Imaging of the Pancreas

Essay

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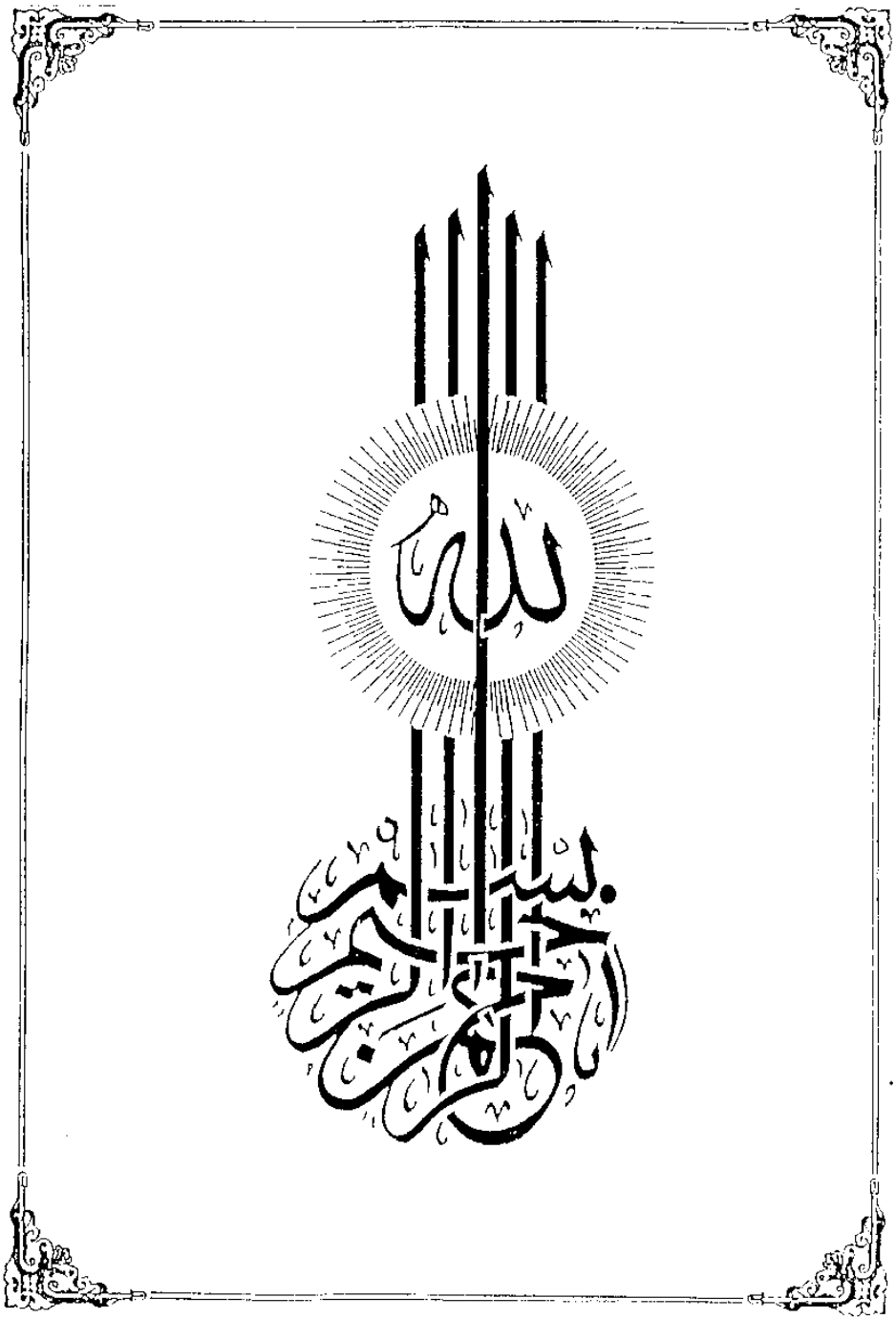

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INTRODUCTION AND AIM OF THE WORK

For long, the pancreas was considered as a difficult organ to be visualized radiologically, no specific contrast medium could be used for this organ. Plain film radiography and barium studies could only demonstrate large masses displacing other organs or occasional calcification seen in chronic pancreatitis.

