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ANATOMICAL VARIATIONS OF PANCREATIC DUCTS

Anatomy

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ABSTRACT

Background: Anatomical variations and congenital anomalies of the pancreatic ducts are often detected as incidental findings in asymptomatic patients and are commonly encountered in radiological investigations. Anatomical knowledge of the pancreatic ducts and its variations are important to avoid pancreatic injury during surgical and investigative procedure. **Objectives:** The aim of the present study is to study anatomical variation of the pancreatic ducts. **Methods:** The study was done in the department of Anatomy, Assam Medical College, Dibrugarh, Assam. 50 specimens were collected, (35 nos perinatal and 15 nos adult). A thorough morphological study of the pancreatic duct system was carried out and the results were recorded. **Results:** Variations of the pancreatic ducts & their different types correlate with the previous studies to some extent. **Conclusion:** Knowledge of the pattern and anomaly of the pancreatic ducts will add in the long list of variations of the pancreas. It will be helpful for safe and effective diagnostic and therapeutic interventions and prevention of inadvertent organ damage or ductal injury.

KEYWORDS

Pancreatic ducts, Accessory pancreatic duct, Anomalies of pancreas

INTRODUCTION

The main pancreatic duct (MPD) or duct of Wirsung begins in the tail of the pancreas. In the lower half of the head of the pancreas, the pancreatic duct joins the bile duct. The joining of these two structures forms the hepatopancreatic ampulla, which enters the second part of the duodenum at the major duodenal papilla. The accessory pancreatic duct (APD) or duct of Santorini empties into the duodenum just above the major duodenal papilla at the minor duodenal papilla. If the accessory pancreatic duct is followed from the minor papilla into the head of the pancreas, a branch point is discovered.

1. One branch continues to the left, through the head of the pancreas, and may connect with the main pancreatic duct at the point where it turns inferiorly.
2. A second branch descends into the lower part of the head of the pancreas, anterior to the pancreatic duct, and ends in the uncinate process.

The main and accessory pancreatic ducts usually communicate with each other. The presence of these two ducts reflects the embryological origin of pancreas from dorsal and ventral pancreatic buds from the foregut. [1] Variations of the ductal system of the pancreas are also seen. All of the variations in the ductal system are secondary to differences in embryologic development and can be of clinical significance [2].

The pancreatic duct system was classified into 3 groups by Bermann et al.
Group A: Without Santorini
Group B: With Santorini
Group C: Blind Santorini [3]

Owing to the prevalence of pancreatic diseases with the variations in the ductal pattern of pancreas, the present study had been undertaken to observe the variations in course, opening and communication pattern of the pancreatic ducts. This would be helpful to prevent inadvertent ductal injuries during diagnostic and therapeutic interventions.

MATERIALS AND METHODS

The present study was carried out on 50 human cadavers (35 nos perinatal and 15 nos adult) in the Department of Anatomy, Assam Medical College & Hospital, Dibrugarh, Assam.

Study type- A cross-sectional, descriptive study.

INCLUSION CRITERIA:

Approximately healthy perinatal and adult cadavers were selected as the subject for collection of specimens.

Perinates of 36 weeks Gestational age and above.

EXCLUSION CRITERIA:

Perinates before 36 weeks of Gestational age.
Cadavers with gross congenital anomalies and
Cadavers having suspicion of pancreatic disease or trauma or abdominal operation.

Study of Ductal System:

While studying the ductal pattern, the bile duct near the head of pancreas was located first and then traced towards the inferior edge of the retro pancreatic portion of the bile duct to check for existence of a biliopancreatic union, preduodenal or intraduodenal. Once the pancreatic duct was identified adjacent to the posteromedial wall of the second part of duodenum, piecemeal dissection of the pancreas was started from head region to tail region. Meticulous dissection was done in head region to check presence of accessory pancreatic duct. To confirm the existence of a biliaropancreatic common channel and permeability of both duodenal papilla following tests were done. [4]

Common Channel Test: It consisted of checking the existence of a biliaropancreatic common channel and whether it is preduodenal or intraduodenal. After clamping the major duodenal papilla, the retro pancreatic choledochus was canalized with an angiocath no 14 /infant feeding tube 1.70 mm FG-05 and was injected with normal saline. If the injected solution progressed into the pancreatic duct from the bile duct it was considered positive. It was considered negative if the reflux was not seen.

