A gross morphological study of the pancreas in human cadavers

1S Sulochana  2T Sivakami

1Assistant Professor of Anatomy, Aarupadaiveedu Medical College, Pondicherry.
2Professor and Head, Department of Anatomy, Thanjavur Medical College, Thanjavur, Tamil Nadu.

Abstract

Background and aims: Normal variants and congenital anomalies of the pancreas and pancreatic duct are often detected as incidental findings. The current interest in the gross anatomy and the blood supply of the pancreas is based on recent developments in pancreatic surgery, particularly in limited resection of pancreas. The purpose of this study is to review the gross morphology of the pancreas, in South Indians, regarding the dimension and shape of the pancreas, the termination of main pancreatic duct and vascular pattern of head of the pancreas. Materials and methods: One hundred specimens of pancreas, procured from cadavers and autopsy cases from Thanjavur Medical College, Thanjavur, were carefully studied, and the data obtained were compared with similar reports available in the literature. Results: The mean length of the pancreas was found to be 16.38±2.38cm and the mean width of the head, neck, body and tail of pancreas were 5±0.78cm, 3±0.46cm, 3.7±0.56cm and 2.7±0.34cm respectively. Three different shapes of pancreas were found: oblique, inverted 'V' and sigmoid. Double anterior pancreaticoduodenal arterial arcade was observed in 2% of specimens. Conclusion: Knowledge of normal anatomy of the pancreas and vascular pattern is essential for understanding the segmental resection of pancreas and in pancreas-sparing duodenectomy.

Key words: Pancreas, Gross morphology, Pancreaticoduodenal arcade.

Introduction

Pancreas is perhaps the most unforgiving organ in the human body, leading most surgeons to avoid even palpating it unless necessary, and situated deep in the center of the abdomen in the retroperitoneal space. It has been described as "the hermit of the abdomen". Pancreas also remained a hidden organ for radiologists for decades. Indirect signs on plain films and contrast studies were present only in advanced stage of diseases. Anatomical knowledge of the pancreas and its relationships with the surrounding organs is critically important to ensure proper treatment of pancreatic disease and to avoid pancreatic injury during surgical procedure on the surrounding structures. The current interest in the anatomy of the blood supply of the pancreas is based on recent developments in pancreatic surgery, particularly in limited resection of pancreas for low-grade malignant tumors. Now, with the advent of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI), pancreas is no longer the hermit of the abdomen. However, recent advances in investigations and surgical techniques demands a review of the morphology of pancreas, and the present study was conducted hoping to shed some additional information on anatomy of the pancreas regarding its dimensions, shape, the termination of common bile duct and major pancreatic duct, and the vascular pattern of the head of pancreas. The results obtained were compared with similar reports available in the literature.

Materials and methods

The present study was based on the gross morphology of the pancreas in the South Indian population. The 100 specimens (male 88, female 12) of pancreas used for this study were obtained from the cadavers and autopsy cases from the Department of Anatomy and Forensic Medicine, Thanjavur Medical College, Thanjavur, Tamil Nadu. The autopsy specimens were collected from adults
(age - 23 to 61 yrs), and the specimens which were injured, diseased or from children were excluded from the study. Twelve cadavers (male 10, female 2) of unknown age were also studied. The specimens of pancreas were removed along with duodenum, serially numbered and preserved in 10% formalin.

Dimensions of pancreas were measured using a string and vernier caliper as follows: The length of the pancreas was taken from the duodenal margin of the head to the tail. The width of the head, neck, body and tail of the pancreas were measured from superior border to inferior border. The main pancreatic duct and the common bile duct were dissected, and their mode of termination into the duodenum was noted. In 50 specimens, in which the gastroduodenal & superior mesenteric arteries were preserved, the formation of anterior and posterior pancreaticoduodenal arterial arcades were studied.