However, in recent years, new and improved techniques of imaging have changed the situation and a whole battery of new tests is now available which includes selective angiography, hypotonic duodenography, Endoscopic retrograde cholangiopancreatography (E.R.C.P) and percutaneous transhepatic cholangiography (P.T.C) which provide direct imaging of the pancreatic duct.

Also ultrasonography and computed tomography which allow direct imaging of the pancreas and peripancreatic tissues. Moreover, recent developments in the imaging capabilities of magnetic resonance promise an alternative method of direct pancreatic imaging.

These increasingly sophisticated imaging techniques, together with recent clinical, laboratory and endoscopic advances have improved tremendously our knowledge and understanding of pancreatic diseases, hence, great improvement in medical and surgical management of diseases related to that organ.

Radiology, has emerged from this spectrum as a keystone for diagnostic evaluation, due to wide variety of radiological techniques now available, and due to the fact, that it is important in the pancreas to use all the techniques at hand, as they all have areas in which false negative results can occur.

The radiologist has become an important member in the team managing the patient with pancreatic disease since the choice of the imaging method depends upon the clinical problem, the apparatus available and the expertise in individual centers.

Consequently, a basic knowledge of the embryology and anatomy of the pancreas together with detailed knowledge of the normal appearance of this organ by the different radiological modalities is an essential starting point to the radiologist.

The aim of this study is to review the normal appearance of the pancreas by the different imaging modalities, so that we can always refer to them when we are analysing what looks to be an abnormal finding during the use of these modalities in studying pathological cases, and also we establish the efficacy, the practical use and limitation of these different imaging modalities used in different pancreatic lesions. Moreover, a protocol for the choice of different imaging modalities in pancreatic diseases, is suggested at the end of this study.

Anatomy and Physiology of the Pancreas

ANATOMY AND PHYSIOLOGY OF THE PANCREAS

A. DEVELOPMENTAL ANATOMY OF THE PANCREAS

Knowledge of the embryology is not only of value in the satisfaction of knowing how the adult arrangement comes about, but has the practical advantage of greatly clarifying and understanding the clinical problem, the outcome of the disease and the diagnostic, medical and surgical approach.

A brief review of developmental changes occurring in the embryo will be considered before presenting the anatomical relation of the pancreas in the adult.

The pancreas develops from two out-pocketings from the endodermal lining of the gut. These buds arise on opposite sides of the duodenum during the 3-4 mm stage of the human embryo (i.e. 3 weeks). One pushes out from the dorsal wall, just opposite and cranial to the hepatic diverticulum, it is the "dorsal pancreas".

The other probably originally paired, appears ventrally in the caudal angle between gut and hepatic diverticula and consequently is called the "ventral pancreas". These two primordia meet and unite, producing a joint organ (Fig. 1:A & B) The dorsal pancreas forms all of the nature gland except most of the head and the uncinate process, which arise from the ventral primordium (Fig. 1:C) ***(Arey, 1974).***

Both pancreatic buds have an axial duct. The dorsal duct arises directly from the duodenal wall, but the base of the ventral duct is carried upwards onto