Permeability Test: Both the pancreatic ducts were individually canalized by the angiocath no 14/infant feeding tube 1.70 mm FG-05 and injected with normal saline. It was considered positive if it immersed from the corresponding papilla and negative if it did not.

However, the above tests could be done only in the adult specimens due to technical difficulties like impossibility to canalize the ducts, damage of ducts leading to leakage of dye solution, absence of anatomical piece, etc in the fetal specimen.

While studying the pancreatic ducts, magnifying glass was used for better visibility.

After exposure of the APD and MPD in the head of the pancreas both ducts were followed to the duodenum and their openings were identified on the internal surface of the duodenum. The ducts' course and position were noted along with any divisum if present.

Contrast X-ray procedure and observation:

In some of the fresh specimens, diluted aqueous solution of barium sulphate was infused into the duodenal opening and radiographs had been taken.

The following points were noted:

1. Presence of accessory pancreatic duct,
2. Course of main pancreatic duct and
3. Communication with the common bile duct. (CBD)

STATISTICALANALYSIS :
Documentation of results and observations were done and statistically analysed using SPSS software.

RESULTS AND OBSERVATION
Variations in the course of the main pancreatic duct were observed in the present study. Among the 50 specimens. 45 specimens (90%) showed a descending course and remaining 5 specimens (10%) showed a sigmoid course. (Figure 1, 2)

Figure 1-showing sigmoid shaped main pancreatic duct

Figure 2- showing descending type main pancreatic duct

There was no specific pattern observed in the formation of the main pancreatic duct in the tail region.

The accessory pancreatic duct was found in 38 % specimens in the present study. 25.71% of specimens in perinates and 66.67% of adult specimens.

(table 1, Figure 3)
Table 1-percentage Of Accessory Pancreatic Duct

Age group	Total no. Of specimen *(n)*	Presence of accessory pancreatic duct	Percentage (%)
PERINATES	35	9	25.71
ADULT	15	10	66.67
TOTAL	50	19	38.00

Figure 3- showing both the APD & the MPD

Type of accessory pancreatic duct was long in 89.47%, short in 5.26 %, no embryological pattern was observed in any of the specimen (0 %) and ansa pancreatica in 5.26% pancreas. (Figure 4) In long type the Accessory pancreatic duct (APD) joins the main pancreatic duct (MPD) at the neck portion of the pancreas, found in 89.47% of specimens. In short type, APD joins MPD at the position of inferior branch in the head of pancreas found in 5.26%. In ansa type the APD joins the MPD forming a loop which passes in front of the CBD found in 5.26%. The embryonic type of APD, the ducts fail to fuse, not found in this study. [5]. **(TABLE 2)**

Table 2-type Of Accessory Pancreatic Duct

Type	Number *(n)*	Percentage *(%)*
Long	17	89.47
Short	1	5.26
Embryonic	0	0.00
Ansa	1	5.26
TOTAL	19	100.00

Figure 4-showing loop of accessory pancreatic duct

3 types of pancreatic ductal system were observed in the adult pancreas.

Type A- without Santorini duct- (33.33%),
Type B- with Santorini duct (53.33%) and
Type C- with blind Santorini duct- (13.33 %).

The mean length of main pancreatic duct in the perinates is 3.17 cm with a standard deviation of 0.70 cm (range from 2cm to 5.5cm). The mean length of main pancreatic duct in adult was 12.66 cm with a standard deviation of 3.09 cm (range from 6cm to 19cm). **(TABLE 3,4)**

The mean length of accessory pancreatic duct in the perinates was 0.64 cm with a standard deviation of 0.28 cm, (range from 0.4cm to 1.2cm). **(TABLE 3)**

Table 3-Length Of Main And Accessory Pancreatic Ducts In Adult Pancreas

LENGTH *(in cm)*	MEAN	S.D.	RANGE *(in cm)*	
			Minimum	Maximum
Main Pancreatic Duct	12.66	3.09	6.00	19.00
Accessory Pancreatic Duct	2.71	1.41	1.50	3.00

Table 4-length Of Main And Accessory Pancreatic Ducts In Perinatal Pancreas

LENGTH *(in cm)*	MEAN	S.D.	RANGE	
			Minimum	Maximum
Main Pancreatic Duct	3.17	0.70	2	5.5
Accessory Pancreatic Duct	0.64	0.28	0.4	1.2

The mean length of accessory pancreatic duct in adult was 2.71cm with a standard deviation of 1.41cm (range between 1.50 cm to 3 cm). **(TABLE 3)**

Biliaropancreatic opening was found to be intramural in 33 number of pancreatic specimen (66%), extramural in 17 number of pancreatic specimen (34 %) and none of the specimen had 2 separate opening into the duodenum. **(TABLE 5).** (Figure 5) This was confirmed by making a slit in the lower portion of common bile duct and injecting dye/ normal saline into the main pancreatic duct. Position of ejection of normal saline was then noted through the interior of the duodenum.

