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Characterization of Biliary Confluence Angle in KSA Using MRCP

توصيف زاوية التقاء القنوات المرارية في السعودية باستخدام التصوير بالرنين
المغناطيسي

A

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Radiological Technology by Research**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

(وَلِلَّهِ مَا فِي السَّمَاوَاتِ وَمَا فِي الْأَرْضِ ۚ وَكَانَ اللَّهُ بِكُلِّ شَيْءٍ
مُّحِيطًا)

صدق الله

العظيم

النساء الآية (126)

Dedication

To my parent

To my husband and daughter

My brother and sister

To my teacher and college

Acknowledgement

We sincerely thank the participants without whom the study would not have been feasible. The Sudan University of Science and Technology- College of Medical Radiological Science Khartoum- Sudan and the Radiology Department- Dr. Suliman Fakeeh Hospital Saudi Arabia.

AbstrAct

This study aimed to evaluate the morphological alterations in the biliary confluence angle of Asian population, describing the most frequent MR cholangiopancreatography (MRCP) findings, evaluating the confluence angle in the cases of dilated and normal ducts, and to correlate the angle with the patients age, gender, nationality, height , weight and body mass index (BMI). The study was done in Suleiman Fakeh Hospital in Jeddah KSA, in the period from March 2011 up to May 2012. The sample was drawn from patients in both gender referred to MRCP imaging with different indications and was classified into two groups, the first group was patients with normal biliary ducts, the second group was patients with dilated biliary ducts. All examinations were done using MRI 1.5 Tesla, Siemens Avanto 2010, single shot fast spin echo (SSFSE). Protocol using coronal oblique images was applied where the angle was measured. Results showed that the most common MRCP findings were: distended gall bladder, gall stone, cholecystitis, cholecystectomy, liver cirrhosis, hepatomegaly, hepatic lesion, pancreatitis, and pancreatic lesion. MRCP can evaluate the biliary confluence angle in dilated and normal ducts. No significant relation was found between the biliary confluence angle and the selected variables in both normal and dilated ducts, but a significant relation was detected with the age in patients with normal biliary ducts. Dependency upon the biliary confluence angle is not beneficial for diagnosis or prediction of diseases. A new equation for predicting the biliary

Confluence angle with the known Asian ages was established

مستخلص

هدفت هذه الدراسة إلى تقييم التبدلات البنيوية (المورفولوجية) في زاوية اقتران القناة الصفراوية لدى الآسيويين، وذلك بوصف أكثر الاصابات تكراراً في التشخيص بواسطة التصوير الإشعاعي للبنكرياس والقنوات الصفراوية، وتحديد وتقييم زاوية اقتران القناة الصفراوية في الحالات العادية والحالات التي تم إجراء عمليات توسعة للقنوات الصفراوية لديها، وإيجاد معامل الارتباط بين اقتران القناة الصفراوية وكلاً من العمر، النوع، الجنسية، الطول، الوزن ومؤشر كتلة الجسم. تمت الدراسة في مستشفى سليمان الفقيه بجدة في المملكة العربية السعودية، في الفترة من مارس 2011م إلى مايو 2012م. تم اختيار العينة من المرضى من النوعين الذين تم تشخيصهم بـMRCP والذين لديهم مؤشرات متنوعة، وقد تم تصنيفهم لمجموعتين: المجموعة الأولى الذين لديهم قنوات المرارية لديهم عادية، والمجموعة الثانية الذين تم إجراء عملية توسعة للقنوات المرارية لهم. أجريت كل الفحوصات باستخدام الرنين المغناطيسي (MRI, 1.5 Tesla, Siemens, Avanto 2010 - Single Shot Fast Echo [SSFSE]). تم تطبيق بروتوكول تصوير الشريان التاجي المنحرف عند قياس زاوية الاقتران.

تشير النتائج إلى إن معظم التشخيصات بـMRCP كانت: انتفاخ المرارة، حصوة المرارة، التهاب المرارة، استئصال المرارة جراحياً، تليف وتضخم الكبد، إصابة في الكبد، التهاب البنكرياس، وإصابة في البنكرياس.

لا توجد علاقة ذات دلالة بين بنية زاوية اقتران القناة الصفراوية والمتغيرات التي تم اختبارها في كلا الحالتين (الذين لم يتم إجراء عمليات توسعة لهم أو الذين تم إجراء عمليات توسعة لهم)، لكن تم تحديد وجود علاقة ذات دلالة بين العمر وزاوية اقتران القناة الصفراوية في المرضى الذين لم يتم إجراء عمليات توسعة لهم. عليه فإن الاعتماد على تحديد بنية زاوية الاقتران الصفراوية غير مجدي في تشخيص أو التنبؤ بالأمراض ذات الصلة. وقد تم إيجاد معادلة للتنبؤ بالبنية المورفولوجية لزاوية اقتران الصفراوية وعمر المرضى الآسيويين.

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Chapter One

Chapter One

1.1 Introduction

Magnetic resonance cholangiopancreatography MRCP noninvasive radiographic technique that make an image of panceratobiliary tree similar to endoscopic retrograde pancerato-chole angiography (ERCP).

(Earls 2002) .MRCP allow pancreatic and biliary anatomy to be defined noninvasively, without risk of pancreatitis and radiation exposure, and may detect micro-lithiasis, choledocholithiasis, unsuspected chronic pancreatitis, and, in some cases, pancreas divisum and annular pancreas. Therefore, MRCP is an appropriate noninvasive tool for suspected Pancreaticobiliary pathology (Zaliekas and Munson. 2008). The basic principle of MRCP is body fluid such as bile and pancreatic secretion had high signal (appear white) on heavy T2 weighted image (echo time longer than 150ms) and the tissue around were markedly suppressed; no signal from flowing blood. This source image obtained in any plane and form volumetric data set suitable for further analysis, especially reformatting algorithm such as maximum intensity projection (MPI) and shaded source display (Gulati et al. 2007)

Several technique were used in MRCP, first 2D T2 weighted gradient echo sequence with steady state free precession (SSFP) during breath hold , this sequence was subsequencely optimized using 3D acquisition volume. Alexander

Fast spin echo (FSE) sequence demonstrated as a very suitable for performing heavy T2Weighted studies in abdomen. FSE sequence compared with gradient echo GRE sequence: FSE had higher signal to noise ratio (SNR), contrast to noise ratio (CNR) lower sensitivity to susceptibility artifacts, motion artifact and blood flow. (Lee. et al 2000) Also, improve image quality such as gradient moment nulling, which reduce artifact from periodic motion, respiratory triggering. Fat Suppression technique additionally improve contrast between bile

duct and back round in breath hold and nonbreath hold technique with similar result(Alexander, et al).

1.2 objectives

1.2.1 General objective

Assessment of biliary confluence angle measurement in Asian population using MRCP

1.2.2 Specific objective

1. To determine the means value of biliary confluence angle using MRCP.
2. To assess changes in this angle correlated to gender, age, height, weight, body mass index, race, and different pathological condition.
3. To study morphological ultration of biliary angle in KSA described most common frequent MRCP finds.
3. Evaluation of angle in case of dilated and normal (not dilated) biliary duct.

1.3problem

The anatomical situation of the main biliary confluence explains the risk of ligating the confluence or the left duct during major hepatobiliary surgery and liver transplantation. Moreover, the biliary confluence angle has no great consideration in evaluation of MRCP image.

1.4 theses over view

Chapter one proposal.

Chapter two literature review.

Chapter three previous studies.

Chapter four management and analysis.

Chapter five results.

Chapter six glossary and reference.

Chapter Two

Literature review

Chapter Two

Literature review

2.1 Introduction to anatomy

The liver, biliary tree and the gallbladder occupy the right upper quadrant of the abdomen. The liver resides between the digestive tract and the rest of the body and functions as a way station between the splanchnic and systemic circulation. (Kumar et al .2004). It is composed largely of epithelial cells (hepatocytes), which passed in blood derived from the hepatic portal veins and hepatic arteries. There are continuous chemical exchange between the cells and the blood. Hepatocytes are also associated with an extensive system of minute canals, which form the biliary system into which products are secreted (Standring.2008).

The biliary tract conduit between the liver and the duodenum and designed to store and transport bile, under control of neuronal and hormonal regulation. Bile formed in the hepatocytes and steadily secreted into canaliculi, which transport it to the larger extrahepatic ducts. The sphincter of Oddi regulates the flow of bile into the duodenum or to the cystic duct and the gallbladder.(Pierre and Laillie. 2014)

2.2 Liver anatomy

The mature liver lies in the right hypochondrium under the rib cage and extends from the right fifth intercostal space at the midclavicular line to just below the costal margin. It projects slightly below the costal margin at right intercostal line under the xyphoid process in the midline. (Kumar et al.2004). To understand anatomy and physiology of biliary tract and bile production, it necessary to outline briefly the anatomy of the liver.

The liver divided microscopically into right and left lobe by falciform ligament anteriorly. Inferiorly, this corresponds to the round ligament and umbilical fissure. The right lobe further divided by gallbladder fossa into right hemiliver to the right of the gallbladder and quadrate lobe to the left.

The fourth lobe (caudate) which lies posterior and surrounds inferior vena cava. Hence, anatomically the liver divided into two main lobes and two accessory lobes. (Pierre and Laillie. 2014)

2.2.1 Liver segmentation

With improved understanding of liver function, the concept of functional anatomy has developed. In December 1998, a Scientific Committee of the International Hepato-Pancreato-Biliary Association created a terminology called The Brisbane 2000 Terminology of Liver Anatomy and Resection. estimate that, The liver divided into three functional livers: right, left and the caudate . (Pierre and Laillie. 2014).