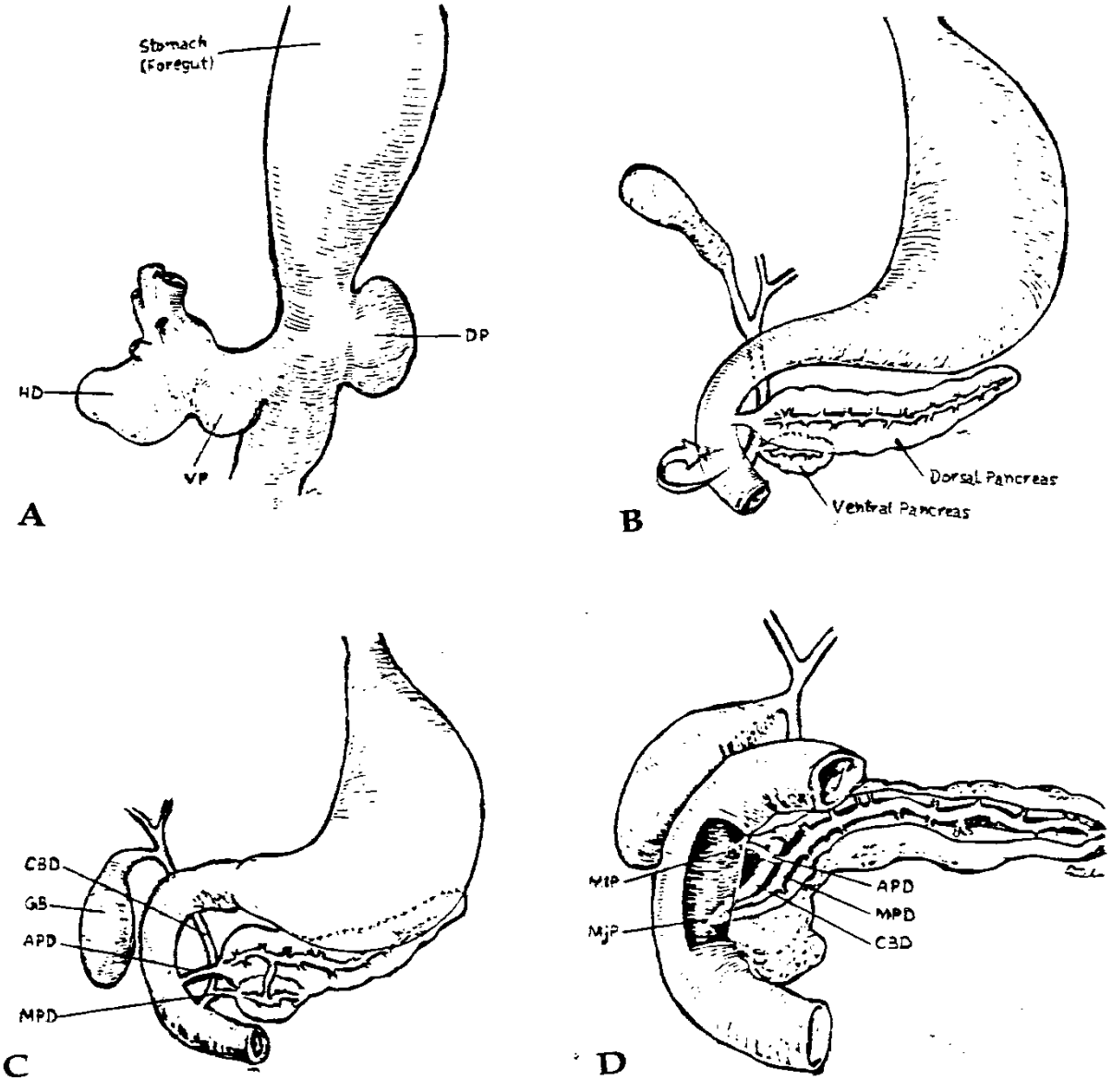

Fig. 1: Diagram of different stages of development of the pancreas till is reaches its mature form

a. Lateral view of the distal stomach and duodenum showing: The dorsal pancreas pointed toward the posterior body wall as it lies in the midline dorsal mesentery. The ventral pancreas and biliary tree lie suspended in the caudal edge of the midline ventral mesentery.

b. Frontal view showing: Rotation and bulging of duodenum to the right to form the C-loop. The common bile duct now lies behind the upper duodenum and the two portions of the pancreas have come into contact.

c. Fusion of the ventral and dorsal pancreas has occurred along with duct anastomosis.

d. The mature relationship of the pancreatic duct and common bile duct. (Quoted from Arey, 1974).

the elongating common bile duct and shares a common stem with it. When duodenal torsion brings the two pancreatic primordia side by side, the short ventral duct taps the dorsal duct (Fig. 1:C & D).

