Congenital Cystic Lesion In Extra Hepatic Biliary Tract

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Abstract

Objective: To illustrate congenital cystic lesions of the extra hepatic biliary tract on the idea of information of embryologic development through the magnetic resonance cholangiopancreatography (MRCP).
Methods: Patients that were suspected to have been suffering from biliary disease were referred to the MRI units, there the patients were narrowed done to confirm with the inclusion and exclusion criteria, thereafter written and informed consent was obtained from them and the procedure was explained to them in detail. MRCP was performed on a 1.5 Tesla in MR unit, using phased-array coil for signal detection. Heavily T2 weighted images were obtained with SSF-SE technique. The axial sections were used for pancreatic and bile ducts whereas the coronal sections were used for the pancreatobiliary tract, axial and coronal source images and reformatted images were evaluated together for the possibility of any anomaly in extra hepatic biliary tract. This was an observational, cross sectional, prospective study with a sample size of 377 patients. Statistical analysis was done by SPSS version 16.
Results: Choledochal cyst was found in 11 of the 377 patients with a gender separate frequency of 6 out of 196 females and 5 out of 181 males, with a total frequency of 2.9% and a p-value at <0.001 which was significant.
Conclusion: By identifying the inherent anomalies that present themselves during the visualization of the biliary tract through MRCP and MRI, while coupled with information regarding the clinical significance of every entity, is vital for establishing an accurate diagnosis and in guiding acceptable clinical intervention and management.
Keywords: Bile ducts, choledochal cyst, cholangiopancreatography, magnetic resonance.
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Introduction

Cystic lesion is a commonly occurring phenomenon in the hepatic biliary tree, but it poses difficulties in diagnosis mainly due to its location in the abdomen. The identification of the biliary tract is normally done by anatomists during dissections, radiologists during radiographic examinations and surgeons during abdominal surgery. It is important for one to be in possession of sound knowledge regarding the embryological development of the structures that make up the biliary tree and of lesion's characterization and classification to better appreciate and understand their pathogenesis and the congenital anomalies that may arise from them. As such the definition of congenital anomalies takes importance as being understood to be the variance in their development from what is deemed normal to an altered state with the effect of deferring from normal resulting in them obtaining pathological signigicance[1]. During the embryological development, in the first trimester, or to be more precise in the fourth week of the pregnancy, formation of the