The separation between the right and left hemiliver is at Cantlie's line, which is an oblique plane extending from the center of the gallbladder bed to the left border of the inferior vena cava. In this plane runs the middle hepatic vein, The Right hemiliver divided further into two sections by the right portal scissura (anterior and posterior sections), within which runs the right hepatic vein. Each section then divided based on their blood supply and bile drainage into two segments (figure 1.1) (segment V & VIII anterior and segment VI & VII posterior). The left hemiliver divided into three segments (segment IV, III, & II). The caudate hemiliver (segment I) considered separately because of its separate blood supply and venous and bile drainage. (Pierre and Laillie. 2014)

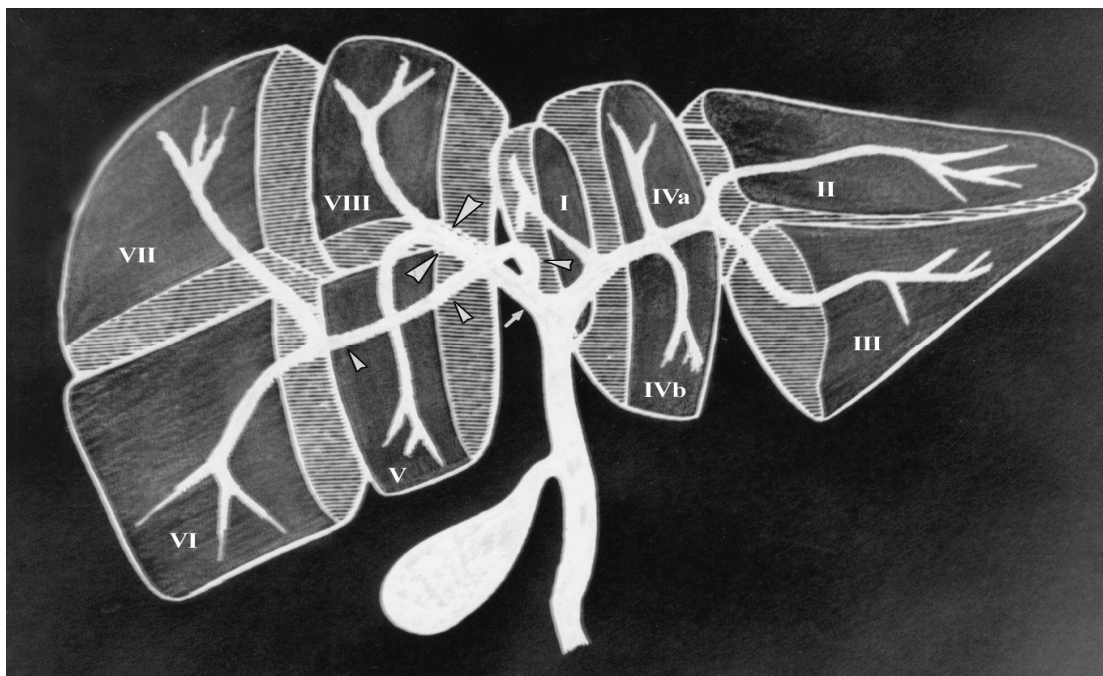


Figure 2.1: shows normal hepatic biliary segmental anatomy, and normal fusion of cystic duct with common hepatic duct. Represented right posterior duct (small arrowheads) and right anterior duct (large arrowheads) to form right hepatic duct (arrow)., segment V, VI, VII & VIII resemble Rt liver, segment I, II, III, IVa, & IVb resemble Lt liver. Mortelé, K. J and Ros, P. R (2001)

2.2.2 Blood supply and venous drainage

The vessels connected with the liver are the portal vein, hepatic artery and hepatic veins. The portal vein and hepatic artery ascend in the lesser omentum to the porta hepatis, where each bifurcate. About One-fourth of the blood and one-half the oxygen come by way of the hepatic artery. The remainder was been carried by the portal vein. Skandalaki et al (2008)

2.2.2.1 Hepatic artery (HA)

In adult, the hepatic artery is intermediate in size between the left gastric and splenic arteries. In fetal and early postnatal life, it is the largest branch of coeliac axis. After its origin from the coeliac axis, it passes anteriorly and laterally below the epiploic foramen to the upper aspect of superior part of the duodenum. The artery may be subdivided into common hepatic artery - from the coeliac trunk to the origin of the gastroduodenal artery - and the hepatic artery 'proper' - from that point to its bifurcation. It passes anterior

to the portal vein and ascends between the layers of the lesser omentum. It lies anterior to epiploic foramen and passes in free border of lesser omentum medial to common bile duct and anterior to portal vein. (Skandalaki.et al (2008))

At porta hepatis, the hepatic artery divides into right and left branches before these run into the parenchyma of the liver. The right hepatic artery usually crosses posterior (occasionally anterior) to common hepatic duct. It always divides into anterior branch supplying segments V and VIII, and posterior branch supplying segment IV and V. The anterior division often supplies a branch to segment I and the gallbladder Standring et al (2008)

2.2.2.2 Portal vein (PV)

The portal vein begins at the level of the second lumbar vertebra. It formed by convergence of superior mesenteric and splenic veins. It lies anterior to the inferior vena cava (IVC) and posterior to the neck of the pancreas. It lies obliquely to the right and ascends behind the first part of duodenum, the common bile duct and gastroduodenal artery. At this point it is directly anterior to the inferior vena cava. It enters the right border of the lesser omentum, and ascends anterior to the epiploic foramen to reach the right end of the porta hepatis. It then divides into right and left main branches, which accompany the corresponding branches of the hepatic artery into the liver. (Standring et al. 2008).

2.2.2.3 Hepatic veins (HV)

The hepatic veins lie in the planes that divide the lobes and segments of the liver. Thus, they are intersegmental and drain parts of adjacent segments.

The hepatic veins arise as central veins of the liver lobules. They coalesce to form interlobular veins, several orders of collecting veins, and right, middle, and left hepatic veins that emerge from the liver to enter the inferior vena cava. (Skandalaki.et al 2008)

2.2.2.4 Lymphatic drainage

Lymph from the liver has abundant protein content. Lymphatic drainage from the liver is wide and may pass to nodes both above and below the diaphragm. (Standring et al. 2008)

2.3 Intra hepatic bile ducts (IHBD)

There are more than 2 km of bile ductules and ducts in the adult human liver. These structures are far from being inner channels, and are capable of significantly modifying biliary flow and composition in response to hormonal secretion. Bile secretion starts at the level of the bile canaliculi, the smallest branch of the biliary tree. (Pierre and Laillie 2014) The bile canaliculi join to form ductules (canals of Hering) which lined with cuboidal epithelial cells. These are not hepatocytes and have a complete basal lamina, the ductules open into interlobular bile ducts, which form part of the portal triads. The interlobular ducts join to form right and left lobar ducts, which join at the hilum to form extrahepatic common hepatic duct. The interlobular bile ducts, form a richly anastomosing network that closely surrounds the branches of portal vein. These ducts increase in caliber and possess smooth muscle fibers within their wall as they reach the hilus of the liver. Furthermore, as they become larger, the epithelium becomes increasingly thicker and contains many elastic fibers. These ducts anastomose to form the segmental branches (from segment I to segment VIII) (Pierre and Laillie 2014),

2.3.1 Right Biliary Tree

The right biliary tree originates in four areas of the right lobe. The branches take their names from their location: anterosuperior from segment(VIII), anteroinferior from segment (V), posterosuperior from segment (VII), and posteroinferior from segment (VI), These area ducts join to form anterior and posterior segment ducts that, in turn, form the right hepatic duct. Some variations occur in the biliary vessels of the right lobe (Skandalaki.et al 2008)

In 80 to 85% of individuals, these segmental branches anastomose to form the anterior (segment V and segment VIII) and posterior sectorial bile ducts (segment VI and segment VII) in the right hemiliver. With the union of these two sectorial ducts, in 57% of individuals, the right hepatic duct has been formed. The right hepatic duct is usually short-approximately 9 mm in length. (Pierre and Laillie 2014).

2.3.2 Left biliary tree

The left hemiliver, segmental branches from segment (II) and segment (III) anastomose to form left hepatic duct in the region of the umbilical fissure. The anastomosis of segment (IV) to the left hepatic duct usually occurs as a single trunk to the right of the umbilical Fissure in 67% of individuals. (Pierre and Laillie 2014)

2.3.3 Variation of the intrahepatic bile ducts

As illustrated previously, the incidence of right anterior and posterior sectorial ducts joining to form the right hepatic duct occurs in only 57% of people (Fig. 2.2). (Pierre and Laillie 2014). In 12%, the right anterior and right posterior ducts join at the junction with the left hepatic duct without the existence of the right hepatic duct. In 20% of cases, drainage occurs directly into the common hepatic duct. There was variation in the segmental anastomosis in the right liver. The main right segmental Drainage was variable in 9% of segment V, 14% in segment VI, and 29% in segment VII. The Variation in segment VII not reported. (Pierre and Laillie 2014). Skandalaki.et al (2008)

The left hepatic duct usually forms by confluence of the ducts that drain medial and lateral segments. With regard to left liver, 67% of individuals have previously described their anatomy. The main variation lies in the ectopic drainage of segment IV It reported that 2% drain directly into the common hepatic duct, and 27% drain directly into segment II or segment III only. (Skandalaki.et al (2008)

Another form of ectopic drainage of the intrahepatic ducts is involvement of the cystic ducts and the gallbladder. As illustrated, these variations are important to note (Pierre and Laillie 2014).

2.3.4 Biliary confluence

The confluence takes place at the right of the hilus of the liver, anterior to the portal venous bifurcation and overlying the origin of the right branch of the portal vein (Fig. 2.3). The biliary confluence separated from the posterior aspect of segment IV of the left liver by the hilar plate, which is the fusion of connective tissue enclosing the biliary and vascular structures with Glisson's capsule (Pierre and Laillie 2014). The classic junction occurs in 61% of instances. During a right hepatectomy, the anatomical situation of the main biliary confluence explains the risk of ligating the confluence or the left duct. The Bismuth–Corlette classification is valid only for a normal confluence. In the event of biliary abnormality, it is necessary to take into account not only the type of confluence, but also its height in relation to the portal vein. Skandalaki et al (2008).

