

**A STUDY ON  
VARIATIONS IN THE SECOND PART OF THE  
DUODENUM, THE PANCREAS AND THE PORTAL VEIN  
WITH APPLIED ASPECTS**

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**M.S. (ANATOMY)  
BRANCH - V**



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# **CERTIFICATE**

This is to certify that this dissertation entitled “ *A study on Variations of the second part of the Duodenum, the Pancreas and the Portal Vein with Applied Aspects*” is the bonafide record work done by **Dr. S. SULOCHANA**, under my overall supervision and guidance in the Department of Anatomy, Thanjavur Medical College, Thanjavur, in partial fulfillment of the regulation of The Tamil Nadu Dr. M.G.R. Medical University for the award of M.S. Degree in Anatomy (Branch V) to be held in September 2006.

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**BIBLIOGRAPHY**

**MASTER CHART**

# INTRODUCTION

*“I find the great thing is not so much where we stand as in what direction we are moving. To reach the port of heaven, we must sail sometimes with the wind and sometimes against it; but we must sail and not drift, nor lie at anchor.”*

*- OLIVER WENDELL HOLMES*

# INTRODUCTION

The duodenum and pancreas are the deepest-lying parts of the digestive tract. Anatomic relations between the duodenum, the pancreas and the surrounding structures are crucial to several disease processes. Knowledge of the anatomy of the duodenum will facilitate intubations and minimize risk.

Until recently the small intestine had been relatively inaccessible for non-operative diagnostic procedures compared with stomach and colon. Several diagnostic techniques like mucosal biopsy, Enteroclysis, Selective Mesenteric Angiography, Scintigraphy and Fiberoptic Endoscopy are now available for specific diseases of the small bowel.

The clinician and the endoscopist should be aware of the basic features of the small intestine structure as well as of regional variation in structure and function. Such knowledge greatly facilitates an understanding of the pathophysiology, evaluation and management of the small intestinal diseases, with the help of the modern diagnostic techniques.

Pancreas is perhaps the most unforgiving organ in the human body, leading most surgeons to avoid even palpating it unless necessary. Situated deep in the center of the abdomen in the retroperitoneal space, it has been described as *“the hermit or hidden organ of the abdomen.”*<sup>50</sup>

Knowledge of the relationships of the pancreas and the surrounding structures is critically important for all surgeons to ensure that pancreatic injury is avoided during surgery on other structures.

Pancreas also remained a hidden organ for the radiologists for decade. Indirect signs on plain films and contrast studies were usually present only in advanced diseases. Now with Endoscopic Retrograde Cholangiopancreatography (ERCP), Angiography, Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), superb visualization of the gland is possible negating the long-held nickname *“hermit of the abdomen”*.

This study on 100 specimens was conducted in the Department of Anatomy, Thanjavur Medical College, hoping to shed some additional information on anatomical variations of the second part of the duodenum, the pancreas and the portal vein.

# **AIM OF STUDY**

## **AIM OF STUDY**

The second part of the duodenum, the pancreas and the portal vein were studied with regard to

### **1. Dimensions of the duodenum**

- a) Length of the duodenum
- b) Width of the duodenum
- c) Length of the second part of the duodenum

### **2. Duodenal papilla**

- a) Position of the major duodenal papilla
- b) Opening of major duodenal papilla into the duodenum
- c) Size of the major duodenal papilla
- d) Shape of the major duodenal papilla
- e) Shape of the orifice of major duodenal papilla
- f) Distance between the pylorus and major duodenal papilla
- g) Presence of minor duodenal papilla
- h) Position of minor duodenal papilla
- i) Size of minor duodenal papilla
- j) Distance between minor and major papilla

### **3. Pancreas**

- a. Length
- b. Width of the Head, neck, body and tail
- c. Shape
- d. Termination of main pancreatic duct

### **4. Portal vein**

- a) Formation of portal vein
- b) Level of formation
- c) Termination of inferior mesenteric vein

### **5. Congenital anomalies**

### **6. Blood Supply**

### **7. Applied aspects**

# **HISTORICAL PERSPECTIVE**

## **HISTORICAL PERSPECTIVE**

About 300 B.C Herophilus of Alexandria gave the name Dodeka-daktulos to the first part of the intestine.<sup>21</sup> The word duodenum is the latin derivation from the Greek word Dodeka-daktulos meaning 12 fingers; Similarly der Zwolffingerdam in German. This is so named because the duodenum measured about 12 fingers in those animals in which it was first described.<sup>18</sup>

Historically the first description of the pancreas is credited to Herophilus of chalkaidon around the year 300 BC. The existence of the pancreas is also described in the Talmud and depicted as the “ finger of the liver” between 200 BC and AD 200.<sup>50</sup>

Four centuries later, this abdominal organ was named the pancreas, meaning “ all flesh “ by Rufus of Ephesus.<sup>12</sup>

The following famous anatomists identified and described the pancreatic anatomy and physiology.<sup>12,43,50</sup>

- Moritz Hoffman discovered the main pancreatic duct in the rooster in 1641.
- Johann Wirsung of Italy (Padua) identified the pancreatic duct in 1642.

- Johan Rhode was the first to describe the existence of the accessory pancreatic duct as early as 1646.
- Bidloo first noted the major duodenal papilla, common to the bile duct and the pancreatic duct, in 1685.
- In 1720, Abraham Vater of Germany described the papilla of Vater.
- Giovanni Santorini of Italy (Venice) described the pancreatic accessory duct in 1775.
- In 1852, Claude Bernard of France suggested the pancreas might have role in digestion.
- The first operative intervention on the pancreas has been attributed to Le Dentu in the year 1862, involving percutaneous aspiration of the pancreatic mass with an unfavorable outcome.
- Rugerio Oddi of Italy described the sphincter bearing his name in 1869.

- Langerhans described the histologic structure of the pancreas in 1869.
- The connection between diabetes and the pancreas was established in the 1890s.
- Allan O. Whipple was a professor of surgery at Columbia University, New York, when he pioneered pancreatic surgery in the 1930s.
- In 1970s, endoscopic retrograde cholangiopancreatography (ERCP), angiography, Computed Tomography (CT) scans, Ultrasound and Magnetic Resonance Imaging (MRI) clearly identified the pancreas, adding to the knowledge of basic anatomy, physiology and to the pathophysiology of pancreatic diseases.

# **NORMAL ANATOMY**

# **NORMAL ANATOMY**

## **DUODENUM**

The duodenum forms a C-shaped loop, which measures 20-25 cm in length and 3.5-5cm in width. The duodenum is the shortest, widest and most sessile part of the small intestine. The first (Superior) part of the duodenum is about 5 cm long.

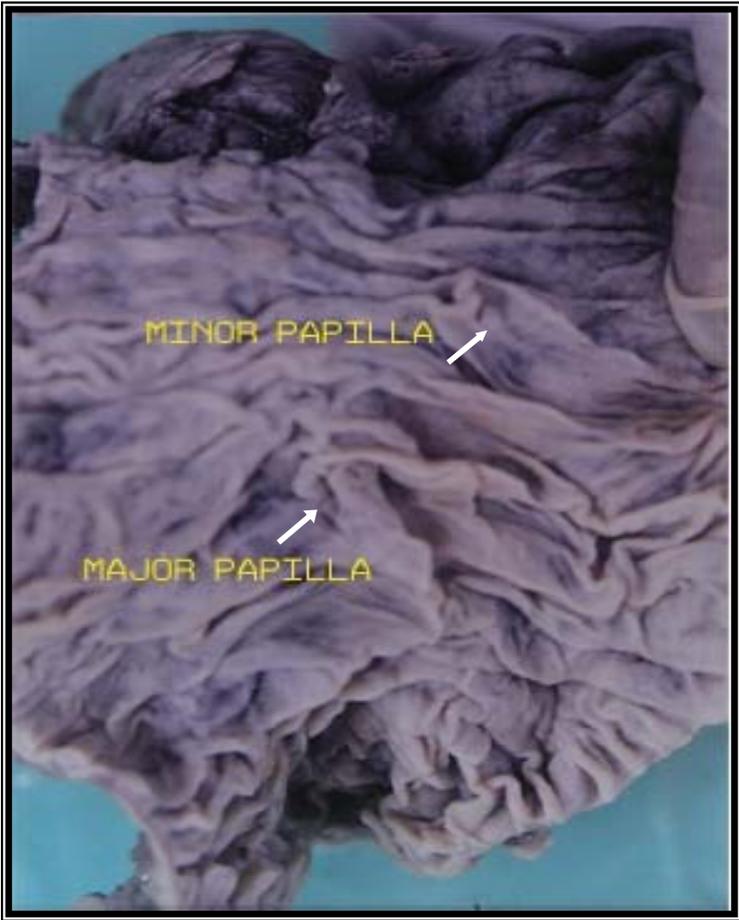
The second (descending) part is 8-10 cm long. The common bile duct and the main pancreatic duct enter its wall obliquely on the medial side and opens on the summit of the major duodenal papilla, sited posteromedially, 8 -10 cm distal to the pylorus. The accessory pancreatic duct opens about 2cm proximal to the major papilla, on a minor duodenal papilla, which is located on the anterior wall of the second part of the duodenum.

The third (horizontal) part is about 10 cm long and the fourth (ascending) part that is about 2.5 cm turns into the jejunum at the duodenojejunal flexure.

## **PANCREAS**

The pancreas is about 12-15 cm long situated nearly transversely on the posterior abdominal wall. The broad right extremity, the head, is about 4.4cm in width, the neck 3.4cm, the body 3.5cm and the tail 3cm. The pancreas can be shaped like L, S or inverted V.

NORMAL ANATOMY



The portal vein is formed by the convergence of the superior mesenteric vein and splenic vein, posterior to the neck of the pancreas. The inferior mesenteric vein usually opens into the splenic vein. Sometimes the inferior mesenteric vein ends in the superior mesenteric vein or at the union of splenic and the superior mesenteric vein.

### **BLOOD SUPPLY TO PANCREAS & DUODENUM**

The head of the pancreas and the horseshoe shaped loop of the duodenum associated with it are supplied by branches from the two pancreaticoduodenal arcades, one being anterior, the other posterior to the head of the pancreas.

The anterior pancreaticoduodenal arcade is formed by the anterior superior pancreaticoduodenal artery, a branch from the gastroduodenal artery, which anastomoses with the anterior division of the inferior pancreaticoduodenal branch of the superior mesenteric artery.

The posterior pancreaticoduodenal arcade is formed by the posterior superior pancreaticoduodenal artery, usually a separate ramus from the gastroduodenal artery, which anastomoses with the posterior division of the inferior pancreaticoduodenal branch of the superior mesenteric artery.

The dorsal pancreatic branch from the splenic or the common hepatic artery and about 2-10 pancreatic branches from the splenic artery also supply the pancreas.

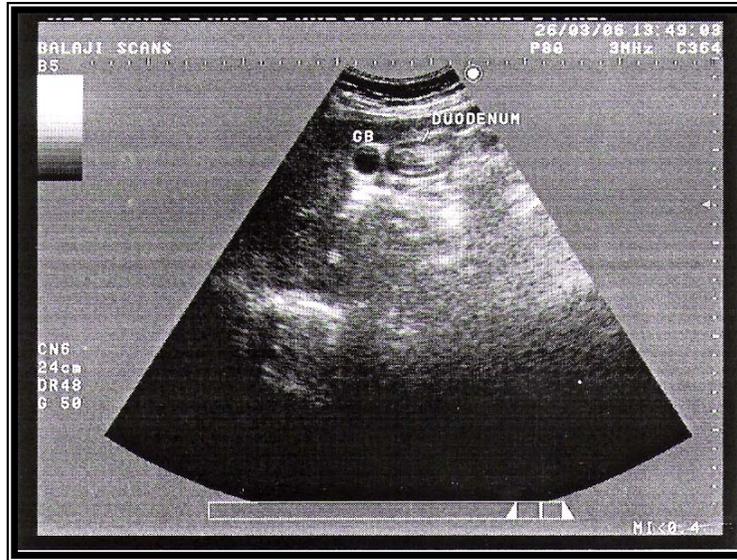
## **RADIOLOGICAL ANATOMY**

The outline of the pancreas is not definable on plain films, but can be visualized using Ultrasound, Computed tomography or Magnetic resonance imaging. The head of the pancreas usually lies just to the right of the T<sub>12</sub>/L<sub>1</sub> vertebra, but may be as high as T<sub>11</sub> or as low as L<sub>5</sub>/S<sub>1</sub>.

