

Original Research Article

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Morphology of the Gall Bladder and Extrahepatic Ducts in the Postnatal Ages of Guinea Pig

S. Rajathi*, Geetha Ramesh, T. A. Kannan, K. Raja, R. Sriram,
S. Hemalatha and S. Paramasivan

Department of Veterinary Anatomy, Madras Veterinary College, Chennai – 7, Tamilnadu
Veterinary and Animal Sciences University, India

*Corresponding author

ABSTRACT

Gall bladder is a small pocket like organ for the storage and concentration of bile. Gall bladder was collected from 24 guinea pigs of four different postnatal ages namely 0-2 weeks, 2-8 weeks, 8-16 weeks and 16-32 weeks of age with six animals each irrespective of sex were collected from the Department of Laboratory Animal Medicine, Madhavaram Milk Colony, Chennai with Ethical committee approval. Gall bladder was completely seen on the visceral surface of the liver but the body of the gall bladder was seen on the parietal surface. It was found in the gall bladder fossa located between the right medial lobe and quadrate lobe of the liver and was well adapted to the gall bladder fossa of the liver. But it was extended slightly outside the liver border. At the neck region of the gall bladder, it had a swelling which continued as cystic duct. The gall bladder with full secretion was round to elongate in shape. It was transparent in colour. When filled with bile, it had light green colouration. It was soft to touch and had smooth surface. The left hepatic duct was formed by the hepatic ducts of quadrate lobe, left lateral lobe and left medial lobe. The right hepatic duct was formed by the hepatic ducts of caudate lobe, right lateral lobe and right medial lobe. The cystic duct first joined with the left hepatic duct and then with the right hepatic duct and formed common bile duct. The common bile duct had an ampullary dilation when it opened to the duodenum. The gall bladder attached to the right medial lobe by a ligament. A small ligament was found connecting the gall bladder to the quadrate lobe.

Keywords

Gall bladder,
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Introduction

The guinea pig (*Cavia porcellus*) is a rodent species of family Cavidae and the genus *Cavia*. It was a domesticated rodent and not found in the wild (Barbara, 1974). Guinea pigs were frequently used as model organism and for biological experimentation. Because

of its robust size, it replaced other rodents like mice and rats. Guinea pigs were used as models for human medical conditions like diabetes, tuberculosis etc. Gall bladder is a small pocket like organ for the storage and concentration of bile. The concentrated bile reaches the small intestine. Gall bladder receives the bile secreted from the

hepatocytes via common hepatic duct and stores the bile. The bile from the gall bladder empties into the duodenum via cystic duct and common bile duct in mammals (Getty, 1975). The bile helps in fat digestion. The study of the postnatal development of morphology of the extrahepatic ducts of liver is scarce. So the present study was undertaken with the objective of the postnatal development of extrahepatic duct of liver in guinea pigs.

Materials and Methods

The guinea pigs were collected from the Department of Laboratory Animal Medicine, Madhavaram Milk Colony, Chennai as per the Ethical committee. Gall bladder was collected from the six number of animals from each groups mentioned in the Table 1.

The animals were anesthetized using carbon-di-oxide asphyxiation and dissected. Gall bladder was located in the abdominal cavity proximity to liver and intestines. Before dissecting the gall bladder, the topography, physical characters, course of cystic duct, common hepatic duct, common bile duct and its opening into the duodenum were studied and compared among all the age groups.

Results and Discussion

In the present study, among the postnatal ages, no specific gross morphological changes were observed except the growth of the organ.

