

## Microscopic Anatomy of Liver in Cats of Tirunelveli Region

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### ABSTRACT

The liver of cat comprised of six lobes namely left lateral, left medial, quadrate, caudate, right lateral and right medial. The livers were collected from six freshly dead cats presented for post-mortem examination. The liver was cut into small pieces, fixed and routine histological processing was done and paraffin blocks were prepared. The paraffin sections of 3-5 micrometer thickness were cut and stained. The liver was the compound tubular gland with a layer of connective tissue capsule enclosing the parenchymatous tissue. The liver consisted of capsule, septa and lobules. The arrangement of hepatocytes in the lobule was in radiating cords. Hepatic sinusoids were observed between the hepatic cords. The hepatocytes were polygonal in shape with vacuolated eosinophilic cytoplasm. The dark blue stained nuclei were centrally located with single dot shaped nucleoli. The sinusoids were lined by single layer of flat squamous sinusoidal endothelial cells with flat centrally located nucleus. The sinusoidal lumen also contained Kupffer cells along with blood cells. The central vein was located at the centre of the hepatic lobule with narrow to wide lumen. The portal areas were observed at the corners of the hepatic lobule with branches of the hepatic artery, portal vein and bile duct. The size of the bile duct was from small to large in different portal areas.

**Key words:** Microscopic anatomy, liver, cat

### INTRODUCTION

The liver is the largest gland in the animal body performing the metabolic function relating to digestion. The average weight of the organ in adult cat is about 3-5 percent of the body weight. The liver filters the blood and does functions necessary for life. Liver is a multi-lobed organ located within the abdominal cavity directly behind the diaphragm with proportionally more of the liver on the right side (Spielman, 2015).

The liver of cat consisted of six lobes namely the left lateral, left medial, quadrate, caudate, right lateral and right medial. The liver parenchyma was formed with parenchymatous and non-parenchymatous cells along with connective tissue (Reem *et al.*, 2019). The histological investigations on the liver of guinea pigs, dogs has been conducted (Rajathi, 2021; Shunmugam and Muthukrishnan, 2024). The comparative histology of the liver of different vertebrates like rats, birds and fishes were studied by Odokuma and Omokora (2015). Hence the research work was carried out to investigate the microscopic

details of liver in adult cats.

### MATERIALS AND METHODS

The liver was collected from six freshly dead cats of the local Non-Descript breed of Tirunelveli district aged between 2-3 years (of both sex) from post-mortem examination and studied for their microscopic anatomy. The liver was cut into small pieces and fixed in 10% neutral buffered formalin for 24-48 hours and routine histological processing was done and paraffin blocks were prepared. The paraffin section of 3-5 micrometer thickness were cut using manual rotary microtome and stained using Haematoxylin and Eosin and Van Gieson's method for collagen fibres (Luna, 1968). The images were recorded using an image size recording system and a digiscope imaging system.

### RESULTS AND DISCUSSION

The microscopic anatomy of the liver of the cat was visualized using lobule concept of demonstration of liver histology and the liver lobule was the structural unit of the liver. The acinus was the functional unit of the liver with portal vein at the centre and central vein at the periphery. The liver lobule consisted of central vein at the centre and portal tract at its

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periphery. The areas in between the central vein and portal tract were divided into three areas and were named as pericentral (around central vein), periportal (around portal tract) and mid-central (between pericentral and periportal). So the blood from portal tract, rich in oxygen and nutrients flowed to periportal, mid-central and then to pericentral areas (Reem *et al.*, 2019).

The microscopic anatomy of the liver of the male and female cats was almost similar without any significant structural differences. The liver was the compound tubular gland with a layer of connective tissue capsule enclosing the parenchymatous tissue (Fig. 1). Similar results were observed by Rajathi (2021) and Shunmugam and Muthukrishnan (2024) in guinea pigs and dogs respectively. But they observed a thin connective tissue capsule and in the present study a thick capsule was found which might be due to species differences. The connective tissue capsule was comprised of dense irregular connective tissue cells and fibres mainly collagen fibres (Fig. 1) as reported by Gupta *et al.* (2017) in rabbits. Faraj (2018) observed a layer of smooth muscle fibres in the capsule of marsh harrier birds and the same could be identified in the present study with few isolated smooth muscle fibres.

The hepatocytes were arranged like cords radiating from central region to periphery of the lobule (Fig. 2). The hepatocyte cords were single cell thick as observed in rabbits (Gupta *et al.*, 2017) and dogs (Shunmugam and Muthukrishnan, 2024). But Elias *et al.* (1971) observed two cell arrangement of hepatocytes as two cords in domestic chicken which might be due to species variation and feed adaptation. Hepatic sinusoids were observed between the hepatic cords (Fig. 3). Separation of the liver into lobules was not evident in the present study as the connective tissue fibres (septa) were not found in the lobules except in the portal triad areas as discussed by Gupta *et al.* (2017) in rabbit and Rajathi (2021) in guinea pigs.