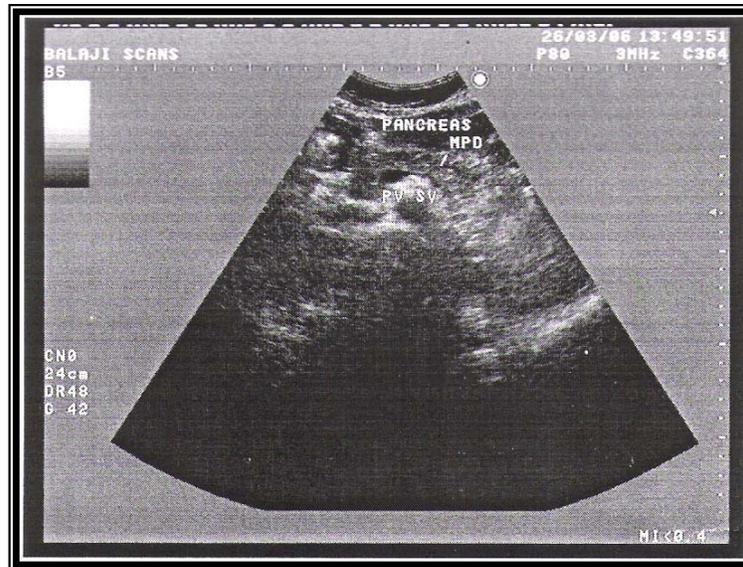
In younger patients the contour of the gland is smooth and the parenchyma is homogenous. With age and progressive fatty deposition, the pancreas becomes lobulated, irregular and inhomogenous and there is increased reduction in the antero-posterior diameter of the pancreatic head, body and tail.

Improved imaging techniques have demonstrated that the ventral pancreas may have a different feature from the dorsal pancreas as a normal variant. ERCP affords opacification of both the pancreatic and bile ducts.

**ULTRASONOGRAM**  
**DUODENUM (NORMAL)**



**PANCREAS (NORMAL)**



# **REVIEW OF LITERATURE**

**REVIEW OF LITERATURE**

**DUODENUM**

Treitz (1853) was reported to have pioneered the description of the suspensory muscle of the duodenum as a structure extending from the duodenojejunal flexure to fibrous tissues surrounding the root of the coeliac and superior mesenteric arteries.<sup>29</sup>

Treitz (1853) further described the presence of the accessory muscle or der Hilfsmuskel extending from the oesophageal opening of diaphragm to the region of the cranial end of suspensory muscle of the duodenum.<sup>29</sup>

Duodenal diverticula are situated frequently near the orifice of the bile duct. They may be false (protrusions of mucous and submucous coats) or true (all the coats are represented) and most of the true diverticula are congenital in origin and possibly associated with the diverticula-giving rise to liver and pancreas (Baldwin 1911).

Jit (1952) reported that the suspensory muscle of the duodenum and accessory muscle are different entities.

Brash.J.C (1953) has described three types of duodenum. (1) Annular- the two extremities come close to one another; (2) U-shaped – the third part is long and fourth part nearly vertical; and (3) V-shaped –

the third part is very short or absent. He says that the duodenum measures 3.5 to 5 cm in diameter and the second part of the duodenum measures 7.5 cm in length.

Hollinshead (1962) says that the duodenal diverticula are frequent around the region of entrance of the common bile duct and chief pancreatic duct into the duodenum.

Wyburn (1972) describes the duodenum as 25cm long and 4-5 cm in diameter being the widest part of the intestine. Its superior part is 5cm long, descending part 7.5 cm, horizontal part 7.5cm and ascending part 5 cm.

Last (1973) describes the duodenum as 10 inches long and its parts as 2, 3, 3 and 2 inches long respectively.

Russell Woodburne (1973) describes that the total length of the duodenum is 25cm and the first part 5cm, the second part 7-10cm, third part 6-8cm and the fourth part 5cm. And the circular mucosal folds are not found in the first 3-5cm of the duodenum beyond the pylorus. He also reports that the circular form of the duodenum is replaced by a U or V- shaped type due to differences in the length of the four parts.

Osnes M. et al., (1981) reported that congenital duodenal diverticula occur within a few centimeters of the ampulla of Vater.

Hola (1994) had named the suspensory muscle of the duodenum as the suspensory muscle complex and described it as having two parts, the suspensory muscle proper caudally and the accessory muscle cranially.

Margot Shiner (1995) says that the duodenum measures 20 to 30 cm in length and 3 to 5 cm in diameter.

Carol and Jeff (1998) says that the duodenum forms a C-shaped loop measuring approximately 30cm (12inches) in length and its first part 5 cm long, second part 7-10cm, third part 10 cm and the fourth part 5cm.

Jean-Pierre Raufman (1999) describes the length of the first part of duodenum to be 5cm, second part 7-10cm and the third part 5-8cm.

Jean-Pierre Raufman (1999) says that the congenital duodenal diverticula are asymptomatic incidental findings on barium contrast studies.

Bannister LH (2000) in Gray's anatomy describes the length of the duodenum to be 20-25 cm and its superior part about 5cm, descending part 8-10cm, horizontal part about 10 cm and ascending part about 2.5cm.

Daniel J. Nolan (2002) says that the duodenum measures 20-30 cm in length and its second part 7.5 cm.

The reported prevalence for duodenal atresia/stenosis ranges between 0.6-2.3/10000 births. (Martinez-Frias, et al. 2002; Haeusler, et al. 2002; Harris, et al. 1995; castilla and Lopez-Camelo, 1990).

Patil (2005) reported a case of mesoduodenum in adult. Mesoduodenum is a part of dorsal mesentery enveloping, extending on the posterior abdominal wall and it is seen in the first part of the duodenum.

## **DUODENAL PAPILLAE**

Letulle and Nattan Larrier (1898) found the distance of major duodenal papilla from pylorus to be 52 to 98 mm, the average being 7 – 8 cm. And the distance between the major papilla and minor papilla is 10 – 35mm, the average being 18mm.<sup>43</sup>

Stracker (1909) reported the distance between the major papilla and pylorus to vary from 55 to 142mm, it most commonly being between 80 to 95 mm.<sup>43</sup>

Baldwin (1911), in his study on 100 specimens, showed that the major and minor duodenal papilla is present in all cases and the distance between them varies from 0.9 to 3.5cm, average being 2cm.

Clair-Mont of Switzerland (1923) reported a distance of 3cm, between the major and minor papilla.<sup>43</sup>

The common bile duct and the pancreatic duct may anomalously open into the papilla minor (Clair-Mont, 1923).<sup>43</sup>

Maeda (1924), in 62 specimens found the distance between the pylorus and major papilla to vary, as a rule, from 70 to 79mm, with extremes from 40 to 159mm, and the distance between both the papilla vary from 20 to 29mm, with extremes of 10-59 mm.<sup>43</sup>

Keyl (1926) reported that the distance between the pylorus and minor papilla varies from 3.5 to 12cm, the average being 7cm, and the minor papilla may be absent (4%), impervious or markedly regressed.<sup>43</sup>

The major or the minor papilla may be double (Holzapfel, 1930; Patzelet, 1936)<sup>43</sup> and even triple (Schirmern, 1983<sup>43</sup>; Baldwin, 1911).

Lurje.A. (1937), Poppel MH and Jacobson NG. (1956) and Dawson W. (1961), in their studies have found the major papilla to be as close as 5cm or as far away as 14cm, thus it can be located at any point from the junction of I & II part of the duodenum to within the III part.<sup>7</sup>

Rienhoff and Pickrell (1945) describes that the major papilla appears endoscopically on the ridge of the duodenal longitudinal fold approximately 8cm from the pyloric ring as a round or oval protrusion of 3mm diameter (range 1.5 to 4.5mm).

Milbourn (1950) found that the bile duct and duct of Wirsung always terminated at the greater papilla and the duct of Santorini at the lesser papilla. He found the distance between the lesser papilla and pylorus to vary from 5.5 to 9cm, the average being 8cm.

Buchanan (1953) describes that the entrance of the common bile duct and pancreatic duct is 4 inches from the pylorus and the minor duodenal papilla is seen one inch above the major duodenal papilla.

Brash J. C. (1953) says that the major papilla opens 8.5 to 10 cm from the pylorus.

Hughes and Kermutt (1954) found the distance from the lesser and the greater papilla to average 21mm.

Most commonly, the papilla minor is calculated as being situated about 7cm below the pylorus and 2cm above the papilla major (Nicholas A. Michels. 1955).

Sterling (1955) found the distance between the pylorus and major papilla to vary from 80 to 120 mm, with extremes from 55 to 142mm.

Sterling (1955) reports that in 76%, the major papilla is visible as a prominence and in 24% it is depressed, still composed of a solid mass of tissue.

Poppel and Jacobson (1956) have reported a diameter of major papilla as large as 3 cm.

Schwartz and Birnbaum (1962) reported that 74% of papilla was found in II part of the duodenum and 18% at the junction of II & III parts and 8% in the III part.

Oi, Takemoto and Kondo (1969) describes the external appearance of the major papilla as flat, papillary or hemispherical.

R.J Last (1973) quotes that the ampulla of Vater is seen on the posteromedial wall of II part of duodenum four inches from the pylorus and the minor duodenal papilla proximal to it.

Russell Woodburne (1973) describes the greater duodenal papilla as a tubular projection on the posteromedial wall of the duodenum overlain by a hood-like fold and the papilla is continued below by the

tapered longitudinal fold of the duodenum. The lesser duodenal papilla lies in the anteromedial wall at the junction of the superior and middle thirds of the second part of the duodenum.

Philip et al. (1974) reported that hemispherical shape of the major duodenal papilla appears to be common, but also described other shapes like unformed, swollen, villous, cone shaped, nipple-shaped and sharply pointed.

The ampulla of Vater can be seen in about two-thirds of patients during routine double-contrast barium examination and the accessory papilla in about one quarter. (Stevenson et al.1980).

Bernard H. Hand (1987) describes the major papilla as smooth elevation that usually lies in the second part of duodenum on the posterior or posteromedial wall usually about 8 cm from the pylorus. The orifice of the major papilla is round or slit-like and 2-5 mm in diameter.

Bernard H. Hand (1987) reported the average size of the major papilla to be 1cm. And the minor papilla is never found dorsal or distal to the major papilla. And its distance from major papilla is usually 1cm

to 3.5cm, its size variable and in dissected specimens it is nearly always identifiable.

Major duodenal papilla lies in the second part of the duodenum in 75% of the population, at the angle between the second and the third parts in 15% and in 9%, in the horizontal third part of the duodenum (Russell 1993).

Forrest (1995) says that the minor pancreatic duct opens 2.5cm proximal to the main duct.

Margot Shiner (1995) describes the papilla of Vater as a mucosal projection situated approximately at the middle of the descending limb of the duodenum, on its medial aspect.

Theodore N. Pappas (1997) describes the endoscopic appearance of the minor papilla as a small, 2mm polypoid structure and the major papilla, which opens into the second part of the duodenum usually, appears as a hooded fold.

Carol & Jeff (1998) says that the major duodenal papilla is seen inferior to the midpoint of second part of the duodenum on the posteromedial wall and minor duodenal papilla 2 cm proximal to it on the same wall.

Jean-Pierre Raufman (1999) describes that the major papilla is seen on the posteromedial aspect of the second part of the duodenum and the minor papilla is seen 2 cm proximal to the major duodenal papilla.

Bannister LH (2000) describes that the hepatopancreatic duct opens on the summit of major duodenal papilla seen posteromedially in the second part of the duodenum, 8-10 cm from the pylorus. The accessory duct opens 2 cm anterosuperior to the major papilla on a minor duodenal papilla.

Kamisawa et al. (2001) reported the size of the minor duodenal papilla to vary from 3 to 6mm endoscopically. In 50% of patients with chronic pancreatitis, the minor papilla was larger than 6mm. They also reported that the minor papilla was patent in 90% when it was near the major papilla (<1.5cm), and in 51% when the distance was more than 2cm.

Daniel J.Nolan (2002) says that radiologically the ampulla lies on the medial wall and the minor duodenal papilla on the anterior wall 1cm proximal to the ampulla.

The ampulla of Vater is recognized in a double-contrast examination by its hooded fold and a distal longitudinal fold. The accessory papilla is sited about 10mm proximal to ampulla. On a prone view, the ampulla lies on the medial wall and the accessory papilla on the anterior wall. (Daniel J. Nolan 2002).

Tadahika (2002) says that the minor papilla may be seen endoscopically as large as major papilla or a rudimentary elevation, with the size of 6.8 to 3.8mm in length and 5.4 to 2.8 mm in width.

## **PANCREAS**

Annular pancreas was first described by Tiedman in 1818 and named by Echer in 1862.<sup>53</sup>

Mehnen (1938) in his study on 449 specimens reported that the bile duct and the main pancreatic duct opened separately in 4% of cases, with the pancreatic duct opening 3 - 4 mm caudal to the papilla of Vater.<sup>43</sup>

Holzafel (1942) in his study on 50 specimens reported separate openings of the bile duct and the pancreatic duct in two papillae in 9 cases.<sup>43</sup>

Stofer (1944) reported three cases of annular pancreas in 7000 autopsies.

Barbosa (1946) & Feldmen (1952) say that the heterotopic pancreatic tissue has been identified in one of every 500 laparotomies and the reported frequency in autopsy studies range from 0.6% to 15%.

Millbourn (1950) in his study on 200 specimens reports that in 18 cases, the bile duct and the pancreatic duct, the latter being the duct of Santorini functioning as the main duct, terminated at separate opening in the duodenum.

Buchanan (1953) describes the dimensions of the pancreas as 6-8 inches long and 1-1/2 inches deep, except at the right and left extremities and 1/2-3/4 inch thick.

Brash J.C. (1953) says that separation of the uncinata process from the head of the pancreas forms a lesser pancreas.

Kleitsch (1955) describes pancreas divisum as a relatively common anomaly found at 5 to 10% of autopsies and in about 2 to 7% of patients undergoing ERCP.