In majority of the specimens the major duodenal papilla was present in middle 1/3rd of 2ndpart of duodenum. In 1 adult pancreas it was situated in lower 1/3rd of 2nd part of duodenum (Figure 6).

Table 5- Biliaropancreatic Union

BILIAROPANCREATIC UNION	NUMBER *(n)*	PERCENTAGE *(%)*
Two Independent Openings	0	0
Extramural Convergence	17	34
Intramural Convergence	33	66
TOTAL	50	100.00

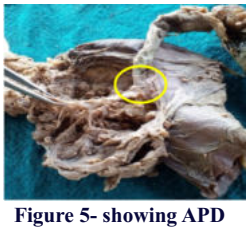

Figure 5- showing APD joining the CBD with extramural convergence

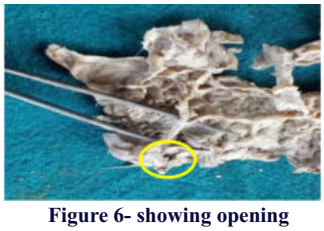

Figure 6- showing opening of MPD in the third part of duodenum

An anomalous connection of pancreatobiliary duct was observed in an adult specimen, where a bifid main pancreatic duct opens into the common bile duct through two openings (Figure-7). This can be explained according to Odger's hypothesis (1930) [6] and Oi's theory of embryological development (1996),[7] which states that "the ventral pancreas which fuses with a pair of ventral buds in the 5th week of fetal life, is connected by two ducts (W1 and W2) to the hepatic diverticulum. The left ventral duct (W1) usually regresses in the 6th week. But if it persists it leads to pancreatobiliary maljunction"

X-ray procedure was done only in limited specimens to correlate with the dissected findings. (Figure 8)

Figure 7-showing two openings of MPD into the common bile duct

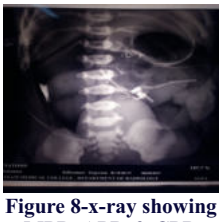

Figure 8-x-ray showing MPD, APD & CPD

DISCUSSION

Johann Georg Wirsung, Prosector of the University of Padua in Italy, discovered the main pancreatic duct in 1642, It was named Duct of Wirsung in 1685. Giovanni Domenico Santorini discovered the accessory pancreatic duct in 1742, [4]. Santorini also observed the major and minor duodenal papillae in association with the pancreatic ducts. In 1685, Bidloo provided the first description of duodenal papilla, biliaropancreatic union and biliaropancreatic ampulla. [4]

Dawson and Langman (1961)
showed patent accessory pancreatic duct in Endoscopic Retrograde Cholangiopancreatography (ERCP) in 42.5%. They in the same year observed a type of ductal anatomy and named it "Ansa Pancreatica". It is characterized by obliteration of the accessory pancreatic duct at its junction with the ventral pancreatic duct, and replacement of this duct by an additional arched communication between the dorsal and ventral duct systems. [8]

Sahni D et al classified pancreatic ducts based on the accessory pancreatic duct and identified the following patterns of accessory pancreatic ducts:

Type–1: When APD commenced from the main pancreatic duct in the neck of the pancreas and extended to the right to open at the minor duodenal papilla.

Type 2: When APD started from lower part of the head and ascending anterior to the MPD it opened into the minor duodenal papilla

Type 3: Embryonic type MPD opened into the minor duodenal papilla. APD opened into the major duodenal papilla with CBD. No connection between the two (pancreas divisum). This condition is also known as isolated ventral pancreas. [9]

Terumi Kamisawa et al (2007) based on their pancreatographic investigations postulated a new embryological theory of long and short type of accessory pancreatic duct development. They stated that the short type accessory pancreatic duct is formed by the most proximal part of the main duct of the dorsal pancreatic bud and its long inferior branch. The long type accessory pancreatic duct represents a continuation of the main duct of the dorsal pancreatic bud. Therefore, the short type accessory pancreatic duct joins the main pancreatic duct near its inferior branch, whereas the long type accessory pancreatic duct forms a straight line and joins the main pancreatic duct at the neck portion of the pancreas. [10]

Percentage of presence of accessory pancreatic duct in the present study was found to be 66.67% and is found to be similar to Gosavi and Gaikwad. [11]

Percentage of long type of accessory pancreatic duct was found to be higher than the previous studies of Gosavi and Gaikwad [11], Kamisawa et al [10] and Lokadulalu CP et al [5] while short type was less than previous studies of Kamisawa et al [10] and Lokadulau CP et al [5]. Percentage of ansa pancreatica type was less than that recorded by Lokadulau CP et al [5].

