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Original Research Article

A STUDY ON ANATOMIC VARIATIONS OF THE PANCREATIC DUCT SYSTEM

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ABSTRACT

Introduction: Pancreatic duct system shows wide range of variations/anomalies due to complexity in its development from two different sources namely Dorsal and Ventral pancreatic buds. Knowledge on these variations holds great importance during various surgical procedures such as drainage procedure in pancreatitis, pancreatico-jejunostomy, reconstruction after pancreatectomy and management of pancreatitis. The present study aims to explore different variations of pancreatic ducts.

Materials and Methods: This cross sectional observational study was conducted in 39 pancreases. Posterior approach was chosen to expose the duct system. Two parallel incisions were made on the posterior surface of the pancreas. Tissue between these two incisions was removed by piece meal dissection and exposed the duct system.

Observation and Results: out of 39 duct systems, 13 (33.3%) were normal and 26 (66.7%) were variations. These variations include 8 (20.5%) cases of Obliterated Duct of Santorini and 12 (30.76%) cases of absent Duct of Santorini, 4 (10.25%) complete pancreas divisum, 1 (2.56%) incomplete Pancreas divisum and 1 (2.56%) case of multiple ducts connecting main pancreatic duct and terminal CBD which is reported for the first time.

Conclusion: Present study is in accordance with findings of most of the studies. Absent duct of Santorini was found to be higher (30.76%) among all types of variations and incomplete Pancreas Divisum with lowest occurrence (2.56%). The knowledge on the prevalence and various types of variations is highly recommended for the surgeons, Physicians and Radiologists for accurate diagnosis and efficient management of various diseases related to pancreas and pancreatico biliary apparatus.

KEY WORDS: Pancreatic duct, Pancreas divisum, Duct of Santorini.

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INTRODUCTION

The pancreas and its duct system were less explored by anatomists, physiologists, pathologists, physicians and surgeons alike. However,a fresh light has been shed on the duct system in the last few decades with the advent of sophisticated advancements such as MRI and MRCP. The differences in embryological origin of pancreatic duct system might be the reason behind the number of anomalies and many of

them go undetected until adulthood or till if any complications develop or many be found incidentally in asymptomatic patients [1]. These wide range variations put together, in turn poses challenge during many surgical procedures such as drainage procedure in pancreatitis, pancreatico-jejunostomy, reconstruction after pancreatectomy and pancreatic anastomosis[2,3]. Therefore, a wide knowledge of ductal anomalies is warranted by physicians and surgeons for accurate diagnosis and management of biliary and pancreatic diseases and for better surgical outcome.

The classical categorisation of duct anomalies includes fusion variations, migration variations and duplication variations. Pancreatic divisum, incomplete pancreatic divisum anomalies are of fusion type, annular, aberrant are of migration anomalies, whereas duplication anomalies are sub grouped into number and form variations [1, 4, 5]. The degree of association between duct anomalies and pancreatitis is high [6].

The aim of the present study is to acquire a fresh insight of the pancreatic duct system for the better understanding of pancreatic duct anomalies among various stakeholders of medical practitioners.

MATERIALS AND METHODS

This cross sectional observational study was conducted in the Department of Anatomy; ACSR Government Medial College and Narayana Medical college Nellore; Andhra Pradesh.

A total of 39 specimens (pancreases with Duodenum) were collected from Department of Anatomy; out of which 24 were previously preserved specimens along with duodenum in 10% v/v Formalin, and 15 specimens were collected from the cadavers during routine dissection. These specimens were dissected to expose the duct system.

Exposure of the duct system: Pancreatic duct lies nearer to the posterior surface in the pancreas rather than the anterior surface. Hence posterior approach was chosen to expose the duct system.

Method – 1: According to the Cunninghams dissecting manual – volume – 2; two parallel incisions were made on the posterior surface of the pancreas from the tail to the neck. Tissue between these two incisions was carefully removed by peeling off or piece meal dissection to expose the duct in the tail and body of the pancreas and is traced towards the neck and then in the head of the pancreas.

Method – 2: We have found in some of specimens, the duct was more superficial to the posterior surface of the neck of the pancreas. In these specimens, after the duct was exposed in the neck region, a probe was passed along the line of duct between the duct and the tissue posterior to the duct. A single incision was made along the line of probe both in tail and head direction to expose the duct. Ducts were injected with normal saline to check the patency. Duct system with variations were recorded, photographed and analysed.

RESULTS

A total of 39 specimens (Pancreas with duodenum) were included in this study, of which 13 (33.3%) showed normal duct pattern and 26 (66.7%) specimens presented with various variations/ anomalies.

These duct variations were classified into the following 3 categories:

A. Fusion variations

B. Duplication variations

C. Variations of accessory duct of Santorini (Duct of Santorini)

Fig. 1a: Complete pancreas divisum: Posterior view of Pancreas showing unfused ducts of Dorsal (DPD) and Ventral pancreatic buds (VPD). Duct of Dorsal pancreatic bud proceeding to the anterior aspect of pancreatic head.