Nicholes N. Michels (1955) reports that the head of the pancreas and the the loop of the duodenum is supplied by branches from the pancreaticoduodenal arcades, one being anterior, and the other posterior to the head of the pancreas. There may be double, triple or quadruple

anterior and posterior arcades. He also reports that the double anterior arcades, formed by the same superior pancreaticoduodenal artery are quite frequent.

Wyburn (1972) says that the duodenum and the head of the pancreas are supplied by the anterior and the posterior duodenal arcades formed by the superior and inferior pancreaticoduodenal branches of the gastroduodenal and the superior mesenteric arteries respectively.

Kreel et al. (1973)) describes the shape of the pancreas as oblique (36%), Sigmoid (19%), transverse (3%) horse-shoe (8%), L-shaped (33%) and inverted (11%).

Dolan et al. (1974) quotes that the heterotopic pancreatic tissue (pancreatic rests) has been found at autopsy in 0.55 to 13.7% of persons. About 75% of all pancreatic rests are located in the stomach, duodenum and jejunum.

Anacker (1975) describes the breadth of the head of the pancreas, from upper margin to lower margin, to vary from 3.5–8cm and the body, approximately 3.3cm and the length of the pancreas, 16.5–27cm.

Ravitch M.M (1975) in his study on annular pancreas quotes that in 85% of cases, the annulus was always proximal to the ampulla of Vater involving the second part of the duodenum.

Skandalakis et al. (1979) reported that there might be complete absence of the main pancreatic duct.

Basmajian (1980) describes the pancreas as 12-15 cm long and lies obliquely in the posterior abdominal wall.

Zylak and Pallie (1981) reported that the pancreas can be shaped like L, S or inverted V.

Bernard H. Hand (1987) describes the mean width of the head, neck, body and tail of the pancreas to be 4.4cm, 3.4cm, 3.5cm and 3cm, respectively.

Bernard H. Hand (1987) says that the site of the annular pancreas is in the II part of the duodenum in 85% of cases.

Uncinate process measures approximately 1cm by 1-3cm in size and extends beyond the left lateral margin of the superior mesenteric vein in all people and reaches to, but not beyond the superior mesenteric artery in more than 90% of subjects (Martin, D.F.1988).

Rogers (1992) says that carcinoma of the pancreas is difficult to diagnose. The deep, relatively inaccessible position of the pancreas and its intimate relationship to large blood vessels like superior mesenteric artery increases the technical difficulty of surgical therapy.

The incidence of annular pancreas has been calculated as 1:20000(Russell 1993).

Russell R. C. G. (1993) says that annular pancreas is diagnosed by plain radiograph of the abdomen in infants and by hypotonic duodenography in adults. Congenital short pancreas is a very rare finding at pancreatography.

Richard M. Gore (1994) describes pancreas as a soft, slender, lobulated organ, which measure approximately 15-25cm in length, 3-5cm in height and 1.5 to 3.5 cm in thickness. He describes three morphological shapes: tadpole shaped (44%), dumbbell shaped (33%) and sausage shaped (23%).

Trede (1997) says that the pancreas measures 18 to 28cm in length and lies transversely and somewhat obliquely in the retroperitoneum.

Carol and Jeff (1998) say that the reported incidence of annular pancreas is approximately 1 per 10000 live births.

Mulholland and Simeone (1999) quotes that the pancreatic rests are found along the upper gastrointestinal tract with duodenum (27.7%) representing the most frequent location followed by stomach (25.5%) and jejunum (15.9%).

Mulholland and Simeone (1999) say that the pancreas is 12-20cm long in adults and lies obliquely rather than transversely. They also say that in 6% of subjects, independent openings of the common bile duct and main pancreatic duct are seen and in 5%, the main duct may be absent. The shared blood supply of the duodenum and the pancreatic head may be compromise the blood supply of the duodenum, in 95% pancreatectomy.

Bannister LH (2000) in Gray's Anatomy says that the length of the pancreas is 12-15 and the neck is about 2 cm long. The superior pancreaticoduodenal artery, branch of the gastroduodenal artery and inferior pancreaticoduodenal artery, a branch of superior mesenteric artery, supplies the duodenum and the pancreas.

Jorge et al. (2005) reported that contrast material-enhanced multi-detector row computed tomography enable depiction of pancreas divisum.

William E. Fisher (2005) says that two thirds of pancreatic adenocarcinomas arise within the head or uncinata process; 15% are in the body and 10% in the tail. Tumours in the head of the pancreas are diagnosed earlier because they cause obstructive jaundice. Ampullary carcinomas, carcinomas of distal bile duct and periampullary duodenal adenocarcinomas have better prognosis, because early obstruction of the bile duct and jaundice leads to the diagnosis.

### **FORMATION OF PORTAL VEIN**

Gilfillan (1950) reported that inferior mesenteric vein terminated in splenic vein in 55.5%, in superior mesenteric vein in 29.5% and in the angle of junction in 15%.

Hollinshead (1962) says that the superior mesenteric vein unites with the splenic vein, thereby forming the portal vein. And the Inferior mesenteric vein joins the splenic vein, the angle between splenic and superior mesenteric vein or the latter vein.

R. J. Last (1973) describes the portal vein as a mere continuation of the superior mesenteric vein and changes its name when the splenic vein joins the superior mesenteric vein at the level of neck of the pancreas.

Russell Woodburne (1973) reports that the portal vein is formed behind the neck of the pancreas by the union of the superior mesenteric vein and the splenic vein. The inferior mesenteric vein empties into the splenic vein in 60 percent and superior mesenteric vein in 40 percent.

Grant (1980) says that the inferior mesenteric vein ends either in the splenic vein or at the angle of union between the superior mesenteric vein and the splenic vein.

Aktan et al (1995) in their study on the portal vein formation reported that in 56.3% the portal vein was formed by a union of the superior mesenteric and splenic veins with the inferior mesenteric vein draining into the splenic vein. In 31.3% the inferior mesenteric vein drained directly into the superior mesenteric vein. And in 12.5% the portal vein was formed by a confluence of the superior mesenteric, inferior mesenteric & splenic vein.

Michael Henderson (1999) says that the portal vein is formed by the union of the splenic vein and superior mesenteric vein behind the neck of the pancreas. The third vein to contribute to portal venous inflow is the inferior mesenteric vein, which enters the splenic vein in

two-thirds of subjects within 1 to 2 cm of the splenic veins union with the superior mesenteric vein or at its confluence with the splenic vein.

Bannister (2000) in Gray's Anatomy says that the portal vein is formed from the convergence of the superior mesenteric and splenic vein posterior to the neck of the pancreas. And the inferior mesenteric vein usually opens into the splenic vein. Sometimes the inferior mesenteric vein ends at the union of the splenic and superior mesenteric vein.

Derrick and Hans-Ulrich (2002) reports that there may be a double portal vein, one element being the continuation of the splenic vein, the other the continuation of the superior mesenteric vein.

William E. Fisher et al. (2005) says that the splenic vein joins the superior mesenteric vein at the inferior border of neck of pancreas to form the portal vein. Sometimes the inferior mesenteric vein, which often joins the splenic vein, may join the superior mesenteric vein or merge with the superior mesenteric portal venous junction forming a trifurcation.

# **MATERIALS AND METHODS**

## **MATERIAL AND METHODS**

Anatome – the name given to the science of anatomy by Aristotle two thousand three hundred years ago. The word means cutting up – the

method by which the study of the structure of living things is made possible.

Although ultrasonography, Magnetic resonance imaging, Computed tomography, contrast radiography are advances in the investigatory methods in the living, manual dissection is still a valuable mode of study in the cadavers and this method is followed in the present study.

## **MATERIALS**

The 100 specimens for the present study were obtained from the cadavers of the Department of Anatomy and from the Department of Forensic Medicine, Thanjavur Medical College. The Specimens were collected without any age, sex, socio-economic status, religion or pathological bias.

The Specimens were removed from the cadaver as per the Cunningham's manual of Practical Anatomy. The abdominal cavity was opened by an incision extending from the xiphoid process to symphysis pubis. The greater omentum was exposed. The attachment of the gastrocolic ligament to the transverse colon was cut, turning the stomach and the ligament upwards, the posterior abdominal wall peritoneum was exposed.

The attachment of transverse mesocolon across the duodenum and pancreas was traced and cut. The mesentery attached to the duodeno-jejunal junction was noted. The superior mesenteric vessels entering the

root of the mesentery crossing the third part of the duodenum were cut. The mesenteric attachments were removed and the surface of the duodenum and pancreas were cleared.

Two ligatures 2.5cm apart were made around the pyloric end of the stomach and on the jejunum 5 cm below the duodeno-jejunal junction, and these structures were cut in between the ligatures.

The peritoneum along the right border of the second part of the duodenum was incised and the duodenum and pancreas were reflected towards the midline. The common bile duct and portal vein that courses behind the first part of the duodenum were cut. Then the duodenum and pancreas were removed along with the spleen from the underlying structures of the posterior abdominal wall.

The specimens collected from the Department of Forensic Medicine were removed during the postmortem. A vertical incision was made from the root of the neck to the pubic symphysis, and the thoracic and abdominal cavities were exposed. The same procedure was used to remove the specimens.

The specimens thus removed were preserved in 10% formalin and they were serially numbered from 1 – 100. The specimens were studied with regard to variations in the second part of the duodenum, the pancreas and the portal vein.

# **OBSERVATION**

**OBSERVATION**

The duodenum, the pancreas and the portal vein, studied in the 100 specimens, presented the following features.

## **I DIMENSIONS OF THE DUODENUM**

### **(a) The length of the duodenum**

The length of the duodenum was found to vary from 15.5 to 28cm, with the average of 22.29 cm.

**Table No. I (a)**

<b>LENGTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
25-30	12	3,4,40,50...
20-25(Normal)	70	2,5,6,8...
15-20	18	1,7,11,14...

In 70 specimens, the length was found to be in the normal range of 20-25cm.

In 18 specimens, the length was found to be in the range of 15-20cm.

In 12 specimens, the length was found to be in the range of 25-30cm.

### **(b) Length of the second part of the duodenum**

The Length of the second part of the duodenum was found to vary from 4-9 cm, with the average of 7.07cm.

**Table No. I (b)**

<b>LENGTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
7-10(Normal)	71	1,2,3,4...
5-7	28	5,6,9,14...
<5	1	31

In 71 specimens, the length was found to be in the normal range of 7-10 cm. In 28 specimens, the length varied from 5-7 cm. In one specimen, the length was below 5 cm (Specimen No.31, Length- 4 cm).

**(c) Width of the duodenum**

The width of the duodenum was found to be in the range of 1.8 to 4.5 cm, with the mean of 3.50cm.

**Table No. I (c)**

<b>WIDTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
3.5-5 (Normal)	72	1,2,3,4...
<3.5	28	5,7,8,19...

In 72 specimens, the width was found to be in the normal range of 3.5-5cm.

In 28 specimens, the width was found to be below 3.5cm.

## II. DUODENAL PAPILLA

### (a) Position of the major Duodenal Papilla

**Table No. II (a)**

POSITION	FREQUENCY	SPECIMEN NO.
At the junction of I & II part of duodenum	5	2,6,20,63,80
II Part	94	3,4,5,8...
Junction of II & III part	1	36
III part	-	-

In 94 specimens, the major duodenal papilla was located in the II part of the duodenum, in 5 specimens, at the junction of the I and II part of the duodenum and in one specimen, it was located at the junction of the II & III part.

### (b) Opening of major papilla into the duodenum

**Table No. II (b)**

OPENING INTO THE DUODENUM	FREQUENCY	SPECIMEN NO.
Posteromedially	79	1,2,3,7...
Medially	21	4,5,10,29...

In 79 specimens, the major duodenal papilla was seen on the posteromedial wall of the duodenum.

In 21 specimens, the major duodenal papilla was found to open medially.

**POSITION OF MAJOR PAPILLA**



**(c) Size of the major duodenal papilla**

The size of the major papilla was found to vary from 0.3-1.7cm, with the average size of 0.74 cm.

**Table No. II (c)**

SIZE (cm)	FREQUENCY	SPECIMEN NO.
0.3-0.5	12	3,24,32....
0.5-1	73	7,8,9...
> 1	11	7,15,17...

In 73 specimens, the size of the major duodenal papilla was found to be in the range of 0.5 to 1cm.

In 12 specimens, the size of the papilla varied from 0.3 to 0.5 cm.

In 11 specimen, the size was found be more than 1 cm.

