Republic of Iraq

Ministry of higher Education & scientific Research

University of Al-Qadissiya

College of Veterinary medicine

Anatomical and Histological study Of Pancreas In One Humped Camel

By

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2016 A.D. 1437 A.H.

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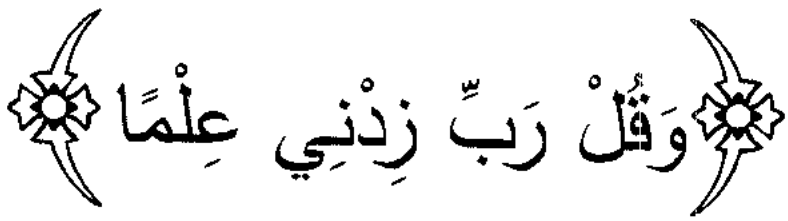

صدق اللَّهُ العظيم

سورة طه الآية (114)

Certificate of Supervisor

I certify that the research entitled (Anatomical and Histological study Of Pancreas In One Humped Camel) was prepared under my supervision at the college of veterinary medicine / University of Al-Qadissiya .

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Dedication

To my family

Firas

Acknowledgments

Firstly I would like to thank the Kind Merciful Allah for helping me in completing this work.

My thanks go to Assist Professor Dr. Nouman Naji Ali (Dean of College of Veterinary Medicine) and Dr. Sameer Ahmed (Vice Dean for College of Veterinary Medicine) for cooperation, facilitation and encouragement to the fulfillment of this study.

Firas

Summary

Abstract

The study was designed to describe the anatomical and histological structure of the pancreas in one hump camels used eight samples from the pancreas of healthy male camel of age1-5 Years, four samples for the study of anatomy, and four samples for histological examination, it rein forced the concentration of a solution of formalin) then treated models means histological routine, colored by stained histological slides by, H&E , PAS

Anatomically left lobe of the pancreas longer than the right lobe, the pancreas in camels covered with a large amount of fat, 14 grams / 171 grams, pancreas characterized by the presence only one pancreatic duct pancreatic incomplete and through Portal vein, pancreatic purple color tends to gray and The pancreas of camel has a complete pancreatic ring, rather than a notch in the body as the case of ruminants..

Histological studies showed that pancreatic covered with a capsule of connective tissue and the capsule is also rich in fatty tissue. capsule sent barriers of connective tissue to board the gland to divided into lobules, secretary units alveolar Islands Langerhans appear as a pale then exocrine units in the camel pancreas, with circular nuclei beta cells form located islands centers, with nuclei oval alpha cells form located on peripheral islands.

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CHAPTER ONE

Introduction

Introduction :

The one humped camel (*Camelus dromedarius*) or Arabian camel is an essential source of meat, skin, milk and transport. It plays economic, social and ecological roles in many parts of the World. It well adapted to life in the desert because of their unique metabolic pathways and more efficient fermentation in stomach and high intestinal absorption, which enable the animals to survive without food and water for a few days (Ouajd and Kamel, 2009).

The pancreas is a gland organ in the digestive and endocrine system of camel. It is both an endocrine gland producing several important hormones, including insulin, glucagon, and somatostatin, as well as a digestive organ, secreting pancreatic juice containing digestive enzymes that assist the absorption of nutrients and the digestion in the small intestine. These enzymes help to further break down the carbohydrates, proteins, and lipids in the chyme. The pancreas of the camel is grayish pink in color with indefinite shape. It consists of a quadrilateral body projecting from it along the left and short right lobes. The two lobes are connected by small accessory lobe and they form complete wide portal ring in between for the passage of the portal vein (Ali, 1999).

The camel pancreas is located at the junction of the fore stomach and of the duodenum. The weight of camel pancreas is about 170 g, widely covered by fat. It is drained by a unique duct that joins the hepatic duct to form the hepatopancreatic duct which opens into the cranial dudenal flexure (Taha and Abdel-Magied, 1998).

The one humped camel is known as old world camel and they classify as follows:

Class: Mammalia

Order: Artiodactyla

Sub-order: Tylopoda or Camelids

Genus: Old world – *Camelus dromedarius* (one humped camel) (Wardeh, 2004)

The dromedary camel (*Camelus dromedarius*) is mostly present in the tropical area (Africa and Asia) and known as the ship of the desert in Arabian countries (AIthnaian *et al.,* 2012).The camel is also used in carrying goods during transportation and travel.

The aim of the study :

Morphological and Histological study of camel pancreas .

CHAPTER TWO

Literatures of Review

LITRATURE REVIW

2.1 Gross anatomy:

2.1.A: Colour, shape and lobation:

The colour of the pancreas varied in various domestic animals. It was described as being pinkish yellow or yellowish brown in bovines(Sack and Wensing, 1987), pinkish yellow, grey, light or dark yellow red or reddish cream in equines (Sisson, 1975) grey pinkish in the camel (Sultan,1999).

It was observed that the colour of the equine pancreas when unpreserved became dark (Bradley, 1946; Sisson, 1975). Similarly variations in the shape of the pancreas were reported in different domestic animals. In the horse, Indian donkey and sheep the shape was irregular but triangular in outline (Bradley, 1946, 1975; Dyce *et al.*, 1987;Dhoolappa Ashok, Ramakarishna and Gadre, 2004); in ruminant it was irregular (Sultan, 1999).

As to the lobation of the pancreas, it was clear that there was a general agreement that the pancreas consists of a left lobe, a right lobe and a body. However; differences were seen within these lobes. A long right lobe and a short left lobe were reported in ruminants (Dyce *et al.*, 1987). Although the camel is a ruminant yet the lobation of the pancreas more or less, resembled that of the horse (Sultan, 1999).

2. 1. B. Topography of the pancreas:

The ruminant pancreas was located almost in the mesoduodenumand the root of the greater omentum entirely to the right of the medianplane (Habel, 1989). In the horse the pancreas lay ventral to the aorta and the caudal vena cava, at the level of the 16th, 17th and 18ththoracic vertebrae; the bulk of the gland being to the right of the median plane (Sisson, 1975; dyce *et al.*, 1987).

The pancreas of the camel lay at the level of the first five lumbar vertebrae (Mustafa *et al.*, 1983; Sultan, 1999). The ruminant pancreas is related dorsally to the liver, diaphragm and the celiac and the cranialmesenteric arteries; ventrally, it

is related to the intestine and the rumen (Habel, 1989). The equine pancreas is related dorsally to the right kidney, the caudal vena cava, portal vein, the stomach and the right and caudate lobes of the liver. Ventrally it is related to the base of the cecum, the right dorsal colon and the transverse colon (Sisson, 1975).

In the camel, the body of the pancreas is related dorsally to the portal vein, caudate lobe of the liver and left crus of the diaphragm and ventrally it is related to the transverse colon (Mustafa *et al.,* 1983 and Sultan, 1999). The right lobe is related dorsally to the visceral surface of the liver, right crus of the diaphragm and the sub lumbar muscles. Ventrally it is related to the transverse colon, the hepatic lymph node, mesenteric node and the second duodenal flexure; cranially it is related to the bulb of the duodenum and descending duodenum, caudally to the transverse and descending colon(Mustafa *et al.,* 1983; Smuts and Bezuidenhout, 1987; Taha and Abdel-Magied, 1998; Sultan, 1999). The left lobe is related cranially to the dorsal sac of the rumen, transverse and descending colons; caudally and laterally to the spleen, left kidney and the left adrenal gland (Mustafa *et al.*, 1983; Smuts and Bezuidenhout, 1987; Taha and Abdel-Magied,1998; Sultan, 1999).

