

Postnatal Development of Pancreas in Non-Descript Pigs - Gross Anatomical Study

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ABSTRACT

The present research aimed to study the gross anatomy of pancreas in postnatal age groups of non-descript pigs. Pancreas in pig was located in the dorsal part of the abdominal cavity intimately related to the proximal part of the duodenum. Six pancreases were collected from each of three different age groups of pigs from the nearby slaughter houses. The pancreas of pigs appeared lobulated and triangular in shape. It was pale yellow, in neonatal group and yellowish cream colour, in young and adult ages. It was soft to touch during postnatal ages. The pancreas of pig was observed with three lobes namely splenic lobe, duodenal lobe, and connecting lobe. Splenic lobe was the largest and formed not only one side of the triangle but also extended from the corresponding angle of the triangle. Duodenal lobe was associated with the duodenum. Connecting lobe was the smallest lobe. Two main ducts were observed; one as main pancreatic duct and the other as accessory pancreatic duct. The accessory pancreatic duct was found to be draining the pancreatic secretions of splenic lobe and the cranial part of duodenal lobe. It opened to the cranial part of duodenum and its opening was in the same level but opposite to the bile duct opening in all the postnatal ages studied. The main pancreatic duct was found to be draining the pancreatic secretions from the caudal part of duodenal lobe, connecting lobe and bridge and opened at further caudal part of the duodenum.

Keywords: Pancreas, Pig, Postnatal development, Gross anatomy

INTRODUCTION

The pancreas is a glandular organ responsible for diverse homeostatic functions, including hormone production from the endocrine islet cells to regulate blood sugar levels and enzyme secretion from the exocrine acinar cells to facilitate food digestion (Loberbaum *et al.*, 2020).

The splenic lobe of the pancreas, corresponds to the tail and body in the human pancreas, is situated posteriorly and is attached to the spleen and the stomach. The duodenal lobe corresponded to the head of the pancreas is located adjacent to the duodenum, while the connecting lobe which corresponding to the uncinata process is an extension of the pancreas, which is attached to the anterior aspect of the portal vein. There is a bridge of pancreatic tissue which serves as an anatomical connection between the splenic and connecting lobes (Ferrer *et al.*, 2008). The pigs are an ideal animal model for human health and diseases because their anatomical structure and function of the cardiovascular system, the gastrointestinal tract

including the pancreas of the pig are very similar to humans making them ideal models for investigating diseases related to these systems (Walters *et al.*, 2013). Pancreas in pig was located in the dorsal part of the abdominal cavity in a close relationship to the proximal part of the duodenum (Kalita and Debroy 2022). This research is aimed to study the gross anatomy of the pancreas in postnatal age groups of Non-descript pigs.

MATERIALS METHODS

The gross anatomical study of the pancreas of non-descript pigs from postnatal age groups namely neonatal (0-3 weeks-old), Young (4-18 weeks-old) and adult (19-40 weeks-old) were conducted at the Department of Veterinary Anatomy, Veterinary College and Research Institute, Tirunelveli -627358. The Six numbers of pancreas of pigs from three different age groups were collected from the nearby slaughter houses.

During the collection of sample, the gross anatomical observations namely location, relation, colour, shape, lobation were recorded in all the postnatal age groups. Gross photographs were taken in situ and dissected pancreas was used for recording the gross anatomical features in the study.

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RESULTS AND DISCUSSION

Gross Anatomy

Topography

The pancreas in the pig of all age group was located on the left side of the abdominal cavity and was related to stomach, intestine, spleen and right kidney (Fig 1). Similar observation was also recorded in goats by Bhuyan and Saikia (2016). In contrast to our observation, Rajathi and Muthukrishnan (2018), Yadav *et al.* (2018), Stan (2018) and Al-Haaik (2019) reported in the mynah, Chabro chicken, rat and kestrel respectively, the pancreas was located on the right side of the abdominal cavity. However in other species, the pancreas was located in the dorsal aspect of the abdominal cavity as in dogs (Tsuchitani *et al.*, 2016), goats (Bhuyan and Saikia, 2016), porcupine (Kalita and Debroy, 2022) and pigs (Iniyah *et al.*, 2018, Singh *et al.*, 2024) and this observation also coincided with our present study. Whereas, in Indian donkey, the pancreas was located below the liver (Dhoolapa *et al.*, 2004), in turkey, it was located between the ascending and descending parts of the duodenum (Suri *et al.*, 2022) and in the pancreas of *Oryzias javanicus*, it was located across intestine (Akmal *et al.*, 2023). Whereas in reindeer, the pancreas was located between the abdominal organs (Nikander, 1990), in Nile Monitor Lizard, it was spread out in mesentery between the intestine and stomach (Mohammed *et al.*, 2022) and in mice, it was diffusely distributed within the intestinal mesentery (Dolensek *et al.*, 2015). The pancreas appeared as triangular in shape with hollow in the middle and extended part on the summit of the triangle in all the ages of pig (Fig 2). The outer surface of the pancreas appeared as lobulated in all ages and found three lobes namely splenic lobe, duodenal lobe and connecting lobe (Fig 3). The present study also identified a connecting bridge area which connected the splenic lobe with connecting lobe. These lobes were clearly demarcated by gross appearance in all the age groups studied.