**(d) Shape of the major duodenal papilla**

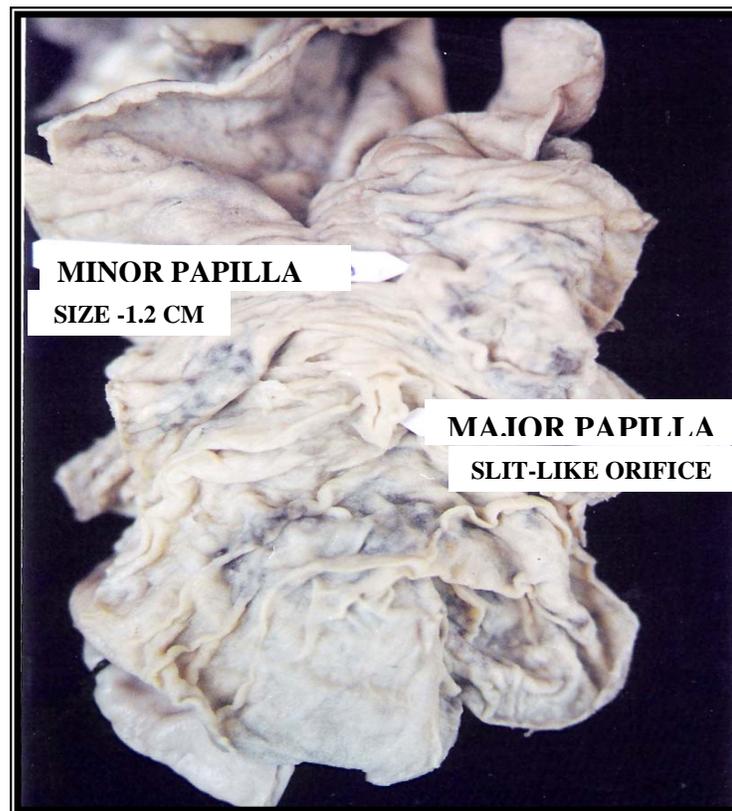
**Table No. II (d)**

SHAPE	FREQUENCY	SPECIMEN NO.
Papillary	96	1, 2, 3, 4,...
Flat	4	6, 23, 54, 85.

In 96 specimens, the shape of the major duodenal papilla was found to be papillary.

In 4 specimens, the shape was found to be flat.

## DUODENAL PAPILLA



**(e) Shape of the orifice of major duodenal papilla**

**Table No. II (e)**

SHAPE	FREQUENCY	SPECIMEN NO.
Round	85	1,2,3,5...
Slit-like	15	4,18,72,75,...

The shape of the orifice of the major duodenal papilla was found to be slit-like in 5 specimens and was round or oval in 95 specimens.

**(f) Distance between the pylorus and major papilla**

The distance between the pylorus and major papilla was found to vary from 5-11.6cm, with the average of 8.20cm.

**Table No. II (f)**

DISTANCE (cm)	FREQUENCY	SPECIMEN NO.
10-12	9	3,5,10,22...
8-10(Normal)	48	13,15,17,18. . .
7-8	30	1,7,14,16...
5-7	13	2,6,11,20...

In 48 specimens, the distance between the pylorus and major papilla was in the normal range of 8-10 cm.

In 30 specimens, the distance was found to be in the range of 7-8cm.

In 13 specimens, the distance was in the range of 5-7 cm.

In 9 specimens, the distance was found to be in the range of 10-12 cm.

**(g) Presence of minor duodenal papilla**

**Table No. II (g)**

MINOR PAPILLA	FREQUENCY	SPECIMEN NO.
Present	91	2,3,5,6....
Absent	9	29,40,44,49....

In 91 specimens, the minor papilla was present and in 9 specimens it was found to be absent.

**(h) Position of minor duodenal papilla**

**Table No. II (h)**

POSITION	FREQUENCY
On the Anterior wall of duodenum	91
Others	0

The minor papilla was located on the anterior wall of the duodenum in all the specimens.

**(i) Size of the minor duodenal papilla**

The size of the minor duodenal papilla was found to vary from 2-12mm, with the average size of 3.6 mm.

**Table No. II (i)**

SIZE (mm)	FREQUENCY	SPECIMEN NO.
2-5	84	1,2,3,4...
5-7	5	33,46,47,52,100.
> 7	2	18,22.

In 84 specimens, the size of the minor duodenal papilla was in the range of 2-5 mm. In 5 specimens, the size was in the range of 5-7mm.

In 2 specimens, the size of the minor papilla was above 7 mm.

**(j) Distance between major and minor papilla.**

The distance between the major and minor papilla was found to vary from 0.5 to 3.5cm with the average distance of 1.80cm.

**Table No. II (j)**

<b>DISTANCE (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
2.5-3.5	12	3,4,9,25...
1-2.5	77	5,8,10,12...
<1	2	20,24.

In 77 specimens, the distance between the major and minor papilla was found to be in range of 1-2.5 cm.

In 12 specimens, the distance was in the range of 2.5- 3.5cm.

In 2 specimens, the distance was observed to be below 1 cm.

**III. PANCREAS**

**(a) Length of the pancreas**

The length of the pancreas was found to vary from 9.2 to 24cm, with the average length of 16.36 cm.

**Table No. III (a)**

<b>LENGTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
>20	6	4,6,21,23,24,40.
15-20	65	31,32,35,39....
12-15	28	7,15,19,20...
<12	1	34.

In 65 specimens, the length of the pancreas was found to be in the range of 15-20cm.

In 28 specimens, the length was found to vary from 12-15cm.

In 6 specimens, the length of the pancreas was found to be above 20cm.

In 1 specimen, the length was found to be below 12 cm.

### **(b) Width of the head of pancreas**

The Width of the head of the pancreas was found to vary from 3.5- 7.5cm, with the average of 5.04cm.

**Table No. III (b)**

<b>WIDTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
>6	8	6,22,23,25, ...
4-6	78	33,35,37,40, ....
<4	14	15,31,41,49, ...

In 78 specimens, the width of the pancreas was found to be in the range of 4-6cm.

In 14 specimens, the width was found to be below 4cm.

In 8 specimens, the width was found to be above 6 cm.

**(c) Width of the neck of the pancreas**

The width of the neck of the pancreas was found to be in range of 2 to 3.7cm and the average width was 3.02 cm.

**Table No. III (c)**

WIDTH (cm)	FREQUENCY	SPECIMEN NO.
3-4	48	1,5,8,10....
2-3	52	13,15,17,18...

In 48 specimens, the width of the neck of the pancreas was found to be in the range of 3-4 cm.

In 52 specimens, the width of the neck of the pancreas was in the range of 2-3 cm.

**(d) Width of the body of the pancreas**

The width of the body of the pancreas was found to vary from 2.2 to 4.7 cm with the average of 3.72cm.

**Table No. III (d)**

WIDTH (cm)	FREQUENCY	SPECIMEN NO.
>4	25	10,13,20,22...
3-4	61	3,4,6,8,.....
2-3	14	5,12,14,29...

In 61 specimens, the width of the body of the pancreas was found to be in the range of 3-4cm.

In 25 specimens, the width of the body of the pancreas was above 4cm.

In 14 specimens, the width was found to be in the range of 2-3 cm.

**(e) Width of the tail of the pancreas**

The width of the tail of the pancreas was found to vary from 1.8 to 3.5cm, with the average width of 2.70cm.

**Table No. III (e)**

<b>WIDTH (cm)</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
>3	10	6,35,39,40...
2-3	85	11,12,17,18...
<2	5	34,52,57,83,94.

In 85 specimens, the width of the tail of the pancreas was found to be in the range of 2-3cm.

In 10 specimens, the width was found to be above 3cm.

In 5 specimens, the width was found to be below 2 cm.

**(f) Shape of the pancreas**

**Table No. III (f)**

SHAPE	FREQUENCY	SPECIMEN NO.
Oblique	87	1,5,7,8...
Inverted	9	2,4,19,24...
Sigmoid	4	9,64,69,95.

In 87 specimens, the pancreas was found to be oblique.

In 9 specimens the pancreas was like inverted 'V'.

In 4 specimens, the pancreas was sigmoid in shape.

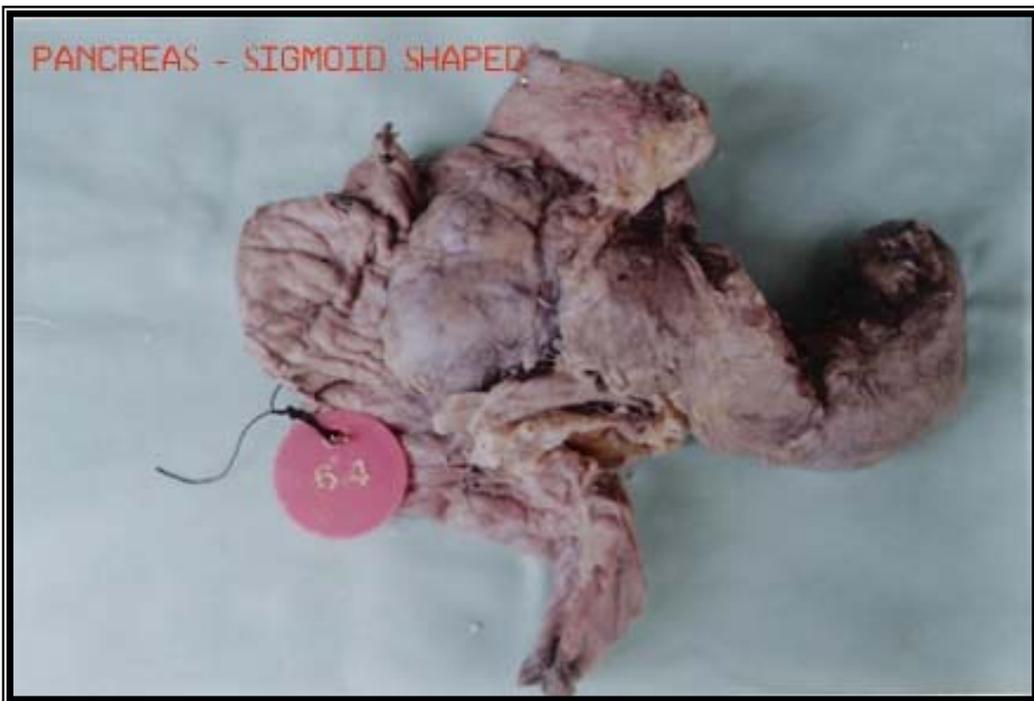
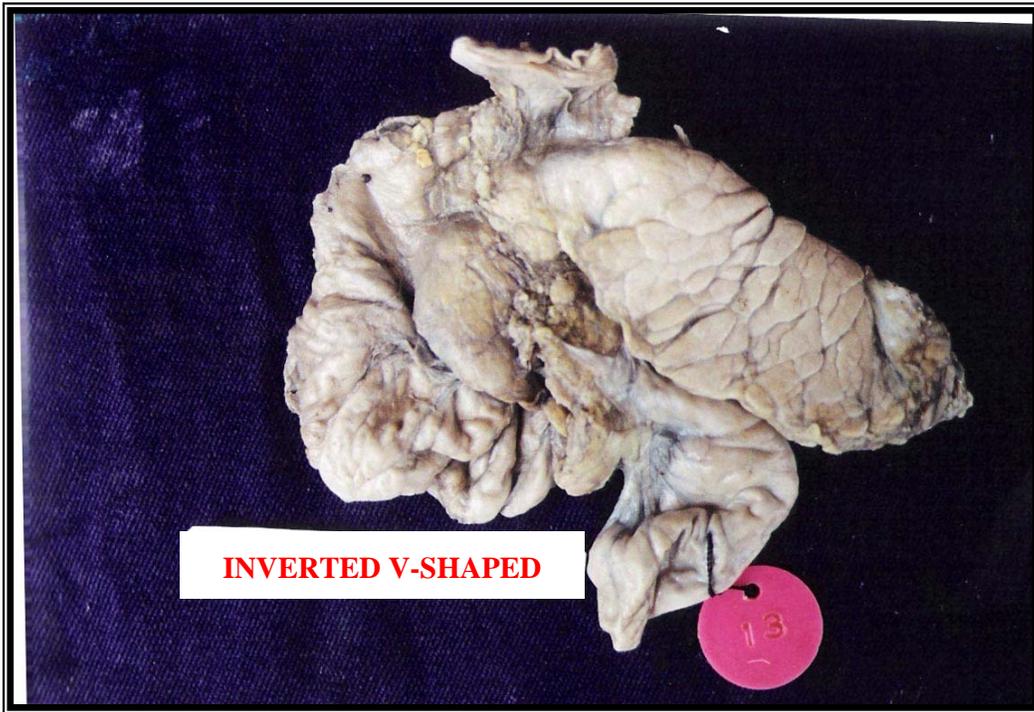
**(g) Termination of main pancreatic duct**

**Table No. III (g)**

TERMINATION	FREQUENCY
Joined common bile duct	100
Opened separately into the duodenum	-

In all the specimens, the main pancreatic duct was found to join the common bile duct and open into the duodenum.

## SHAPE OF PANCREAS



#### **IV. PORTAL VEIN**

##### **(a) Formation of Portal Vein and The Level of formation**

**Table No. IV (a)**

<b>FORMATION OF PORTAL VEIN</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
Splenic Vein + Superior mesenteric Vein	74	2,3,4,6...
Splenic vein + superior mesenteric vein + Inferior mesenteric vein	26	1,18,19,22...

In 74 specimens, the splenic vein and the superior mesenteric vein joined to form the portal vein.

In 26 specimens the inferior mesenteric vein merged with the superior mesenteric portal venous junction forming a trifurcation.

In all the specimens, the formation of the portal vein was posterior to the neck of the pancreas.

##### **(b) Termination of Inferior Mesenteric Vein**

**Table No. IV (b)**

<b>TERMINATION OF INFERIOR MESENTERIC VEIN</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
Splenic vein	45	2,3,4,6...
Superior mesenteric vein	29	7,10,13,20...
At the union of splenic and superior mesenteric vein	26	1,5,8,18....

