RESEARCH ARTICLE

Role of magnetic resonance cholangiopancreatography (MRCP) in learning anatomical variations in pancreatic duct

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Abstract

Objective: To assess the frequency of anatomical variations of pancreatic duct through magnetic resonance cholangiography pancreatography.

Method: The cross-sectional prospective study was conducted from May 2011 to December 2012 at the Department of Anatomy, Institute of Basic Medical Sciences (IBMS), Dow University of Health Sciences, Karachi, in collaboration with the Department of Radiology, Aga Khan University Hospital, Karachi. The study comprised diagnosed cases of pancreato-biliary disease booked for magnetic resonance cholangiography pancreatography. Images were obtained using 1.5 Tesla magnetic resonance imaging scanner, and information of anatomical variations visualised on the imaging film was assessed and documented.

Results: Of the 377 subjects, 196(52%) were females and 181(48%) were males. Pancreas divisum was found in 21(5.6%) subjects; 13(62%) females and 8(38%) males. . Duct of Santorini was detected in 3(0.8%) subjects; 2(66.6%) females and 1(33.3%) male.

Conclusion: Variations in pancreatic duct could be identified by using the simple, non-invasive method of magnetic resonance cholangiography pancreatography.

Keywords: Anatomical variation, MRI, MRCP, T2-weighted image. (JPMA 70: 472; 2020).
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Introduction

In pancreas and biliary tract surgical procedures, bile duct injuries are very common and therefore the risk of serious complications is higher. It has been observed that the presence of anatomical variations in pancreas and biliary tract is one of the factors behind bile duct injuries. Therefore, during pancreatobiliary procedures, recognition of these variations has become essential to avoid such injuries and to control any complication postoperatively.[1] Lack of this knowledge may lead to trauma and/or difficulties during procedure such as in dividing or ligating the major bile duct or biliary leak.[2,3] To find out variations, it is unconditionally required to understand the necessary information of embryology and gross anatomy of the pancreatobiliary tract.

In the 7th week of pregnancy, the pancreas develops from ventral and dorsal pancreatic buds arising from the caudal part of the foregut. These buds are endodermal in origin. The dorsal bud forms the head, body and tail, while the ventral bud develops into the uncinate process. In majority of individuals, the union of these structures allows for a fusion of their ductal systems such that the main pancreatic duct (MPD) serves as the path for emptying of pancreatic secretions into the duodenum via the major duodenal papilla. A normal variant anatomy is present in approximately 30% individuals, where the proximal dorsal pancreatic duct (DPD) persists as an accessory pancreatic duct and empties via the minor duodenal papilla (Figure 1).[4]

The frequency of anatomical variation and congenital anomalies in pancreatobiliary tract are 57.7% and 42.3% in the general population, with females being more prone to variations compared to the males.[5,6] The variations are more commonly seen in Asian populations compared to Europeans and Americans.[7]

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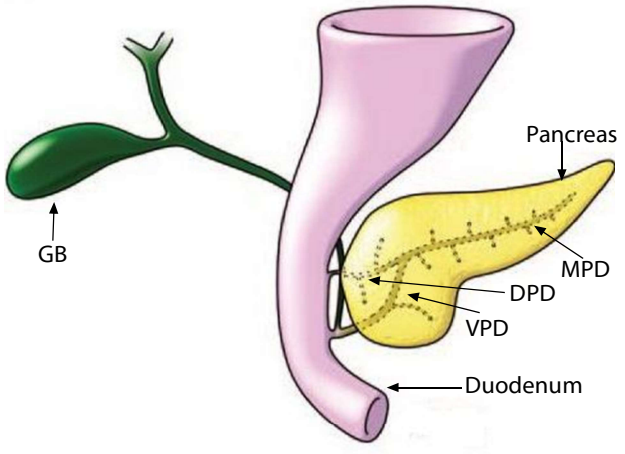

GB: Gallbladder, MBD: Main pancreatic duct, VPD: Ventral pancreatic duct, DPD: Dorsal pancreatic duct.