Topography

The gall bladder of guinea pig was located in the ventral border of the liver. Gall bladder was absent in the birds like ostrich, pigeon and parrots and in rat (Faraj and Al-Bairuty, 2016; Stan, 2018a). Entire gall bladder was covered by the visceral surface of liver but a portion of gall bladder was observed on the parietal surface of the liver in the present

study (Fig. 1, 2). It was found in the gall bladder fossa located between the right medial and quadrate lobe of the liver and was well adapted to the gall bladder fossa of the liver (Fig 2). Similar results were noted in gull and Mallard duck and rabbit (Perez and Lima, 2007 and Stan, 2018). However, Stan (2018a) observed that the gall bladder of guinea pig was attached to the fossa of the quadrate lobe alone. Further, he observed that the gall bladder of Chinchillas was found on the visceral surface on the fossa between the right middle and right lobe of the liver. In desert rodent, the gall bladder was located in the depression in the right central lobe of the liver (El-Sakth *et al.*, 2008). In falcon, gall bladder was located at the posterior surface of the right lobe (AL-tae, 2017). In neonatal and adult rabbit, the gall bladder was embedded completely on the visceral surface of the right lobe with three parts, the widest part was fundus and the thinnest was its neck (Gupta *et al.*, 2017). In the present study, the gall bladder was extended slightly outside the liver border. Similar results were found in the rabbit and ferret liver, gall bladder (Poddar, 1977 and Hristov *et al.*, 2006) whereas, the gall bladder of goosidid not extended outside the liver (Subhan, 2005). At the neck region of the gall bladder, it had a swelling which continued as cystic duct (Fig. 2) in the present study. But in Goose and guinea fowl, the gall bladder had no neck (Subhan, 2005). In humans, just below the gall bladder neck, a dilated pouch at the cystic duct beginning, named Hartmans pouch was found (Ellis 2011).

Physical characters

In the present study, the gall bladder with full secretion was round to elongate in shape. It was transparent in colour. When filled with bile, it had light green colouration (Fig. 1). Goat gall bladder was yellowish white in colour and was filled with green coloured bile

juice (Bamaniya *et al.*, 2016). Falcon gall bladder was oval-shaped, thin-walled sac and dark green in colour (Al-tae, 2017) but in guinea fowl, it was fusiform and elongated in shape (Sivagnanam and Geetha, 2008). Gupta *et al.*, (2017) stated that in neonatal rabbit, gall bladder was pyriform in shape but in adult rabbit, it was cylindrical in shape. In the present study, it was soft to touch, thin walled and had smooth surface. But in Prairie dogs, the gall bladder was thin-walled and varied in shape (Grace *et al.*, 1988). In Goose, it was blind ovoid hollow musculomembranous sac and green in colour capable of distension (Subhan, 2005). Guinea pig, rabbit, ferret and goat had a pear shaped gall bladder (Poddar, 1977, Hantami-Monazah and Abdallah, 1978, Cai and Gabella, 1983 and Hristov *et al.*, 2006). But Stan (2018) observed round shaped gall bladder in guinea pigs and oval shaped in Chinchillas whereas in Chicken, it was fusiform in shape (Getty, 1975). Gall bladder was absent in horse, camel, deer, rat ostrich and pigeon (Uemura *et al.*, 2015).

Interiorly, the mucosa in the present study showed irregular folds. The wall of the gall bladder was the thickest in the cystic duct and thin in the bladder part. Similar observations were recorded in goat (Hantami-Monzah and Abdallah, 1978). But Cai and Gabella (1983) observed that the mucosa of the distended gall bladder had an areolar appearance and

displayed several prominent folds arranged transversely and obliquely.

Cystic duct

In the present study, the left hepatic duct was formed by the hepatic ducts of quadrate lobe, left lateral lobe and left medial lobe. The right hepatic duct was formed by the hepatic ducts of caudate lobe, right lateral lobe and right medial lobe (Fig.2). The cystic duct first joined with the left hepatic duct and then with right hepatic duct and formed the common bile duct (Fig. 3). Similar results were found in humans (Ellis, 2011). The common bile duct had small ampullary dilation when it opened to the duodenum. The opening of common bile duct into the duodenal lumen was in the summit of the duodenal papilla which was located 10-15 mm distal to the pylorus (Fig. 4). Similar results were observed in the guinea pig (Cai and Gabella, 1983 and Stan, 2018b). Cai and Gabella (1983) mentioned that cystic duct was 8-10 mm long and 1mm diameter. Right and left hepatic ducts were 3-5 mm long and 0.3 to 0.5 mm in diameter. The common bile duct was 11 mm long and 1.0-1.5 mm diameter. The angle formed between the bile duct and duodenum was 300 degrees. But Cai and Gabella (1983) found a pouch of 4mm long and 3mm wide within the duodenal wall.