In 45 specimens, the inferior mesenteric vein drained into the splenic vein.

**FORMATION OF PORTAL VEIN**



**INFERIOR MESENTERIC VEIN DRAINS INTO  
SUPERIOR MESENTERIC VEIN**



PV – PORTAL VEIN      SMV – SUPERIOR MESENTERIC VEIN  
SV – SPLENIC VEIN    IMV – INFERIOR MESENTERIC VEIN

In 29 specimens, the inferior mesenteric vein was observed to drain into the superior mesenteric vein.

In 26 specimens, the inferior mesenteric vein was found to end at the union of the superior mesenteric vein and splenic vein.

## **V. CONGENITAL ANOMALIES**

**Table No. V**

	<b>ANOMALY</b>	<b>FREQUENCY</b>	<b>SPECIMEN NO.</b>
Duodenum	Diverticulum	5	6,23,32,50,54.
Pancreas	Short pancreas	1	34.

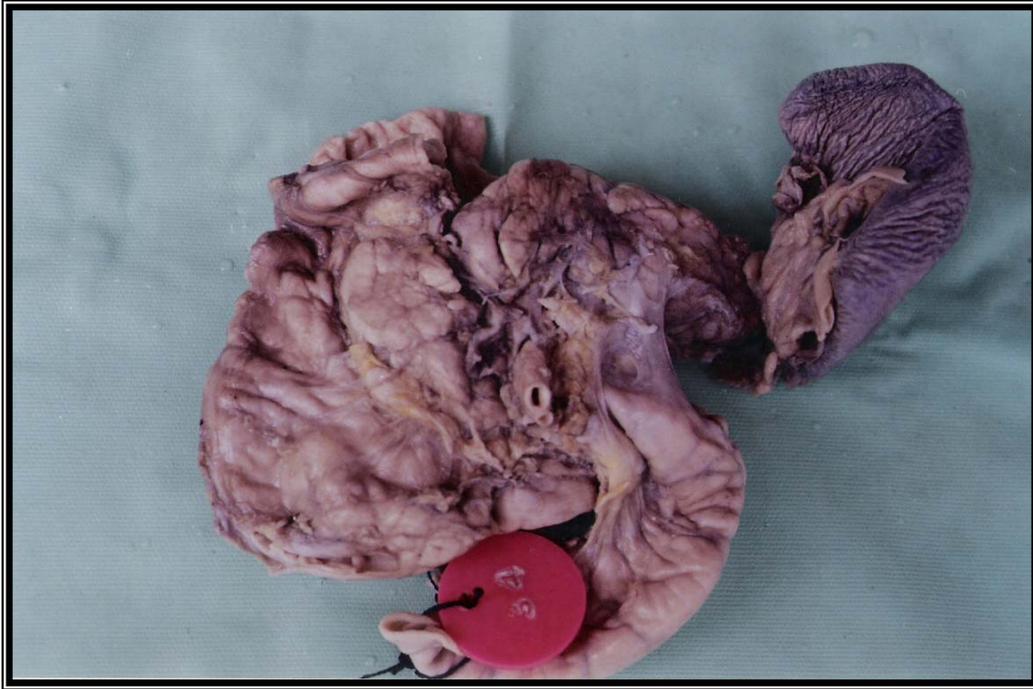
In the duodenum, diverticulum was found in four specimens, three in the second part and two in the third part of the duodenum. They were seen in the medial side near the opening of the common duct and main pancreatic duct.

A short pancreas was observed which was 9.2 cm long.

## **VI. BLOOD SUPPLY**

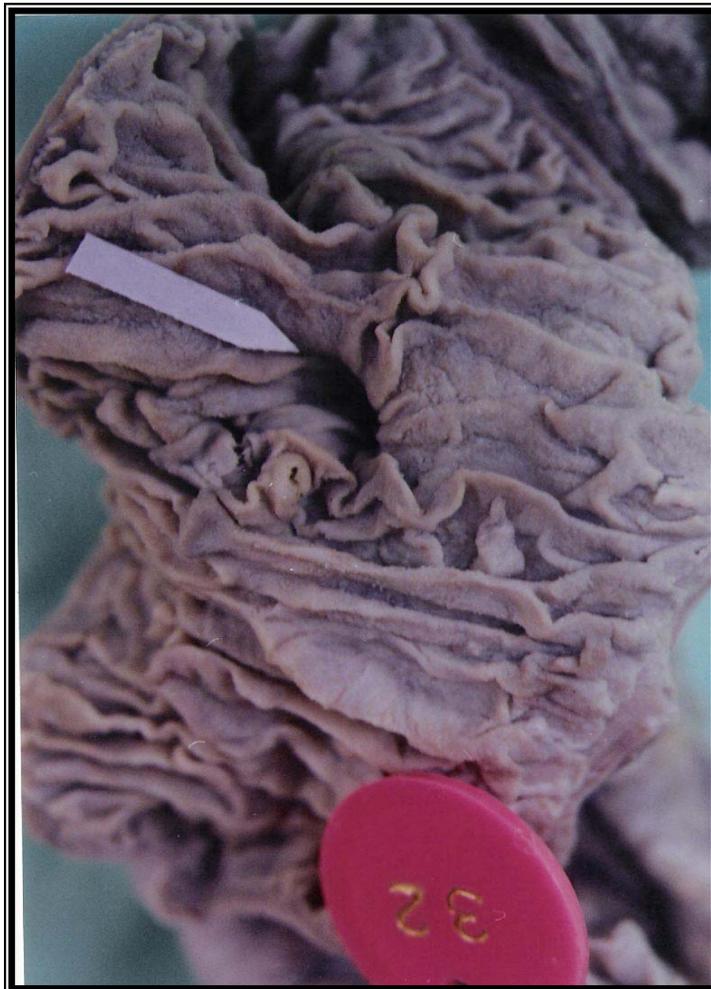
Of the 50 specimens studied for variations in the arterial supply of the head of the pancreas and the duodenum, 49 specimens were supplied by single anterior and posterior pancreaticoduodenal arcades. In one specimen, double anterior arcade was observed to arise from the superior pancreaticoduodenal artery.

**SHORT PANCREAS – LENGTH 9.2 CM**

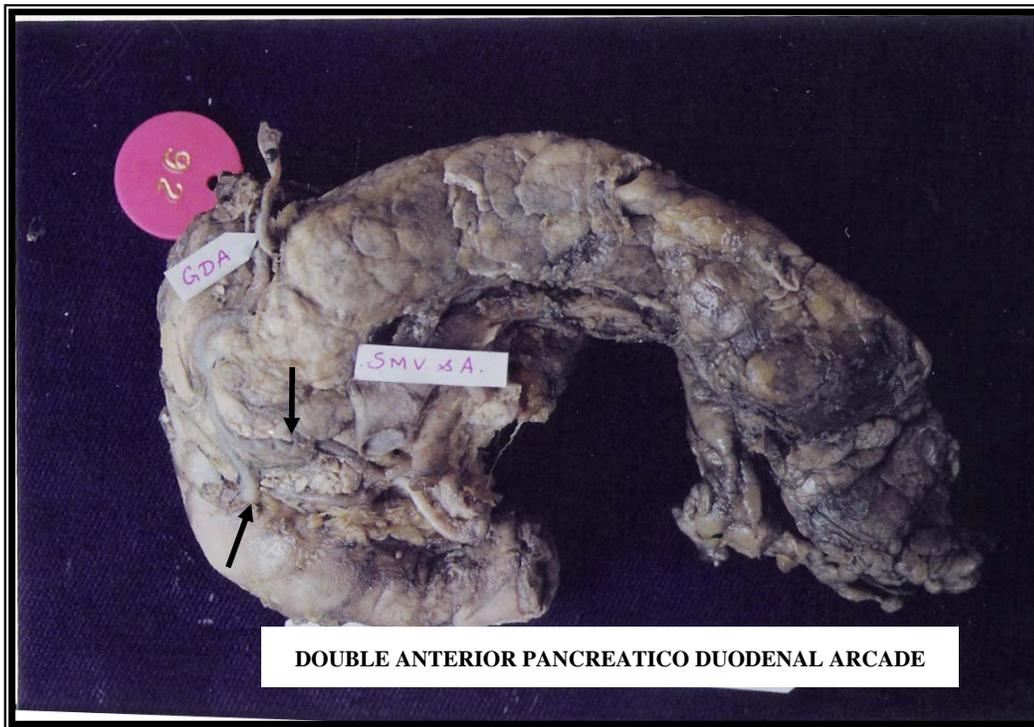
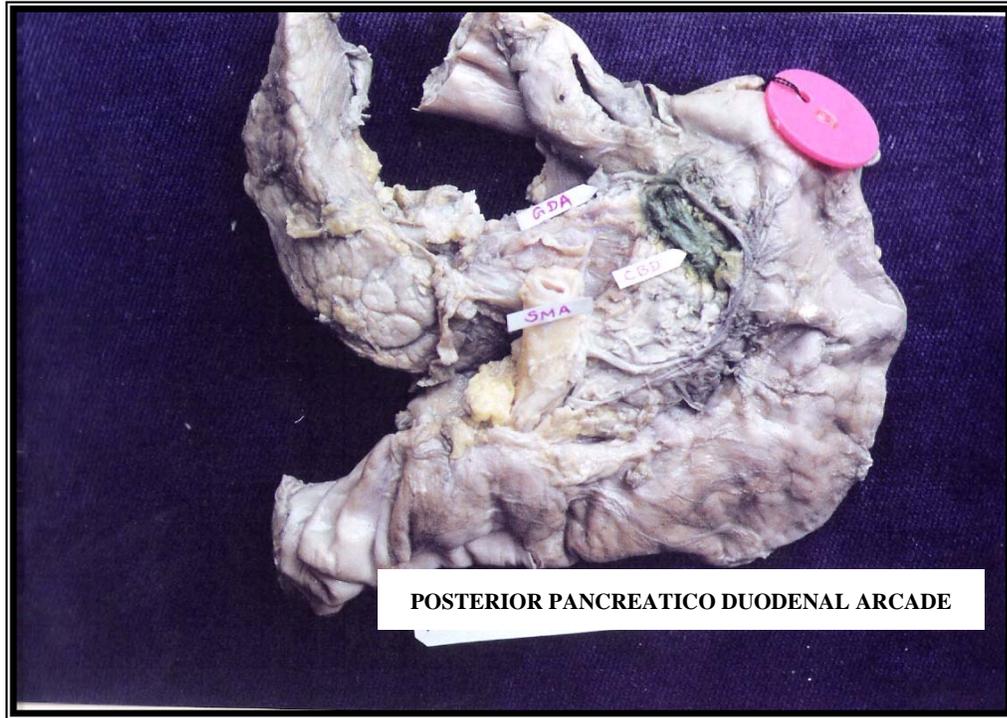


**COMMON BILE DUCT AND MAIN PANCREATIC DUCT**

## DUODENAL DIVERTICULUM



## BLOOD SUPPLY



**GDA – GASTRO DUODENAL ARTERY;**  
**SMA – SUPERIOR MESENTERIC ARTERY**

# **DISCUSSION**

## **DISCUSSION**

The present study on the duodenum, the pancreas and the portal vein in 100 specimens, is compared with earlier studies and discussed.

### **DIMENSIONS OF THE DUODENUM**

#### **(a) Length of the duodenum**

Wyburn (1972) describes the duodenum as 25cm long. Carol and Jeff (1988) reported that the duodenum measures approximately 30 cm in length.

Bannister LH (2000) describes the length of the duodenum to be 20-25 cm. Daniel J. Nolan (2002) reported that the duodenum measures 20-30 cm in length.

In the present study, the length of the duodenum was found to vary from 15.5 to 28cm, with the average of 22.29cm.

#### **(b) Length of the second part of the duodenum**

Wyburn (1972) reports that the second part of duodenum measures 7.5cm in length. Russell Woodburne (1973) describes the second part as 7-10 cm long, which was similar to Carol and Jeff (1998) and Jean –Pierre Raufman (1999).

Bannister LH (2000) in Grays anatomy describes that the second part of duodenum measures 8-10 cm in length. Daniel J. Nolan (2002) says that the second part measures 7.5cm.

In the present study, the length of second part of the duodenum was in the range of 4-9cm, with the mean length of 7.07cm.

### **(c) Width of the duodenum**

Brash J.C (1953) says that the width of the duodenum is 3.5 – 5cm.

Wyburn (1972) reports that the duodenum measures 4-5cm in width. Marget Shiner (1995) says that the duodenum is 3-5cm in width.

In the present study, the width of the duodenum was found to be in the range of 1.8 to 4.5cm. The mean width was 3.50cm.

## **II. DUODENAL PAPILLA**

### **(a) Position of the major duodenal papilla**

Lurje (1937), Poppel & Jacobson (1956) and Dawson (1961) in their studies reported that the major papilla could be located at any point from the junction of I & II part of the duodenum to within the III part.

Schwartz and Birnbaum (1962) reported that 74% of papilla was found in II part of the duodenum, 18% at the junction of II & III part and 8% in the III part.

Russell (1993) says that the major papilla lies in the second part of duodenum in 75%, at the angle between the second and third parts in 15% and in the third part in 9%.