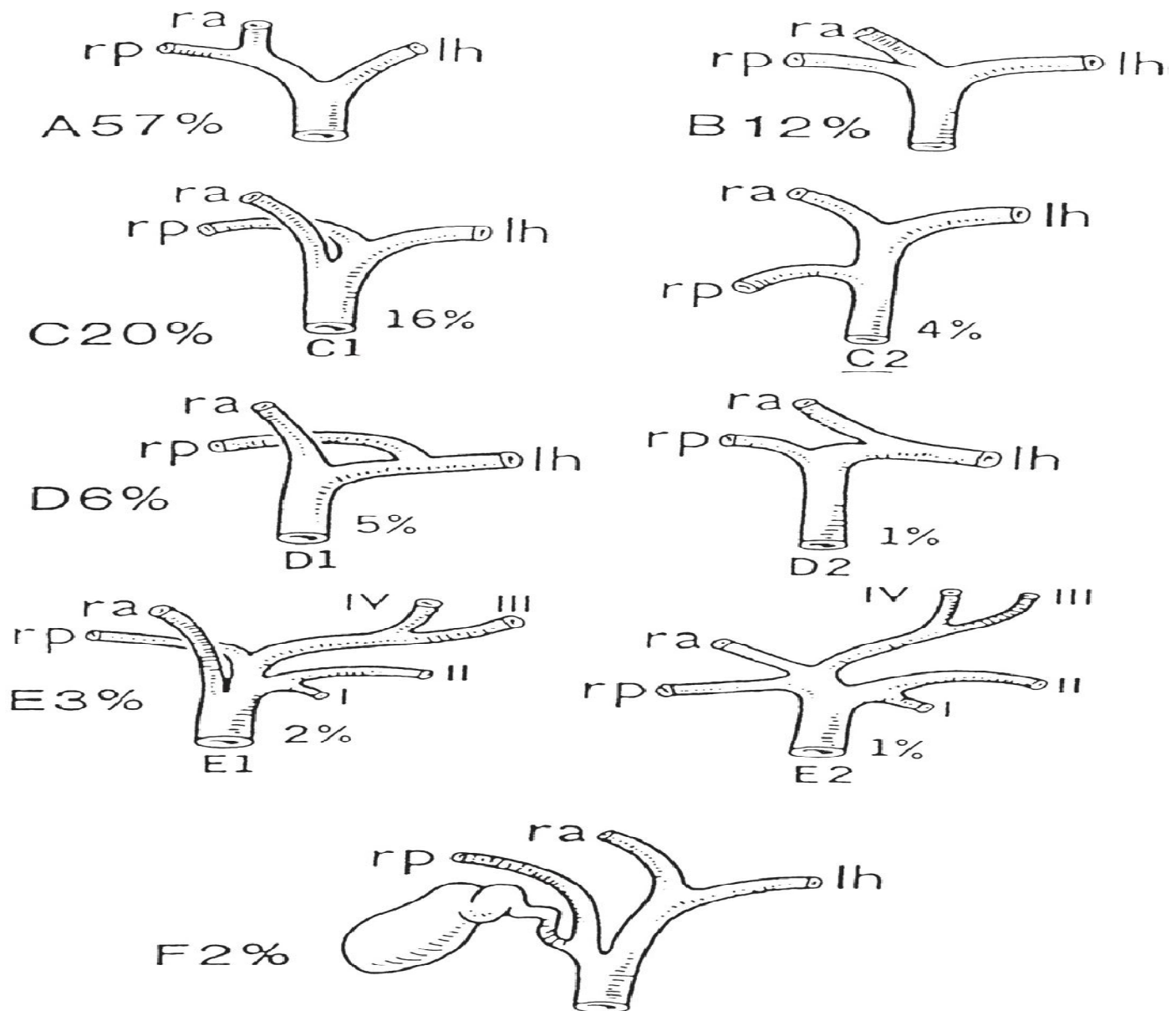


Figure 2.2 Variations in the confluence of sectorial and hepatic ducts Ra, right anterior; rp, right posterior; LH, left hepatic PIERRE, E.C, and LAILLIE, J (2014).

2.3 Extrahepatic biliary duct

The extrahepatic biliary tree consists of right and left hepatic ducts, common hepatic duct, cystic duct, gallbladder and common bile duct.

(Standring et al. 2008).

The main right and left hepatic ducts emerge from the liver and unite near to right end of the porta hepatis as the common hepatic ducts begin. The common hepatic duct (Fig2.3) formed by the union of the right and left hepatic ducts in the porta at the transverse fissure of the liver. Its lower end defined as its junction with the cystic duct. The distance between these points varies from 1.0 cm to 7.5 cm. The diameter of the duct is about 0.4 cm Skandalaki.et al (2008). This descends and joint on its right at an acute angle by the cystic duct to form the common bile duct. The common hepatic duct lies to the right of the hepatic artery and anterior to the portal vein in free edge of lesser omentum. (Standring et al. 2008)

2.3.1 Cystic duct

The cystic duct drains the gallbladder into the common bile duct. It between 3 & 4 cm long, passes posteriorly to the left from the neck of the gallbladder, and joins the common hepatic duct to form the common bile duct. It usually runs parallel to, and is adherent to the common hepatic duct for a short distance before joining it. The junction usually occurs near porta hepatis but may be lower down in the free edge of the lesser omentum. (Standring et al. 2008).The cystic duct contains a series of 5 to 12 crescent-shaped folds of mucosa similar to those seen in the neck of the gallbladder. These form the so-called spiral valve of Heister. The length of the cystic duct and the manner in which it joins the common hepatic duct vary. The cystic duct joins the hepatic duct at an angle of about 40° in 64-75% of individuals. In 17-23%. The cystic duct parallels the hepatic duct for a longer or shorter distance and may even enter the duodenum separately. This has been call "absence" of the common bile duct (Skandalaki.et al (2008).

2.3.2 Gallbladder (GB)

The gallbladder is a flask-shaped, blind-ending diverticulum attached to the common bile duct by the cystic duct it is 7-10 cm long and has a capacity of 30-50 ml. (Skandalaki .et al (2008). It usually lies in a shallow fossa in the liver parenchyma covered by peritoneum continued from the liver surface. This attachment can vary widely. At one extreme the gallbladder may be almost completely buried within the liver surface,

having no peritoneal covering (intraparenchymal pattern); at the other extreme it may hang from a short mesentery formed by the two layers of peritoneum separated only by connective tissue and a few small vessels (mesenteric pattern). The gallbladder divided into a fundus, body, infundibulum, and neck (Standring et al. 2008).

2.3.2.1 The fundus

The fundus is usually located at the angle of the ninth costal cartilage with the right border of the rectus sheath and to the left of the hepatic flexure of the colon. It has been completely covered by peritoneum, because it projects beyond the lower border of the liver (Skandalaki et al 2008).

2.3.2.2 The body

The body of the gallbladder is in contact with the first and second portions of the duodenum and occupies the gallbladder fossa of the liver. The body also related to the transverse colon. (Standring et al. 2008)

2.3.2.3 Infundibulum

The infundibulum is the angulated posterior portion of the body between the neck and the point of entrance of the cystic artery. When this portion dilated, with eccentric bulging of its medial aspect, it called a Hartmann's pouch (Skandalaki et al 2008)

2.3.2.4 The neck

The neck lies at the medial end close to the porta hepatis, and usually has a short peritoneal covered attachment to the liver (mesentery); this mesentery usually contains the cystic artery. The mucosa at the medial end of the neck obliquely ridged, forming a spiral groove continuous with the spiral valve of the cystic duct. (Standring et al. 2008).

2.3.3 The duct of Luschka

The duct of Luschka is a small bile duct, running in the bed of the gallbladder, outside the wall. It is present in 50% of individuals (Pierre and Laillie 2014)

2.3.4 The common bile duct (CBD)

The common bile duct begins at the union of the cystic and common hepatic ducts and ends at the papilla of Vater in the second part of the duodenum. It varies in length from 5 cm to 15 cm, depending on the actual position of the ductal union. In 22%, the common hepatic and cystic ducts, on average, run parallel for 17 mm before the ducts actually unite. The average diameter is about six mm (Skandalaki. et al 2008).

It descends posteriorly and slightly to the left, anterior to the epiploic foramen, in the right border of the lesser omentum. It lies anterior and to the right of the portal vein and to the right of the hepatic artery. It passes behind the first part of the duodenum with the gastroduodenal artery on its left, and then runs in a groove on the superolateral part of the posterior surface of the head of the pancreas. It lies anterior to the inferior vena cava and sometimes embedded in the pancreatic tissue. The duct may lie close to the medial wall of the second part of the duodenum or as much as 2 cm from it. Even when it has been embedding in the pancreas, a groove in the gland marking its position palpated behind the second part of the duodenum (Standring et al. 2008).

2.3.5 Hepatopancreatic ampulla (of Vater)

It lies medial to the second part of the duodenum; the common bile duct approaches the right end of the pancreatic duct. The ducts enter the duodenal wall together, and usually unite to form the hepatopancreatic ampulla. Rarely the common bile duct and pancreatic duct drain into the duodenum separately. (Skandalaki. et al 2008).

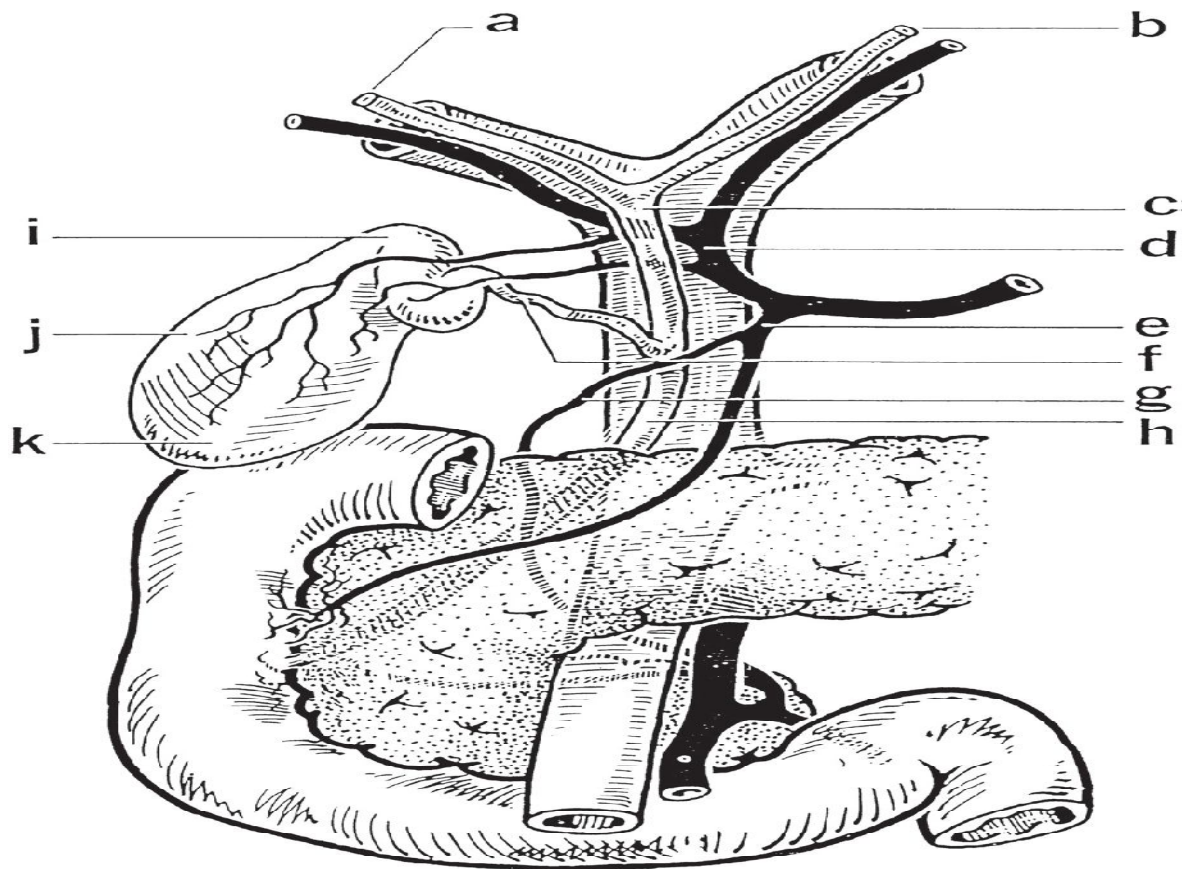


Figure 2.3 the anatomy of the extrahepatic biliary system: (a) right hepatic duct, (b) left hepatic duct, (c) common hepatic duct, (d) hepatic artery, (e) gastroduodenal artery, (f) cystic duct, (g) retroduodenal artery, (h) common bile duct, (i) neck of the gallbladder, (j) body of the gallbladder, (k) fundus of the gallbladder. PIERRE, and LAILLIE, (2014):