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hepatic diverticulum occurs that is an outgrowth (endodermal) of the primitive midgut. 'Pars hepatica', the cranial part of the hepatic diverticulum, arises from and develops into the primordium of the liver and the hepatic duct. Along with the cranial part, the caudal part of the hepatic diverticulum gets divided to form a superior bud that is 'pars cystica' from which the cystic duct and gallbladder arises along with an inferior bud that is the place of origination of the ventral bud of pancreas. In the sixth week of pregnancy, 180-degree rotation (clockwise) of ventral and choledochal bud of the pancreas occurs around the duodenum to take their ultimate positions. Precursor cells of the liver originate from the liver primordium. By the eighth week of gestation, some of the liver precursor cells get differentiated into epithelial cells and arrange in mesenchyme as double-layer cylindrical structures near to the portal vein branches to form the ductal plates. By the twelfth week of pregnancy, remodelling of the ductal plates starts and up to the twentieth week, partially mature bile ducts and the peribiliary glands become visible at hilum of liver. Maturation of these glands occurs at the end of pregnancy or in the initial postnatal period[2]. Congenital anomalies arise from different sorts of inborn malformations, including the abnormal remodeling of the ductal plates along with other that arise or come in to effect during the process of development. These differences arise as a result of failure of compete rotation and fusion of the tract throughout the events that take place in during the fourth week of gestation in humans[3]. These malformations thus take up great significance for clinicians, surgeons, radiologist and anatomist due to the clinical significance that they in turn present with the pathologies that come in to play. Therefore, having the awareness of embryological development and normal anatomy of the biliary tree proves helpful in figuring out these inborn malformations. The extra hepatic bile ducts of the biliary system are sauce structures that are affected by the presence of an inherited cystic lesion known as the choledochal cyst. Choledochal cyst is the wide range spectrum of anomalies and is characterized by the inborn dilation of extra hepatic ducts, which arise from the distortion that occurs in the developmental phase of the pancreatobiliary junction. The malformations are known to be one of the predisposing factors in the development of conditions such as pancreatitis, cholangitis, cholilithiasis and the development of malignancies. Furthermore, they are attributed to be one of the cause for unrecognized and undiagnosed development of recurrent pancreastitis and cholangitis[4,5]. Moreover, it is understood that no preceding data is present regarding the prevalence of choledocal cyst in the population of Pakistan, whereas the recognition of this malformation holds great clinical importance for surgeons. The presence of a congenital cyst is a rare malformation that is identified by the dilation seen in the extra hepatic bile duct system, which was discovered by Vater in 1723; later these malformations were classified and further explained by a study conducted by Alonso - Lejin in 1959. Subsequently, Babbitt added to the literature regarding these malformations and inturn their effect by defining the association between dilation of the duct and the reflux of the juices which are secreted, stating that this reflux was occurring due to the abnormal formation of the pancreatobiliary junction[6]. In normal system, the location of bile duct joining the pancreatic duct is 2.5 to 3 cm away from sphincter of Oddi, but in the case of dilatation, more proximal joining occurs that allows the pancreatic juice to move with high pressure from pancreatic duct. This causes dilatation more than 5 mm in diameter that ultimately leads to damage of epithelia, inflammation, hyperplasia of epithelia, fibrosis and also dysplasia. Increased level of amylase can also cause choledochal cysts. On microscopic view, gall bladder can be differentiated from CCs, as it is characterized by flattened epithelium, fibrosis of sub-epithelia and inflammation. In embryonic development, left anlage of pancreas join to the right or dorsal pancreas adjacently. When left ventral anlage fails to join and leads to delay the canalization of bile duct, CCs may occur[7]. In 1977, Todani and colleagues set out to further classify and divide the extra hepatic bile duct cysts according to the cystic dilatation's location; in to Type IA cystic dilatation of the extrahepatic bile ducts, Type IB extrahepatic distal focal - segmental biliary dilatation, Type IC extra hepatic fusiform biliary dilatation, Type II extra hepatic biliary diverticula, Type III Intra duodenal portion of the common bile duct dilatation (Choledococel), Type IVA multiple cystic dilatation of the intra hepatic and extra hepatic bile duct,