2. 2. The histological studies:

The pancreas which is a compound tubulo-acinar gland is encapsulated, lobulated and consisted of both exocrine and endocrine secretary portions in animals (Stinson and Calhoun, 1981). The human pancreas was covered by a thin layer of connective tissue that does not form a definite capsule (Bloom and Fawcett, 1986).

The pancreas of the camel consisted of both exocrine and endocrine portions and it is enclosed by a thick connective tissue capsule which is rich in adipose tissue, reticular fibers, collagen fibers, elastic fibers, blood vessels and nerve fibers (Sultan, 1999).

The connective tissue septa extended into the gland to divide it into lobules. These septa contained adipose tissue, blood vessels, nerve fibers, ducts and groups of

lymphatic cells (Stinson and Calhoun, 1981; Bloom and Fawcett, 1986; Sultan, 1999).

2.2.A. : The secretory units:

The secretory units of the pancreas were tubulo-acinar with the tubular portion more prominent in ruminants (Stinson and Calhoun,1981). In the horse, the pancreas was tubulo-alveolar and the alveoli were long, like those of the duodenal glands (Sisson and Grossman, 1964). In the pig pancreas, the secretory units showed different shapes: round, ovalor irregular (Singh and Singh, 1980).

In the camel, they were tubulo-acinar with the acinar portion morepromínent (Sultan,1999).The secretory epithelial cells were generally pyramidal in shape with spherical nuclei near the base of the cell(Stinson and Calhoun,1981); they rested upon a basal lamina supported by delicate reticular fibres (Bloom and Fawcett, 1986).The acinar cells of sheep were mononucleated but a few were binucleated and the nuclei were mostly spherical or oval in shape (Mukherjee *et al.*,1986). In the camel, the acinar cells were pyramidal in shape with spherical basal nuclei and their lumina were narrow; the acinus cells rested upon a basal lamina and supported by an etwork of reticular fibres (Sultan, 1999; Dhoolappa *et al.*, 2004). Three types of acinar cells were recognized in the pancreas of sheep, buffaloes, ox, goats, horses, dogs, cats, pigs and fowl. These types were active acinar-cell, exhausted acinar-cell and resting acinar-cell (Singh, 1980;Singh and Singh, 1980; Mukherjee *et al.*, 1986).

2. 2. B. The endocrine portion (islets of Langerhans):

The endocrine portion was incorporated among the exocrine portion of the pancreas. It was in the form of small masses of endocrine cells which were highly vascular and were known as islets of Langerhans. The endocrine portion of sheep pancreas was organized in irregular clumps of cells which were dispersed intralobularly. These clumps showed no distinct capsule but they were separated from the pancreatic acini by a thin layer of reticular tissue. These clumps of cells

were actually the islets of Langerhans. The islets were of variable size and shape (Mukherjee, *et al.,* 1988). In the camel, the islets displayed different shapes which varied from round, oval, elongated to irregular (Alani, 1987; Sultan, 1999). Sultan (1999) has claimed that interlobular islets of Langerhans were present but they were much smaller than the intralobular islets. Some of the intralobular islets were located near the ducts while others were connected by slender epithelial cords to the duct in the camel (Sultan,1999). In the camel, the islets had a rich blood supply and they were divided by connective tissue septa; some of the blood capillaries were enlarged forming a large central cyst–like structure (Alani, 1987; Sultan,1999).In a number of animals, the pancreas showed three types of endocrine cells, alpha cells (A cells), beta cells (B cells) and delta cells(D cells)(Bloom and Fawcett,1986). These types of cells were also described in the bovine (Bonner-Wier and Like 1980) and camel(Alani, 1987; Khatim, *et al.,* 1985; Sultan, 1999).

2. 2. B.1. The beta cells:

The central location of the beta cells in the islets seemed to be the general rule for the vast majority of domestic animals (Erlandsen *et al.*,1976; Bonner-Wier and Like, 1980; Khatim*et al.,* 1985; Alani, 1987;Mukherjee *et al.,* 1988; Sultan, 1999). However, the horse seemed to be the exception since the beta cells were located peripherally in the islets (Helmstaedter *et al.*,1976; Dellmann, 1981; Furuoka *et al.,* 1989). In the camel pancreas the beta cells have oval nuclei and arranged in cords (Sultan, 1999).

2. 2.B. 2. The alpha cells:

The alpha cells were few in number compared to the beta cells and they were located at the periphery of the islets, but their central location was not uncommon. Their nuclei were generally ovoid in shape, although spherical nuclei were sometimes present (Mukherjee *et al.,* 1988). The peripheral location of the alpha cells in the islets seemed to be the general rule for the vast majority of domestic

animals (Erlandsen *et al.*, 1976; Bonner-Wier and Like, 1980; Dellmann, 1981; Khatim*et al,* 1985;Alani, 1987; Sultan, 1999). Again the horse seemed to be the exception since the alpha cells were located centrally in the islets (Helmstaedter *et al.*, 1976; Furuoka *et al.*, 1989).

2. 2. B. 3. The delta cells:

Most of these cells were located in the periphery of the islets in bovines (Bonner-Wier and Like, 1980), the horse (Helmstaedter *et al,*1976 and Furuoka *et al.*, 1989), and the camel (Alani, 1987), but in camels their location could be peripheral or central (Khatim *et al.*, 1985;Sultan, 1999).

CHAPTER THREE

Materials and Methods

Material and method

Specimens of the pancreas from8 male camels were used in this study from al-qudisyia albotter. Their age varied from 1-5 years old in the camels .

3. A. Gross anatomy:

Some of these specimens (specimens from four number of camels) were used to study the topography of the pancreas.

3. B. Histology:

Pancreatic specimens from four number of camels were used to study the microscopic structure. Small pieces of tissue were taken from three regions of every pancreas; the body, the right lobe and the left lobe. Fixation was carried out in 10% Formalin for 48 h. This was followed by dehydration in ascending grades of alcohol(70%, 90% and 100%). Then they were cleared in xylene and embedded in paraffin wax. Sections, 5-7μ thick, were cut using microtome. Sections were spread in water path at 40c° and mounted on clean slides and were then put in an oven at 37c° to dry. The slides were then cleared in xylene and rehydrated in descending grades of alcohol (100%, 90%,and 70%). After that the slides were washed with distilled water and finally stained with haematoxyline and eosin (H&E) for routine histology and (Culling, 1974).

The following special stain were used to study certain structures:

Periodic acid Schiff (PAS) reagent for basement membrane and goblet cells. (Drury and Wallington, 1980).

CHAPTER FOUR

Results

4.1. Gross anatomy (General topography):

The pancreas of the camel is grayish pink in color in the fresh state. The camel pancreas has no definite shape, lies at the level of the first five lumbar vertebrae. The camel pancreas consists of a quadrilateral body, long tongue shaped left lobe and a wide quadrate right lobe (Fig1). Abridge of glandular tissue was observed dorsal to the portal vein, extending from the right lobe to the left lobe thus forming a ring through which the portal vein passes (Fig 2).

The body lies entirely to the right of the median plane at the region of the portahepatis. It measured about 10cm in length, 4cm in width and 1.5cm in thickness. It is related cranially to the ampulla of the duodenum, mediodorsally to the portal vein and the hepatic lymph node; laterally to the first flexure of the descending duodenum. Dorsally, the body is related to the visceral surface of the liver at the region of the portahepatis and to the hepatic duct, ventrally it is related to the transverse colon.