Results

Dimensions of the pancreas: The length of the pancreas was in the range of 9.2 to 24 cm (Mean: 16.38±2.38 cm). In one of the specimens, the pancreas was very short measuring only 9.2 cm (Fig-1). The mean width of the head of the pancreas was 5±0.78 cm (Range: 3.5-7.5 cm). The width of the neck of the pancreas was found to be in the range of 2 to 3.7 cm (Mean: 3±0.46 cm). The width of the body of the pancreas was in the range of 2.2 to 4.7 cm (Mean: 3.7±0.56 cm) and the width of the tail of the pancreas was in the range of 1.8 to 3.5 cm (Mean: 2.7±0.34 cm). (Table - 1).

Shape of the pancreas: Three different shapes of the pancreas were found - oblique in 87% (n = 87), inverted ‘V’-shaped in 9% (n = 9) and sigmoid in 4% (n = 4) of specimens (Fig-2 & Fig-3).

Pancreatic duct: In all the specimens, the main pancreatic duct was found to join the common bile duct and open into the major duodenal papilla of the duodenum. In 79%, the main pancreatic duct opened into the duodenum posteromedially (n = 79) and in 21%, medially (n = 21).

Variations in the arterial supply of the head of the pancreas were studied in 50 specimens and in only one specimen (2%), a double anterior pancreaticoduodenal arcade was observed.

Discussion

Size and shape of the pancreas: A survey on the morphology of the pancreas showed that the dimensions and shape of pancreas vary, according to different authors. Gore¹ has reported the length of the pancreas as 15-25 cm whereas, Mulholland and Simeone² have quoted a range of 12-20 cm. Anacker³ found that the length of the pancreas varies from 16.5-27 cm. In a study⁴ in Bangladesh, the mean length of the adult male pancreas was found to be 18.2±0.63 cm and of the adult female pancreas was 17.2±0.25 cm. The dimensions observed in the present study (16.38±2.38 cm) are higher

Table - 1 : Dimensions of the pancreas.

<table>
<thead>
<tr>
<th>Length of the pancreas (16.38 ± 2.38 cm)</th>
<th>Width of the pancreas (figs in brackets indicate Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head (5 ± 0.78 cm)</td>
</tr>
<tr>
<td>Range (cm)</td>
<td>% (n = 100)</td>
</tr>
<tr>
<td>&lt;12</td>
<td>1</td>
</tr>
<tr>
<td>12-15</td>
<td>28</td>
</tr>
<tr>
<td>15-20</td>
<td>65</td>
</tr>
<tr>
<td>&gt;20</td>
<td>6</td>
</tr>
</tbody>
</table>
observed in the present study. Only a few cases of congenital short pancreas have been reported in literature and it may be associated with polypsplenia syndrome and calcifying pancreatitis. In the present study, a case of short pancreas was found, which measured 9.2 cm in length.

The width of the head of the pancreas between its upper and lower margin ranges from 3.5 to 8 cm and that of the body, 3.3 cm. Anacker found in his study that the mean width of the head and body from its upper margin to the lower margin was 4.4 cm and 3.3 cm respectively. Hand describes the mean width of the head, neck, body and tail of the pancreas to be 4.4 cm, 3.4 cm, 3.5 cm and 3 cm respectively. The average width of the head (5 cm) and body (3.7 cm) of the pancreas in the present study is higher than the values reported by Anacker. Gore reported that the neck of the pancreas measured 3–4 cm in width. However, the width of neck (3 cm) and tail (2.7 cm) of pancreas in present study were lower than the values reported by Anacker and Hand. The average width of the pancreas in the present study is compared with that of Anacker in Chart - 1.

Kreel et al. in their study of 120 cases (61 males & 59 females), found the shape of the pancreas as oblique in 37%, sigmoid in 27%, transverse in 2%, horse-shoe in 7%, L - shaped in 27% and inverted in 1%, with no particular relationship of shape to age. In the present...
study, only three variant shapes of the pancreas could be found: In 87% (n=87), it was oblique, in 9% (n=9), inverted 'V' and in 4% (n=4), it was sigmoid in shape (Chart - 2).