Type IVB multiple cystic dilatation of the only extra-hepatic bile duct and Type V cystic dilatation of the intra hepatic bile ducts (Caroli's disease). The classification is still largely used by clinicians to date. In 1924 MacWorter was the first to surgically excise the choledocal cyst which had developed due to the abnormal union of the pancreatobiliary ducts. Formed frusta choledochal cyst (FFCC) is another type of this classification and it is characterized by the non-specific, change in the mucosa of bile duct causing mucosal ulceration or sloughing, infiltration of inflammatory cells, and fibrosis. The patients having formed fluster choledochal cyst are at a greater risk of developing carcinogenesis in extra hepatic bile duct. These changes can be similarly seen in the simple choledochal cysts. All these types can be easily classified by MRCP[1]. During the development of the pancreatobiliary system, a sphincter forms at the junction of the pancreatic and bile ducts known as the sphincter of Oddi. These serves as the function of regulating the flow of bile and pancreatic juices as well as to prevent the reflux of duodenal contents into the pancreatobiliary system. The pressures that build up in the pancreatic and bile duct are 30-50 mm and 25-30 mm of water respectively. These distinctions in pressures account for the flow of fluid from the pancreatic duct into the extra hepatic system. As such this combination of the juices can cause activation of the enzymes present in the pancreatic secretions. Thus, if the pancreatoduodenal valve becomes incompetent which further facilitates reflux of the mixed juices, this can result in inflammation as well as deterioration of the ductal wall and result in an attack of cholangitis and pancreatitis[8]. Several techniques are present for the diagnosing the malformation in tract of biliary passage such as Intra-operative cholangiography, that was discovered in 1937 by Mirizzi and used as a road map by the clinicians to stop injuries in pancreatobiliary tract[9]. Even though this procedure provides high quality images, nevertheless it does come with its own set of limitations; which are its invasive nature, it is quite time consuming, it has a requirement of a trained and experienced hand as well as having unsatisfactory results with a success rate of only 71%[10]. Role of imaging is quite appreciative in the diagnosis. Ultrasound (US) is primer of this technique and is used for finding the liver abnormalities including the cystic abnormalities and large bile ducts' detection. With the development of radiographical imaging, it is seen that Computed tomography (CT) has more advantages such as it being faster and more extensively available for the diagnosing of disease and anomalies in pancreatobiliary system[11]. Endoscopic retrograde cholangiopancreatography (ERCP) is currently the gold standard for investigation and identification of the biliary tract system. However, it finds limitation based on the need of skilled members for conducting the procedure, may cause bleeding, infection, leakage of bile that can induce pancreatitis in 1-7% of the patients undergoing the course of treatment. Both techniques use contrast medium and ionizing radiation during the procedure[12]. On the other hand, magnetic resonance cholangiopancreatography (MRCP) is the diagnostic tool for the assessment of the pattern of disease in the biliary tract and useful for the recognition of variations, anomalies, tumours and parenchymal changes of the liver[13]. MRCP has a specificity of 100% in regards to the investigation and identification of choledochal cysts[14]. Furthermore, this technique is safe, non-invasive, and cost effective as seen in a study done by where it was performed on a 1.5 Tesla, General electrical unit (Signa) employing a body part phased-array coil, and set plain gradient-echo localizing pictures were obtained and accustomed plan MRCP sequence. All the sequences were taken throughout one breath-hold, needs four to six hour of fast prior to scan. Twenty minutes required for the completion of examination[15].

This study can be a helpful addition in the analysis and addition of information in regards to our country proving it beneficial. Also, it will subsequently help in the reduction of the risks associated with the complications that may arise such as cholangitis, pancreatitis and malignancy.

Subjects and Methods

This is a cross-sectional, prospective study which was conducted at the Institute of Basic Medical Health Sciences (IBMS) in the department of Anatomy, and in Department of Radiology at Dow University of Health Sciences (DUHS) - Ojha Campus and Aga Khan University Hospital (AKUH) from May 2011 to December 2012. Non-probability sam-