The right lobe is situated in between the two layers of the mesoduodenum. It measured about 16cm in length, 5cm in width and 1.5cm in thickness. It is related dorsally to the visceral surface of the liver and the right kidney, medially to the portal vein, the hepatic lymph node and the caudal vena cava. Laterally it is related to the descending duodenum and ventrally to the transverse colon (fig.4)

The left lobe is lying in between the two layers of the greater omentum. It measured about 29cm in length, 5cm in width and 1cm in thickness. It is related cranially and ventrally to the caudodorsal sac of the rumen, caudolaterally to the spleen and the splenic vessels, dorsally to the left crus of the diaphragm and the left kidney(fig.5).

4.2. Histology of the pancreas:

The camel pancreas is made up of exocrine as well as endocrine portions. The pancreas is covered by a connective tissue capsule which was rich in adipose

tissue and blood vessels (Fig 6). were also present in the capsule . Many connective tissue septa extended from the capsule into the parenchyma of the pancreas dividing it into lobules (Fig 7). These septa contained adipose tissue, blood vessels, nerve fibers and ducts (Fig 8). The adipose tissue was not confined only to the septa but it was also observed infiltrating the parenchyma (Figs 7).

4. 2. 1. Exocrine portion:

The exocrine portion of the pancreas was made up of secretory units and duct system. The secretary units were tubulo-acinar with the acinar portion more pronounced (Fig 9). The secretary units consisted of a single row of pyramidal epithelial cells converging toward a central narrow lumen (Fig 9). The nuclei of these cells were spherical in shape, and they were usually located near the base of the cell although some of them were centrally located (Fig 9) . The cells located in the lumen of the acini were identified as centroacinar cells (Fig 10). The centroacinar cells formed the beginning of the intercalated duct which constituted the first part of the duct system. The duct system was divided into five segments which include intercalated duct, intralobular duct, interlobular duct, main duct and the hepatopancreatic duct. The intercalated duct started as centroacinar cells; it was lined by low cuboidal cells with flattened nuclei (Fig 11). The interlobular duct was found between the lobules in the connective tissue septa (Fig 12). It was lined by cuboidal cells. The hepatopancreatic duct showed a folded mucosa (Fig13) which was lined by tall columnar cells (Fig 14), no goblet cells were seen.

4. 2. 2. Endocrine portion (Islets of Langerhans):

The islets of Langerhans which represented the endocrine portion of the camel pancreas appeared as pale areas among the acini. The islets varied in shape; they were round, oval or irregular (Fig 15).

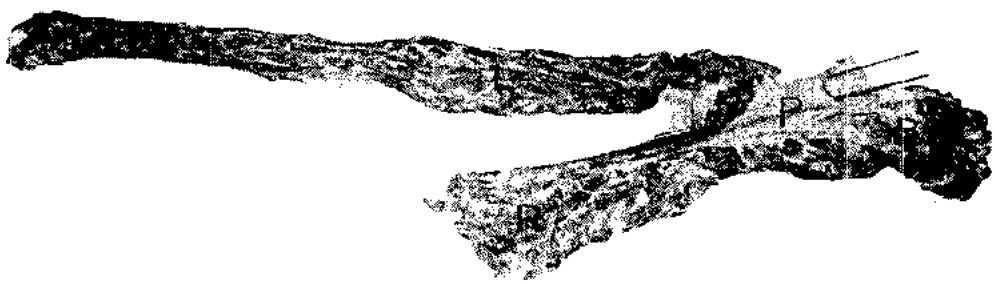

Fig 1. Camel pancreas. Dorsal view. Showing the tongue-shape left lobe (L), the quadrate right lobe (R), and the body (B). Note that the glandular tissue extending between the left and right lobes and over the portal vein (P) forming a bridge (b). Also note the great amount of fat covering the pancreas.

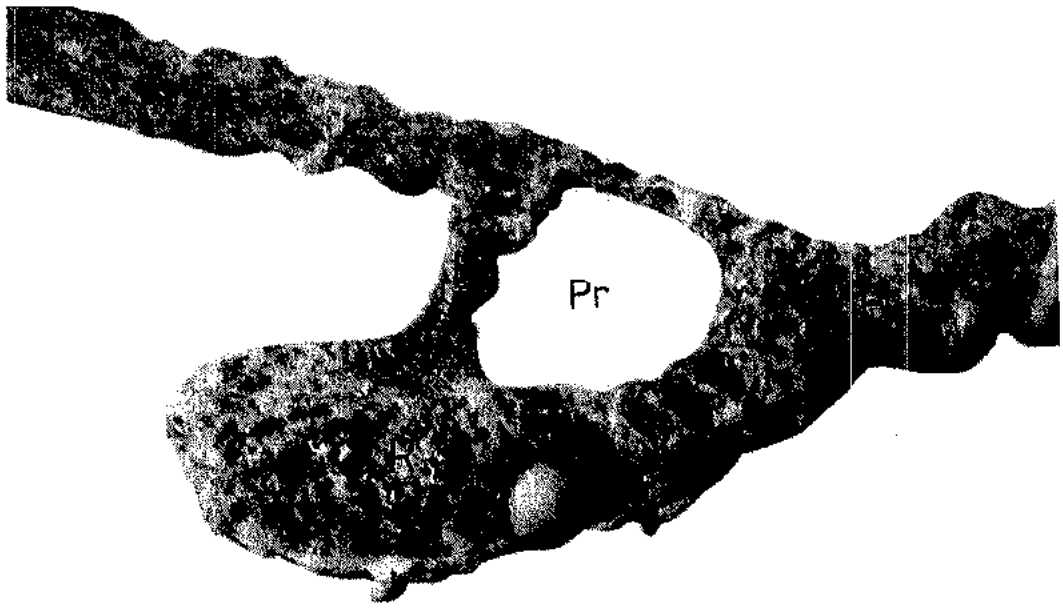

Fig 2. Camel pancreas. The portal vein has been removed, note the bridge (b) between the left lobe (L) and the right lobe (R) forming the pancreatic ring (Pr)

through which the portal vein passes. Note the great amount of fat covering the pancreas.