Table.1 Group wise distribution of animals

S. No.	Group	Age	No. of Animals
1	I	0-2 weeks	6
2	II	2-8 weeks	6
3	III	8-16 weeks	6
4	IV	16-32 weeks	6

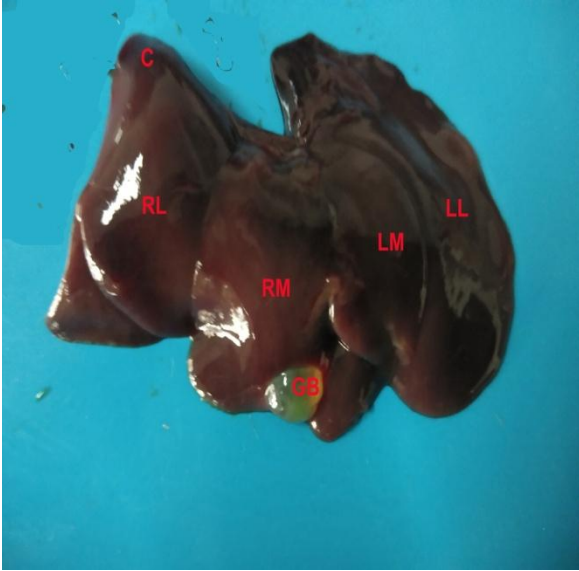


Fig.1 showing the dorsal surface of liver with Right lateral (RL), Right medial (RM), Left Medial (LM), Left lateral (LL) and Caudate (C) lobes with GB – Gall Bladder of 2 week old guinea pig

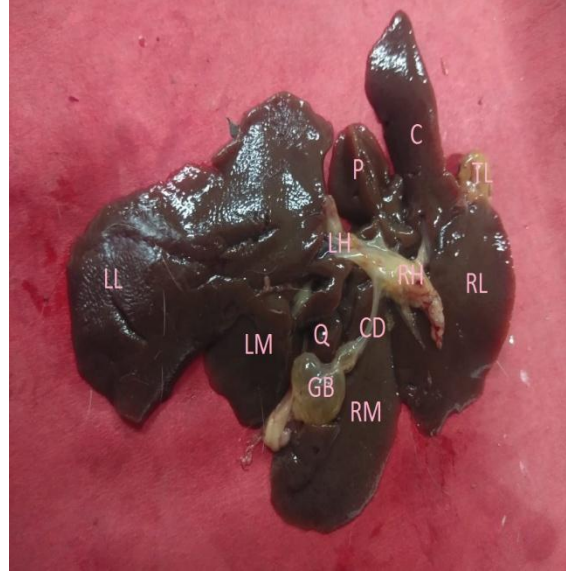


Fig.2 showing the ventral surface of liver with Right lateral (RL), Right medial (RM), Left Medial (LM), Left lateral (LL), Quadrate (Q) and Caudate (C) lobes, papillary process (P) with GB – Gall Bladder of 32 week old guinea pig
CD – cystic duct LH – Left hepatic duct
RH – Right hepatic duct

