Haryana Vet. (March, 2024) **63(SI),** 114-118 ISSN 0033-4359 (P) **Short Communication**

POSTNATAL GROSS ANATOMICAL DEVELOPMENT OF LIVER IN GUINEA PIGS (*CAVIA PORCELLUS*)

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SUMMARY

The present study was undertaken to assess the gross anatomy of the liver in guinea pigs of four postnatal age groups. Liver was collected from the guinea pigs received from department of Laboratory Animal Medicine, Chennai. The liver in guinea pig was found on the right side of the cranial and middle part of the abdominal cavity whereas in pre-weaning guinea pig, it was located on the entire cranial part of the cavity. In the preweaning guinea pig, the colour of the liver was dark reddish brown, whereas in animals from 2-8 weeks to 16-32 weeks of age, it was pale, reddish brown. The liver showed six lobes, namely the right lateral lobe, the right medial lobe, quadrate lobe, left medial lobe, left lateral lobe and caudate lobe The left lateral lobe was the largest. The right medial lobe was separated from the left lobe by falciform ligament. The caudate lobe had two parts namely caudate process and papillary process. In all the age groups, the liver showed parietal and visceral surfaces. The hilus or portal fissure of the liver was noticed in the transverse groove formed between the dorsal and ventral parts of the liver on the visceral surface. In the liver of guinea pig of the all age groups studied, four borders were observed *viz*., dorsal border, ventral border, right border and left border. The liver of guinea pig in all the groups studied showed six ligaments namely falciform ligament, coronary ligament, round ligament, triangular ligament, hepatorenal ligament and hepatogastric ligament. The liver of guinea pigs showed similar features of other mammalian liver like lobulation, colouration, topography and relations but showed slight variations with respect to its species.

Keywords: Development, Gross anatomy, Guinea pigs, Liver

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The experimental animals like guinea pigs, mouse, rats, pigs and monkeys play an important role in human medicine, since the anatomical structure of the organs of experimental animals is similar to anatomical structure of the organs of humans (Al-Sharoot, 2014). Since, there is a paucity of literature on the structure of liver in guinea pig the present research work is carried out with the following objective to study the gross anatomy of the liver in postnatal age groups of guinea pig.

The gross anatomy of the liver of 6 numbers of guinea pig each from postnatal age groups (Preweaning (0-2 weeks), Weaning (2-8 weeks), Young one (8-16 weeks) and Adult (16-32 weeks)) was conducted at the Department of Veterinary Anatomy, Madras Veterinary College, Chennai. Guinea pigs were procured from the Department of Laboratory Animal Medicine, Madhavaram Milk Colony, TANUVAS, Chennai. After collecting the guinea pigs, they were euthanized as per the standard operating procedure by using the Carbon dioxide asphyxiations as per CPCSEA norms and subjected to the dissection.

After careful dissecting of the animals, the liver was dissected, and gross anatomical observations were recorded in all the postnatal age groups.

ETHICAL APPROVAL

The animal ethical committee of the Madras Veterinary College, Tamilnadu Veterinary and Animal Sciences University, Chennai, India had approved the collection of laboratory animals and handling as per the Ethical Committee approval (Lr. No. 1467/DFAB/IAEC/2018 dated 13.07.2018). The methods were performed in accordance with the guidelines of the institutional ethical committee of TANUVAS, India. All procedures were performed in accordance with the CPCSEA norms.

TOPOGRAPHY

The liver in guinea pig was the largest gland in the body and was found on the right side of the cranial and middle part of the abdominal cavity (Fig. 2). Similar results were recorded in rabbit (Hristov *et al.*, 2006), nutria (Perez and Lima, 2007), human (Sherif *et al.*, 2010) and guinea pig, rat, rabbit and chinchilla (Stan, 2018). In contrast to this observation, Ibrahim *et al.* (2016) stated that the liver of birds was located in both right and left hepatoperitoneal cavity. In pre-weaning guinea pig, the liver was located on the entire cranial part of the abdominal cavity (Fig. 1). The liver was covered by last four ribs and had little costal impression on the diaphragmatic surface of the liver in the 12 week-old and 24 week-old guinea pigs. Similar findings were observed by Gupta *et al.* (2017) in rabbit liver. The half of the mass of the liver was located in the intrathoracic part of the abdominal cavity. The liver was related to the gall bladder, diaphragm, stomach,

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intestines and lesser omentum in all the postnatal groups studied (Fig. 2). Caudate lobe of the liver was related to the right kidney (Fig. 7).