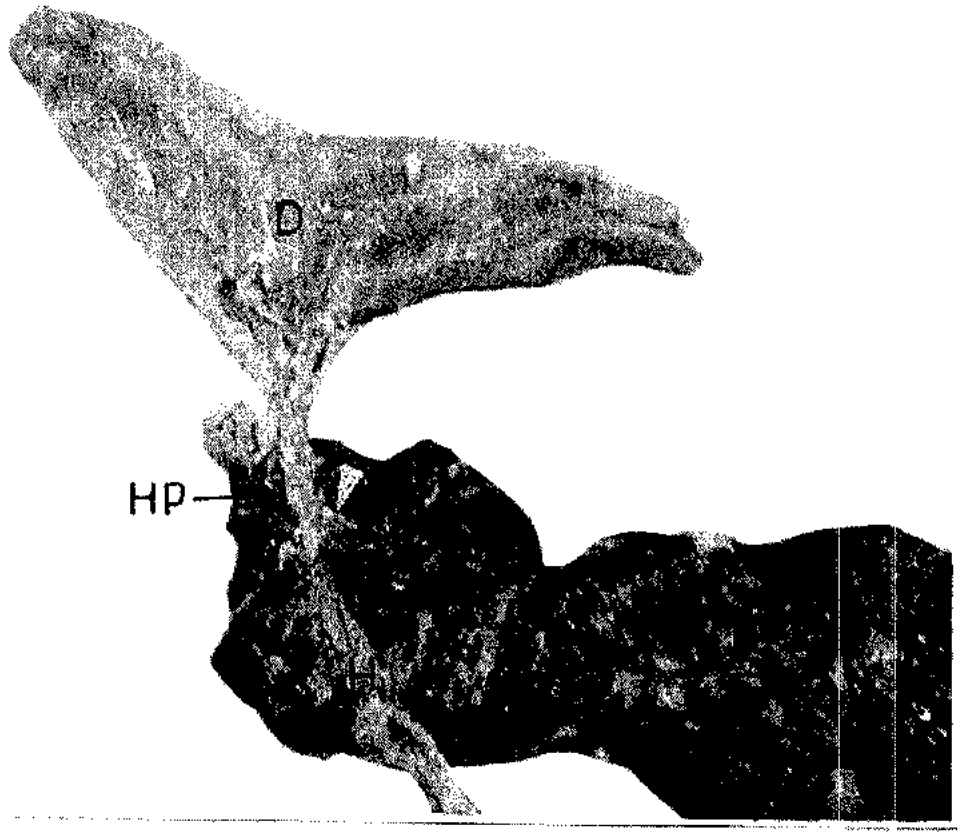

Fig 3. Camel pancreas. The hepatic duct (H) passed dorsally to the cranial part of the body of the pancreas (B), joined by the pancreatic duct (arrow head) and thus forming the hepatopancreatic duct (HP) which opens in the duodenum (D).

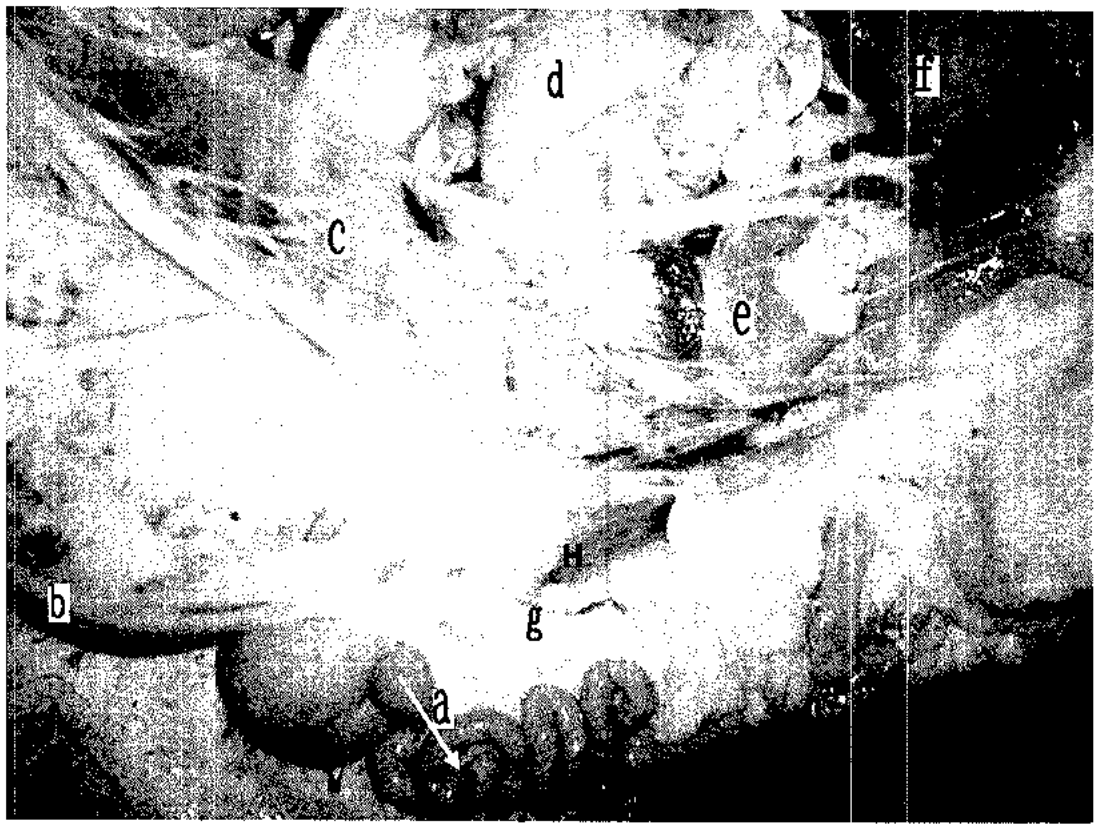

Fig 4. Camel Right view of the pancreas in situ showing its topographical relations

A. convolutions of duodenum

B. abomasum

C.mesentry

d.right kidney

e . liver

f. spleen

g. duodenum

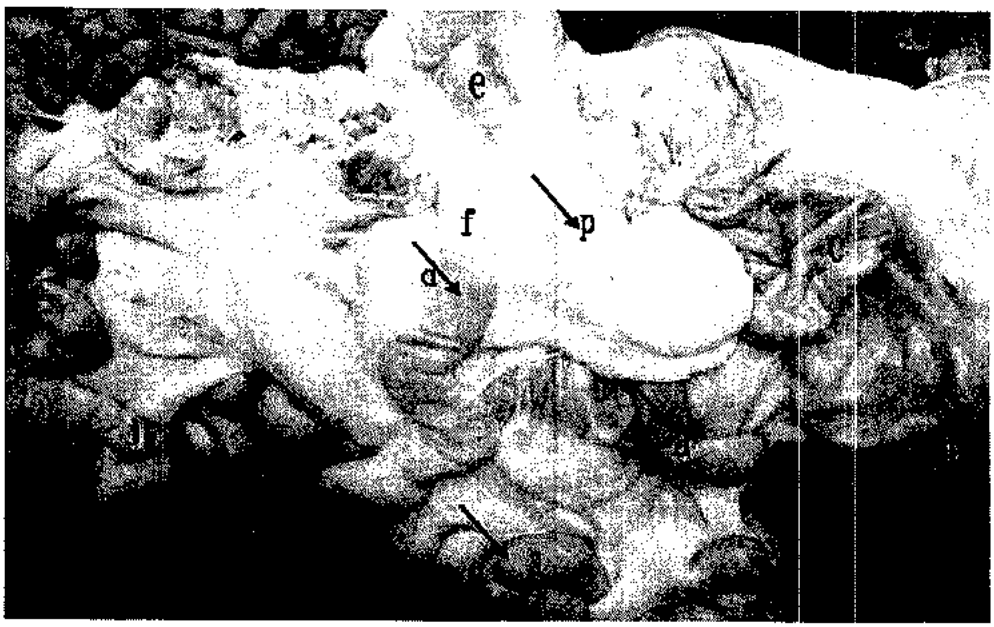

Fig 5. Camel. Left view of the pancreas in situ showing its topographical Relations

a. duodenum.