2.3.6 Vascular supply and lymphatic drain

2.3.6.1 The cystic artery

The cystic artery usually arises from the right hepatic artery. It usually passes posterior to the common hepatic duct and anterior to the cystic duct to reach the superior aspect of the neck of the gallbladder (fig1.4). It divides into superficial and deep branches. The superficial branch ramifies on the inferior aspect of the gallbladder body, the deep branch on the superior aspect. These arteries anastomose over the surface of the body and fundus. (Standring et al. 2008)

2.3.6.2 Cystic vein

The venous drainage of the gallbladder is rarely by a single cystic vein. There are usually multiple small veins (fig2.4). Those arising from the superior surface of the body and neck lie in areolar tissue between the gallbladder and liver and enter the liver parenchyma to drain into the segmental portal veins. (Standring et al. 2008)

2.3.6.3 Lymphatic drain

Long collecting trunks drain the lymphatic plexus of the fundus and body of the gallbladder. The trunks are on the right, left borders (lateral and medial borders of the gallbladder wall), and connected by an oblique trunk to form a large "N" on the surface. The trunks on the left drain into cystic node, which lies in the angle formed by the cystic and common hepatic ducts. The trunks on the right follow the cystic duct, passing without entering the cystic node. These vessels and the efferent vessels of the cystic node drain to the node of the anterior border of the epiploic foramen, and to the superior pancreaticoduodenal nodes on the common bile duct. (Skandalaki. et al 2008).

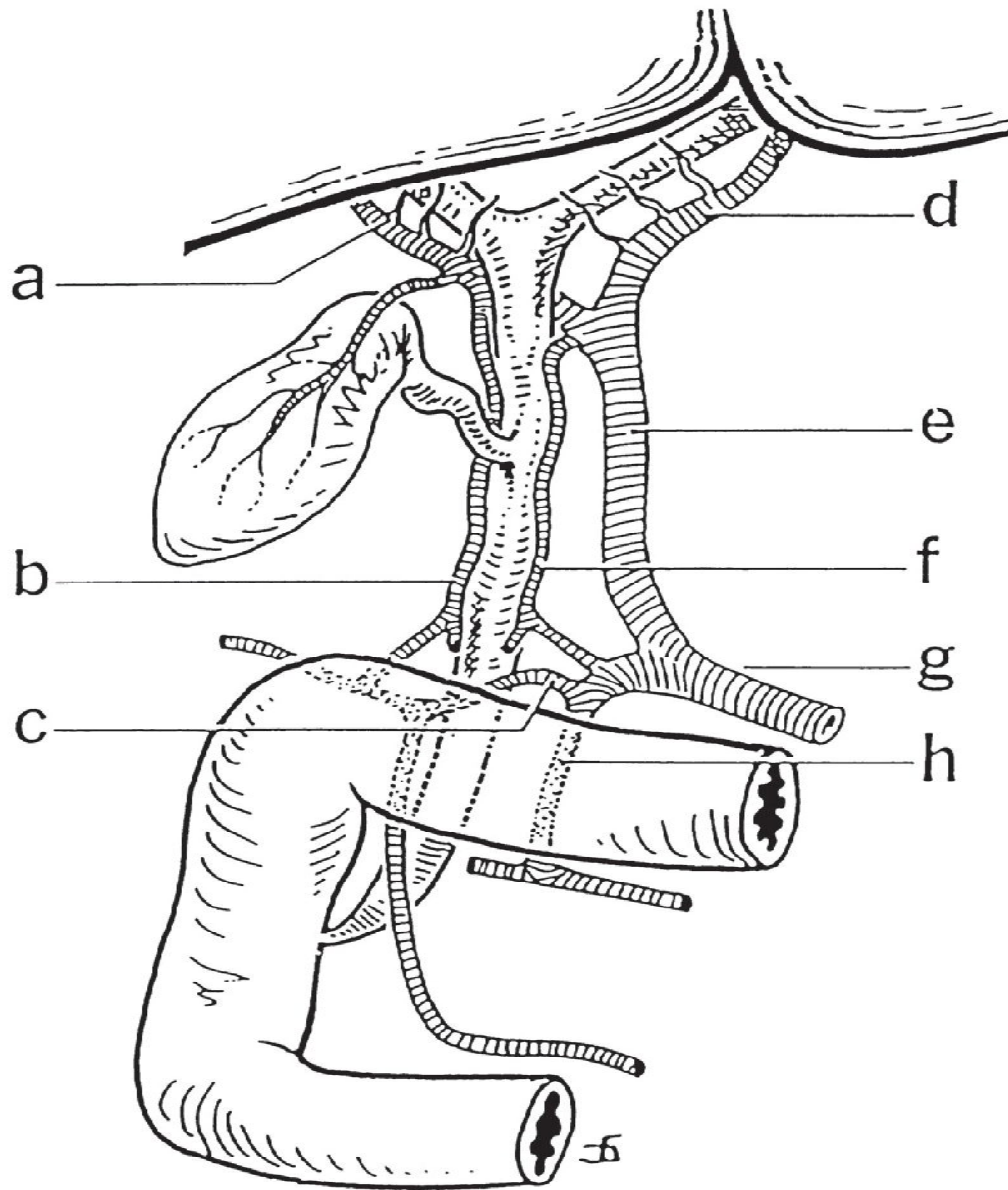


Figure 2.4 Blood supply to the extrahepatic bile ducts. (a) right hepatic artery, (b) 9 o'clock artery, (c) retroduodenal artery, (d) left hepatic artery, (e) hepatic artery, (f) 3 o'clock artery, (g) common hepatic artery, (h) gastroduodenal artery: PIERRE, E.C and LAILLIE, J (2014):

2.4 The pancreas

The pancreas is the largest digestive glands and performs a range of both endocrine and exocrine functions. The pancreas is salmon pink in color with

a firm, lobulated smooth surface. the pancreas divided into four parts :head, neck, body, and tail.(Standring et al. 2008).

The pancreas lies transversely in the retroperitoneal sac, between the duodenum on the right and the spleen on the left. It related to the omental bursa above, the transverse mesocolon anteriorly, and the greater sac below. For all practical purposes, the pancreas is a fixed organ. (Skandalaki. et al 2008).

The head of the pancreas lies to the right of the midline, anterior and to the right side of the vertebral column. (Standring et al. 2008) It flattened and has an anterior and posterior surface. The anterior surface is adjacent to pylorus and transverse colon. The posterior pancreaticoduodenal vascular arcade is a major entity on the posterior surface of the head. (Skandalaki. et al 2008).

The neck of the pancreas is only 0.2 cm wide, it links head and body. It is often the anterior portion of the gland. (Standring et al. 2008).

The body of the pancreas runs from the left side of the neck to the tail. It is the longest portion of the gland and becomes progressively thinner and less broad towards the tail. It is triangular in cross-section and described as having three surfaces: anterosuperior, posterior, and anteroinferior. (Standring et al. 2008).

The tail of the pancreas is the narrowest, most lateral portion of the gland and lies between the layers of the splenorenal ligament. It is continuous medially with the body and is between 1.5 and 3.5 cm long in adults. (Standring et al. 2008).

The exocrine pancreatic tissue drains into multiple small lobular ducts, which drain into a single main duct (Skandalaki. et al 2008).

The main pancreatic duct runs within the substances of the gland from left to right. It tends to lie towards the posterior more than anterior surface. The junction of several lobular ducts in the tail forms the main pancreatic duct. As it runs within the body it increases in caliber as it receives further lobular ducts, which join I t almost at right angles to the axis of the main

duct to form a 'herringbone pattern'. On ultrasound the duct can often be demonstrated, measuring 3 mm in diameter in the head, 2 mm in the body, and 1 mm in the tail in adults. As it reaches the neck of the gland it usually turns inferiorly and posteriorly towards the bile duct, which lies on its right side. These two ducts enter the wall of the descending part of the duodenum obliquely and unite in a short dilated hepatopancreatic ampulla (Standring et al. 2008).

2.4.1 Blood supply

The pancreas has rich arterial supply derived from the coeliac axis and superior mesenteric arteries via both named vessels and multiple small unnamed vessels. (Skandalaki. et al 2008)

2.4.1.1 Inferior pancreaticoduodenal artery

The inferior pancreaticoduodenal artery arises from the superior mesenteric artery or its first jejunal branch, near the superior border of the third part of the duodenum. (Skandalaki. et al 2008)

2.4.1.2 Superior pancreaticoduodenal artery

The superior pancreaticoduodenal artery is usually double. The anterior artery is a terminal branch of the gastroduodenal artery. It supplies branches to the head of the pancreas. The posterior artery is usually a separate branch of the gastroduodenal artery arising at the upper border of the first part of the duodenum. The posterior superior artery supplies branches to the head of the pancreas and the first and second parts of the duodenum. (Standring et al. 2008).