Thereafter the long distal segment of the dorsal duct plus the entire ventral duct will serve as the chief line of drainage. This combined tube is known in adult anatomy as the "pancreatic duct of Wirsung".

The proximal, stem segment of the dorsal duct constitutes the accessory duct of Santorini. It becomes tributary to the main duct, but it may retain its duodenal outlet as well (Fig. 1:D).

The occurrence of a permanent common outlet into the duodenum for bile and pancreatic juice is a direct consequence of the close relationship between the bile and ventral pancreatic ducts.

The region of the common outlet is the ampulla of vater which opens at the major duodenal papilla. This joint duct gains a circular sheath of smooth muscle (sphincter of Oddi) in the seventh week ***(Gray, 1973).***

The Glandular Tissue

Secretory acini begin to appear in the third month as terminal and side buds from the primitive duct.

Pancreatic islands "of ***Langerhans***" also are differentiated from the ducts at about the same time.

They are composed of distinctive cells which take the form of single sprout, but later through growth become complex island masses. In all about a

million islets are formed, some of which retain their original connections with the parent ducts.

No histological distinction exists between the acini of the dorsal and ventral pancreatic masses, but probably the dorsal pancreas alone differentiates islands.

B. MACROSCOPIC "GROWTH ANATOMY OF THE PANCREAS" (FIGS. 2,3)

Without knowledge of the normal anatomy, there can be no knowledge of pathological changes, therefore, a detailed anatomic view will be considered before proceeding to the normal appearance of the organ by different diagnostic modalities.

The pancreas is a soft, lobulated, greyish-pink gland, 12-15 cm. long, extending nearly transversely across the posterior abdominal wall, behind the stomach, from the duodenum to the spleen. Its broad, right extremity is called the "**head**", and is connected to the main part, or "**body**", by a slight constricted "**neck**". Its narrow left extremity form the "**tail**". It passes obliquely to the left and slightly upwards, across the posterior wall of the abdomen, in the epigastric and left hypochondriac regions *(Gray, 1973)*.

The head

Flattened from before backwards, is sited within the curve of the duodenum. Its upper border is overlaped by the superior part of the duodenum. Sometimes a small part of the head of the pancreas is actually embedded in the wall of the descending part of the duodenum.

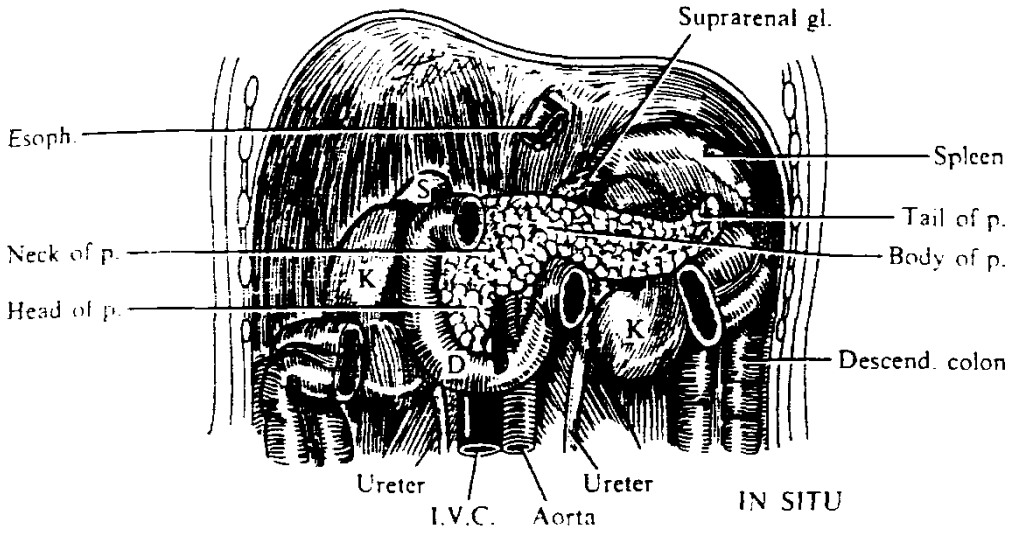

Fig.2: Anatomic relations of the pancreas. (Quoted from Meschan, 1980).