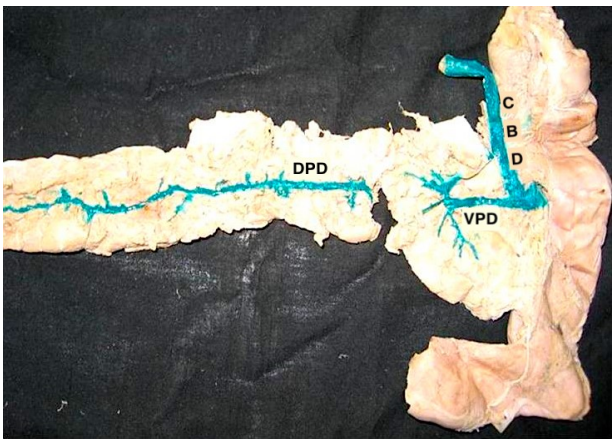


Fig. 1b: Complete pancreas divisum: Anterior view of Pancreas sowing duct of Dorsal pancreatic bud (DPD) proceeding to the minor duodenal papilla (Red arrows).

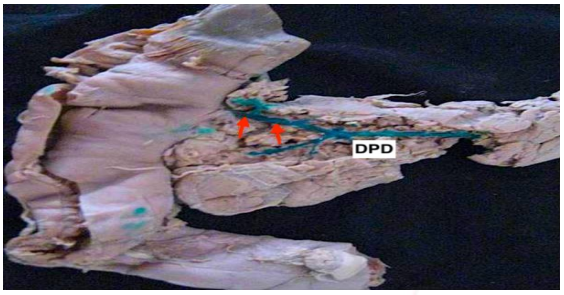


Fig 2a: Multiple slender ducts (Red arrow heads) connecting main pancreatic duct (MPD) with terminal part of the common bile duct (CBD).

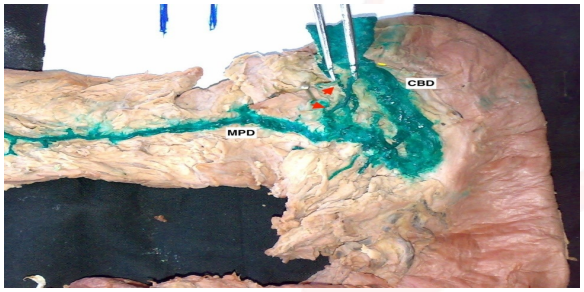


Fig 2b: Histology of slender duct which connected the main pancreatic duct with terminal part of common bile duct, showing luminal epithelium (Blue arrows).

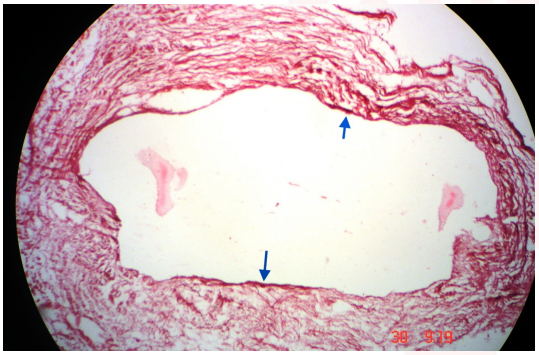
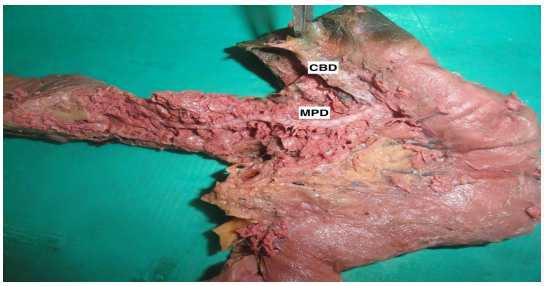


Fig. 3: Absence of Accessory duct of Santorini.



MPD: Main Pancreatic Duct, **CBD:** Common Bile Duct

Fusion and accessory duct variations were found to be 6 (15.4%) and 20 (51.3%), which accounts for 23% and 77% among variations (Table 1). No duplication anomalies encountered in this study.

Fusion variations includes 5 (12.8%) Pancreas Divisum (PD)(Fig. 1a, 1b) and only 1(2.56%) case of Multiple slender ducts connecting the main pancreatic duct (MPD) with terminal part of Common Bile Duct (CBD). 4 (10.25%) among the 5 PD were complete PD and remaining 1 (2.56%) case was Incomplete PD which shares 80% and 20% within PD group.

Table 1: Proportion of different duct variations.

Classification	Pancreatic duct		n	Percent within total sample (N = 39)	Percent within variations (N = 26)
Normal	Normal		13	33.3	----
Fusion variations	Pancreas divisum	Complete	4	10.25	15.4
		Incomplete	1	2.56	3.85
	Multiple ducts connecting MPD and CBD		1	2.56	3.85
Duplication variations	Nil		Nil	Nil	Nil
Accessory ducts variations	Absent Duct of Santorini		12	30.76	46
	Obliterated Duct of Santorini		8	20.5	30.8
Total			39	100	100

We have found 1(2.6%) case of multiple slender ducts connecting the MPD with terminal part of CBD (Fig. 2a, 2b) for the first time. Since there is paucity of this finding in the literature, it needs to be taken with caution of this will not reflect on general population.