PHYSICAL CHARACTERS

In preweaning guinea pig (three days of age), the colour of the liver was dark reddish brown (Fig. 1), whereas in adult animals from 2-8 weeks to 16-32 weeks of age, it was pale, reddish brown in colour (Fig. 2). The liver was soft to touch and had compact appearance in all the postnatal group of animals studied. It was curved and adapted to the abdominal face of diaphragm (Fig. 3).

LOBATION

The liver of the guinea pig showed six lobes namely the right lateral lobe, the right medial lobe, quadrate lobe, left medial lobe, left lateral lobe and caudate lobe in all the groups studied (Fig. 4). In contrast to this, three lobes in rat liver (Hebel and Stromberg, 1986), four lobes in praire dog (Grace *et al.*, 1988), five lobes in Muridae and Dipodidae families of rodent (El-Salkh *et al.*, 2008), five lobes in adult rabbit (Stamatova *et al.*, 2012 and Verma *et al.*, 2015), four lobes in rats (Hollander *et al.*, 1984), five lobes in rabbit (Stan, 2018) and four lobes in adult guinea pigs (Imam *et al.*, 2021). Similar observations regarding the number of lobes were found in adult guinea pig (Stan, 2018). The left lateral lobe was the largest and was found visible on both visceral and parietal surface in all the postnatal ages studied. Similar results were observed by Hebel and Stromberg (1986) in rat liver, Grace *et al.* (1988) in praire dog and Stan (2018) in guinea pig. It was found on the left most part of the abdominal cavity and related to diaphragm, stomach and left body wall. On the parietal surface, it was covered to some extent by left medial lobe. The left medial lobe was observed to be medial to the left lateral lobe and was also visible on both the surfaces of the liver. The quadrate lobe was found medial to the left medial lobe. It was visible to some extent on the parietal surface but clearly visible on the visceral surface (Fig. 4). Similar findings were observed by Stan (2018) in rabbit. It was related to the gall bladder, portal fissure, round ligament and quadrate lobe, intestines and lesser omentum (Fig. 2). Dorsal to the portal fissure, attachment of the caudate lobe was identified in all the age groups studied.

