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Short Communication

Histo-Architecture of The Pancreas in Adult Dogs

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Abstract

The pancreas consists of exocrine and endocrine portions. The work was conducted in six adult dogs of different breeds. The gland was removed cut and fixed in 10 percent neutral buffered formalin and Bouin' s fluid. The normal tissue processing was done and paraffin blocks obtained and was cut into 5-micron thick sections and stained by the H & E technique. The pancreas of a dog is a compound tubulo-alveolar gland. It was surrounded by a loose connective tissue capsule. Connective tissue septa entered into the parenchyma and divided it into many lobes and lobules. Each lobule of parenchyma consisted of exocrine and endocrine portions. Islets of Langerhans were seen as scattered clusters of pale pink stained cells among the dark blue stained acinar cell units of the exocrine portion. The exocrine portion consisted of many secretory acini along with the duct system. Each acinus consisted of varying numbers of single rows of polygonal-shaped acinar cells. The duct system consisted of centroacinar cells, intercalated ducts, intralobular ducts, interlobular ducts and the main pancreatic duct. The pancreatic duct lumen was very large and was lined by columnar epithelium.

Keywords: Acini, Dog, Histology, Islets, Pancreas.

Introduction

Pancreas is the accessory vital gland located on the right side of the abdomen adjacent to the stomach. Dog pancreas consisted of a body and left and right lobes and was related to the duodenum, pylorus and spleen (Evans and DeLahunta, 2013). Pancreas in all domestic animals is consisted of exocrine and endocrine portions. The exocrine portion of pancreas has two types of epithelial cell types namely acinar and ductal epithelial cells. The exocrine portion secretes digestive juices to assist in food digestion. The endocrine part hormonal secretion regulates the metabolism of carbohydrates, proteins and fats. The exocrine part of pancreas is a tubulo-alveolar gland. The endocrine portions islets of Langerhans which consisted of three types of cells each produces different hormone. Beta cells produce insulin, alpha cells produce glucagon and delta cells produce stomatostatin. Insulin and glucose work together to maintain adequate glucose concentration in blood and other body fluids (Getty, 1975). Diabetes mellitus is a chronic disorder of carbohydrate metabolism caused by deficiency of insulin. Middle aged female dogs were most commonly affected with diabetes mellitus. Dogs were also affected with pancreatitis, pancreatic cysts and abscesses. So the study of histology of pancreas will definitely form the basis for understanding the pathogenecity of the disease. With this objective the current research was taken to study the histoarchitecutre of pancreas in adult dogs.

Materials and Methods

The present work was conducted in six adult dogs (Irrespective of sex) of different breeds collected from the Post-Mortem samples. The pancreas was observed on opening the abdominal cavity and relationships were studied. The gland was cleaned and morphology was recorded. Then the gland was cut into small pieces and fixed in 10% neutral buffered formalin and Bouin's fluid. The fixed tissue was then dehydrated in ascending series of alcohol, cleared in xylene and embedded in paraffin. The paraffin block was cut into 5 micron thick sections using manually operated Leica Microtome. Then the sections were stained by H & E technique (Luna, 1969). The slide were examined under microscope and photographed using Lynx Trinocular microscope with imaging system software.

Results and Discussion

Pancreas

The pancreas in the present study consisted of a body and left and right lobes and was located in the abdominal cavity related to the duodenum, pylorus and spleen as stated by Horalsky *et al* (2020) in clinically healthy dogs. The pancreas of dog was a compound tubulo-alveolar gland with serous secreting exocrine and hormone secreting endocrine portions (Fig. 1).

Capsule

In all dogs studied, the pancreas was surrounded by a loose connective tissue capsule as reported by Budipitajo *et al*. (2016) in Sunda porcupine and Rajathi (2021) in guinea pigs. Thin smooth muscle fibres were observed in the capsule. The distribution of fat cells was observed beneath the capsule and in the septa (Fig. 2). Blood vessels, nerve fibres were seen in the capsule of all dogs studied.

From the capsule, connective tissue septa entered into the parenchyma and divided it into many lobes and lobules (Fig. 2). Similar results were also recorded by Garg *et al*. (2007) in the pancreas of porcupine and Rajathi (2021) in guinea pigs whereas Fattah (2008) noticed thin connective septa in the pancreas of albino rat and Budipitajo *et al*. (2016) in Sunda porcupine found thin and incomplete septa. These differences may be due to species variation and depended on the functionality of the gland.

Interlobular connective tissue consisted of loose connective tissue with absence of smooth muscle fibres (Fig. 2). Nerve fibres, blood vessels were seen in the interlobular connective tissue septa with fat cells. Similar results were also recorded by Budipitajo *et al*. (2016) in Sunda porcupine and Rajathi and Muthukrishnan (2018) in myna.

