only two dogs, the virtual point was distal to the hepatic duct (Fig. 5). The gallbladder neck was wide in diameter and suddenly tapered where it joined the hepatic duct from the right medial lobe.

The biliary tree is complex because the canine liver is divided into 6 lobes by deep fissures [3]. Sleight and Thomford [10] reported the variations in the biliary tree based on anatomical examinations of healthy dogs. The hepatic duct is formed by 3 (36%) or 4 (64%) major tributaries. The present study using radiographs showed similar results regarding the number of hepatic ducts and their tributaries (3 hepatic ducts in 30% of the dogs and 4 in 70% of the dogs). Some studies have reported that the 2 ducts from the central division (right medial and quadrate lobes) of the liver enter the CBD immediately distal to the gallbladder [3, 10]. However, previous studies have not mentioned which is more proximal. In this study, the two hepatic ducts from the right medial and quadrate lobes were located proximal to the gallbladder. In addition, the hepatic duct from the right medial lobe terminated at the cystic duct more proximal than the quadrate lobe in 90% of the dogs.

During mobilization of the gallbladder and cystic duct, a sufficient length of the cystic duct stump is left to prevent ligature of the hepatic duct. Ligature of the hepatic duct results in icterus and an increase in alkaline phosphatase in dogs [2, 6]. The length of the cystic duct estimated in this study was more than 5 mm in most dogs (88%). These results show that an efficient approach to the cystic duct in most dogs is to detect the hepatic duct from the right medial lobe and base of the quadrate lobe. This may provide valuable information for shortening the operative period and enable the application of laparoscopic surgery to cholecystectomy. However, about 10% of the dogs showed exceptions in hepatic duct order and length of the cystic duct. Therefore, cholangiography, the basic information of which was described in the present study, is recommended for accurate diagnosis and reliable operation.

Fig. 1. Radiograph of the liver and biliary tree in a dog. The length of the cystic duct (thick white vertical line) is estimated by the distance between the virtual line and the terminal point of the most proximal hepatic duct (black arrow). The virtual line (broken line) is the intersection of the perpendicular line through the base of the fissure between the quadrate and left medial lobes (white arrow) to the long axis of the quadrate lobe (thin line). Ca: caudate lobe. Gb: gallbladder. Ll: left lateral lobe. Lm: left medial lobe. Q: quadrate lobe. Rl: right lateral lobe. Rm: right medial lobe.

Fig. 2. Radiographs showing the variations of the biliary tree. Hepatic ducts from each lobe form three (A) or four (B) main ducts (arrows) and terminate in the common bile duct. Abbreviations are the same as in Fig. 1.
Canine Extrahepatic Biliary Tree

Fig. 3. Schematic drawings of the tributaries of the hepatic ducts. In 35/50 dogs, four hepatic ducts terminate in the common bile duct (A). In 15/50 dogs, three hepatic ducts from the quadrate, left medial and left lateral lobes gather into one hepatic duct and terminate in the common bile duct. Abbreviations are the same as in Fig. 1.

Fig. 4. Schematic drawings showing the order of hepatic duct termination. The nearest hepatic duct is from the right medial lobe in 45/50 dogs (arrow in A), while in 5 dogs, the nearest hepatic duct is from the quadrate lobe (B). Abbreviations are the same as in Fig. 1.

Fig. 5. Radiographs showing the length of the cystic ducts. (A) In most cases, the termination of the most proximal hepatic duct (black arrow) is further from the gallbladder than the virtual point (broken line). (B) In only two dogs, the termination of the hepatic duct (black arrow) is located proximal to the virtual point (broken line). Thick lines indicate the length of the cystic duct estimated in this study.

REFERENCES