Gross Anatomy

The pancreas in all the age groups of pigs appeared lobulated and triangular in shape (Fig 4). Iniyah *et al.*, (2018) and Singh *et al.*, (2024) recorded similar shape of pancreas in Large White Yorkshire pig as per our observation but did not mention about the extended part. In contrast to our observation, Kalita

and Debroy (2022) reported that pancreas of Zovawk pig did not possess any definite shape. In swamp buffalo, it was axe-like or 'F' shape (Ruangkijkrai and Klomkleaw, 2014). Dhoolapa *et al.*, (2004) observed the pancreas of Indian donkey as irregularly triangular in shape. Bhuyan and Saikia (2016) recorded the pancreas was in 'V' shaped in goat. In chinchilla, Stan (2018) recorded the shape of the pancreas as triangular with irregular margin. These differences might be due to species variation. Stan, (2018) and Suri *et al.*, (2022), reported the pancreas of chinchilla and turkey as lobulated gland as per the observation of present study. It was pale yellow in neonatal group (Fig 4) and yellowish cream colour in young and adult ages (Fig 2 and 3). Similar colour of pancreas was recorded in reindeer calves (Nikander, 1990) and in Chabro chicken (Yadav *et al.*, 2018). In contrast to our study, Al-Haaik (2019) reported pale pink to white pink colour pancreas in kestrel, Al-Safar and Nasif (2020) stated light pinkish colour pancreas in guinea pigs, Patki *et al.*, (2019) reported pink to light brown colour pancreas in Kuttanadu duck and Kalita and Debroy (2022) recorded greyish pale pink colour pancreas in Large White Yorkshire pig. These differences might be due to species variation. It was soft to touch in all the postnatal ages. In contrast to this observation, Ferrer *et al.*, (2008) recorded the pancreas of pig with a nodular surface. This may be due to species or feed variation.

Lobation

The pancreas of pig presented three lobes; namely, splenic lobe, duodenal lobe, and connecting lobe (Fig 2). Similar results were also observed in pigs by Iniyah *et al.*, (2018) and Singh *et al.*, (2024). However, the pancreas of pigs showed three lobes namely left lobe, right lobe and a body (Kalita and Debroy, 2022), in rat, it was made up of right lobe, splenic lobe, gastric lobe and duodenal lobe. It consisted of duodenal lobe, splenic lobe, gastric lobe and duodenal lobe in chinchilla (Stan 2018) and in guinea pigs and monkey, it consisted of head, body and tail (Tsuchitani *et al.*, 2016). Pancreas of goat and dog consisted of body, left lobe, right lobe (Bhuyan and Saikia, 2016 and Shunmugam, 2024). Pancreas of kestrel consisted of dorsal lobe, middle lobe, ventral lobe by Al-Haaik (2019). Pancreas of camel consisted of body, left lobe, right lobe and accessory lobe (Lakhel *et al.*, 2025). Pancreas of adult Indigenous male ducks had four lobes namely ventral lobe, dorsal lobe, accessory lobe and splenic