Figure-1: Development of pancreas and pancreatic ducts.

Pancreas divisum is the most common congenital anatomic abnormality of the pancreas. There are three major types of pancreatic divisum. Type I, or classic pancreatic divisum, is a complete failure of the fusion of dorsal and ventral buds. Their ducts open separately into the duodenum. Type II pancreatic divisum is characterised by the absence of the ventral duct, so the duct opening on the minor papilla drains the entire pancreas and the common bile duct (CBD) opens on the tip of major papilla. Type III pancreatic divisum presents with a small communication between the dorsal and ventral ducts. The majority of cases of pancreatic divisum are asymptomatic, but there has been a reported frequency of acute pancreatitis ranging 25-38%. These patients often experience recurrent pancreatitis which could develop into a chronic pancreatitis. The accessory pancreatic duct, or duct of Santorini (DS), compared to MPD, is the smaller and less constant one. It enters the duodenum at the minor duodenal papilla, the orifice of the accessory pancreatic duct, situated about 2cm ventroproximal to the major duodenal papilla. Although pancreas divisum is a congenital anomaly present at birth, it is often not diagnosed until the fifth decade of life when it becomes symptomatic. Autopsy series have reported the incidence of pancreas divisum to be 5-10% of the general population.[8,9]

With increasing use of cross-sectional diagnostic imaging, pancreas divisum is being diagnosed earlier in asymptomatic patients. Uncounted tomography techniques are offered to research patients littered with exocrine gland diseases, for example ultrasound (US), X-ray photography and biliary scintigraphy, examination retrograde cholangiopancreatography (ERCP) and connective tissue transhepatic X-ray photography (PTC). However, there is another non-invasive imaging technique known as magnetic resonance imaging (MRI) that shows proposing outcome in giving the knowledge of hepatic and pancreatobiliary tract in both physiological as well as pathological states. MRI helps physicians and surgeons in the diagnosis of aforementioned conditions.[6] The current study was planned to assess the frequency of anatomical variations of pancreatic duct through magnetic resonance cholangiography pancreatography (MRCP).

Patients and Methods

The cross-sectional, prospective study was conducted from May 2011 to December 2012 at the Institute of Basic Medical Health Sciences (IBMS), Department of Anatomy, and in the Department of Radiology at the Ojha campus of Dow University of Health Sciences (DUHS), Karachi, in collaboration with the Department of Radiology, Aga Khan University Hospital (AKUH) Karachi.

Approval was obtained from the ethic committees of above two hospitals. Sample size was calculated using Open-Epi 3.01 taking prevalence of anatomical variations and anomalies in general population as 43%, margin of error 5% at 95% confidence interval (CI).[10] Using non-probability sampling technique, the sample was raised including known cases of pancreatobiliary disease found on ultrasound report and other modalities. All subjects of either gender were post-pubertal. MRCP scans with evident anatomical views were included. Patients excluded were claustrophobic, having dementia, who cannot hold their breath for more than 30 seconds and patients who had pacemaker or other implants or any mechanical prosthesis inserted into their bodies as MRI would not have been possible. Non-optimal MRCP images were also excluded.

Patients included after informed consent underwent MRCP via appointments. They were to be in a fasting state for 6-8 hours before undergoing the examination. The hospital provided them with certain attire which was a loose comfortable gown. To establish the communication between the technologist and the subjects, a ding-dong was also set near the patients. About 350-500ml pineapple

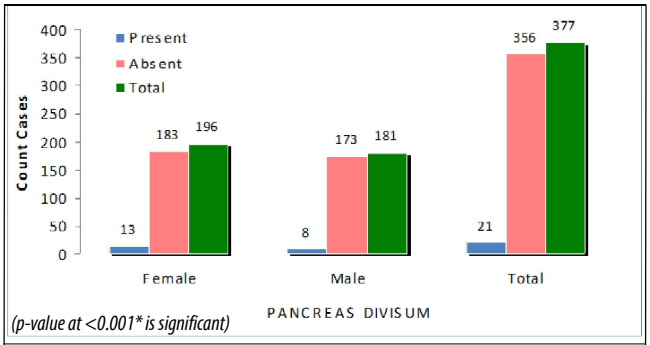

Figure-2: Frequency of distribution of pancreas divisum in adult male and females through magnetic resonance cholangiography pancreatography (MRCP).