b: abomasum

c. ampulla of duodenum

e. colon

f. descending colon

j. jejunum

p. pancreas

s. convolutions of duodenum

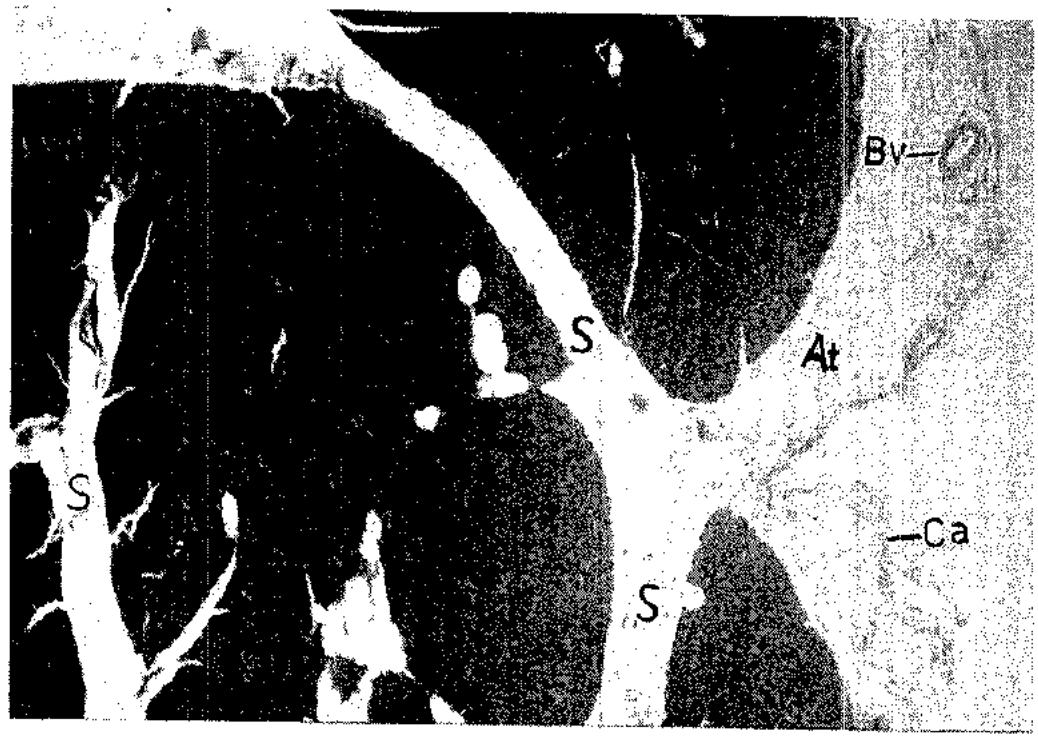

Fig 6. Camel pancreas. Showing the capsule (Ca) of pancreas which is rich in adipose tissue (At), connective tissue septa (S). the connective tissue septa extended into the parenchyma dividing it into incomplete lobules (L). Bv: Blood vessel. H & E stain. X40.

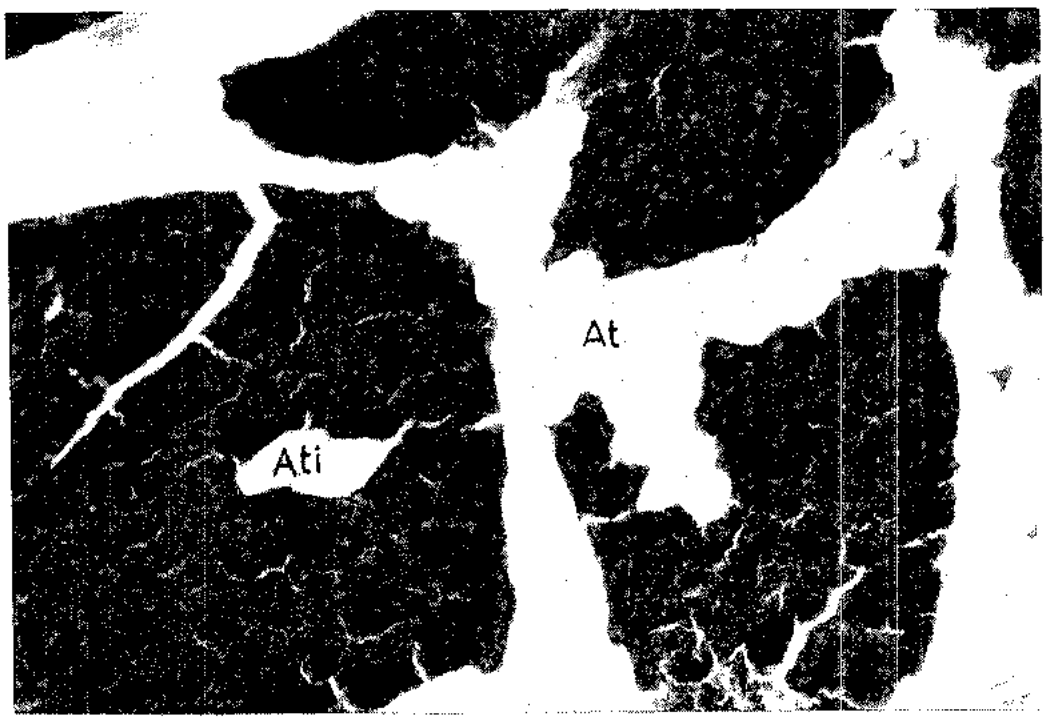

Fig 7. Camel pancreas. Micrograph showing the septa which are highly rich in adipose tissue (At). Note the infiltrated adipose tissue (Ati) inside the parenchyma. H&E stain. X40.

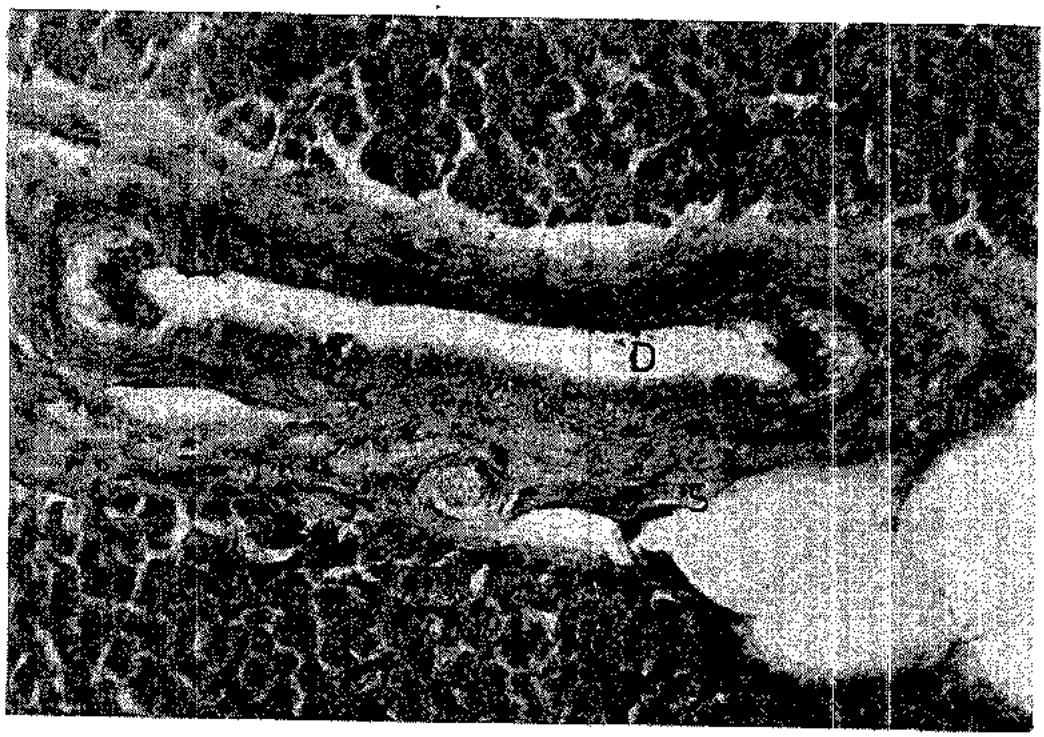

Fig 8. Camel pancreas. Showing interlobular duct (D) in the connective tissue septa (S). H&E stain. X 250.