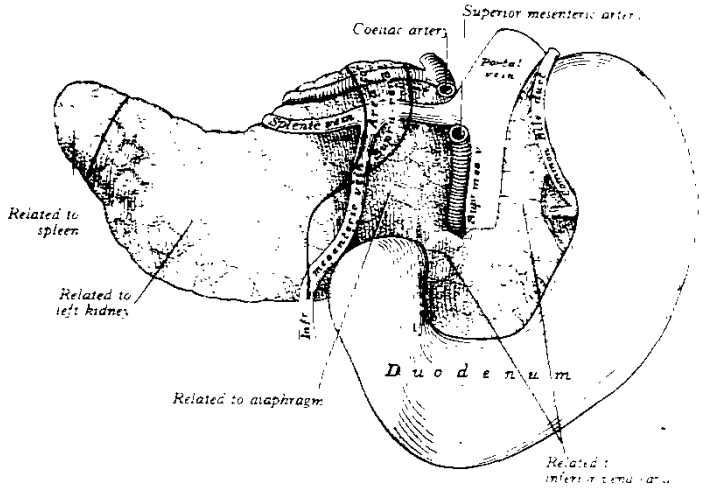

Fig. 3: Posterior aspect of the pancreas and duodenum from behind (Quoted from Meschan, 1976).

From the lower and left part of the head there is a prolongation, the **ucinate process** which projects upwards and to the left behind the superior mesenteric vessels. In or near the groove between the right lateral and lower borders of the head and the duodenum there is anastomosis between the superior and inferior pancreaticoduodenal arteries. The superior one is a branch from the gastroduodenal artery which is a branch from a hepatic artery while the inferior one is a branch from superior mesenteric artery ***(Gray, 1973).***

Anterior surface:

From the anterosuperior aspect of the head of the pancreas, the neck juts forwards, upwards and towards the left, to be continued into the body of the pancreas. Between the head and neck, on the right side and in front, there is a groove for the gastroduodenal artery; on the left side and behind there is a deep notch where the superior mesenteric and splenic veins unite to form the portal vein. Below and to the right of the neck the anterior surface of the head is in contact with the transverse colon. The uncinate process is crossed anteriorly by the superior mesenteric vessels.

Posterior Surface:

The posterior surface of the head of the pancreas is related to the inferior vena cava, which runs upwards behind it and covers nearly the whole of this aspect. Also, it is related to the terminal parts of the renal veins and the right crus of the diaphragm.

The uncinate process passes in front of the aorta. The bile duct lies either in a groove on the upper and lateral part of the posterior surface of the head of the pancreas, or in a canal in its substance.

The neck

It is about 2 cm long, extends forwards,, upwards and to the left from the head and merges imperceptibly into the body. Its anterior surface is covered with peritoneum and adjoins the pylorus, the gastroduodenal and the anterior branches of superior pancreaticoduodenal artery descend infront of the gland at the right side of the junction of the neck with the head; its posterior surface is in relation with the superior mesenteric vein and the beginning of the portal vein (Fig. 3).

The body

Is somewhat prismoid in section, and has three surfaces: anterior, posterior and inferior, and also has three borders; superior, anterior and inferior.

The anterior surface: Is concave, and is directed forwards and upwards; it is covered with peritoneum, namely the anterior of the two ascending layers of the greater omentum and is separated from the stomach by the omental bursa.

The posterior surface: Is devoid of peritoneum, and is in contact with the aorta and the origin of the superior mesenteric artery, the left crus of diaphragm, the left supra-renal gland and the left kidney and its vessels, particularly the left renal vein.

It is related to the splenic vein which passes from left to right and separate it from the above mentioned structures.