In the present study, major papilla was located in the second part of duodenum in 94% of the specimens, at the junction of I & II part, in 5% and at the junction of II & III part, in 1%.

### **(b) Opening of major papilla into the duodenum**

Russell Woodburne (1973), Carol & Jeff (1998) and Bannister LH (2000) reported that the major papilla is seen on the posteromedial aspect of the second part of the duodenum.

Bernard H. Hand (1987) reported that the major papilla lies on the posterior or posteromedial wall of the duodenum.

Margot Shiner (1995) says that the major papilla is seen on the medial aspect of the duodenum.

In the present study the major papilla opened posteromedially, in 79% and medially, in 21%.

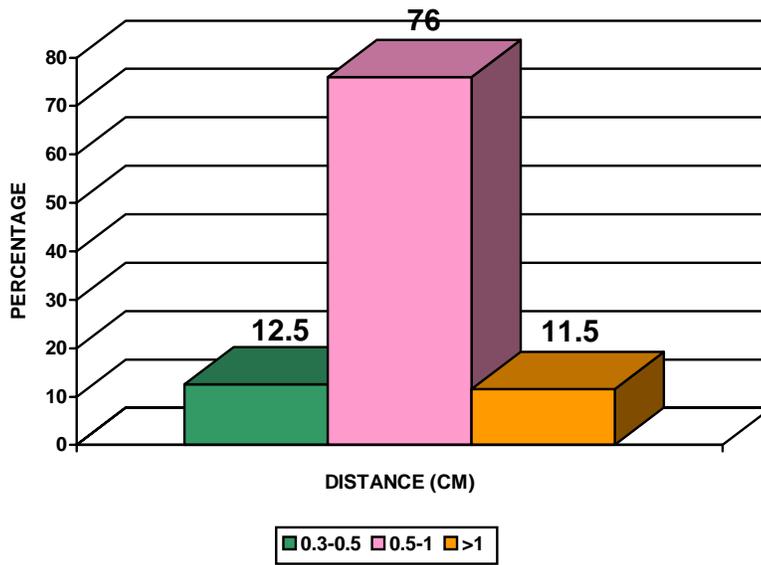
### **(c) Size of the major duodenal papilla**

Rienhoff and Pickrell (1945) reported the size of major papilla to be 3mm (range 1.5 – 4.5mm).

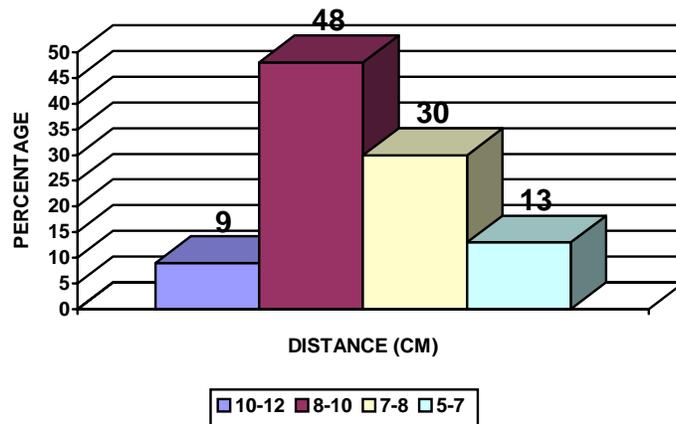
Bernard H. Hand (1987) reported that the size of major papilla measures 1 cm in size.

In the present study, the size of the major papilla was found to vary from 0.3-1.7cm, with the average size of 0.73cm.

### SIZE OF THE MAJOR PAPILLA



### DISTANCE BETWEEN PYLORUS AND MAJOR PAPILLA



#### **(d) Shape of the major papilla**

Oi, Takemoto & Kondo (1969) describes the shape of the major papilla as flat, papillary and hemispherical.

Philip et al. (1974) reported that the hemispherical shape of the major papilla is common.

In the present study, the shape of the major papilla was papillary in 96% and flat in 4%.

#### **(e) Shape of the orifice of the major duodenal papilla**

Bernard H. Hand (1987) describes the orifice of the major papilla as round or slit-like.

In the present study, the orifice of the major papilla was found to be round in 85% and slit-like in 15%.

#### **(f) Distance between the pylorus and major papilla**

Brash J. C. (1953) reported that the major papilla is seen 8.5-10cm from the pylorus. Buchanan (1953) says that the major papilla is seen 4 inches from the pylorus.

Bannister LH (2000) says that the major papilla is seen 8-10 cm from the pylorus.

In the present study, the distance between the major papilla and pylorus was in the range of 5 -11.6 cm, with the average of 8.2cm.

The tabulation below gives a comparative study on the distance of the major papilla from the pylorus in the present study and previous studies.

<b>STUDY</b>	<b>DISTANCE (cm)</b>	<b>AVERAGE (cm)</b>
Letulle and Nattan Larrier (1898)	5.2 – 9.8	7-8
Stracker (1909)	5.5-14.2	8-9.5
Sterling (1955)	5.5-14.2	8-12
Present Study	5-11.6	8.2

**(g) Presence of minor duodenal papilla**

Keyl (1926) reported that the minor papilla might be absent (4%), impervious or markedly regressed.

Bernard H. Hand (1987) says that the minor papilla is nearly always identifiable in dissected specimens.

In the present study, the minor papilla was present in 91% whereas it was absent in 9%.

**(h) Position of minor duodenal papilla**

Russell Woodburne (1973) reported that the minor papilla lies in the anteromedial wall. Carol & Jeff (1998) says that the minor papilla lies in the posteromedial wall.

Bannister (2000) and Daniel J. Nolan (2002) say that the minor papilla is seen on the anterior wall.

In the present study, the minor papilla was found to open in the anterior wall of the second part of the duodenum in all the specimens.

**(i) Size of the minor duodenal papilla**

Theodore N. Pappas (1997) describes the minor papilla as 2mm polypoid structure. Kamisawa et al. (2001) reported the size of the minor papilla to vary from 3 to 6 mm.

Tadahika (2005) says that the minor papilla measures 3.8 to 6.8mm in length and 2.8 to 5.4 mm in width.

In the present study the size of the papilla was found to vary from 2 to 12 mm, with the average size of 3.6mm.

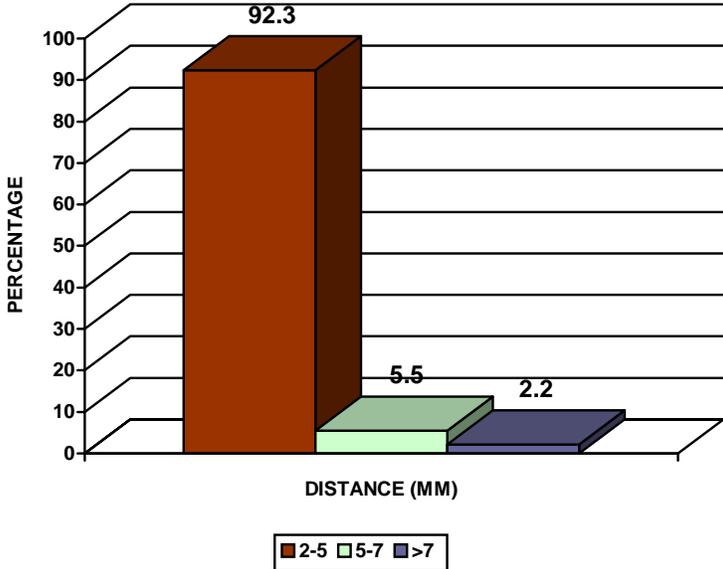
**(j) Distance between major and minor papilla**

Baldwin (1911) reported that the distance between major and minor papilla varies from 0.9 to 3.5 cm, average being 2 cm. Bernard H. Hand (1987) says that the distance between both papilla is usually 1 cm to 3.5cm.

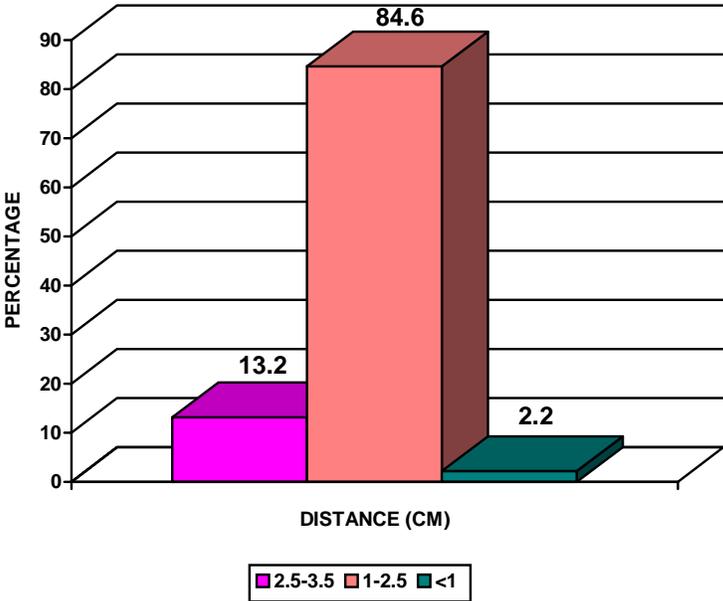
Carol & Jeff (1998) and Jean-Pierre Raufman (1999) say that the distance between both the papilla is 2 cm. Bannister LH (2000) says that the minor papilla is seen 2 cm proximal to major papilla.

Daniel J. Nolan (2002) reported that the minor papilla is seen 1 cm proximal to the major papilla.

### SIZE OF THE MINOR PAPILLA



### DISTANCE BETWEEN MAJOR AND MINOR PAPILLA



In the present study, the distance between both the papilla was found to vary from 0.5 to 3.5 cm, the average being 1.80 cm.

The tabulation below gives comparative study on the distance between the major & minor papilla in the present study and previous studies.

<b>STUDY</b>	<b>DISTANCE (cm)</b>	<b>AVERAGE (cm)</b>
Letulle and Nattan Larrier (1898)	1-3.5	1.8
Baldwin (1911)	0.9-3.5	2
Maeda (1924)	1-5.9	2-2.9
Present study	0.5-3.5	1.8

### **III. PANCREAS**

#### **(a) Length of the Pancreas**

Anacker (1975) reported that the pancreas varies from 16.5- 27cm in length. Richard M.Gore (1994) says that the length of the pancreas is approximately 15-25cm.

Mulholland and Simeone (1999) describe the pancreas as 12-20cm long. Basmajian (1980) and Bannister LH (2000) describe the pancreas as 12-15 cm long.

In the present study, the length of the pancreas varied from 9.2 to 24 cm. The average length of the pancreas was 16.36cm.

## **(b) Width of the pancreas**

Anacker (1975) describes the width of the head of the pancreas, from upper margin to lower margin to vary from 3.5 – 8 cm, and the body approximately 3.3cm.

Bernard H. Hand (1987) describes the mean width of the head, neck, body and tail of the pancreas to be 4.4cm, 3.4cm, 3.5cm and 3cm respectively. Richard M.Gore (1994) says that the pancreas measures 3-5cm in heights.

In the present study,

The width of the head of the pancreas was found to be 3.5 – 7.5cm, with the average of 5.04 cm.

The width of the neck of the pancreas was found to vary from 2 to 3.7cm, with average of 3.02cm.

The width of the body of the pancreas was observed to be 2.2 – 4.7cm, with the average of 3.72cm.

The width of the tail of the pancreas varied from 1.8 to 3.5cm, with the average width of 2.70cm.

### **(c) Shape of the pancreas**

Kneel L et al. (1973) describes the shape of the pancreas as oblique (36%) sigmoid (19%), transverse (3%), horse –shoe (6%), L-shaped (33%) and inverted (11%).

Basmajian (1980) says that pancreas lies obliquely in the posterior abdominal wall.

Zylak and Pallie (1981) reported the shape of the pancreas as L, S or inverted V.

The shape of the pancreas in the present study was found to be oblique in 87%, inverted ‘V’-shaped in 9% and sigmoid in 4% .

### **(d) Termination of main Pancreatic duct**

Mehnen (1938) in his study on 449 specimens reported that the bile duct and the main pancreatic duct opened separately in 4% of cases, with the pancreatic duct opening 3 - 4 mm caudal to the papilla of Vater.

Holzafel (1942) in his study on 50 specimens reported separate openings of the bile duct and the pancreatic duct in two papillae in 9 cases.

Millbourn (1950) in his study on 200 specimens reported that in 18 cases (9%), the bile duct and the pancreatic duct opened independently into the duodenum.

Bannister LH (2000) says that the hepatopancreatic duct opens on the summit of major duodenal papilla seen posteromedially in the second part of the duodenum.

In the present study, the main pancreatic duct was observed to join the common bile duct and open into the duodenum in all the specimens.