The hepatocytes were polygonal in shape with eosinophilic vacuolated cytoplasm. The dark blue stained nucleus was centrally located with single dot shaped nucleoli (Fig. 2). Similar reports were also recorded by Rajathi (2021) in guinea pigs. However oval shaped hepatocytes were observed in rats (Rady and Amani, 2016) and polyhedral shaped in dogs (Shunmugam and Muthukrishnan, 2024). This may be due to species difference. Binucleated

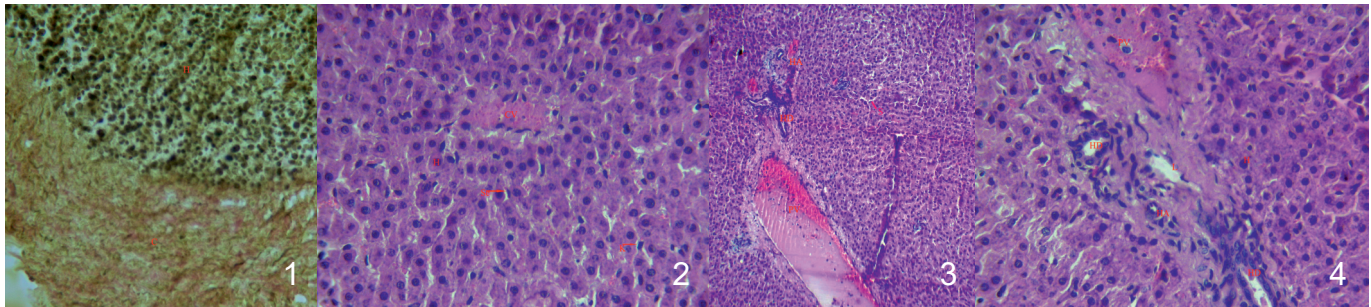
hepatocytes were rarely observed in the present study as reported by Shunmugam and Muthukrishnan (2024) in dogs but were commonly seen in the guinea pigs (Rajathi, 2021). The sinusoids were noticed in between the hepatocyte cords as irregular thin walled spaces with narrow lumen. The lumen contained most of the blood cells namely erythrocytes and leucocytes. The sinusoids were lined by single layer of flat squamous sinusoidal endothelial cells with flat centrally located nucleus (Fig. 2). The sinusoidal lumen also contained Kupffer cells (Fig. 2) along with blood cells.

The Kupffer cells were large, irregular shaped, eosinophilic with many cytoplasmic processes and contained centrally located dark blue stained round nucleus (Fig. 2) as reported by Gupta *et al.* (2017) in rabbit and Rajathi (2021) in guinea pigs. But Kupffer cells were polygonal in shape in dogs (Shunmugam and Muthukrishnan, 2024).

The central vein was located at the centre of the hepatic lobule with narrow to wide lumen (Fig. 2) and was lined by simple squamous epithelium. Tunica intima and tunica media comprised of few layers of connective tissue fibres and smooth muscle fibres and tunica adventitia comprised of connective tissue fibres continuous with hepatic cords were present. The location of the central vein shared the reports of Hassan *et al.* (2018) in rats. The simple squamous epithelial lining of central vein also continued to the hepatic sinusoids. The portal areas were observed at the corners of the hepatic lobule with branches of the hepatic artery, portal vein and bile duct which constituted the portal triad (Fig. 3). Some portal areas contained nerve fibres and lymphocytes in addition to the hepatic artery, portal vein and bile duct (Fig. 4). Similar results were also observed by Hassan *et al.* (2018) in rats and Shunmugam and Muthukrishnan (2024) in dogs.

The hepatic artery contained tunica intima with lining epithelium of simple squamous epithelium, internal elastic membrane, tunica media with smooth muscle fibres and tunica adventitia with few layers of connective tissue fibres (Fig. 4). The lumen was small, round to oval in shape. The layers of smooth muscle fibres in the media layer was comparatively more than the central and portal vein as stated by Rajathi (2021) in guinea pigs and Shunmugam and Muthukrishnan (2024) in dogs.

The size of the bile duct was from small to large in



**Fig. 1:** Photomicrograph showing the liver section of adult cat with Capsule (C) and Parenchyma (H) Van Gieson Method x 400; **Fig. 2:** Photomicrograph showing liver of adult cat with central vein (CV), Hepatocytes (H), Sinusoidal Epithelium (Se) and Kupffer cell (K) H & E x 400; **Fig. 3:** Photomicrograph showing the liver of adult cat with sinusoids (S), Hepatic artery (HA), Bile duct (BD) and Portal vein (PV) H & E x 100; **Fig. 4:** Photomicrograph showing the liver of adult cat with hepatocytes (H), Hepatic artery (HA), hepatic duct (HD), Lymphocytes (L) and Portal vein (PV) H & E x 400.

different portal areas as stated by Ijzer *et al.* (2009) in cats. The small ducts were lined by simple cuboidal epithelium with centrally located round nucleus and eosinophilic cytoplasm surrounded by few layers of connective tissue fibres. The large ducts were lined by simple columnar epithelium with round to oval shaped nucleus located at the basal part of the cell within the eosinophilic cytoplasm. The epithelium of the large ducts was surrounded by many layers of smooth muscle fibres and connective tissue fibres. Similar observation was recorded in dogs (Shunmugam and Muthukrishnan, 2024). They mentioned irregular shaped nucleus but in the present study it was round to oval in shape which may be due to species and feed variation.

The portal vein was found with an irregular wide lumen with a lining epithelium of simple squamous type in tunica intima, tunica media with few layers of smooth muscle fibres and tunic adventitia with many layers of connective tissue fibres as stated by Rajathi (2021) in guinea pig and Shunmugam and Muthukrishnan (2024) in dogs. Lymph vessels were also observed in the portal areas with simple squamous epithelium surrounded by connective tissue fibres (Fig. 4).

### CONCLUSION

The microanatomical observations of liver of the cat resembled with the histology of liver of other vertebrates species. The occurrence of binucleated hepatocytes were rare in the present study as compared to reports of more of these cells in laboratory animals and birds indicating the development of the organ from acini-like morphology to the cord-like morphology. There were also some changes in the shape of the cells and nucleus when compared to dogs, laboratory animals and birds which might be due to differences in the

food and digestion pattern.

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