Parenchyma

Each lobule of parenchyma consisted of exocrine and endocrine portions (Fig. 1). Islets of Langerhans were seen as

scattered clusters of pale pink stained cells among the dark blue stained acinar cell units of exocrine portion as reported by Tsuchitani *et al*. (2016) in experimental animals and Rajathi (2021) in guinea pigs. The endocrine portion was the maximum in the left lobe than in body and right lobe. The duct system of the exocrine portion consisted of intercalated ducts, intralobular ducts, interlobular ducts and main pancreatic duct with many arteries and veins, nerve fibres and lymphatics and was observed in the parenchyma (Fig. 2). Similar observations regarding the presence of duct system were also recorded by Morini *et al*., (2005) in pancreas of rodent and Tsuchitani *et al*. (2016) in experimental animals.

Exocrine Part

In all the dogs, the exocrine portion consisted of many secretory acini along with duct system as reported by Al-Muhtaseb and Ali (1997) in the pancreas of rabbit. The acini were of in numerous size and shape and enclosed a very narrow lumen (Fig. 1). The acini were well supported by a delicate network of connective tissue. Myoepithelial cells were not noticed surrounding the acini.

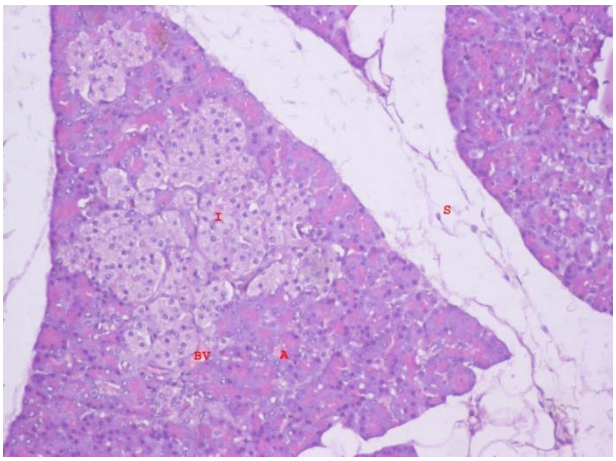

Fig. 1: Photomicrograph showing the pancreatic lobe with Acini (A), Islets (I), Septa (S) and Blood vessel (BV) H & E x 400

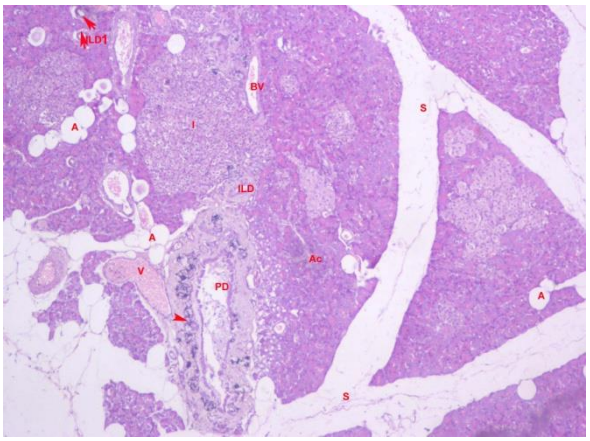

Fig. 2: Photomicrograph showing the pancreatic lobe with Acini (Ac), Islets (I), Septa (S) Blood vessel (BV), Vein (V), Adipose tissue (A), Intralobular duct (ILD1), Interlobular duct (ILD) and Pancreatic duct (PD). Arrow head – Glands in connective tissue layer of pancreatic duct H & E x 100

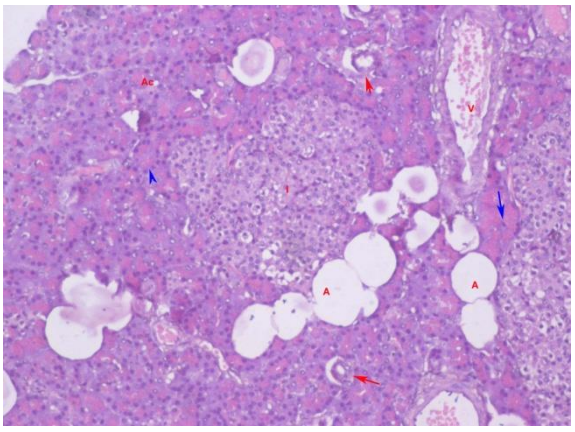

Fig. 3: Photomicrograph showing the pancreatic lobe with Acini (Ac), Islets (I), Vein (V), Adipose tissue (A), Intralobular duct (Red arrow), Blue arrow head – Acinar cells. Blue Arrow – Centroacinar cells H & E x 100