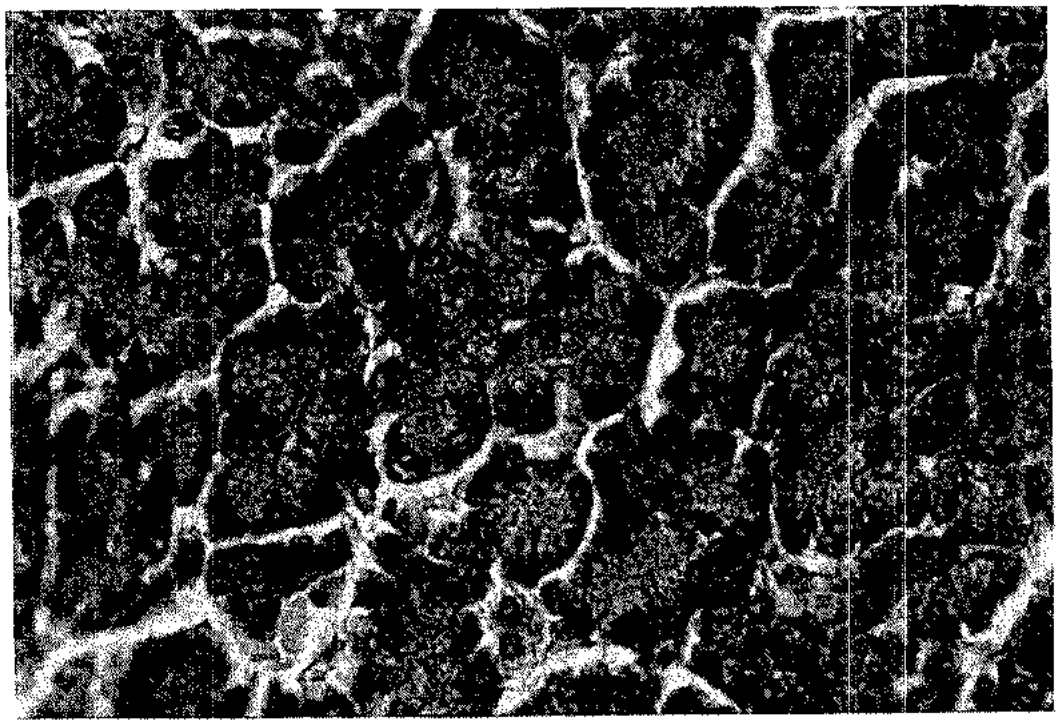

Fig 9. Camel pancreas. Showing the secretory units which are tubuloacinar,A: acinar potion and T: tubular portion. P: Pyramidal cell with spherical nucleus, O: Oval nucleus. H&E stain. X 400.

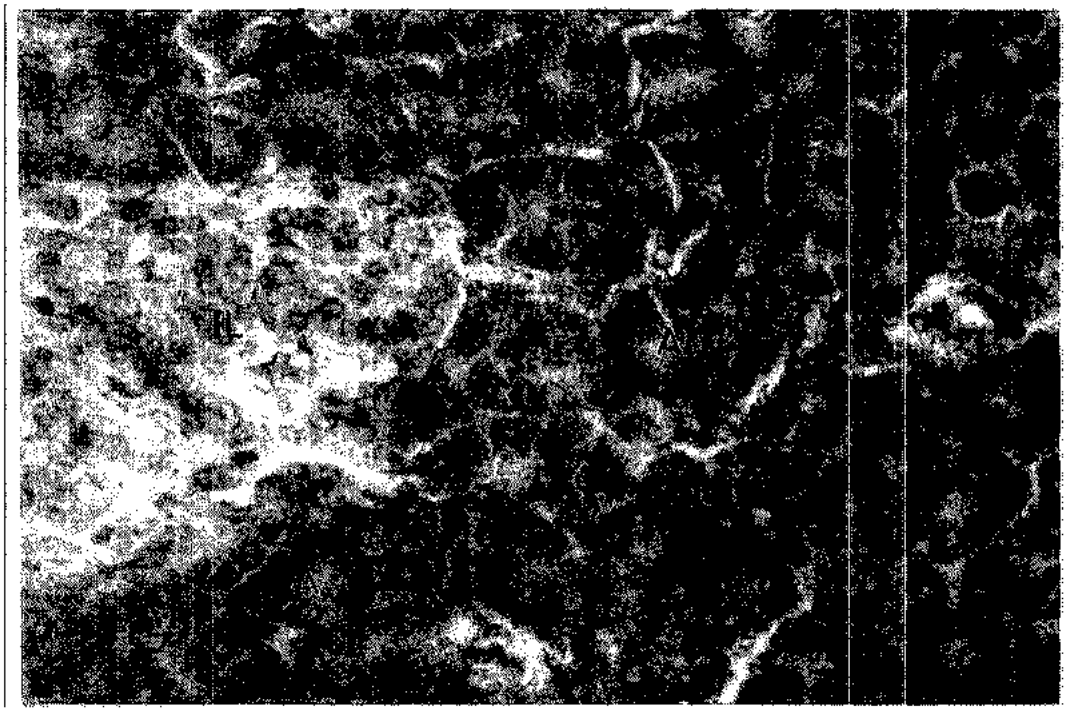

Fig 10. Camel. The parenchyma of the pancreas, showing part of islets of langerhans (IL), acini (A) and centroacinar cell (arrowhead). H&E stain. X 400.

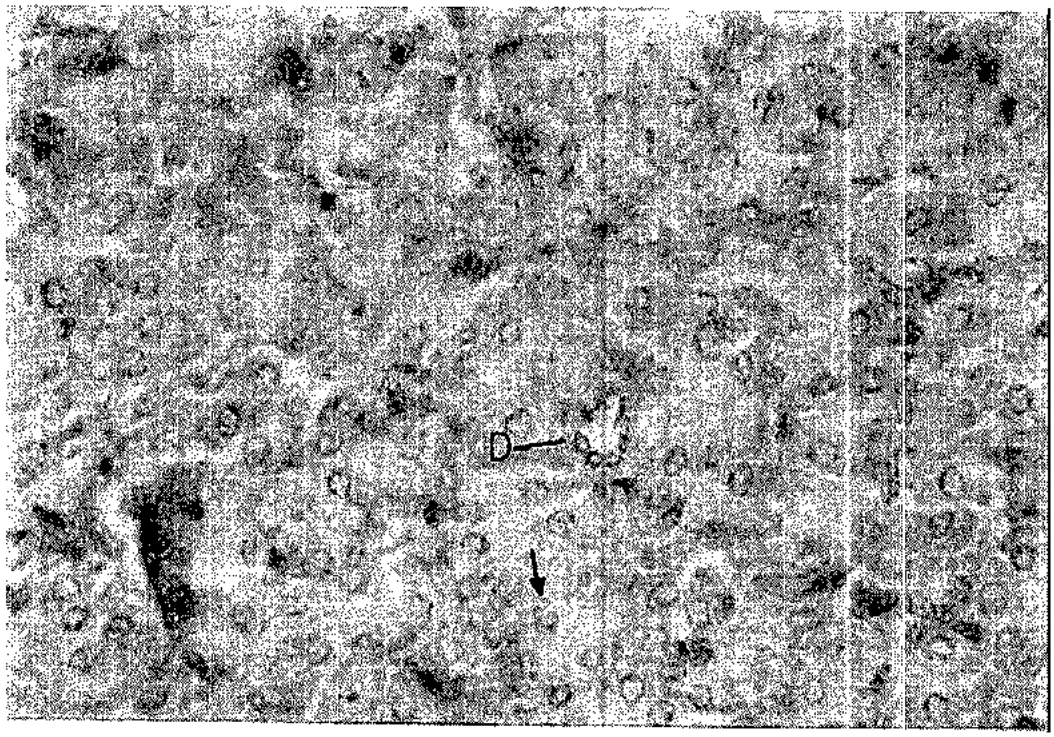

Fig 11. Camel. Exocrine portion of the pancreas, showing intercalated duct (D) and centroacinar cell (arrow). P. A. S. stain. X400.