The present study shows the range of length of Accessory pancreatic duct in adult pancreas ranging from 1.50 cm to 3.00 cm, which is similar to done by Kamisawa T [10].

No previous data on length of accessory pancreatic duct in fetal pancreas was found in the available literature.

Percentage of different types of biliaropancreatic union was 66% intramural type and 34% extramural type was almost similar to Khan L F.et al [12].

CONCLUSIONS

Knowledge of the anatomical variations of the pancreatic ducts is of great importance in general surgery, especially in pancreatic surgery, and is essential to help surgeons perform pancreatic anastomoses safely and effectively. [13,14] Knowledge of anatomical variations of pancreatic ducts is important in planning and performance of surgical, diagnostic and therapeutic procedures of the pancreas.

REFERENCES:

[1]. Raveendranath Veeramani, Sunil Jonathan Holla, Sunil Chumber, Parkash Chand,Elsevier Health Sciences, 05-Apr-2017; pg 371-372.
[2]. Burdick JS Tompson ML. Anatomy, histology, embryology and developmental anomalies of the pancreas. In:Fiedman M Fiedman LS ,Brandt LJ edsSleisenger & Fordtran's Gastrointestinal and liver disease ,8th edition vol 1.Philadelphia; Saunders Elsevier :2006;p 1173-87.
[3]. Berman G.L, Prior. T, Abramow. M, Ziegler. D, A study of three pancreatic duct system in man by the use of vinyl acetate casts of postmortem preparations. Surgery, Gynaecology & Obstetrics 1960,110,391-403.
[4]. Lucas N. Pina, Leonardo Abramson, Franca S. Samoilovich, Agustín Rodriguez, Débora C. Knaus, María L. Tartag.The pancreatic ductal system and biliaropancreatic union: a study of 50 cases Eur. J. Anat.17 (4): 193-201 (2013).
[5]. Lokadolalu Chandracharya Prasanna, KV Rajagopal, Huban R Thomas and Kumar MR Bhatt: Accessory pancreatic duct patterns and their clinical implications, Journal of clinical and diagnostic research 2015 mar,9(3): AC05-AC07, doi 10.7860/ JCDR/ 2015/ 11539.5660 PMCID: PMC4413057
[6]. Odgers PNB (1930) Some observation on the development of the ventral pancreas in man. J Anat65,1-7
[7]. Oil(1996) The development of the ventral pancreas and anomalous bilio-pancreatic junction. J Biliary Tract Pancreas 17,723-729(in Japanese)
[8]. Dawson W, Langman J (1961) An anatomical –radiological study on the pancreatic duct pattern in man. Anat Rec,59-68.
[9]. Sahni D, Jit I, Harjeet. Gross anatomy of the pancreatic ducts in north Indians. Trop Gastroenterol. 2001 Oct-Dec;22(4):197-201
[10]. Terumi Kamisawa and Atsutake Okamoto; Pancreatographic investigation of the pancreatic duct system and pancreatobiliary malformation.; J.Anat.(2008), pp-125-134.doi:10.1111/j.1469-7580.2007.00843.
[11]. Gosavi VS, Gaikwad PG. The duct system of the human pancreatic gland. J Anat Soc India.1980;29(3):142-146.
[12]. Laila Farzana Khan, Humaira Naushaba, Jubaida Gulshan Ara: Observational study of variation in termination of the common bile duct in human cadaver. Bangladesh Journal of Anatomy January 2014, vol.12. No. 1 pp. 11-13
[13]. Brar NS, Bajwa RS. Prospective observational study on pancreatic duct system diversity in different pancreatic diseases. International Surgery Journal. 2017;4(10):3330- 3337.
[14]. Kim HJ, Kim MH, Lee SK, Seo DW, Kim YT, Lee DK, Song SY, et al. Normal structure, variations, and anomalies of the pancreaticobiliary ducts of Koreans: a nationwide cooperative prospective study. Gastrointest Endosc. 2002;55(7):889-896.