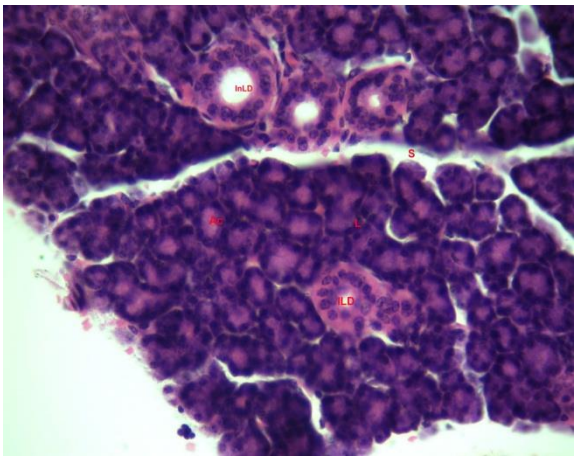

Fig. 4: Photomicrograph showing the pancreatic lobe (L) with Acini (Ac), Septa (S) Intralobular duct (ILD), Interlobular duct (InLD). H & E x 400

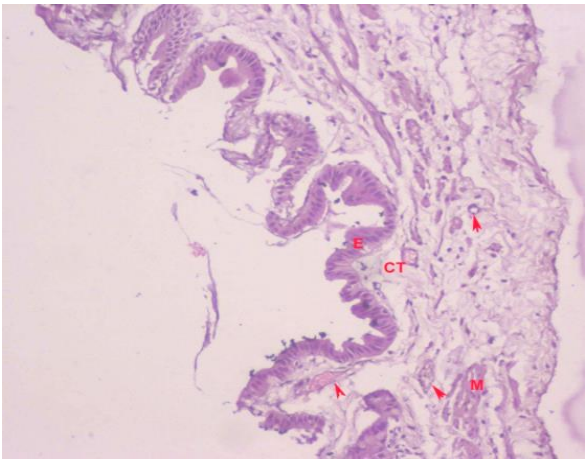

Fig. 5: Photomicrograph showing the pancreatic duct with Epithelium (E), connective tissue (CT), Muscle (M) and Blood vessel (arrow) H & E x 400

Secretory Units/Acini

In all dogs, each acini consisted of varying numbers of single row of polygonal shaped acinar cells (Fig. 3) whereas Patent and Alfert (1967) in rat, Garg *et al*. (2007) and Budipitajo *et al*. (2016) in Sunda porcupine observed single row of pyramidal shaped acinar cells in porcupine. The acinar cells showed dark homogenous basophilic appearance basally and numerous acidophilic zymogen granules apically (Fig. 4) as stated by Bradley and Grahame (1960) in human pancreas and Rajathi and Muthukrishnan (2018) in Myna. But Patent and Alfert (1967) and Fattah (2008) and Beheirya *et al*. (2018) reported it as two distinct zones in each acinar cell of pancreas in albino rat and goose which might be due to species variation. The boundaries of the acinar cells were found clear and distinct. The nucleus of the acinar cells was round to spherical in shape and showed dense chromatin material with one or two nucleous (Fig. 4) as in human pancreas (Bradley and Grahame, 1960).

Surrounding the acinar cells, individual elongated cells resembled fibrocytes were seen with limited numbers in all the dogs of present study. Numerous blood capillaries were found between the acinus. Pancreas of present study showed some acinar cells with dark nucleus in the centre as active cells and some acinar cells with pale nucleus at the periphery as resting cells (Fig. 3) whereas in human pancreas, Bloom and Fawcet (1968) found three types of acinar cells namely active, resting and exhaused type and here observed only two types of cells. The cords of undifferentiated cells found in human pancreas were not found in the present observations (Williams *et al*., 1989).

Duct System

The duct system of the pancreas in the present study consisted of centroacinar cells, intercalated ducts, intralobular ducts, interlobular ducts and main pancreatic duct (Fig. 2, 4) whereas Patent and Alfert (1967) in rat pancreas observed the duct system as large, interlobar, medium sized interlobular and small intralobular ducts. Similar observations related to the duct system of present study were also reported by Singh and Gupta (1999) in the pancreas of buffalo, Garg *et al*. (2007) in the pancreas of porcupine, Budipitajo *et al*. (2016) in the pancreas of Sunda porcupine and Rajathi (2021) in guinea pigs.

Centroacinar Cells

Small centroacinar cells without cytoplasmic granules were found in the central lumen of the acini which were the beginning cells of the intercalated ducts and were comparatively smaller than acinar cells (Fig. 3) as reported by Singh and Gupta (1999) in buffalo pancreas and Beheirya *et al*. (2018) in goose pancreas.