![Chart - 2: Comparison between the study by Kree et al. and present study](image)

**Variations of the pancreatic duct:** Holzapfel in a study on 50 specimens, reported that in nine cases, the bile duct and the pancreatic duct opened separately into two papillae. Millbourn in a study on 200 specimens found that in 18 cases (9%), the bile duct and the pancreatic duct opened independently into the duodenum. Dardinski came across two cases, in which both ducts emptied separately into the second part of duodenum. Of the 100 cases he examined, in one case, both ducts emptied separately into the intestine, and in another case, the pancreatic duct passed through the major papilla, and the common bile duct passed through a slit-like opening one cm below the tip of the papilla. However, in the present study, we did not come across the above mentioned variations, and the main pancreatic duct was observed to join the common bile duct and open in the major duodenal papilla as usual. Besides, in 79% (n=79) of cases, it opened on the posteromedial wall of the duodenum and in 21% (n=21), on the medial wall.

**Variations in the arterial supply of the pancreas:** The superior and inferior pancreaticoduodenal arteries which supply the pancreas, by forming the anterior pancreaticoduodenal arcade (APDA) and posterior pancreaticoduodenal arterial arcade (PPDA). The APDA artery was found to be present in all cases (n=250).

![Fig - 4: Termination of main pancreatic duct and common bile duct and posterior pancreaticoduodenal arterial arcade.](image)

**Fig - 5: Posterior pancreaticoduodenal arterial arcade.**

**Fig - 6: Double anterior pancreaticoduodenal arterial arcade.**

**Abbreviations:** Duo - duodenum; MPD - main pancreatic duct; CBD - common bile duct; GDA - gastroduodenal artery; SMV - superior mesenteric vein; SMA - superior mesenteric artery; APDA - anterior pancreaticoduodenal arterial arcade; PPDA - posterior pancreaticoduodenal arterial arcade; SPDA - Superior pancreaticoduodenal artery; IPDA - Inferior pancreaticoduodenal artery.
pancreaticoduodenal arcade (PPDA), are the branches of the gastroduodenal and superior mesenteric arteries, respectively. Michels, in a study on pancreas vascularisation, in 200 cadavers, described four types of APDA and PPDA: type I (a single arcade), type II (a double), type III (a triple) and type IV (a quadruple). Woodborne et al. demonstrated APDA in every case in their series (n=150), but the posterior inferior pancreaticoduodenal artery was absent in one specimen. Similarly, Kimura et al. demonstrated the APDA in all the 40 autopsy cases examined, whereas PPDA was found only in 88%. Sarnowska et al., in a study of 60 fetuses (33 male, 27 female), observed the APDA and PPDA in all cases, but in two cases (3.3%), a double anterior pancreaticoduodenal arcade was observed. Likewise, in the present study of 50 specimens, the APDA and PPDA were present in all cases. We were able to separate the PPDA (fig- 4 & 5) easily from the posterior surface of the pancreas, whereas, the APDA were partially buried into the pancreas and was difficult to dissect. Furthermore, we observed a double anterior pancreaticoduodenal arcade (fig-6), in one specimen (2%), formed by the anastomosis of two anterior superior and two anterior inferior pancreaticoduodenal arteries. The gastroduodenal artery gave rise to a single branch of anterior superior pancreaticoduodenal artery, which further divided into two branches. Similarly, the two anterior inferior pancreaticoduodenal arteries were found to arise from a single stem, from the superior mesenteric artery. Knowledge regarding the course of the pancreaticoduodenal arteries is of great importance in the segmental resection of pancreas and in pancreas-sparing duodenectomy, in the preservation of blood supply.

Conclusion

Normal variants and congenital anomalies of the pancreatic duct and the pancreas are often detected as incidental findings in asymptomatic patients and are commonly encountered in radiological investigations. Even though congenital pancreaticobiliary abnormalities are relatively uncommon, the increased association of pancreatitis seen with pancreatic anomalies makes variant anatomy clinically important. Knowledge of normal anatomy of the pancreas and vascular pattern is essential for understanding the segmental resection of pancreas and in pancreas-sparing duodenectomy.

References


Address for communication:

Dr. S. Sulochana,
G-2, Swarnalayam apartments,
Jansi nagar, First cross street extension, Puducherry- 605 004.
e-mail ID : drsulochanasaktivinel@gmail.com
Mobile : 098945 84185