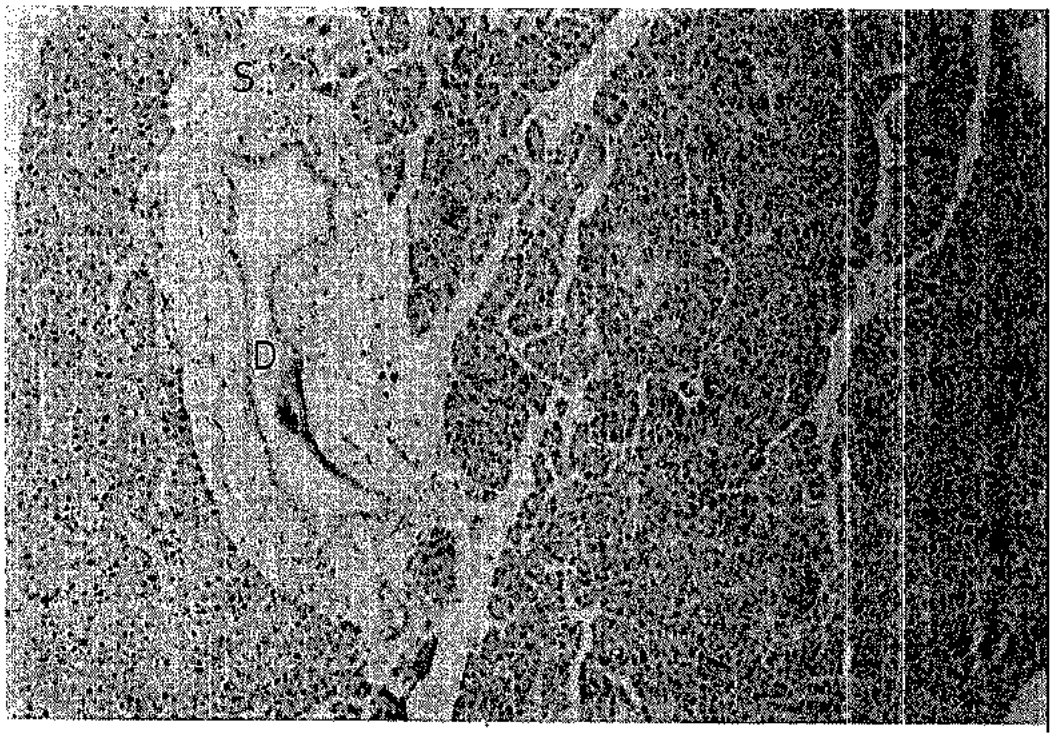

Fig 12. Camel pancreas. interlobular duct (D) in the septa (S), the duct is lined by cuboidal cells. H&E stain.X100.

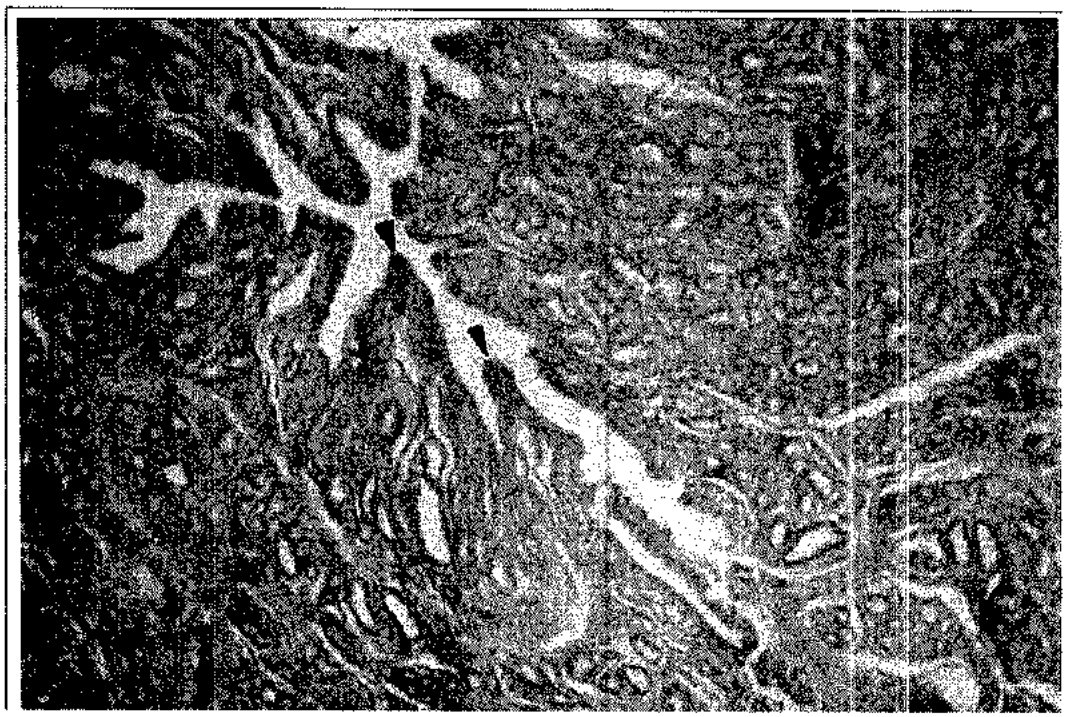

Fig 13.Camel. Showing the highly folded mucosa of the hepatopancreatic duct (arrow heads). H&E stain. X40.

Fig 14. Camel. Micrograph of the hepatopancreatic duct, showing the tall columnar cells (c) which lined the duct. Mucous glands (g) and their duct (d) are also present. P. A. S. stain. X250.