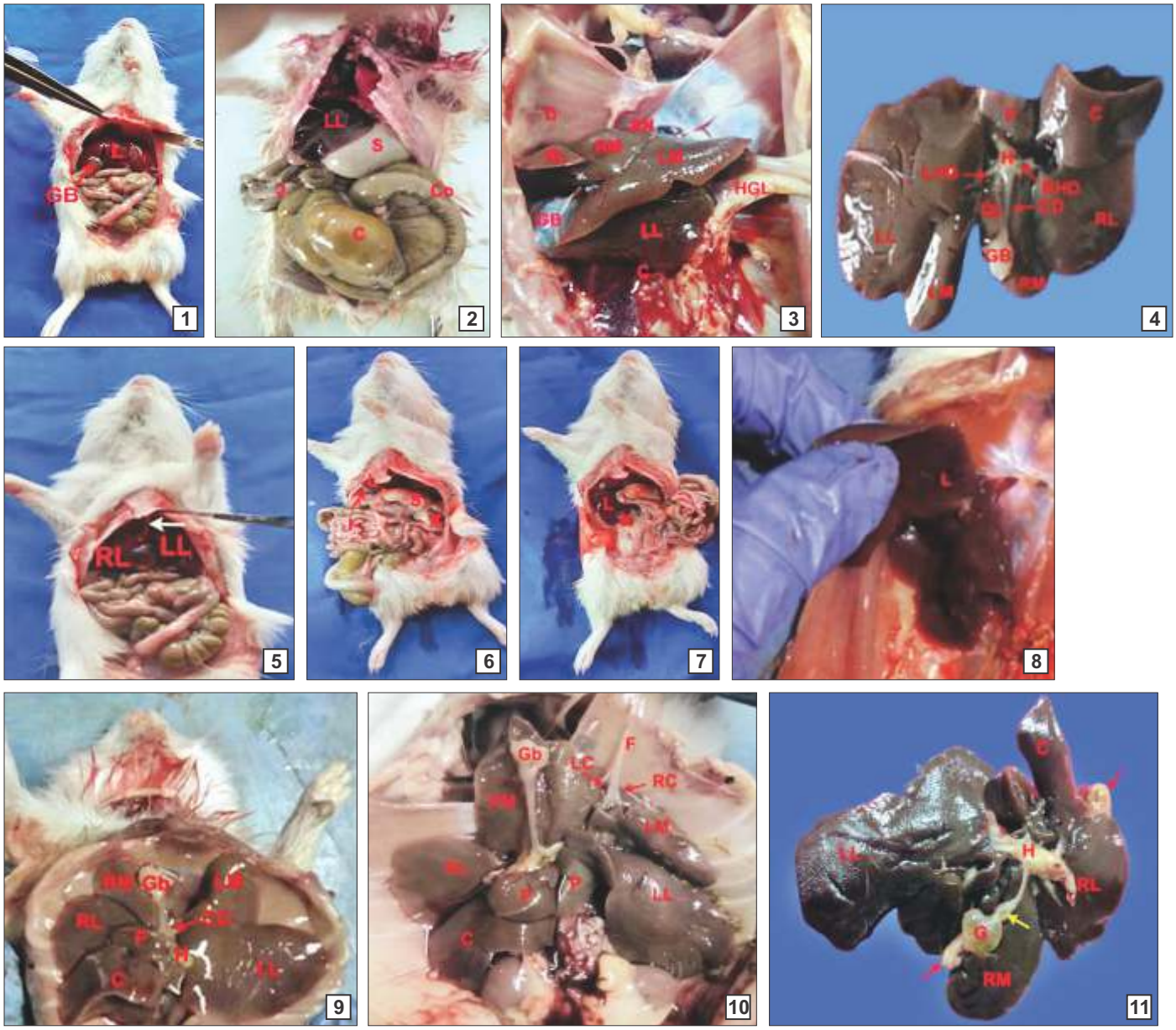
The right medial lobe was noticed medial to the left medial and quadrate lobe and was separated from the left lobe by falciform ligament (Fig. 5) in all the postnatal ages of guinea pigs studied. The right medial lobe was visible on both the surfaces of the liver. It was related to the gall bladder, intestines and lesser omentum on the visceral surface (Fig. 6). The right lateral lobe was found on the extreme right side of the abdominal cavity and was visible on both the surfaces. It was found related to the right body wall and diaphragm. The visceral surface was related to the ligaments and intestines. The visceral surface showed a groove for the posterior vena cava and was seen in all the postnatal age groups of animals studied. The ventral border of the right lateral lobe had caudate lobe (Fig. 7).

The caudate lobe had two parts namely caudate process and papillary process in all the postnatal ages of guinea pigs. Stamatova *et al.* (2012) and Verma *et al.* (2015) in adult rabbit, Stan (2018) in rabbit and guinea pig observed similar findings whereas caudate lobe in praire dog was divided into anterior and posterior lobule (Grace *et al.*, 1988) and in rats, it was divided into dorsal and ventral lobe (Stan, 2018) but in the present study undivided caudate lobe was found. The caudate process was well developed with renal impression of the right kidney. Similar findings were recorded by Stan (2018) in rabbit and guinea pig. The papillary processes were two in number and triangular in shape (Fig. 4). They were in contact with the lesser curvature of the stomach. The visceral surface of the caudate and left lateral lobe had small notches.

SURFACES

In all the age groups, the liver showed two surfaces namely parietal and visceral surface. Similar findings were recorded by Perez and Lima (2007) in nutria liver, Stamatova *et al.* (2012), Verma *et al.* (2015), Gupta *et al.* (2017) in rabbits, Stan (2018) in rat, rabbit, guinea pig and chinchilla. The parietal surface was convex, smooth and adapted to the contour of the abdominal wall. It consisted of four lobes namely left lateral, left medial, right medial and right lateral lobes (Fig. 3) and visceral surface showed six lobes as stated by Stan (2018) in guinea pig. But in chinchilla, the parietal surface of the liver showed three lobes and visceral surface with four lobes (Stan, 2018) which may be due to species difference. Between the left medial and right medial lobe, falciform ligament was found (Fig. 5) and was thin in 10 days of age. The right lateral lobe on its cranial border showed area nuda, in which the liver surface was observed to be in direct contact with the diaphragm without any peritoneal covering (Fig. 8) and was in accordance with the findings of Stan (2018) in rats.