2.4.1.3 Venous drainage

The venous drainage of the pancreas is primarily into portal system. The head and neck drain primarily via superior and inferior pancreaticoduodenal veins. The body and tail drain mostly via small veins running directly into the splenic vein along the posterior aspect of the gland or occasionally directly into the portal vein. Small venous channels exist between the gland and the retroperitoneal veins, draining into the lumbar

veins and these may hypertrophy and become clinically significant in cases of portal hypertension. (Standring et al. 2008).

2.4.2 Lymphatic drainage

As the position of the pancreas might predict, lymphatic drainage is centrifugal to the surrounding nodes.

The lymphatic vessels of the pancreas arise in a rich, perilobular, and interanastomosing network. Channels course along the surface of the gland and in the interlobular spaces with the blood vessels. These lymphatic drains into five main collecting trunks and five lymph node groups: superior nodes, inferior nodes, anterior nodes, posterior nodes, and splenic nodes (Skandalaki. et al 2008).

2.5 Physiologic Anatomy of Biliary Secretion

Bile fulfils two major functions. It participates in the absorption of fat and forms the vehicle for excretion of cholesterol bilirubin , iron, and copper. Bile acids are the main active component of biliary secretion, then secreted into the duodenum, and efficiently reabsorbed from the terminal ileum by the portal venous system (Standring et al. 2008). Bile secreted in two stages by the liver: the initial portion secreted by the principal functional cells of the liver, hepatocytes; this initial secretion contains large amounts of bile acids, cholesterol, and other organic constituents. It secreted into minute bile canaliculi that originate between the hepatic cells. Next, the bile flows in the canaliculi toward the interlobular septa, where the canaliculi empty into terminal bile ducts and then into progressively larger ducts, finally reaching the hepatic duct and common bile duct. From these, either the bile empties directly into the duodenum or diverted through the cystic duct into the gallbladder, a second portion of liver secretion added to the initial bile. This additional secretion is a watery solution of sodium and bicarbonate ions secreted by epithelial cells that line the ductules and ducts. This second secretion sometimes increases the total quantity of bile by as much as an additional 100 percent. The second secretion stimulated especially by secretin, which causes release of additional quantities of bicarbonate ions to supplement the bicarbonate ions

in pancreatic secretion (for neutralizing acid that empties into the duodenum from the stomach (Skandalaki. et al 2008)

2.6 Pathology of the liver, biliary system, and pancreas

The liver and its companion: biliary ducts and gallbladder considered together because of their anatomic proximity, their interrelated functions, and the overlapping features of some of the diseases that affect these organs (Skandalaki. et al 2008).

The liver is vulnerable to a wide variety of metabolic, toxic, microbial, circulatory, and neoplastic insults. The dominant primary diseases of the liver are viral hepatitis, alcoholic liver disease, and hepatocellular carcinoma. More often, hepatic damage is secondary, to some of the most common diseases in humans, such as cardiac decompensation, disseminated cancer, and extrahepatic infections. (Kumar et al.2004)

2.6.1 The Liver

The liver is almost inevitably involved in blood-borne infections, whether systemic or arising within the abdomen. The foremost hepatic infections are viral in origin. Other infections in which the hepatic lesion is prominent include miliary tuberculosis, malaria, staphylococcal bacteremia, the salmonellosis, candida, and amebiasis (Skandalaki. et al 2008).

2.6.1.1 Viral hepatitis

The term viral hepatitis reserved for infection of the liver caused by a group of viruses having a particular affinity for the liver. Systemic viral infections that can involve the liver include

- (1) Infectious mononucleosis (Epstein-Barr virus), which may cause a mild hepatitis during the acute phase
- (2) Cytomegalovirus, which particularly found in the newborn or immunosuppressed patient.
- (3) Yellow fever, which considered as the major and serious cause of hepatitis in tropical countries. (Kumar et al.2004)

The radiological feature of viral hepatitis: The US finding in acute viral hepatitis includes "Starry-sky" appearance: Echogenicity of portal venous walls Hepatomegaly & periportal lucency edema (Federle, 2004).

The MR Findings in Viral hepatitis **are** increase in T1 & T2 relaxation times of liver. And in T2WI show High signal intensity bands paralleling portal Vessels (periportal edema). Alcoholic steatohepatitis (diffuse fatty infiltration), in T1WI while in-phase GRE image show Increased signal intensity of liver than spleen or muscle in T1WI out-of-phase GRE image Decreased signal intensity of liver (due to lipid in liver) (Federle, 2004).

2.6.1.2 Pyogenic Liver Abscesses

Liver abscesses result from parasitic infections, the parasitic liver abscesses or bacterial abscesses are more common, representing a complication of an infection elsewhere (Kumar et al.2004). Most common causes of pyogenic abscess are Diverticulitis, Ascending cholangitis Infection from infarcted tissue (e.g., post liver transplantation, necrotic tumor) (Federle, (2004).

The Simple pyogenic abscess chest x ray show Elevation of right hemidiaphragm & Right lower lobe atelectasis .the Plain x-ray abdomen show Hepatomegaly, intrahepatic gas, air-fluid level (Federle 2004).

The Simple pyogenic abscess demonstrated on non-enhanced CT as Well-defined, round, hypodense mass. Otherwise, in contrast enhanced CT demonstrated as sharply defined, round, hypodense mass with Rim- or capsule- and septal-enhancement and Right lower lobe atelectasis & pleural effusion (Federle, 2004)

The MR Findings of Simple pyogenic abscess in T1WI appear Hypointense, on T2WI appear as Hyperintense mass with high signal intensity on the perilesional edema, and In contrast enhanced T1 weighted image demonstrated as Hypointense mass. The MRCP is highly specific in detecting Obstructive biliary pathology the Leading cause of cholangitis ~ pyogenic abscess. (Federle 2004)

2.6.1.3 Liver cirrhosis

Chronic liver disease characterized by diffuse parenchymal necrosis with extensive fibrosis & regenerative nodule formation (Federle 2004).

The Classification of cirrhosis based on morphology, histopathology, & etiology as: Micronodular (Laennec) cirrhosis, Alcoholism Macronodular (postnecrotic) cirrhosis: Viral hepatitis & Mixed cirrhosis (Kumar et al 2004).

The MR Findings in liver cirrhosis include Siderotic regenerative nodules: Paramagnetic effect of iron within nodules. In T1WI: Hypointense, in T2WI: Increased conspicuity of low signal intensity T2 Gradient-echo & fast low-angle shot (FLASH) images markedly appear hypointense. (Federle 2004).

2.6.2 Intrahepatic biliary systems

2.6.2.1 Primary Biliary Cirrhosis

Primary biliary cirrhosis is a chronic, progressive, and often fatal cholestatic liver disease, characterized by the destruction of intrahepatic bile ducts, portal inflammation, and scarring, and the eventual development of cirrhosis and liver failure (Kumar et al .2004).

2.6.2.2 Secondary biliary cirrhosis

Prolonged obstruction of the extrahepatic biliary tree results in profound alteration of the liver itself. The most common cause of obstruction in adults is extra hepatic cholelithiasis followed by malignancies of the biliary tree or head of the pancreas (Kumar et al .2004).

2.6.2.3 Primary sclerosing cholangitis

Primary sclerosing cholangitis characterized by inflammation and obliterative fibrosis of intrahepatic and extrahepatic bile duct, with dilation of preserved segments. Primary sclerosing cholangitis commonly found in association with inflammatory bowel disease, particularly chronic ulcerative colitis (Kumar et al .2004).

2.6.2.4 Caroli disease

The larger ducts of the intrahepatic biliary duct are segmentally dilated and may contain inspissated bile. Pure forms are rare; this disease is usually associated with portal tract fibrosis of the congenital hepatic fibrosis (Kumar et al .2004).

The Radiographic Findings of caroli disease on the (ERCP) appear as: Saccular dilatations of IHBDs, stones, strictures also May show communicating hepatic abscesses. The non-enhanced CT show Multiple, rounded, hypodense areas inseparable from dilated IHBD and contrast enhanced CT show Enhancing tiny dots (portal radicles) within dilated IHBD.

On MR Caroli disease appear in T1 WI as Multiple, small, hypointense, saccular dilatations of IHBD, while in T2WI appear as Hyperintense and in T1 with contrast as Enhancement of portal radicles within dilated IHBD. the (MRCP) show Multiple hyperintense oval-shaped structures and Luminal contents of bile ducts appear hyperintense in contrast to portal vein, which appears as signal void (Federle 2004)

2.6.3extrahepatic biliary system

2.6.3.1 Cholelithiasis (gallstone)

There are two main types of gallstones. In the West, about 80% are cholesterol stones, containing more than 50% of crystalline cholesterol monohydrate. The remainder is composed predominantly of bilirubin calcium salts and is designated pigment stones (Kumar et al .2004).

2.6.3.2 Choledocholithiasis

Choledocholithiasis is stones or calculi Located in Intra- & extrahepatic bile ducts (more common in CBD). Its Size range Varies from 1-15 mm. Choledocholithiasis is the most frequent cause of biliary obstruction without ductal dilatation (Kumar et al .2004)

Choledocholithiasis Findings on non-enhanced CT show Attenuation of calculi varies from less than water density, through soft tissue, to dense

calcification," Bull's eye" sign: Rim of bile surrounding a stone within duct and thin meniscus of water density bile around stone posteriorly

The MR Findings on MRCP, Bile appear Very bright signal and Ductal stones appear as Decreased signal intensity foci. (Federle 2004).

2.6.3.3 Mirizzi syndrome

It is Partial or complete obstruction of common hepatic duct due to gallstone impacted in cystic duct or infundibulum of gallbladder Mirizzi syndrome appear on the ERCP as Extrinsic narrowing of common hepatic duct; dilated intrahepatic ducts; lack of GB filling defects. And on MRCP, demonstrated as dilated intrahepatic ducts, filling defect in common hepatic duct (Federle 2004).

2.6.3.4 Cholecystitis

Is Inflammation of gallbladder may be acute, chronic, or acute superimposed on chronic. The acute cholecystitis either calculous cholecystitis or non-calculous cholecystitis (Kumar et al .2004). The Radiographic Findings in ERCP: document common bile duct, (CBD) stones with associated cholangitis, and No filling of gallbladder. The non-enhanced CT shows Distended GB with Edematous pericholecystic fat with stranding & calcified gallstones the contrast enhanced CT show uncomplicated cholecystitis, GB wall thickening & increased mural enhancement (Federle 2004).

The MR Findings in T2WI as Distended GB with stones & High signal pericholecystic fat. In contrast enhanced T1 as "Rim sign" of increased hepatic enhancement in patient with gangrenous cholecystitis and Focal interruption of enhancement (Federle 2004).