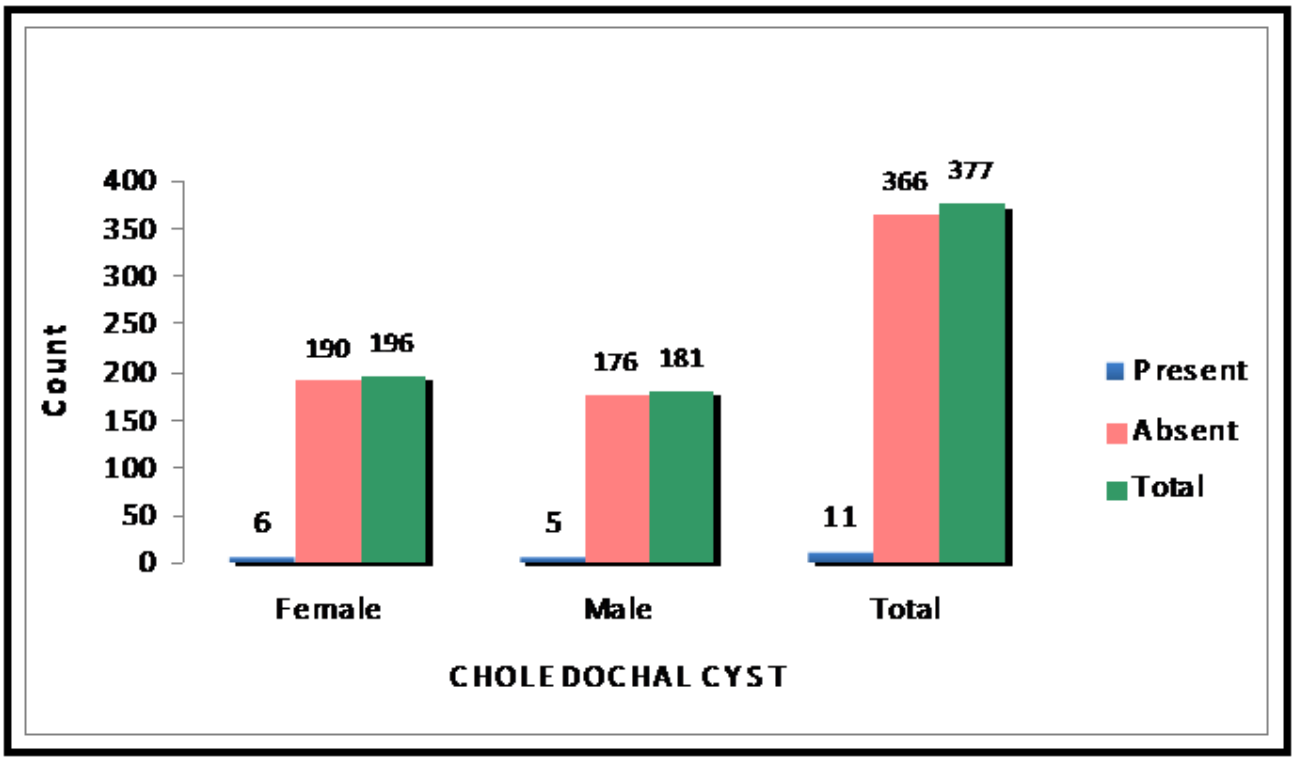

Fig 1. Shows the frequency of distribution of choledochal cyst adult male and females through MRCP