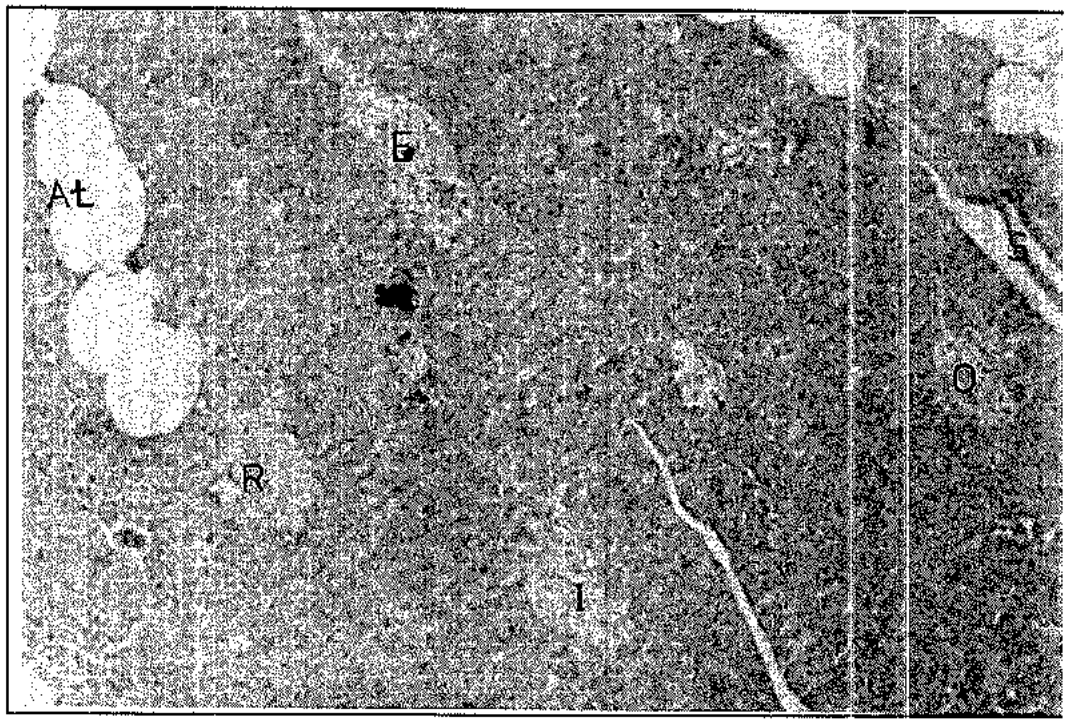

Fig 15. Camel pancreas. Showing the different shapes and sizes of the islets of Langerhans, (E) elongated, (I) irregular, (O) oval and (R) round. At: Adipose tissue, S: Connective tissue septa. H&E stain. X100.

CHAPTER FIVE

Discussion

Discussion

5.1. Anatomical studies:

In the present study, the colour of the pancreas of the camel was greyish pink in the camel. This observation was in conformity to that mentioned by Sultan (1999) in the camel .It appeared that there is a general agreement that the pancreas of the camel has no definite shape (Taha and Abdel-Magied, 1998; sultan, 1999). This is also true for the present study. the pancreas of the camel consisted of a left lobe, a right lobe and a body. But it differed in that the left lobe was longer than the right lobe. This observation is similar to what had already been described by Mustafa *et al.* (1983), Smuts and Bezuidenhout (1987), Taha and abdel-Magied (1998) and Sultan (1999) in the camel . The presence of an accessory lobe, which was described to the pancreas of the camel by Hegazi (1945), Mustafa *et al.* (1983) and Sultan (1999), was not seen during the present study. It was also not reported by Taha and Abdel-Magied (1998). In the present study the pancreas of the camel is situated at the level of the first five lumbar vertebrae; this is similar to the finding of Mustafa *et al.* (1983) and Sultan (1999). In the present investigation, the body of the pancreas did not show a notch for the passage of the portal vein and cranial mesenteric artery as the case in ruminants. Instead, a ring formed by a glandular tissue extending from the right lobe to the left lobe was observed. This confirms previous findings in both the camel (Bradley, 1946;Nickel *et al.*, 1973; Sisson, 1975; Mustafa *et al.,* 1983; Dyce *et al.*, 1987;Taha and Abdel-Magied, 1998; Sultan, 1999). The relationships of the pancreas of both the camel with the stomach, duodenum, liver, hepatic lymph node, kidneys and the large intestine were generally in agreement with the observation of Nickel *et al.* (1973) in ruminants, Mustafa *et al.* (1983), Smuts and Bezuidenhout (1987), Taha and Abdel-Magied (1998) and Sultan (1999) in the camel .

5. 2. Histological studies:

5. 2. A. The exocrine portion:

In the present investigation in both the camel, the pancreas is covered by a connective tissue capsule, which is composed mainly of blood vessels . A striking feature of the camel pancreas is that the capsule is loaded with adipose tissue, which infiltrated inside the parenchyma; some of this adipose tissue shall be converted to water when the animal is dehydrated. Furthermore, it could also serve as a source of energy. The connective tissue septa extend from the capsule into the parenchyma dividing it into incomplete lobules. This last observation is similar to that in other animals and man (Arey, 1974; Stinson and Calhoun, 1981; Bloom and Fawcett, 1986; Sultan, 1999,).

The secretory units of the pancreas of the camel as seen in this study and as reported by Sultan (1999) are tubuloacinar with the acinar portion more prominent. This is slightly different from the exocrine portion of the ruminant pancreas (Stinson and Calhoun, 1981).

The present study showed that the duct system of the pancreas of camel started as centroacinar cells, similar to the findings of Bloom and Fawcett. (1986) in humans, Lone *et al.* (1988) in sheep, sultan (1999) in the camel . Gemmel and Heath (1973), Sultan (1999), and the present study reported that the intercalated duct lined by low cuboidal cells. This disagrees with the findings of Lone *et al.* (1988) in sheep.

In the present investigation, the intralobular duct is lined by cuboidal cells, similar to the previous observation made by Stinson and Calhoun (1981); Lone *et al.* (1988) and Sultan (1999). Nevertheless, Gemmel and Heath (1973) have found that the intralobular duct is lined by columnar cells and not cuboidal cells.

Lone *et al.* (1988) stated that in the interlobular duct there are goblet cells interspersed amongst the columnar lining cells in sheep. On the other hand, Bloom and Fawcett (1986) have reported that in addition to the goblet cells, small mucous glands are present in the connective which supported the inter lobular duct. In the

present investigation, neither the goblet cells nor the small mucous glands were observed in relation to the lining epithelium or the surrounding connective tissue of the interlobular duct of the pancreas of the camel In the present study, the main pancreatic duct of the camel and donkey is lined by columnar cells, and this is similar to that in sheep (Gemmel and Heath, 1973; Lone *et al.,* 1988) and in the camel (Sultan, 1999). The goblet cells and the mucous glands in the wall of the main pancreatic duct which were reported by Gemmel and Heath (1973) were not observed in the present study.

The present study has shown that the common hepatopancreatic duct of the camel are lined by columnar cells and their mucosa is folded. This is in accord with the previous work of Sultan (1999) and Siddig (2002) in the camel Absence of goblet cells from the pancreas of the camel .

5. 2. B. The endocrine portion (islets of Langerhans):

In the present study the islets of Langerhans of the camel displayed different size and shape and were made up of irregular clumps of cells. This confirms the findings of Alani (1987) and Sultan (1999) in the camel and Mukherjee *et al.* (1988) in sheep. Sultan (1999) claimed that there are interlobular islets of Langerhans in the camel pancreas.

Chapter six

Conclusions and Recommendations

6-1Conclusion

1. The left lobe of the pancreas is longer than the right

2. The pancreas has a complete pancreatic ring, rather than a notch in the body as the case of ruminants.

3. The camel pancreas loaded with adipose tissue.

4. The camel has only one pancreatic duct (the ventral one).

5. The secretory units in the camel pancreas are tubulo-acinar.

6. The position of the beta cells is central and that of alpha cells is peripheral in the islets of Langerhans of the camel.

6-2Recommendations

1. Further studies are needed to determine the nature of the innervation of the pancreas ultrastructurally and histochemically.
2. Further studies are needed to reveal the peptide hormones which are present in the pancreas Immunohistochemical.