The visceral surface was concave and was found related to the stomach, descending duodenum, pancreas, transverse colon, spleen, right kidney and right adrenal gland (Fig. 7). On the visceral surface of the caudate lobe, renal impression for the right kidney was found in all the postnatal age groups of guinea pigs studied. Similar observations were reported by Perez and Lima (2007) in nutria liver, Stamatova *et al.* (2012), Verma *et al.* (2015),



Figs. 1 to 11. **(1)** Photograph of the liver in 10 day-old guinea pig showing its location in the entire cranial surface of the abdomen [L -Liver GB - Gall bladder]; **(2)** Photograph showing the topography of the liver of 10 week-old guinea pig with its relation to other organs [LL - Left lateral lobe S - Stomach, J - Jejunum C - Caecum, Co - Colon]; **(3)** Photograph of the liver in 8 week-old guinea pig showing its adaptation to the abdominal face of diaphragm [LL - Left Lateral lobe D - Daiphragam AN - Area nuda LM - Left medial lobe, RM - Right medial lobe RL - Right lateral lobe C - Caudate lobe GB - Gall bladder, HGL - Hepatogastric ligament]; **(4)** Photograph of the liver in 12 week-old guinea pig showing its visceral surface with the hilus (H) [LL - Left Lateral lobe LM - Left medial lobe, RM - Right medial lobe RL - Right lateral lobe C - Caudate lobe QL - Quadrate lobe P - Papillary process GB - Gall bladder, CD - Cystic duct LHD - Left hepatic duct, RHD - Right hepatic duct]; **(5)** Photograph of the liver in 2 week-old guinea pig showing the falciform ligament (arrow) [LL - Left Lateral lobe RL - Right lateral lobe]; **(6)** Photograph of the liver in 4 week-old guinea pig showing the relationship with stomach (S) and intestine (I) [L - Liver K - Kidney Arrow - Gall bladder]; **(7)** Photograph of the liver in 10 day-old guinea pig showing the relationship of caudate lobe with right kidney [L - Liver K - Kidney]; **(8)** Photograph of the liver of four week-old guinea pig showing the attachment of the parietal surface of the liver with diaphragm [L - Liver D - Diaphragm]; **(9)** Photograph of the liver of 28 week-old guinea pig showing the visceral surface with hilus (H) [LL - Left Lateral lobe LM - Left medial lobe, RM - Right medial lobe RL - Right lateral lobe C - Caudate lobe P - Papillary process Gb - Gall bladder CD - Cystic duct]; **(10)** Photograph of the liver in 12 week-old guinea pig showing the right caudate (RC) and left caudate (LC) ligaments on the visceral surface [LL - Left Lateral lobe LM - Left medial lobe RM - Right medial lobe RL - Right lateral lobe C - Caudate lobe P - Papillary process GB - Gall bladder F - Falciform ligament]; **(11)** Photograph of the liver in 28 week-old guinea pig showing the visceral surface with hilus (H) [LL - Left Lateral lobe RM - Right medial lobe RL - Right lateral lobe C - Caudate lobe G - Gall bladder]; Dilatation of cystic duct (Yellow arrow), Right and left triangular ligaments (Red arrow)

Gupta *et al.* (2017) in rabbits, Stan (2018) in rat, rabbit, guinea pig and chinchilla. On the visceral surface, six lobes were seen which were separated by deep fissures and was less deep in 0-2 weeks of age and became deeper from 2-8 weeks to 16-32 weeks of age. Left lateral, left medial, quadrate, right medial, right lateral and caudate lobes were found with two papillary processes and hilus of the liver found between the two papillary process and the right

medial lobe (Fig. 9).

The hilus or portal fissure of the liver was noticed in the transverse groove formed between the dorsal and ventral parts of the liver on the visceral surface (Fig. 4) in all the age groups of guinea pigs of present study. The location of portal fissure in the visceral surface of the liver was as reported by Perez and Lima (2007) in nutria and Stamatova *et al.* (2012) in adult rabbit. Hilus was observed with the hepatic artery and portal vein entered the liver and bile duct emerged. The portal fissure was seen with a common bile duct, hepatic artery and portal vein. The common bile duct was found on the ventral border of right side of the liver. The hepatic artery was found on the left side. The portal vein was found located on the dorsal surface of the bile duct and hepatic artery. Posterior vena cava was found dorsal to the portal vein. The cystic duct was found connecting the common bile duct with the gall bladder (Fig. 4).