2.6.3.5 Biliary atresia

Biliary atresia defined as a complete obstruction of lumen of the extrahepatic biliary tree within the first 3 months of life. It is the single most frequent cause of death from liver disease in early childhood (Kumar et al .2004)

2.6.3.6 Choledochal cysts

Choledochal cysts are congenital dilations of common bile duct, presenting most often in children before age 10 with the nonspecific symptoms of jaundice and/or recurrent abdominal pain that are typical of biliary colic. Choledochal cysts predispose to stone formation, stenosis and stricture, pancreatitis, and obstructive biliary complications within the liver. In elder patient, the risk of bile duct carcinoma elevated (Kumar et al .2004).

In Radiography of upper gastrointestinal series Choledochal cysts demonstrated as anterior displacement of second part of Duodenum & antrum, and inferior displacement of duodenum and Widening of duodenal sweep.

The ERCP Demonstrates all types of choledochal cysts such as Cystic or fusiform dilatation of common duct and also Shows mucosal diaphragm & aberrant insertion of CBD into pancreatic duct.

On MR in T1WI the Choledochal, cysts appear Hypointense, in T2WI as Hyperintense, and in MRCP the Bile appears hyperintense in contrast to portal vein (Federle 2004).

2.6.3.7 Carcinoma of the gallbladder

Carcinoma of the gallbladder slightly more common in women and occurs most frequently in the seventh decade of life. Gallstones present in 60% to 90% of cases. In Asia, where pyogenic and parasitic diseases of the biliary tree are common, the coexistence of gallstones is much lower. Presumably, gallbladders containing stones or infectious agents develop cancer because of irritative trauma and chronic inflammation (Kumar et al .2004).

2.6.3.8 Carcinomas of the extrahepatic biliary tree

Carcinomas of the extrahepatic biliary ducts, down to level of the ampulla of Vater, are uncommon tumors. They are extremely insidious tumors and generally produce painless, progressively deepening jaundice (Kumar et al .2004).

2.6.4 The pancreas

2.6.4.1 Pancreatitis

Pancreatitis encompasses a group of disorders characterized by inflammation of the pancreas. It may be acute or chronic. An acute pancreatitis is a group of reversible lesions characterized by inflammation of the pancreas ranging in severity from edema and fat necrosis to parenchymal necrosis with severe hemorrhage. (Kumar et al .2004) [20]

Chronic pancreatitis is characterized by inflammation of the pancreas with destruction of exocrine parenchyma, fibrosis, in the late stages, Although chronic pancreatitis may present as repeated bouts of acute pancreatitis, the chief distinction between acute and chronic pancreatitis is the irreversible impairment in pancreatic function that is characteristic of chronic pancreatitis(Kumar et al .2004)

2.6.4.2 Non-Neoplastic Cysts

A variety of cysts can arise in the pancreas. Most are non-neoplastic pseudocysts, but congenital cysts and neoplastic cystic tumors also occur. In general, unilocular cysts tend to be benign, while multilocular cysts are more often neoplastic and possibly malignant (Kumar et al .2004)

2.6.4.3 Cystic Neoplasm

Cystic neoplasm makes up fewer than 5% of all pancreatic neoplasm. While some, such as the serous cystadenoma, are entirely benign, others, such as mucinous cystic neoplasm, can be benign, borderline malignant, or malignant. (Kumar et al .2004)

2.7 MRCP technique

MR imaging uses a powerful magnetic field, radio waves, and a computer to produce detailed pictures of organs, soft tissues, bone, and virtually all other internal body structures.

The Contraindications of MRI abdomen are Patients with cardiac pacemakers, or neuro-stimulators cannot have MRI. Additionally Patients

with pins, plates, screws, and joint replacements can have an MRI as long as it has been 6 weeks since placement of the device. Patients with stents and filters can have an MRI as long as it has been at least 6-8 weeks since placement of the device. (Dahlstrom. 2009).

MRCP Originally described in 1991, takes advantage of the inherent contrast-related properties of fluid in the biliary and pancreatic ducts. (Fulcher. 1999).

The basic principle underlying MRCP is that Images of fluid-containing organs could obtain using MR imaging sequences based on the long T2 relaxation time of static fluids. On heavily T2-weighted, images (echo times longer than 150 ms), these fluids exhibit high signal intensity, and where as the signal of surrounding body organs and tissues markedly suppressed (Maccioni et al 2010) Since a large component of residual background signal in the abdomen arises from fat, magnetic resonance techniques that allow the selective suppression of fat can substantially reduce the background signal. Sanyal. et al (2012). Contrast agents are not strictly necessary to obtain MRCP images. However, negative oral contrast agents (so called “super paramagnetic” agents) usefully employed to reduce the brightness of the gastric and intestinal fluids, in order to enhance the evidence and brightness of the biliary tree and pancreatic ducts. Sanyal et al (2012)

Heavily T2-weighted images originally achieved using a gradient-echo (GRE) balanced steady-state free precession technique. A fast spin-echo (FSE) pulse sequence with long echo time (TE) then introduced shortly after. With the advantages of relatively high spatial resolution, a higher signal-to-noise ratio and contrast-to-noise ratio, and therefore, lower sensitivity to motion and susceptibility artifacts. Limitations of SSFSE techniques include image blurring induced by long ETLs, flow artifacts within the biliary tree that can occasionally simulate stones or masses Alexande et al.

Modified FSE sequences had been describe, including rapid acquisition with rapid enhancement (RARE), half-Fourier acquisition single-shot turbo

spin-echo (HASTE) and fast-recovery fast spin-echo (FRFSE) sequences. Both breath-hold (using a single shot approach) and non-breath-hold techniques (with respiratory triggering) had been used, with images obtained as either a two-dimensional (2D) or three-dimensional (3D) acquisition. Alexande et al [1]. A 3D technique provides a higher signal to noise ratio, which traded off for thinner contiguous slices. Acquiring images with near isotropic voxels allows improved post-processing manipulation of the images with multi-planar reconstruction, maximum intensity projection (MIP) and volume rendering. (Maccioni et al. 2010)

To ensure that the gall bladder, Hepato-biliary and pancreatic ducts filled with fluid and at their maximum distension, the patient would need to fast. It is recommended that the patient be nil per oral for at least four hours prior to commencing the examination. Throughout this period, the patient is permitted to drink clear fluids only (namely water), and routine medication is allowed as per normal. (Mandarano et al. 2008)

Mitchell (2007) as cited by Mandarano (2008) concurs that suspended expiration is more consistent, and provides less motion variation, whereas full inspiration reserved for situations where the lung diaphragm needs to be in more inferior position. It is imperative that the patient understands their role and that their co-operation and active participation is needed to ensure overall diagnostic success. If the breath hold technique is not adequate, then the CBD and the main pancreatic duct may not appear to unite or may appear either stenotic or dilated. (Mandarano et al. 2008)

The Coronal T2-weighted images are thin collimation images (3-5 mm), and then processed to obtain a MIP (maximum intensity projection) image, which is a chole-angiogram like image. Otherwise a coronal thick slab (30 to 50 mm) obtained, to produce the same effect in a very short time (<5 seconds). Usually both imaging technique are associated and reviewed, to achieve the higher accuracy. Sanyal et al (2012).

2.7.1 Three Planes Localizer

Performed at the beginning of the MRCP exam, obtained in three plans (coronal, sagittal, and transverse). This sequence provides low spatial resolution images demonstrating anatomy for orientation purposes.

2.7.2 Axial 2D SSFSE:

The purpose of this sequence is obtain images of the hepatic ducts, biliary tree, and pancreatic duct in the transverse plane. Fat suppression improves conspicuity of solid lesions and minimizes phase ghosting artifacts from subcutaneous and intraperitoneal fat. Westbrook et al (2005). The first prescribed slice figure (2.5) should be almost at the most superior aspect of the liver to ensure that the majority of the right and left hepatic ducts are captured. The inferior prescribed slice should be located into the lumen of the duodenum to ensure that the sphincter of Oddi captured as well as any variation in the location of the union of the pancreatic duct. (Mandarano et al. 2008)

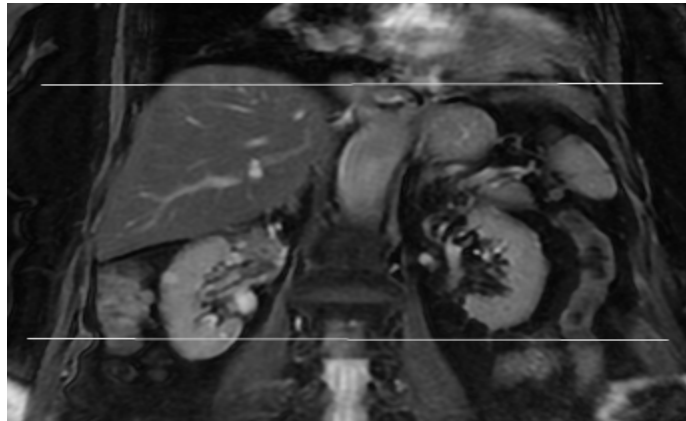


Figure 2.5: Scanning range prescription for the axial 2D SSFSE Fat Suppressed series, Mandarano et al (2008).

2.7.3 Coronal 2D SSFSE (Fat Suppressed).

The reasons for performing this sequence are exactly the same as for the axial series, but another view of the relevant anatomy obtained. In particular, this plane is useful in adding assessment value of the condition of the CBD, cystic duct, hepatic ducts and the gallbladder; with pathology affecting the ampulla of Vater particularly well noted. The scanning range (figure 2.6) should have the prescribed slices commencing within the

lumen of the duodenum (to visualize any biliary fluid passing through the sphincter of Oddi) and ending at almost the most anterior surface of the liver (to ensure that the intra hepatic ducts are included).

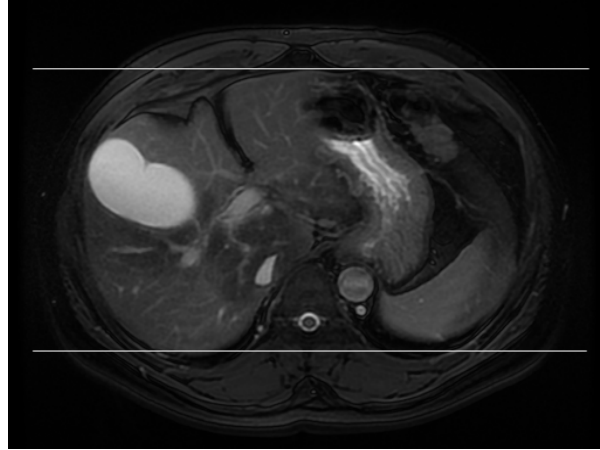


Figure 2.6 Scanning range prescription for the Coronal 2D SSFSE Fat Suppressed Sequence in: The diagnostic MRCP examination: Mandarano et al (2008).