Intercalated Ducts

The intercalated ducts had small lumen with low cuboidal epithelium alone as opined by Budipitajo *et al*. (2016) in Sunda porcupine.

Intralobular Ducts

The intralobular ducts were observed with comparatively wide lumen than intercalated ducts and the epithelial lining cells were simple cuboidal cells (Fig. 4) as reported by Budipitajo *et al*. (2016) in the pancreas of Sunda porcupine. The epithelial lining cells were surrounded by a thin layer of connective tissue. The nucleus of the cuboidal cells was spherical and occupied whole of the cell within the thin acidophilic cytoplasm. The lumen of the duct contained secretory material which stained acidophilic with haematoxylin and eosin staining. This showed that the functional activity of the pancreas.

Interlobular Ducts

The interlobular ducts were found with a wider lumen and the epithelial lining cells were high cuboidal epithelium (Fig. 4) as reported by Budipitajo *et al*. (2016) in the pancreas of Sunda porcupine. The luminal surface of epithelial cells showed projections into the lumen with eosinophilic secretory material. The nucleus was spherical to oval in shape and placed centrally within the eosinophilic cytoplasm with a single nucleolus. Presence of goblet cells was observed within the lining epithelium of present study. Thick connective tissue fibres were found surrounding the lining epithelium which was made up of collagen and reticular fibres.

Pancreatic Duct/Large Duct

The pancreatic duct lumen was very large and was lined by columnar epithelium which varied from simple to stratified type (Fig. 2) as reported by Budipitajo *et al*. (2016) in the pancreas of Sunda porcupine and he stated it as pseudostratified columnar epithelium. In contrast to this, Deprem *et al*. (2015) found the dorsal and ventral pancreatic duct mucosa in goose pancreas was lined with simple columnar epithelium. The nucleus of the columnar cells was oval in shape and basally located with one or two nucleoli (Fig. 5). The apical part of the columnar cells was found acidophilic. Goblet cells were found in the apical part of the lining epithelial cells. Few small basal cells with lightly stained nucleus were seen among the regular epithelial lining cells. Few epithelial mucous gland-like structures was seen beneath the lining epithelium (Fig. 2). Thick connective tissue was found beneath the epithelium. Surrounding the connective tissue layer, few smooth muscle fibres were also found (Fig. 5).

Endocrine Part

Islets of Langerhans

The islets of Langerhans were appeared as cell clusters and consisted of pale staining acidophilic cytoplasm within the dark staining acinar cells (Fig. 1) by haematoxylin and eosin staining as stated by Wieczorek *et al*. (1998) in rat pancreas. But, Nakamura *et al*. (1980) noticed four types of granular cells viz., alpha, beta, delta, and pancreatic polypeptide cells in the islets in rat and Bani and Bani (1985) found five types of islet cells namely insulin, glucagon, somatostatin, pancreatic polypeptide cells and enterochromaffin like cells. Different cells of islets were not observed in the present study as special staining protocol of islets cells was not done.

The islets size was differed in the pancreas from small to large (Fig. 2) as reported by Castaldo *et al*. (1988) in mice and Garg *et al*. (2007) in porcupine pancreas. Abou-zaid *et al*. (2010) found that the distribution of islets were concentrated in the dorsal and splenic lobe in young and adult pigeon. Some few isolated islets cells were also found among the acinar cells. But Morini *et al*. (2005) found whole and fragmented islets in rat pancreas. The pancreatic islets showed different shape of the cells with sinusoids as stated by Al-Muhtaseb and Ali (1997) in pancreatic islets of rabbit.

Nucleus of the islets cells mostly found in the centre of the cells and in some cells found eccentrically. Some cells had dark nucleus and some had light stained nucleus. Nucleolus was found in all the islet cells (Fig. 1). By haematoxylin and eosin staining, it was not possible to differentiate the islets cells as alpha and beta cells as stated by Wieczorek *et al*. (1998) in rat pancreas.

Conclusion

The pancreas in dog showed both exocrine and endocrine portion. But the proportion of exocrine portion was found

little more than endocrine portion. But in laboratory animals, the endocrine portion will be very less. So this concludes that endocrine portion as it is responsible for blood glucose metabolism is found more. Thus, dogs could be used as an experimental animal to study blood glucose metabolism and pathology related to diabetes.

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Contribution by Authors

Equal contribution. All authors declared that 'written informed' consent was obtained from the approved parties for the publication of this article and accompanying images.

Conflict of Interests

There is no conflict of interest.

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