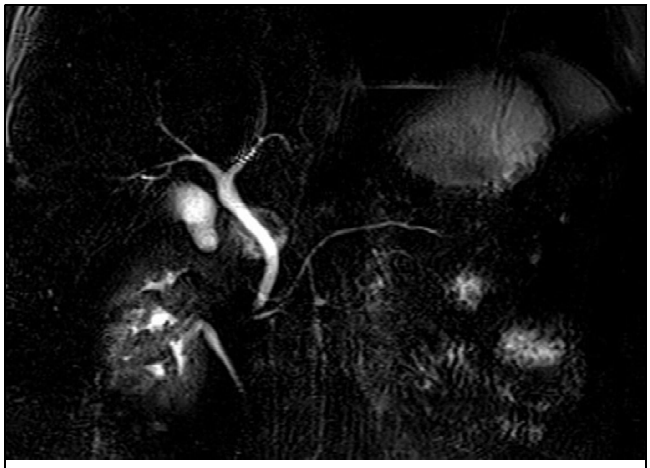

Figure-3: Coronal magnetic resonance cholangiography pancreatography (MRCP) showing main pancreatic duct (MPD) entering minor papilla in duodenum without joining with the common bile duct (CBD). CBD and ventral pancreatic duct (VPD) both enter into major duodenal papilla (MDP). There is no communication in dorsal pancreatic duct (DPD) and VPD. Gallbladder (GB) is also noted.

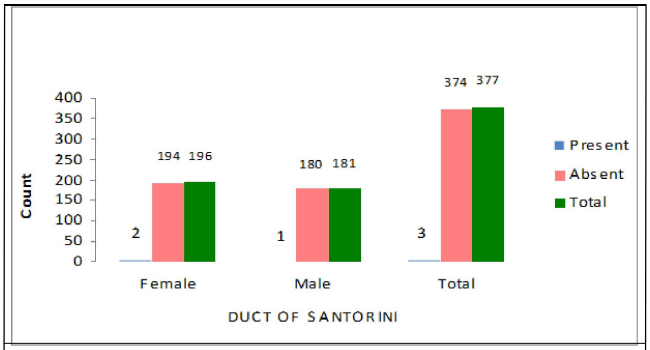

Figure-4: Frequency of distribution of duct of Santorini in adult male and females through magnetic resonance cholangiography pancreatography (MRCP).

juice was used as a negative oral contrast which was given 20 minutes before the examination. MRCP was conducted at the MRI unit and 1.5 Tesla (Magnetom, Vision, Erlangen,

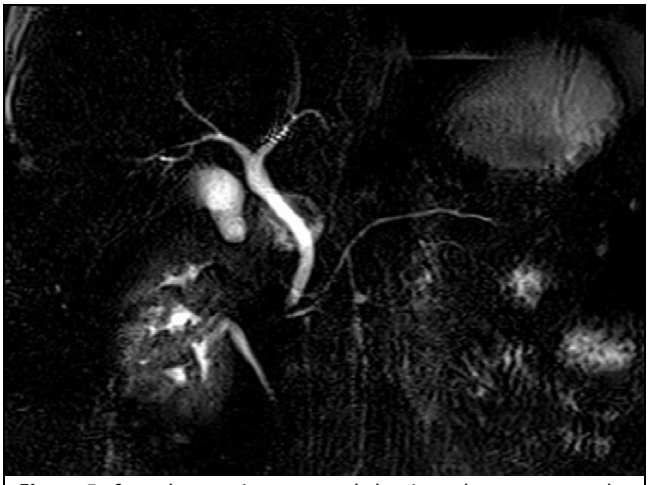

Figure-5: Coronal magnetic resonance cholangiography pancreatography (MRCP) showing main pancreatic duct (MPD) entering major papilla in duodenum by joining with common bile duct (CBD). Dorsal pancreatic duct or duct of santorini (DS) enters into minor duodenal papilla (MDP). There is no communication in MPD and DS.