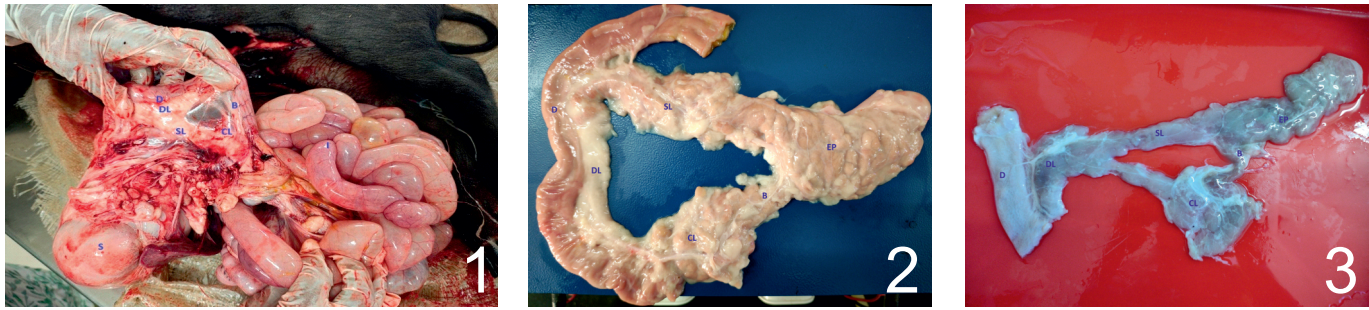


Fig. 1: Photograph showing the in situ location of pancreas with clear demarcation of Splenic lobe (SL), Duodenal lobe (DL), Connecting lobe (CL) and Connecting bridge (CB) and was found related to Duodenum (D), Stomach (S) and Intestines (I) in adult pig of 22 weeks of age; **Fig. 2:** Photograph showing the pancreas of adult pig of 26 week of age with Splenic lobe (SL), Extended part (EP), Duodenal lobe (DL), Connecting lobe (CL) and Bridge (B) along with Duodenum (D); **Fig. 3:** Photograph showing the pancreas of young pig of 7 weeks age with Splenic lobe (SL), Extended part (EP), Duodenal lobe (DL), Connecting lobe (CL) and Bridge (B) along with Duodenum (D).

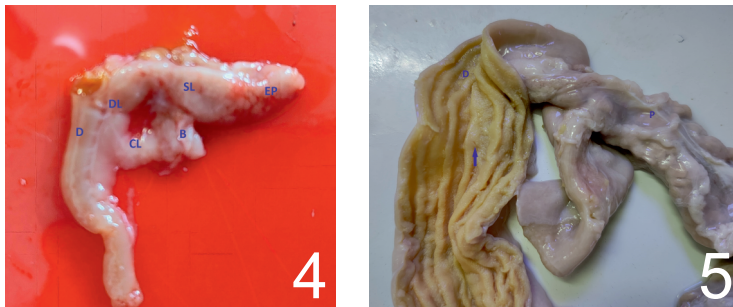


Fig. 4: Photograph showing the pancreas of neonatal pig of 14 day- old with Splenic lobe (SL), Extended part (EP), Duodenal lobe (DL), Connecting lobe (CL) and Bridge (B) along with Duodenum (D);

Fig. 5: Photograph showing the opening of accessory pancreatic duct (blue arrow) of pancreas (P) of 20 week- old adult pig into the duodenum (D).

lobe (Patki *et al.*, 2019). The pancreas of reindeer and Nile monitor lizard had only two lobes (Nikander 1990 and Mohammed *et al.*, 2021). Splenic lobe was found to be the largest in one side of the triangle but also extended from the corresponding angle of the triangle and was related to the spleen and stomach and a branch of splenic artery was found to be passing in the middle of splenic lobe (Fig 2). Duodenal lobe was found to be associated with the duodenum and so it might be also called as intestinal lobe (Fig 1). It was found attached to the left side of the duodenum and forming the base of the triangle (Fig 3). Connecting lobe was found as the smallest lobe and was seen to be connecting the duodenal and splenic lobe through a connecting bridge (Fig 3). Connecting lobe was related to left kidney and the intestines (Fig 1). Connecting bridge was a part containing pancreatic parenchyma, connective tissue, blood vessels and nerve elements. This connecting bridge connected the splenic lobe and connecting lobe and completes the triangular shape of pancreas (Fig 4).

Pancreatic Duct

In the present study of all the age groups of pig, we observed two main ducts, one as main pancreatic duct and the other as accessory pancreatic duct. In contrast to our study, Ferrer *et al.*, (2008) recorded

only one main pancreatic duct. However, he recorded in rare cases similar observation to our present study. No accessory pancreatic duct was observed in Indian donkey (Dhoolapa *et al.*, 2004) which was not in concurrence with our present study which might be due to species variation. Singh *et al.* (2024) reported only one pancreatic duct in Large White Yorkshire pig which might be due to breed variation whereas in White Wister Rat (Damian and Miclaus, 2010) two pancreatic duct namely wirsung or main pancreatic duct and Santorini, accessory pancreatic duct was found which was in coincidence with our present study. Bhuyan and Saikia (2016) recorded two pancreatic ducts in goats whereas in Prairie dog, single pancreatic duct was observed by Grace *et al.*, (1988) which was in contrast to our present study but Al-Safar and Nasif (2020) recorded only a minor pancreatic duct in guinea pig and Mohammed *et al.*, (2021) recorded single pancreatic duct in Nile Monitor Lizard whereas the pancreas of Black Partridge and crow contained three pancreatic ducts (Naser *et al.*, 2014). These differences might be due to species, feed and environmental variations. The accessory pancreatic duct was found to be draining the pancreatic secretions of splenic lobe and the cranial part of duodenal lobe and opened to the cranial part of duodenum in opposite to the opening of bile duct in all the postnatal ages studied (Fig 5).

The opening of accessory and main pancreatic duct differed in different species which might be due to species variations.

The main pancreatic duct was found to be draining the pancreatic secretions from the caudal part of duodenal lobe, connecting lobe and bridge and was found to be opened at the caudal part of the duodenum. In the present study of young age group, the accessory pancreatic duct opening to duodenum was found at 3.8-3.9 cm distance from the pyloric sphincter and the main pancreatic duct opening to the duodenum was found at 5.8-5.9 cm distance from the pyloric sphincter.

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