#### **IV. PORTAL VEIN**

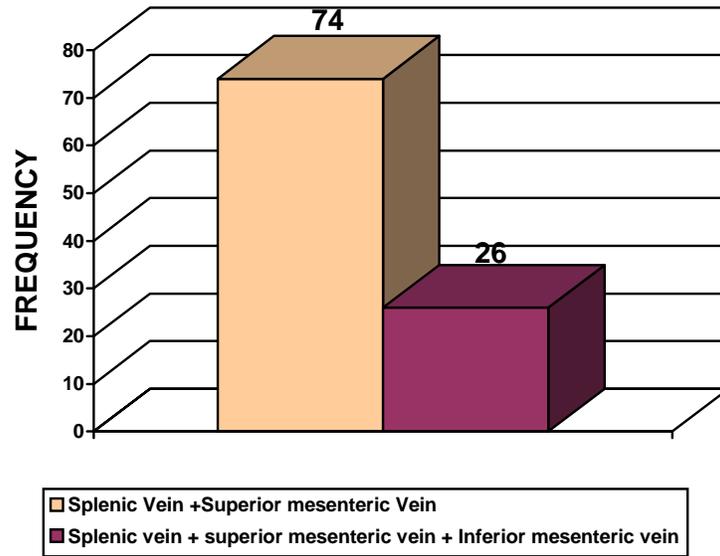
##### **(a) Formation of portal vein and level of formation**

Hollinshead (1962) and Bannister (2000) say that the portal vein is formed by the union of splenic vein and superior mesenteric vein behind the neck of the pancreas. Sometimes the inferior mesenteric vein might end at the union of the splenic and the superior mesenteric vein.

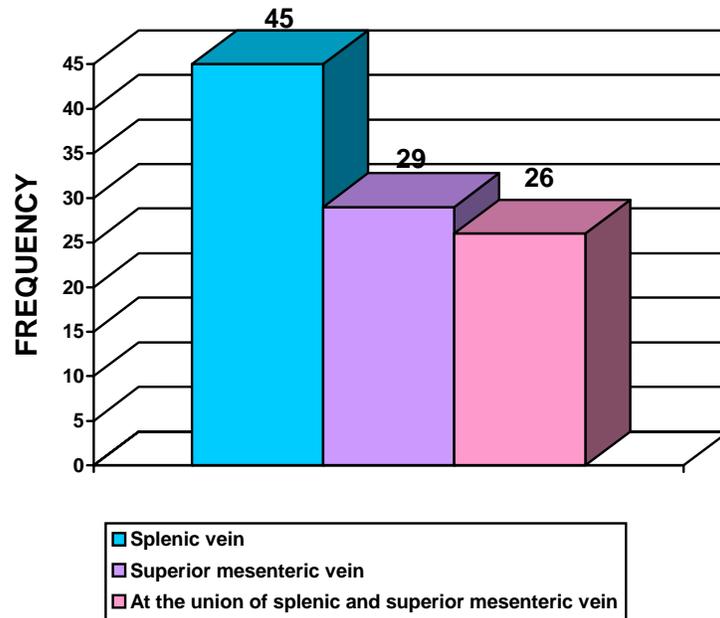
R.J Last (1973) describes the portal vein as a mere continuation of the superior mesenteric vein and changes its name when joined by the splenic vein at the level of the neck of the pancreas.

Aktan et al. (1995) reported that in 56.3%, the union of the superior mesenteric vein and splenic vein formed the portal vein. In 12.5%, a confluence of the superior mesenteric, inferior mesenteric and the splenic vein formed the portal vein.

### FORMATION OF PORTAL VEIN



### TERMINATION OF INFERIOR MESENTERIC VEIN



In the present study, the portal vein was formed by the union of splenic vein and superior mesenteric vein, in 74% and by the confluence of the superior mesenteric, inferior mesenteric and splenic vein in 26%.

In all the specimens, the formation of the portal vein was behind the neck of the pancreas.

### **(b) Termination of inferior mesenteric vein**

Gilfillan (1950) reported that the inferior mesenteric vein terminated in splenic vein in 55.6%, in the superior mesenteric vein in 29.6% and in the angle of junction between the superior mesenteric vein and splenic vein in 14.8%.

Russell Woodbourne (1973) reported that the inferior mesenteric vein empties into the splenic vein in 60% and superior mesenteric vein in 40%.

Aktan et al. (1995) reported that the inferior mesenteric vein drains into the splenic vein in 56.3%, directly into the superior mesenteric vein in 31.3% and at the confluence in 12.5%.

The tabulation given below gives a comparative study on the termination of the inferior mesenteric vein between the present study and previous studies.

<b>STUDY</b>	<b>NUMBER OF DISSECTION</b>	<b>SPLENIC VEIN (%)</b>	<b>SUPERIOR MESENTERIC VEIN (%)</b>	<b>AT THE JUNCTION (%)</b>
Gilfillan (1950)	54	55.6	29.6	14.8
Aktan (1995)	64	56.3	31.3	12.5
Present Study	100	45	29	26

In the present study, the inferior mesenteric vein terminated in the splenic vein in 45%, into the superior mesenteric vein in 29% and at the confluence, in 26%.

## **V. CONGENITAL ANOMALIES**

### **(a) Duodenum**

Osnes M. et al. (1981), Baldwin (1911) and Hollinshead (1962) say that duodenal diverticula are usually situated near the entrance of the bile duct and the main pancreatic duct.

Haeusler et al. (2002) and Harris et al. (1995) reported that the incidence of duodenal atresia / stenosis ranges between 0.6 – 2.3 / 10,000 births.

In the present study, duodenal diverticulum was observed in 5%, which were seen near the ampulla of Vater.

### **(b) Duodenal Papilla**

Clair –Mont (1923) says that the common bile duct and the pancreatic duct may anomalously open into the papilla minor.

The major or the minor papilla may be double (Holzapfel, 1930, Patzelet, 1936) or even triple (Baldwin 1911).

Mehnen (1938), Millbourn (1942) and Holzapfel (1950) reported that the common bile duct and the main pancreatic duct might open separately into the duodenum.

In the present study, we did not come across any of the above anomalies.

### **(c) Pancreas**

Stofer (1944) reported 3 cases of annular pancreas in 7000 autopsies. Barbosa (1946) and Feldmen (1952) reported that the frequency of heterotopic pancreatic tissue in autopsy studies range from 0.6% to 15%.

Kleitsch (1955) says that pancreas divisum is a relatively common anomaly found at 5-10% of autopsies. Ravitch M.M. (1975) in his study on annular pancreas says that in 85% of cases, the annulus was always proximal to the ampulla of Vater, involving the second part of the duodenum.

Skandalakis et al. (1979) says that there may be complete absence of the main pancreatic duct.

Russell R.C.G (1993) quotes that congenital short pancreas is a very rare finding at pancreatography. Brash (1953) says that separation of the uncinata process from the head of the pancreas forms a lesser pancreas.

In the present study, one specimen of short pancreas was observed.

#### **(d) Portal Vein**

Derrick and Hans-Ulrich (2002) reported that there may a double portal vein, one element being the continuation of the splenic vein, the other the continuation of the superior mesenteric vein.

In the present study, we did not come across any anomalies in the portal vein.

## **VI. RADIOLOGICAL DIAGNOSIS**

Jorge et al. (2005) reported that contrast material –enhanced multi-detector row computed tomography enable depiction of pancreas divisum. Kleitsch (1955) reported that the pancreas divisum is found in about 2 to 7% of patients undergoing ERCP.

Russell (1993) says that annular pancreas is diagnosed by hypotonic duodenography, in adults and by plain radiograph, in infants.

Theodore N. Pappas (1997) describes the endoscopic appearance of the minor papilla as a small, 2mm polypoid structure. Rienhoff and Pickrell (1945) describes that the major papilla appeared endoscopically on the ridge of the duodenal longitudinal fold, 8cm from the pylorus.

Richard M. Gore (1994) describes three morphological shapes radiologically: tadpole shaped (44%), dumbbell shaped (33%) and sausage shaped (23%).

Stevenson et al. (1980) reported that the ampulla of Vater can be seen in about two- thirds of patients during routine double –contrast barium examination and the accessory papilla in about one quarter.

## **VII. APPLIED ASPECTS**

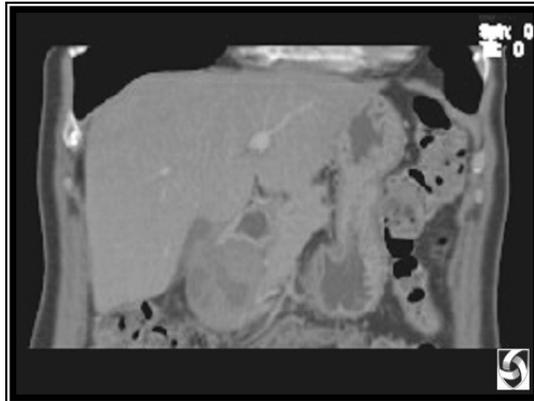
Rogers (1992) says that carcinoma of the pancreas is difficult to diagnose. The deep, relatively inaccessible position of the pancreas and its intimate relationship to large blood vessels increases the technical difficulty of surgical therapy.

Mulholland and Simeone (1999) says that because of the shared blood supply of the duodenum and the pancreatic head, extensive interference with the pancreaticoduodenal arcades in the course of a 95% pancreatectomy, may compromise the blood supply of the duodenum.

**PANCREATIC ACINAR CELL CARCINOMA**



**CORONAL REFORMAT CT (ABOVE CASE)**



**POST CONTRAST AXIAL CT (ABOVE CASE)**



Kamisawa et al. (2001) reported that in 50% of patients with chronic pancreatitis, the minor papilla was larger than 6mm.

William E. Fisher (2005) says that two thirds of pancreatic adenocarcinomas arise within the head or uncinate process; 15% are in the body and 10% in the tail. Tumours in the head of the pancreas are diagnosed earlier because they cause obstructive jaundice. Ampullary carcinomas, carcinomas of distal bile duct and periampullary duodenal adenocarcinomas have better prognosis, because early obstruction of the bile duct and jaundice leads to the diagnosis.

### **VIII. BLOOD SUPPLY**

Nicholes N. Michels (1955) reports that the head of the pancreas and the loop of the duodenum are supplied by branches from the pancreaticoduodenal arcades, one being anterior, and the other posterior to the head of the pancreas. There may be double, triple or quadruple anterior and posterior arcades.

In the present study, double anterior arcade was observed to arise from the superior pancreaticoduodenal artery in 2%.

# CONCLUSION

## CONCLUSION

In the present study, the duodenum, the pancreas and the portal vein have been studied and the results compared with the earlier studies.

The summary of the present study in human, in 100 specimens of duodenum and pancreas is as follows:

- ✦ The dimensions of the duodenum were within normal limits in about 70%.
- ✦ The major duodenal papilla was located in the second part of the duodenum in 94%, at the junction of I and II part in 5% and at the junction of II and III part in 1%.
- ✦ The major papilla opened posteromedially into the duodenum in 79% and medially in 21%.
- ✦ The size of the major papilla was in the range of 0.5 to 1 cm in 76%, 0.3 to 0.5cm in 12.5% and above 1 cm in 11.5%.
- ✦ The shape of the major papilla was papillary in 96% and flat in 4%.
- ✦ The shape of the orifice of the major papilla was round in 85% and slit-like in 15%.
- ✦ The distance between the pylorus and the major papilla was in the normal range of 8 – 10 cm in 48%. The range was 7 – 8 cm in 30%, 5 - 7cm in 13% and 10 – 12cm in 9%.

- ✦ The minor papilla was absent in 9%.
- ✦ The minor papilla was located on the anterior wall of the duodenum in 100%.
- ✦ The size of the minor papilla was in the range of 2 - 5 mm in 92.3%, 5-7mm in 5.5% and above 7mm in 2.2%.
- ✦ The distance between the major and minor papilla was within the normal range of 1-2.5 cm in 84.6%. In 13.2%, the distance was 2.5 – 3.5cm and in 2.2%, it was less than 1cm.
- ✦ The dimensions of the pancreas were within the normal limits in about 70%.
- ✦ The shape of the pancreas was oblique in 87%, inverted V-shaped in 9% and sigmoid in 4%.
- ✦ The union of the splenic vein and the superior mesenteric vein formed the portal vein in 74% and the confluence of the superior mesenteric, inferior mesenteric and splenic vein, in 26%.
- ✦ The inferior mesenteric vein terminated in the splenic vein in 45%, in the superior mesenteric vein in 29% and in the junction of the splenic and superior mesenteric vein in 26%.
- ✦ Duodenal diverticula were found in 5%, which were seen near the ampulla of Vater.
- ✦ Double anterior pancreaticoduodenal arcade was observed to arise from the superior pancreaticoduodenal artery in 2%.
- ✦ Short pancreas was observed in 1%.

Interest in pancreatic anatomy has been stimulated by the development of improved clinical imaging modalities (e.g. Ultrasonogram, Computed tomography, Magnetic resonance imaging) and by the growing application of pancreas transplantation to the treatment of diabetes mellitus.

This study is presented to shed more light on normal anatomy and variations of the duodenum, the pancreas and the portal vein.