Variations of Duct of Santorini were 20 (51.3%) which include 12 (30.76%) specimens with absent Duct of Santorini (Fig. 3) and 8 (20.5%) cases of obliterated Duct of Santorini. These two variations share 60% and 40% within the group of Duct of Santorini variations.

DISCUSSION

Pancreatic ducts show a wide spectrum of variations due to its diversity and complexity in the development from the fusion of two different pancreatic buds (dorsal and ventral). As per the existing literature many of these variations does not seem to have any adverse effects, hence most of these variations can be considered as clinically normal [2].

Normal pattern of ducts was observed in 13 out of 39speimens in the present study which accounts for 33.3%. Narayanan Govindraj et al [7] conducted study with 50specimen in resin casting method and found 40% of all the pancreases had normal pattern of duct system.

Similarly Kamisawa T et al [8, 9] conducted ERCP studies on 123 and 291 cases and found 41%and 43% of normal pattern of ducts respectively. This slight difference in the prevalence between present and older studies might be due to the difference in the methodology and variations in sample size.

However in line with the literature this current study also showed the higher rate of duct variations than normal pattern.

Out of 39 sample 26 (66.7%) had various anomalies in the duct system. Fusion variations were 23% within all the variations while duplication variations were nil in our study. Umo G et al [10] reported 54.1% Fusion variations and 45.8% Duplication variations among 485 cases (ERCP study). Seungmin Bang et al [11] conducted study with 582 cases (ERCP Method) and found that 8.8% (n: 51) of pancreatic ducts were anomalous, of which 37% (n: 19) and 63% (n: 32) were fusion and duplication anomalies respectively.

Five cases (12.8%) of Pancreas Divisum (PD) and only one case (2.56%) of multiple ducts connecting MPD and CBD were the fusion variations identified in the present study.

PD has the prevalence reported between 4-14% of autopsy population and 3-8% of ERCP population [12]. P M Bretet al [13] reported 9% of PD cases in his study. Stimec B et al [14] carried out the study to evaluate the morphometry of duct system in autopsy group (n=203) and ERCP group (n=610) and reported 5.9% (n=12) and 2.3% (n=14) of PD respectively. Similar to the present study Tehreem Fatima [4] reported the incidence of PD at 12% where the author conducted study in dissection method. In line with existing studies, the present study witnessed the higher prevalence of Complete PD (n=4; 80%) than Incomplete PD (n=1; 20%). Seungmin Bang et al [11] in his study mentioned that 63% PD were complete and 37% of and incomplete PD. Terumi Kamisawa [15] identified the 52% and 48% of complete and incomplete PD. In contrast to all above studies and present study as well, Kim MH et al [16] reported higher prevalence of Incomplete PD i.e. 52% than the Complete PD (48%).

A rare and peculiar case of multiple slender ducts connecting the MPD with terminal part of CBD has been encountered in this study which hasn't been reported yet to the best of the author's knowledge after the wide literature survey. It shares 2.56% incidence rate in this study. Histologically these slender connecting channels were conformed as ducts. Incorporation of this rare case into the study didn't alter the percentages of other cases significantly.

A wide range of variations pertaining to the Duct of Santorini had been reported in the literature such as duplication variations, obliterated ducts, ansa panreatica, dominant duct of Santorini and so on. However only 2 of these variations namely absent duct of Santorini and obliterated duct of Santorini were encountered in this present study at 30.76% and 20.5% respectively. This shares 46% and 30.8% among all the variations. Lucas N. Pina et al [17] found similar proportion of variations at 38% and 24% in his study on 50 specimens. Dawson W et al [18] identified 35% obliterated duct of Santorini in his study. Narayanan Govindraj et al [7] reported a higher rate of absence of duct of Santorini at 52% in his study with 50 sample and he witnessed a very less specimens with obliterate duct of Santorini (8%). Mortele KJ [19] stated 30% of his cases with obliterate duct of Santorini. Adibelli ZH et al [20] carried out a MRCP study with 1158 patents where he reported 45.6% of cases with absent duct of Santorini.

Our present study findings are little away from the studies done in ERCP or MRCP. This is perhaps due to the fact that most of the patients with symptoms or suspicion of biliary, pancreatic disease only undergo ERCP or MRCP. Therefore it is natural to have higher preponderance of variations in this type of studies. On the contrary, the present study is in accordance with findings of studies which were done using dissection method. The limitation of this study includes lesser sample size.

CONCLUSION

In this present study, found higher rate of pancreatic duct variations than normal pattern, which might be due the complexity in its development from two different sources (Dorsal and

Ventral Pancreatic buds). Absent duct of Santorini was found to be higher (30.76%) among all types of variations and incomplete Pancreas Divisum with lowest occurrence (2.56%). The knowledge on the prevalence and various types of variations/ anomalies of pancreatic duct system is highly recommended for the surgeons, Physicians and Radiologists for accurate diagnosis and efficient management of various diseases related to pancreas and pancreatico biliary apparatus.

Conflicts of Interests: None

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