Siemens, Germany) scanner was used to obtain images. The MRI scanner has a channel about 1.5 meters long enclosed by a rounded magnet. A receiving device was placed behind or around the part to be examined in order to detect the tiny ratio signals emitted from the patient's body. The whole process took place in 15-20 minutes during which the patients remained still and silent. The radiographer sat in the control room next to the scanner for continuous monitoring. Information of anatomical variations visualised on the imaging film was assessed and documented.

Results

Of the 377 subjects, 196(52%) were females and 181(48%) were males. Pancreas divisum was found in 21(5.6%) subjects; 13(62%) females and 8(38%) males (Figures 2-3). DS was detected in 3(0.8%) subjects; 2(66.6%) females and 1(33.3%) male (Figures 4-5).

Discussion

Accurate preoperative delineation and assessment of the biliary anatomy is imperative to ensure safe and successful procedure. MRCP is an ever-evolving imaging technique used to image the biliary and pancreatic ductal anatomy in an optimal manner. It is non-invasive, free from ionising radiation and requires no anaesthesia. Besides helping to avoid iatrogenic injuries, preoperative pancreatobiliary tract anatomy is identified along with variations and anomalies.[11]

A study of 122 participants identified 31(25.2%) subjects as having anatomical variations at different levels of the pancreatobiliary tract.[12] In our study, the corresponding number was 21(5.6%). Extensive literature review showed studies presenting 13% to 19% of their respective samples having such variations.[13] A study conducted in Italy concluded that 57% patients owned a normal pattern of pancreatobiliary tract anatomy compared to 43% with variations.[1] One study with 590 patients, reported 39.5% of the sample having similar variations.[14] Our findings are well below these numbers.

Another study showed that pancreas divisum affected 5-11% of the patients examined and concluded it to be pancreatic ductal configuration,[15] which was reported in 15-20% of patients with unexplained pancreatitis. In our study, this anomaly was found to be present in 21(5.6%) patients which represented a frequency of 5.6% which was in accordance with a 2011 study which reported 5.7%.[16] However, our results differed from the findings of one study which reported 9.3% and 10.8% prevalence in the sample.[17] The prevalence of this variation is more readily seen in the Western world in comparison with the Asian population.[7] The patency of accessory pancreatic duct (APD) has been reported 12-82% by various research studies.[18] It is understood that a patent APD may function as an alternative to the main drainage system and thereby preventing pancreatitis. APD was found to be a rare variation in our study. It was detected only in 30(0.80%) participants compared to a series of studies done in Japan from 1989 to 2003 which showed 166(43%) subjects had patent APD.[19] Another study in 2010 on 167 patients reported patent APD in 21% subjects.[20]

In terms of limitations, the current study had a small sample size and was unable to include general population due to financial constraints, and included only those patients who needed MRCP due to some problem in the pancreatobiliary tract. Also, cadaveric dissection was not done due to non-availability of sufficient number of human bodies. Further, the study only used 1.5 Tesla as the facility of 2 Tesla was not available at study sites. Finally, the data of the current study relates to a period several years ago.

Despite the limitations, however, the study will prove to be of benefit to clinical health professionals. It will help in the evaluation of variations which are related to the pancreatobiliary tract, and will ultimately help in decreasing the incidence of surgical complications during the procedures.

Conclusion

Variations in pancreatic duct could be identified by using the simple, non-invasive method of MRCP, which will decrease the chances of complications during surgical procedures.

Disclaimer: The text is part of a thesis submitted with the DUHS, Karachi.

Conflict of Interest: None.

Source of Funding: None.

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