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# **MASTER CHART**

Sl. No.	DUODENUM				MAJOR DUODENAL PAPILLA						MINOR DUODENAL PAPILLA							
	LENGTH (cm)	LENGTH (cm)			WIDTH (cm)	PRESENCE IN DUODENUM			EXTERNAL APPEARANCE			DISTANCE FROM PYLORUS (cm)	PM / M	ORIFICE	PRESENT (OR) ABSENT	POSITION ON THE ANTERIOR WALL	SIZE	DISTANCE FROM MAJOR PAPILLA (cm)
		I	II	III		IV	JN. OF I & II	II	JN. OF II & III	III	FLAT							
1	19.5	4	7.5	6	3	3.6												
2	21.5	4.5	7.5	6	3.5	4.2	✓											
3	26	6	8	9	3	4												
4	26.3	5	9	8.5	3.8	3.8												
5	24.5	7.5	6	6	5	3.2												
6	21.5	6	6.5	6.5	2.5	3.8	✓											
7	16	4.8	5	3.5	2.7	3.5												
8	21	5.5	8	5	2.5	3.2												
9	22.5	4	6.5	8	4	3.8												
10	23	5.5	8	7	2.5	3.8												
11	16	4.2	6.3	5	1.5	3.3												
12	24	5	7	9	3	3.5												
13	23	5	7	8	3	4.2												
14	19.5	4	5	8.5	2	3.5												
15	22	5	7.5	7	2.5	3.2												
16	24	4.5	7	10	2.5	4												
17	22.5	5	6.5	8	3	3.7												
18	25	5	7.5	9.5	3	3.5												
19	17.8	4	5	6	2.8	3.6												
20	20	5	5.5	7	2.5	3.5	✓											
21	22.2	3.5	7.7	8	3	3.5												
22	22.5	6.5	7.5	5	3.5	3.6												
23	20	4	6.5	6	3.5	2.7												
24	22.5	3.5	8	7.5	3.5	3.5												
25	22	4.5	6.5	8	3	3.7												
26	21.7	5.2	7	7	2.5	3.8												
27	22.2	5.2	6.5	6.5	4	3												
28	22.5	5.5	7.5	7	2.5	3.6												
29	16.5	4.5	5.5	4.5	2	3												
30	19.5	4	6	6.5	3	3.5												

Sl. No.	PANCREAS										PANCREATIC DUCT		FORMATION OF PORTAL VEIN				ANOMALIES		
	LENGTH (CM)		WIDTH (CM)				SHAPE				JOINS CBD	OPENS SEPERATELY	LEVEL OF NECK	SV + SMV	SMV + IMV	SV + SMV + IMV	SV + IMV	DUODENUM	PANCREAS
	HEAD	NECK	BODY	TAIL	OBLIQUE	SIGMOID	INVERTED	OTHER											
1	17	5	3.2	3.5	2.5	>				>	>	>	>	>	>				
2	17.5	4.5	2.8	3.5	2.8	>				>	>	>	>	>	>				
3	15.5	5.5	2.2	3.7	2.5	>				>	>	>	>	>	>				
4	21.5	5	2.8	4	2.2	>				>	>	>	>	>	>				
5	19	4.8	3.5	2.8	2.8	>				>	>	>	>	>	>				
6	21	6.2	2.8	3.8	3.2	>				>	>	>	>	>	>		Diverticulum II part		
7	14.5	4.5	2.7	3	2.7	>				>	>	>	>	>	>				
8	16.5	5.7	3.2	4	2.5	>				>	>	>	>	>	>				
9	16	5.7	2.7	3.5	2.5	>				>	>	>	>	>	>				
10	18	4.5	3.4	4.5	2.4	>				>	>	>	>	>	>				
11	17.3	5	3.2	3.8	2.5	>				>	>	>	>	>	>				
12	19	5.5	3.0	2.8	2.5	>				>	>	>	>	>	>				
13	12.5	4.2	2.8	4.5	2.8	>				>	>	>	>	>	>				
14	18.5	5.2	3.0	2.8	2.5	>				>	>	>	>	>	>				
15	13.2	4	2.8	4	2.4	>				>	>	>	>	>	>				
16	12.4	5.8	3.2	3.5	2.8	>				>	>	>	>	>	>				
17	16.7	5	2.8	4	2.5	>				>	>	>	>	>	>				
18	15.5	5.2	2.8	3.5	2.3	>				>	>	>	>	>	>				
19	13.7	4.5	2.5	3.5	3.0	>				>	>	>	>	>	>				
20	15	4.5	3.4	4.5	2.5	>				>	>	>	>	>	>				
21	20.8	4.5	3.2	3.2	2.7	>				>	>	>	>	>	>				
22	17	6.5	3.4	4.5	2.8	>				>	>	>	>	>	>				
23	22.2	6.5	3.2	4.5	2.5	>				>	>	>	>	>	>		Diverticulum II part		
24	24	7.2	3.2	4.2	2.9	>				>	>	>	>	>	>				
25	14.5	7.5	3.8	4.2	3	>				>	>	>	>	>	>				
26	16.8	5.2	3.2	3.8	2.5	>				>	>	>	>	>	>				
27	15.8	5	2.8	4.2	3	>				>	>	>	>	>	>				
28	17	5.1	2.8	3.2	2.7	>				>	>	>	>	>	>				
29	19	4.2	2.8	2.8	2.7	>				>	>	>	>	>	>				
30	15.4	4.7	3.0	4	2.5	>				>	>	>	>	>	>				

Sl. No.	DUODENUM				MAJOR DUODENAL PAPILLA						MINOR DUODENAL PAPILLA									
	LENGTH (cm)	LENGTH (cm)			WIDTH (cm)	PRESENCE IN DUODENUM			FLAT	EXTERNAL APPEARANCE			ORIFICE	PRESENT (OR) ABSENT	POSITION ON THE ANTERIOR WALL	SR	DISTANCE FROM MAJOR PAPILLA (cm)			
		I	II	III		IV	JN. OF I & II	II		III	JN. OF II & III	P						H	PM / M	SIZE (cm)
		II	III	IV		III	II	III		III	II	III						PM / M	SIZE (cm)	ORIFICE
II	III	IV	III	II	III	III	II	III	PM / M	SIZE (cm)	ORIFICE	PRESENT (OR) ABSENT	POSITION ON THE ANTERIOR WALL	SR	DISTANCE FROM MAJOR PAPILLA (cm)					
31	15.5	4	4	5	2.5	2.8											0.5	1.5		
32	19.5	4.5	6	7.5	1.5	3											0.5	2.2		
33	23.5	8	6	8	1.5	3.5											0.6	2.2		
34	18.5	3.5	7	6	2	3.5											0.4	1.6		
35	18.5	4.5	5.5	6.5	2	3.5											0.3	2.0		
36	20	4.5	6	7.5	2	3.5											0.5	2.5		
37	22.5	5	7.5	8.5	1.5	4.2											0.5	1.7		
38	19.5	3.5	6	7.5	2.5	3.7											0.3	1.8		
39	23.5	5	7	9.5	2	3.5											0.4	3.5		
40	26.5	8	7	8.5	3	4											-	-		
41	16	4.5	6.5	5	1.5	3.8											0.3	2		
42	25	6	7.5	8.5	3	4.2											0.5	3		
43	19	5	6.5	6	1.5	4.1											0.5	2		
44	20.5	4.5	7	6.5	2.5	3.3											-	-		
45	24.5	4.5	7	10	3	3.5											0.3	2.7		
46	18.8	4	6.5	5.8	2.5	3.8											0.7	1.7		
47	24.5	4.5	8	10	2	4.5											0.7	1.6		
48	20.5	5	7	7	1.5	3.5											0.5	2		
49	21	5.5	7	7	1.5	3.5											-	-		
50	26	5	8.5	10	2.5	4											0.5	2.3		
51	25.5	5.5	7.5	9	3.5	4											0.4	1.3		
52	21.7	4.5	7	7.5	2.7	3.5											0.6	2		
53	21	4.5	7	7	2.5	2.8											0.4	1.8		
54	25.8	5.3	8	9.5	3	3.5											0.4	1.7		
55	19.3	5	6	6.5	1.8	1.8											0.4	1.3		
56	20	3.5	5.5	8	3	3.2											0.2	2.3		
57	28	6	9	9.5	3.5	2.2											0.3	3		
58	19.5	4	6	7	2.5	3.5											0.5	1		

Sl. No.	PANCREAS				MAIN PANCREATIC DUCT		FORMATION OF PORTAL VEIN				ANOMALIES			
	LENGTH (CM)		WIDTH (CM)		SHAPE		JOINS CBD	OPENS SEPERATELY	LEVEL OF NECK	SV + SMV	SMV + IMV	SV + SMV + IMV	DUODENUM	PANCREAS
	HEAD	NECK	BODY	TAIL	OBLIQUE	SIGMOID								
31	15.7	4	2.8	3.7	2.8									
32	19.5	6.4	3.5	3.5	2.5									
33	14.8	4.2	3.2	3.5	2.8									
34	9.2	4.5	2.5	3.2	2.0									
35	19.5	5.2	2.7	4	3.3									
36	15.8	5.3	2.5	3.7	2.5									
37	16	4.7	2.8	3.7	2.5									
38	17.3	5.2	2.5	3.7	2.7									
39	19.5	5.5	3.6	4.4	3.2									
40	21	5.5	3.5	4.8	3.5									
41	14.7	4	2.9	3.2	2.5									
42	18.2	6	3.5	4.2	3.2									
43	18	4.5	3.2	3.4	2.8									
44	13.2	4.5	3.5	3.8	3									
45	16.7	4.5	3.0	4.2	2.8									
46	12.5	4.2	2.5	3.5	2.5									
47	16.2	5.5	3.5	4.5	3									
48	16.8	5.0	2.0	2.8	2.3									
49	14.5	4	2.5	3.8	2.8									
50	16	6.5	3.7	4.5	3									
51	19	6	3.5	3.8	2.8									
52	16.2	5.5	2.5	2.2	2									
53	15.7	4.5	2.5	3.5	3.2									
54	14.2	5.3	3.6	4.4	2.5									
55	15.8	4.5	2.9	3.5	2.2									
56	15	5.7	3.0	4.5	3.2									
57	20	5	2.8	4.4	2									
58	15	3.5	2.7	4.5	2.5									



Sl. No.	PANCREAS				SHAPE			MAIN PANCREATIC DUCT		FORMATION OF PORTAL VEIN				ANOMALIES		
	LENGTH (CM)	WIDTH (CM)			OBLIQUE	SIGMOID	INVERTED	OTHER	JOINS CBD	OPENS SEPARATELY	LEVEL OF NECK	SV + SMV	SMV + SMV + IMV	SV + SMV + IMV	DUODENUM	PANCREAS
		HEAD	NECK	BODY												
59	17	6	3.2	4.5	2.7	>			>		>					
60	16.5	5.5	2.5	3.2	3	>			>							
61	15	5.5	3.3	4.5	2.8	>			>							
62	18.5	5.5	3.5	4	3	>			>							
63	16	4	2.8	3.2	2.8	>			>							
64	14	5.5	3.1	3.3	2.5	>	>		>							
65	14	4	2.8	3.5	2.4	>			>							
66	16	4	2.7	3	2.2	>			>							
67	14.5	5	2.5	2.5	2.7	>			>							
68	16.5	4.5	3.2	3.8	2.3	>			>							
69	15.5	5.7	3.1	3.5	2.3	>	>		>							
70	17.5	4.5	3.6	4.7	2.8	>			>							
71	16	4.5	3.2	4	3	>			>							
72	13.5	5.5	3.5	4	3	>			>							
73	16.2	5.5	3.4	4.2	2.5	>			>							
74	17	5.7	3.5	4	3.1	>			>							
75	20	6.5	3.8	4.2	2.9	>			>							
76	16	4.8	3.2	3.8	2.8	>			>							
77	13.5	5	2.8	3.0	2.5	>			>							
78	13	5.5	3.2	3.5	2.9	>			>							
79	17	6.0	2.8	3.8	3.0	>			>							
80	17.2	4.7	3	4	2.5	>			>							
81	15	4	2.5	2.5	2.5	>			>							
82	17	5	2.8	3	3	>			>							
83	17.5	6	3.2	2.5	1.9	>			>							
84	18.5	5.5	2.2	3.5	2.5	>			>							
85	16	4.5	3.3	3.5	3.2	>			>							
86	15.5	4.5	3.5	3.8	3.5	>			>							
87	18	5	3.0	3.5	2.5	>			>							
88	16.5	5.6	3.3	3.5	3.2	>			>							
89	14.5	5.5	2.8	3.2	2.8	>			>							



Sl. No.	PANCREAS										MAIN PANCREATIC DUCT				FORMATION OF PORTAL VEIN				ANOMALIES	
	LENGTH (CM)		WIDTH (CM)				SHAPE				JOINS CBD	OPENS SEPERATELY	LEVEL OF NECK	SV + SMV	SV + SMV+ IMV	SV + SMV+ IMV	SV + IMV	DUODENUM	PANCREAS	
			HEAD	NECK	BODY	TAIL	OBLIQUE	SIGMOID	INVERTED	OTHER										
90	14	4	3.2	3.5	2.5	✓					✓		✓							
91	13.5	4.5	3.5	3.7	2.8						✓		✓							
92	18	5.5	3.5	4.5	3.5						✓		✓							
93	18.5	4.5	3.2	4.5	3						✓		✓							
94	13	4	2.5	3	1.8						✓		✓							
95	14	4.5	3	4	3				✓		✓		✓							
96	19	5.5	3.5	4	3						✓		✓							
97	17	5	3.1	4	2.8						✓		✓							
98	15.5	4	3	3.5	2.5						✓		✓							
99	14	3.8	2.6	4	2.5						✓		✓							
100	14.5	4	2.5	4	3						✓		✓							