2.7.4 Coronal Oblique three Slabs MRCP:

The underlying concept is to image fluid within the ducts. And suppressing signal from non-fluid structures. The main aim of this classic MRCP sequence is to demonstrate ductal fluid as hyperintense. While filling defects, such as those caused by stones, displayed as hypointense. From axial 2D SSFSE images obtain three specific images aimed at the CBD, cystic duct and the pancreatic duct. The first slice straight through the CBD in a coronal fashion the second slice is prescribed parallel to the cystic duct. The third slice needs to prescribe parallel through the pancreatic duct along the head of pancreas, as depicted in figure 2.7 a. b c respectively.



Figure 2.7.a: the First slice prescribed coronal, directly through the CBD. Mandarano et al. 2008

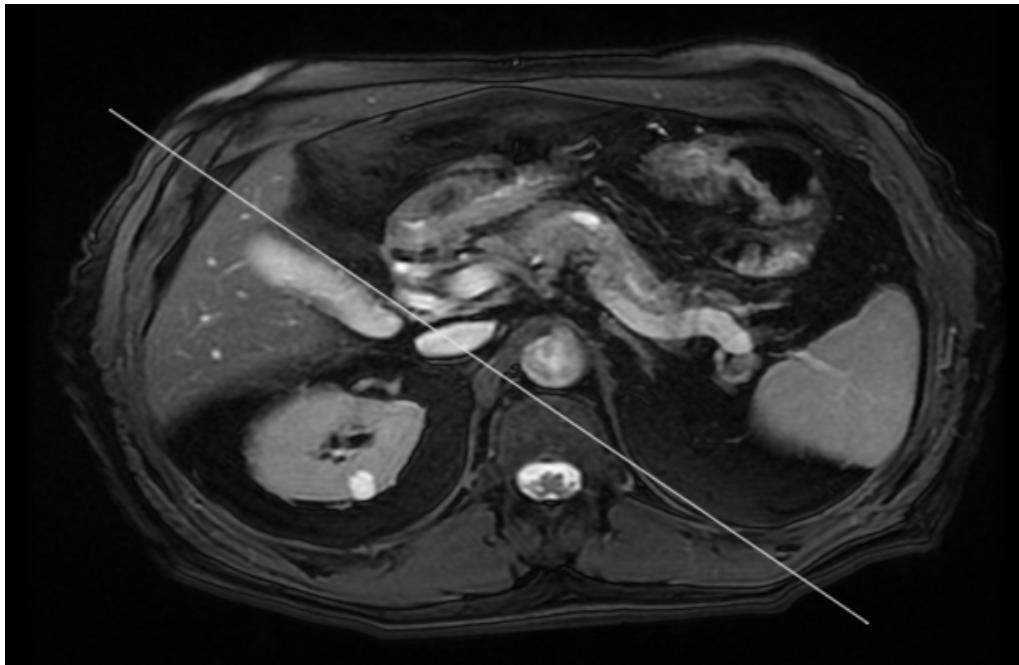


Figure 2.7 b indicates the second prescribed slice parallel to the cystic duct. Mandarano et al. 2008

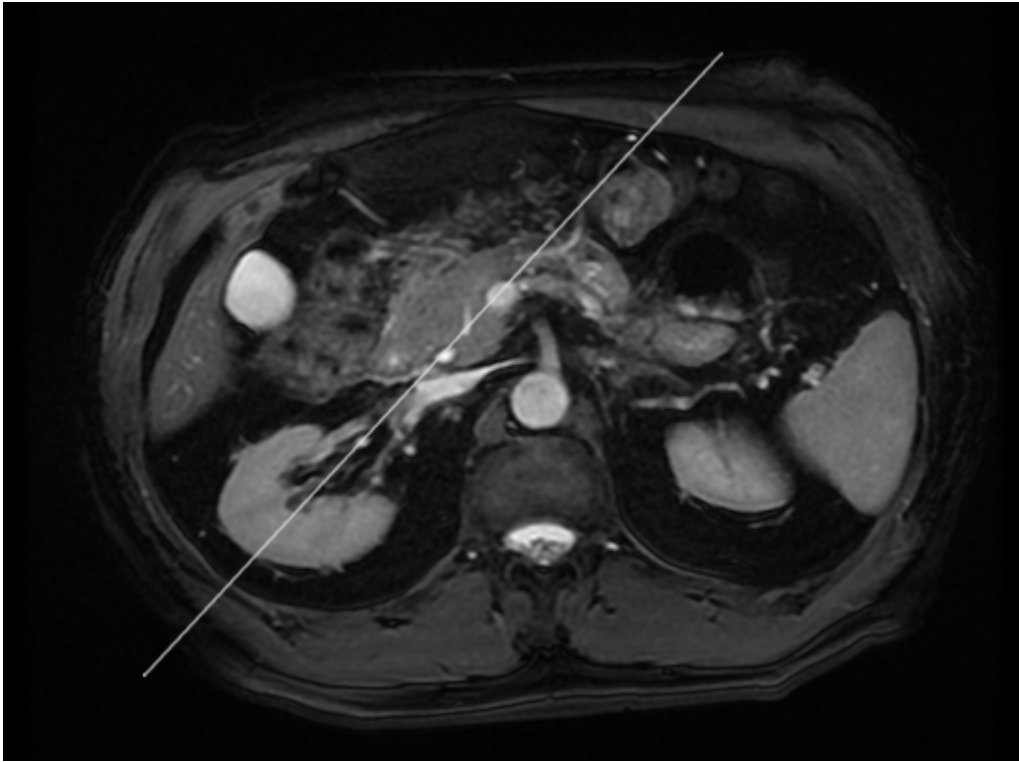


Figure 2.7 c: indicates how the third slice prescribed parallel to the main pancreatic duct through the head of pancreas, Mandarano et al. 2008

2.7.5 Para Coronal 3D MCRP Respiratory Triggered:

This is also a heavily T2-weighted sequence, but acquired as a 3D volume. The main purpose of this approach is to capture a 3D perspective of the biliary tree, and with appropriate software, permit the observer to rotate the volume representation of the biliary tree in order to view its intricacies from practically limitless angles provides thin, contiguous slices. This volume positioned to capture the entire biliary tree. The Para-coronal angle used would be identical to that mentioned in the Coronal Oblique 3D Slab MRCP sequence. The volume centered to and along the cystic duct, and the volume expanded to include the entire components comprising the biliary tree, (Figure 2. 8). It is important to include saturation pulses immediately adjacent to all boundaries of the imaging volume in order to minimize artifacts originating from both

respiratory and physiological motion from degrading the data within the imaging volume. (Mandarano et al. 2008)

These source images suitable for further analysis, especially reformatting algorithms such as maximum intensity projection (MIP) and shaded surface display. The frontal MIP reconstruction produces projection images of Pancreaticobiliary ductal system that resemble those obtained from direct cholangiopancreatography. Furthermore, the data set can be reconstructed in multiple angles (from anteroposterior to lateral views), allowing separation of pertinent structures from overlapping fluid-containing organs. (Soto et al 1995)

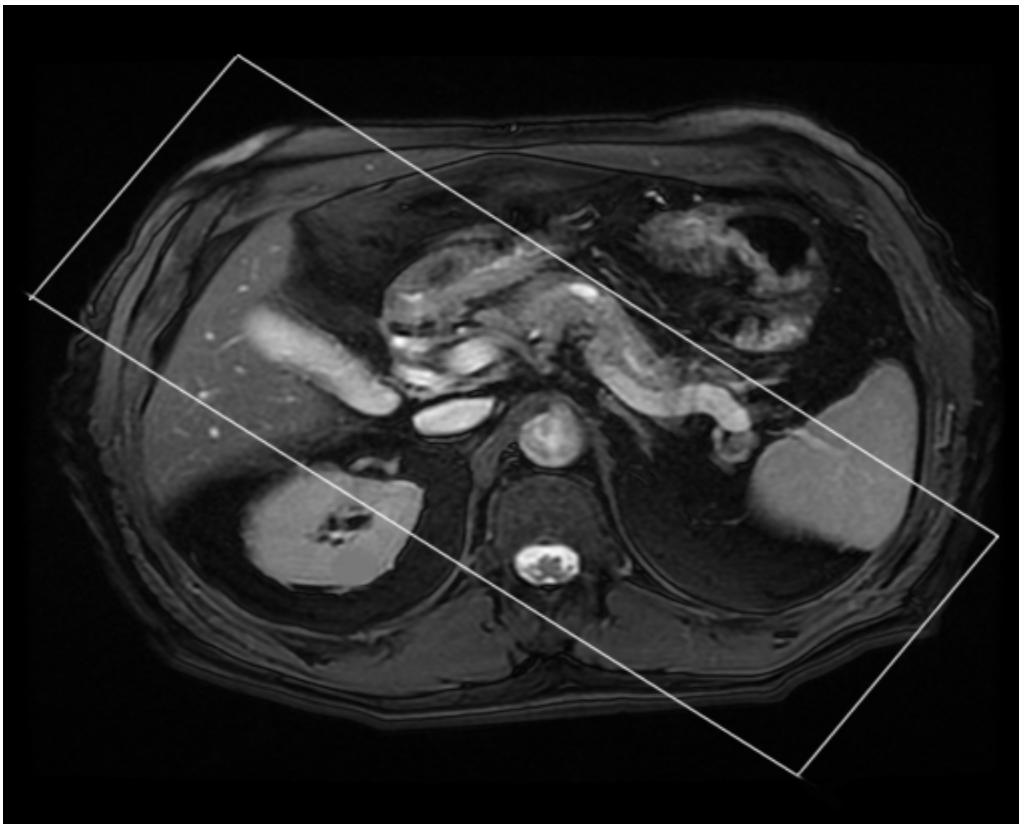


Figure 2.8 Volume prescription for the Para-coronal 3D MRCP Respiratory Triggered sequence. Mandarano et al (2008).