In the liver of guinea pig of the all age groups studied, four borders were observed *viz.*, dorsal border, ventral border, right border and left border. The dorsal border was rounded and had impression of posterior vena cava and oesophagus and the ventral border was sharp. The ventral border of the left lobe was observed to be related to the stomach, duodenum, pancreas and to some extent left kidney. The ventral border of right lobe was in relation with the proximal colon. The lateral border was sharp and found between the diaphragm and hypochondrium. The medial border of right side showed falciform ligament.

LIGAMENTS

The liver of guinea pig in all the groups studied showed six ligaments namely falciform ligament, coronary ligament, round ligament, triangular ligament, hepatorenal ligament and hepatogastric ligament.

In the present study, the falciform ligament was well developed and noticed as a thin white band connected the parietal surface of liver on the insertion of the medial lobes with the diaphragm at the xiphoid cartilage and the ventral abdominal wall (Fig. 5) in 0-2 weeks of age and was found thicker in the guinea pigs of age groups from 2-8 weeks to 16-32 weeks. Similar results were observed by Perez and Lima (2007) in nutria liver and Stan (2018) in rats and rabbits. It separated the right and left lobes of the liver. The round ligament was found on the free margin of the falciform ligament, which connected with the umbilicus as stated by Sherif *et al.* (2010) in human liver and Stan (2018) in rats whereas Stan (2018) stated that round ligament was absent in rabbits. The falciform ligament divided the left medial lobe from quadrate lobe on the visceral surface.

The coronary ligament was observed as a direct continuation of falciform ligament on the viseral surface (Fig. 10). The coronary ligaments were two in number namely right and left and were found in the liver of 2-8 weeks old and 16-32 week-old guinea pig and were in accordance with the findings of Sherif *et al.* (2010) in human liver and Stan *et al.* (2017) in adult guinea pigs. The coronary ligament was not observed in the liver of 0-2 weeks of age and the coronary ligament was not seen as two divisions in the liver of 8-16 weeks of age. The right coronary ligament had upper and lower layer. The upper layer was observed to be connected the dorsal margin of the area nuda to the diaphragm. The lower layer was found below the upper layer and connected the diaphragm with dorsal margin of the liver.

The dorsal border of the liver had two triangular ligaments namely right and left and was observed in the liver of 16-32 weeks of age (Fig. 11) as stated by Sherif *et al.* (2010) in human liver and Stan (2018) in rats and guinea pigs. The right triangular ligament was short. The coronary ligament of the right side was continued as small right triangular ligament. The left triangular ligament was well developed, undivided and connected the dorsal part of the left lateral lobe to the diaphragam whereas Perez and Lima (2007) noted two parts of each left and right triangular ligament in nutria liver.

The hepatorenal ligament was observed on the ventral border of the caudate lobe to the medial aspect of the right kidney and duodenum. Similar findings were observed in nutria liver by Perez and Lima (2007) and in rabbits and guinea pigs liver by Stan (2018). The hepatogastric ligament was found connected the lesser curvature of the stomach with the papillary process as stated by Stamatova *et al.* (2012) in adult rabbit liver and Stan (2018) in guinea pig liver. On the right side, the hepatogastric ligament was continued as hepatoduodenual ligament but was wide in chinchilla as stated by Stan (2018).

CONCLUSION

The liver in guinea pig was similar to other mammalian animals in terms of lobulation, topography, colour and relations but showed certain unique features of guinea pig like maximum number of lobes, location of portal fissure, location of gall bladder, colouration, and ligaments. The liver of preweaning guinea pigs was dark brown in colour showing that functionality of the liver was just started but from weaning to adult, the liver colour turned to pale brown. The change in the colour of the liver from preweaning to adult indicated the funcational activity of the liver. The location of the liver in the preweaning guinea pig was found in the entire cranial part of

abdominal cavity but from weaning to adult, it was located in the cranial right side of the abdomen. This proves that the liver was the largest organ and well developed organ in the fetal stage but as age advances it related to the adult liver.

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