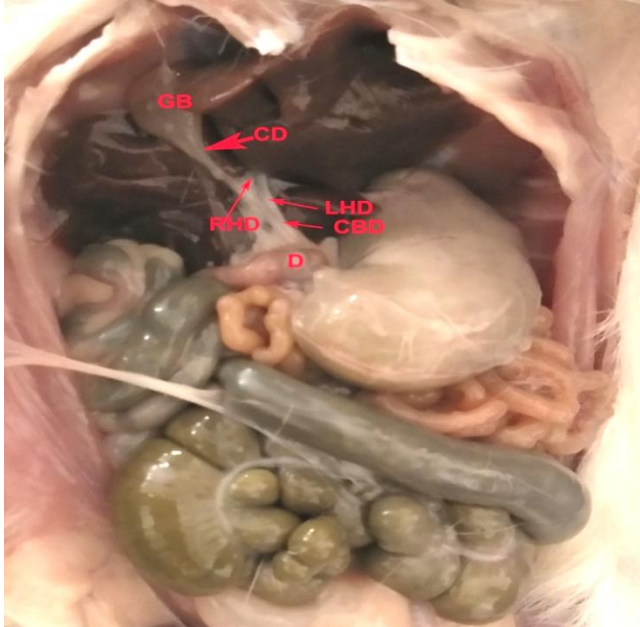


Fig.3 showing the cystic duct (CD) and Right hepatic duct (RHD), Left hepatic duct (LHD) and Common hepatic duct (CHD) opening to the duodenum (D) of 12 week old guinea pig
GB – Gall Bladder



Fig.4 showing the opening of cystic duct (CD) and hepatic duct (HD) to the duodenum (D) of 2 week old guinea pig
HGL – Hepatogastric ligament
RL, LL – Right and Left lobes of liver



Fig.5 Showing the insitu view of gall bladder (GB) with cystic duct and gall bladder ligament of 5 week old guinea pig
HGL – ligament from liver to gall bladder
GHL – Hepatogastric ligament
RL, LL – Right and Left lobes of liver
S – Stomach P (arrows) –Pylorus

Grace *et al.*, (1988) observed in Praire dogs that the cystic duct was 20.0 ± 5.5 mm in length. In contrast to the present observations, bile ducts of the right lateral and caudate lobes entered the common bile duct directly and the diameter of the common bile duct was 1.4 ± 0.4 mm. At its lower end, the common bile duct formed an S-shaped configuration. The common bile duct entered the small papilla of the duodenal lumen approximately 5 mm distal to the pylorus. The lower end of the common bile duct dilated to form a well-defined ampulla. The sphincter choledochus (sphincter of Oddi) and ampulla measured 8-10 mm in length and 2-3 mm in diameter. The

intraduodenal portion of the ampulla was surrounded by a thickened band of circular muscle fibres, which formed the sphincter of Oddi. In rabbit, Barone (2009) described the absence of common hepatic duct and the presence of two hepatic ducts, the left duct which draining the left lobes and the quadrate lobe joined the cystic duct to form the common bile duct, which received the right hepatic duct, formed by the union of the ducts draining the right lobe and the caudate lobes. But chinchilla gall bladder had a complex system of extrabiliary tract with multiple cystic ducts. Chinchillas also had multiple anastomosing hepatic ducts (Cai and Gabella,

1983). And also mentioned that in guinea pigs, the common hepatic duct was absent which was contrast with the present study.

Ligaments

The gall bladder attached to the right medial lobe by a ligament. A small ligament was found connecting the gall bladder to the quadrate lobe. Similar observations were reported by Stan (2018b) in guinea pigs. A two ligaments which branched from the ligament connecting liver with gall bladder connected the gall bladder with the stomach named hepatogastric ligament was also found on both the borders of the gall bladder (Fig. 5)

From this study, it is concluded that the gall bladder did not structurally differ as age increased. Only the size of the gall bladder and the extrahepatic duct were increased as age increased. Gall bladder in guinea pig was located in the gall bladder fossa and was slightly extended outside the surface of the liver. It had a swelling in the neck region and continued as cystic duct. Gall bladder in guinea pig was round to elongate in shape and transparent in colour.

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