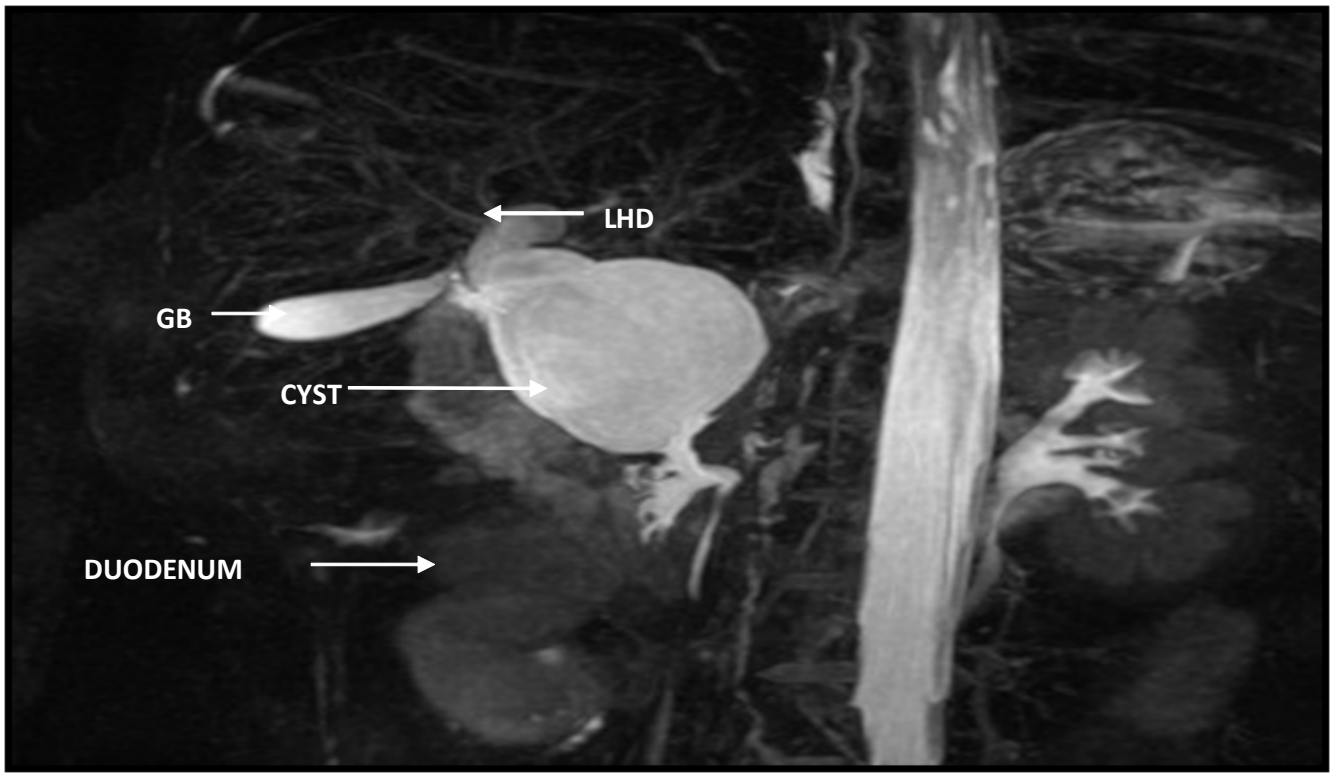

Fig 2. Coronal MR Cholangiopancreatography (MRCP) shows the large extra hepatic bile duct cyst (arrows).Left hepatic duct is slightly distended. Gallbladder (GB) and duodenum (D) are noted.

pling technique was used. Sample size estimation was calculated using the expertise of a statistician, an epidemiologist using an Open Epi sample size calculator version 3.01. The estimations were made out of 43% of prevalence of anatomical variations and anomalies in general population. Level of significance and margin of error was kept at 5% with 95% confidence interval. The total sample size was 377. The study included known cases of pancreatobiliary disease found on ultrasound report and other modalities. Moreover, all individuals were post-pubertal. It included cases of both sexes. Furthermore, it included MRCP scans with evident anatomical views. MRCP scans with evident anatomical views were incorporated and excluded cases were claustrophobic, mentally deteriorated patients (dementia), patients who cannot hold their breath for more than 30 seconds and patients who had pace maker or other implants or any mechanical prosthesis inserted into their bodies as MRI wouldn't have been possible. Moreover non-optimal MRCP images were also excluded from the study

Three hundred seventy seven (377) cases were identified using the inclusion criteria from the mentioned hospitals. Patients had to follow certain guidelines prior to the examinations which were done via appointments. They were to be in fasting state for 6-8 hours before undergoing examination. Hospital provided them with certain attire which was a loose comfortable gown. A well-informed written consent was signed. The procedure of MRCP Was explained to the patients in the terms understandable to them. To establish the communication between the technologist and the participants a ding dong was also set near the patients. 350-500ml pineapple juice was used as a negative oral contrast which was given 20 minutes before the examination. MRCP was conducted using Magnetic Resonance Image (MRI) unit and 1.5 TESLA (Magnetom, Vision, Erlangen, Siemens and Germany) machinery was used to obtain images. The MRI scanner had a channel about 1.5 meters long enclose by considerable rounded magnet. The patient lied on a couch which slided into the scanner. 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 lied still and silent. The radiographer sat in the control room next to the scanner for continuous monitoring.

Results

It is of importance to note that the patients who were inducted in to the research sample varied in their presentation. While some candidates complained of pain in the epigastric regions, other showed signs of obstructive jaundice, whereas some were even seen to present with acute or chronic prancreatitis and cholangitis associated with fever. All participants were advised to undergo MRCP, which was performed to examine the biliary tract.

The existence of a choledochal cyst was found in 6 out of the 181 and 5 out of 196, females and males who were examined respectively, this equatesto a percentage of 3.1% in the females and 2.8% in the males. As a whole the numbers add up to a percentage of 2.9% with a p-value of <0.001 which is significant, whereas, from the participants who took part 97.1% showed an absence of a choledochal cyst, for the whole sample size (Fig 1 and 2).

Discussion

Choledochal malformation (CDM) is an inborn pathological error we become aware of by using distinctive degree of congenital dilatation of the biliary device which includes the common, intrahepatic, and intrapancreatic bile duct. This entity regularly occurs in Asia as in distinction to the western nations with most evaluations originating from Japan. The incidence ranges from 1 in 13,000 in Japan to 1 in 2 million in England. However, there are no reviews of CCD in adults from Oman or Middle East. They usually occur in young people and very few of them current when adults[16].

The characteristic feature of choledochal cyst malformation is the dilatation of extra or intra hepatic biliary tract without obstruction of flow of bile in biliary tract. The cause of this cyst is still not known. Yet there are two generally proposed hypotheses to justify this malformation. The simplest of this describes the incomplete obstruction of the bile duct which increases adjacent bile duct pres-

sure that causes dilatation, first of the extra hepatic bile duct than lead to intrahepatic segment[17]. The second theory known as Babbitt's hypothesis is based on the pathophysiological consequence of reflux of activated proteolytic pancreatic enzymes on the biliary tract wall REF. The lining epithelium of the biliary tract becomes weak due to prolong exposure to activated proteolytic enzymes causing dilatation of biliary tract. The abnormal communication predisposes to reflux of pancreatic juice into bile duct, leading to ineffective bile flow which in turn results in increased intraductal pressure, chronic inflammation, and its associated carcinogenic effect. This reflux occurs due to the existence of common channel of biliary and pancreatic juice drainage. Several reports suggest a close association of CCD with anomalous union of the pancreaticobiliary duct. The extra-hepatic biliary apparatus is said to have more anomalies in one cubic centimetre of the space around the region of the cystic duct than any other part of the body[18]. Malformed anatomy causes difficulties during the surgery and management of disease by the physician. The disclosed percentage or prevalence of congenital anomalies in biliary tract lies among 0.58 and 47.2%[17].

The majority of choledochal cysts are diagnosed in childhood. Clinical presentation varies and most often consists of nonspecific abdominal pain. Diagnosis is typically accomplished using multimodality imaging techniques including computed tomography, magnetic resonance imaging, ultrasound and MRCP. The use of diagnostic PTC and ERCP in CC has been largely replaced by MRCP[19]. MRCP can disclose the clear anatomy and network of biliary tract entirely therefore, it is a preferred technique for diagnosis of related anomalies. Optimal mages of bile duct can be produces by means of MRCP, being non-invasive nature of MRCP; it helps to gather the pre-operative information about the cystic ducts that helps clinicians to interpret accurate abnormality to avoid iatrogenic injuries. This pre-operative information about the features of bile duct in patient also helps in medical jurisprudence. The choledochal cysts may be found in infants, children or after the age of 20 years. The true reason of choledochal cysts is not familiar but, it has been advised to be an indication of abnormal pancreatobiliary junction (APBJ) during development resulting in reflux of digestive juice into the bile duct[17]. Choledochal cyst was found 2.9% out of 377 patients in this study. Our findings were almost equal with the study done in 2013[19] that showed frequency rate of 1.1% out of 356 cases. Asians more prone to develop choledochal cyst as compare to Western. The percentage rate was in Western countries varies between 1 in 100,000 and 1 in 150,000 and in Asian population is 1 in 1000 of which about 2/3 cases are reported in Japan[17,19] 1 in 13500 in the United States and 1 in 15000 in Australia. The cause of preponderance in Asian is still not clear[20,21].

Conclusion

In conclusion, it can be seen, that the identification of the congenital anomalies that appear in the biliary tract through the use of imaging modality, MRCP and MRI, can provide information that is of great clinical significance for all clinically oriented individuals. This will help in establishing an accurate diagnosis followed by the development of a more comprehensive clinical management program for each individual. Therefore, fundamental knowledge of embryology of the biliary tree is important for determining the cause of abnormality, and for understanding the imaging produced through diagnosing imaging such as MRCP in this study.

Conflict of Interest

Authors have no conflict of interest and no grant/funding from any organization.

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