2.7.6 Dynamic Coronal MRCP

Offers added possibility of a functional study, during the intravenous administration of secretin, which physiologically stimulates the exocrine

pancreas. The secretin rapidly increases the production of pancreatic fluids, thus increasing the duct size and producing an excellent display of the entire pancreatic ductal system (main and secondary ducts). Moreover, by acquiring consecutive MRCP images every 10 seconds from time 0 to 10 minutes after secretin I.V injection. (0.2 mcg/kg of body weight), it stimulates pancreatic fluid secretion and simultaneously increases the Oddi sphincter tone for a few minutes, thus producing a mild dilation of the main and secondary ducts. It is possible to evaluate the total amount of increased duodenal fluid, which is a reliable index of the exocrine pancreatic function. In a second phase, the Oddi sphincter relaxes, the pancreatic fluid passes in the duodenal lumen; by quantifying the amount of pancreatic fluids in the duodenum, it is directly assess the pancreatic exocrine function, the so-called cholangiopancreatography quantification (MRCPQ) (Sanyal et al. 2012).

There is an increasing interest in the use of hepatobiliary contrast agents, such. These agents are hepatocyte-selective T1 weighted MR agents that are administered intravenously and excreted primarily through the biliary system. (Sanyal et al. 2012). The direct visualization of the biliary tree starts after 20 to 100 minutes following injection, according to the different agent, and lasts for 1-2 hours. The use of these contrast agents should provide both anatomic information and functional (Sanyal et al. 2012)

on the other hand, Tschirch et al (2005) as cited by Hyodo et al (2012) reported that EOB-MRC was sufficient for anatomical visualization of the biliary tree in 40% of patients with liver cirrhosis, and in 100% of adult individuals with normal liver function.

The utilization of contrast enhanced -MRC using Gd-EOB-DTPA and the 3D GRE technique is a robust tool that displays the biliary anatomy and provides functional information about physiological or pathological biliary flow. The added diagnostic properties make it invaluable in the accurate detection of bile leaks and cysto-biliary communication (Fulcher et al. 1999)

2.7.7 Previous studies

Several researches try to determine biliary ductal diameter and ageing effect. Robert et al (2000). The goals of this prospective study were first to determine if a significant change occurs in the diameter of the CBD with aging, in particular after the age of 60 year, and second, if a significant change in duct diameter does occur, to determine what the normal size of the common duct is in this patient population. the result, that the adding 1 mm per decade after the age of 60 years to the upper range of duct size in determining a normal diameter.

Furthermore Bachar et al (2003) report in a sonographic study the age-dependent change in the diameter of the extrahepatic bile duct. Moreover, suggest that the upper normal limit of the duct in elderly persons be set at 8.5 mm.

Horrow et al (2010) reviews the history and ongoing issues regarding sonography of the normal-size duct and a variety of factors that may affect its size, including age, prior surgery, congenital abnormalities, anatomical variations, and medications. Other related sonographic issues discussed including abnormal nondilated ducts and abnormal intraluminal contents such as sludge or air that make evaluation of the duct more difficult but their Findings were not able to help confirm an association between age and size of the extrahepatic bile duct in an asymptomatic adult population.

Majeed (1999) studied the verification of common bile duct dilatation after cholecystectomy. The diameter of the common duct does not change significantly after cholecystectomy. Increase in diameter beyond 6 mm ultrasonography should therefore consider an for further imaging of the common duct.

Park et al. (2012) clarified that The CBD dilated slightly from 4.1 mm at baseline to 5.1 mm at 6 months and 6.1 mm at 12 months after cholecystectomy. Seven cases at 6 months and 5 cases at 12 months showed bile duct dilation of more than 3 mm compared to baseline. There were no cases having bile duct dilation of more than 10 mm. therefore, Post cholecystectomy dilatation of the bile duct occurred slightly in most cases.

Nevertheless, some cases showed more than 3 mm dilatation over baseline. Asymptomatic bile duct dilatation of up to 10 mm considered as normal range in patients after cholecystectomy.

Hung et al (2011) compared the diameters of proximal and distal common bile duct CBD using MRCP and found that the proximal part is significantly larger than the distal part in both normal and disease groups. Therefore measuring only the distal segments of CBD may underestimate the degree of obstruction in addition the CBD diameters in both proximal and distal segments correlated significantly with patients' age. On the other hand, CBD diameters significantly not affect by patients' sex.

Chen et al. (2012) explained that the mean CBD diameter for an asymptomatic Taiwanese adult is 4.6 mm, with an upper limit of 10.49 mm. CBD diameters are significantly different in patients both younger and older than 65 years of age. It only significantly correlated with age and not significantly related to gender, serum glucose level, cholesterol level, hepatitis status, and PVD.

Nuray et al. (2009) statistically there was almost perfect agreement between 2 observers ($p < 0.001$, interclass correlation coefficient = 0.93). The mean value was 87.87 ± 22.92 degrees for the 1st observer (range 51-155 degrees) and 85.40 ± 25.80 degrees for the 2nd observer (range 45-166 degrees). No statistically significant correlation found between biliary confluence angle and age, gender or body mass index. The lower and upper bounds of 95% confidence interval for mean were 80.54-95.20 degrees for the 1st observer and 77.14-93.65 degrees for the 2nd observer. Reported in their research that the Normal biliary confluence angle is independent of age, gender, and body mass index.

Chapter Three

Material and methods

Chapter Three

Material and methods

3.1material

A hundred fifty six patients referred to MRI department in Suliman fakeeh hospital from March 2011 up to May 2013, with different Hepato panceratobiliary disorder for evaluation with MRCP. All patients examined using MRI 1.5 Tesla Siemens 2010, SSFSE protocol using coronal oblique image applied where the angle measured the result show that the most common MRCP finds noted as: distended gallbladder gallstone, cholecystitis, cholecystectomy, liver cirrhosis, hepatomegaly, hepatic lesion, pancreatitis, and pancreatic lesion.

The patient lies supine with supper conductive coil over the liver to increase magnetic field homogeneity , a conventional liver examination performed before 2D MRCP. The 2D MRC done for the patient without use of contrast media, steady state free precession image used with high contrast in several breath hold. The 2D single shot fast spin echo SSFSE coronal oblique applied for all patient with TR 4500 ms, TE 752ms, flip angle 180, FOV 83cm. All image performed at the end of full expiration.

Two Presaturation bands placed above and below the imaging volume to suppress the signal from incoming blood and undesired signals arising from imperfect 180° refocusing RF pulses outside the imaging volume.

The quality of Breath-hold assessed immediately on a coronal maximum intensity projection after image reconstruction. On the raw transverse sections or on a transverse maximum intensity projection image, the presence of bile fluid ghosting along the plane of phase-encoding direction over the liver was indicative of inadequate breath holding and was used as the main criterion for repeat acquisition of the same image.

Included criteria: patient with normal hepatobiliary finds hepatitis, liver cirrhosis, hepatomegaly, cholelithiasis, cholecystitis, Mirizzi syndrome and

distended gallbladder; with no evidence of biliary obstruction, aneurism, biliary stent, or biliary leakage were included in the study.

Excluded criteria all patients had obstructive biliary disease, biliary cirrhosis, sclerosing cholangitis, caroli disease, and biliary atresia were excluded from the study

Data sample categorized according to diameter of intrahepatic biliary duct into normal (not dilated) and dilated group. The normal group includes 137 patients as 76 male and 61 female and the dilated group include 28 patients as 10 male and 18 female.

Both normal and dilated group subdivided according to their Hepato pancreato biliary finds to normal, distended gallbladder, gallstone, cholecystitis cholecystectomy, Mirizzi syndrome, hepatomegaly, pancreatic lesion, and pancreatitis.

Additionally normal group categorized according to their nationality to Saudi, Egyptian, Sudanese, Indian, Yemeni and other nationalities

The dilated group categorized according to their nationality in to Saudi and non Saudi

Both normal and dilated data sample correlated with age, weight, height, and body mass index BMI which equal the square of height divided by weight

The biliary confluence in the classical junction measured by syngo imaging XS- DICOM tools (angle measurement) by drawing line within the biliary confluence run parallel to Rt hepatic duct , from that reference point draw another line runs parallel to Lt hepatic duct the angle created between these two line consider as biliary confluence angle. The angle measured in three successive coronal oblique then take the means of these values.

Chapter Four

Table and figure

Chapter four

Table and figure

First: Normal biliary (no dilated biliary dcuts):

Table (1): Distribution of the study sample according to (Gender)

Gender	Frequency	Percent
Male	76	55.5%
Female	61	44.5%
Total	137	100.0%

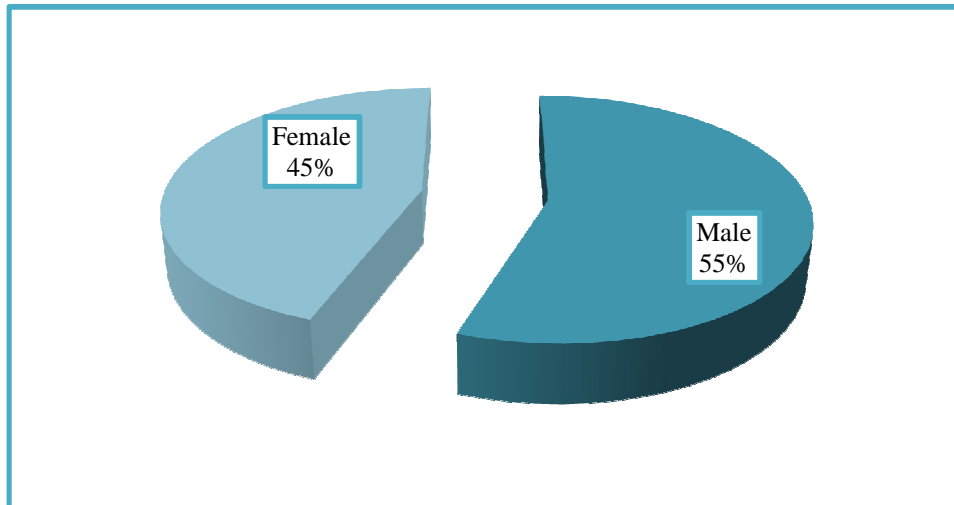


Figure (1): Distribution of the study sample according to (Gender)

Table (2): Distribution of the study sample according to (Nationality)

Nationality	Frequency	Percent
Egyptian	12	8.8%
Indian	5	3.6%
Saudi	89	65.0%
Sudanese	6	4.4%
Yemeni	8	5.8%
Others	17	12.4%
Total	137	100.0%

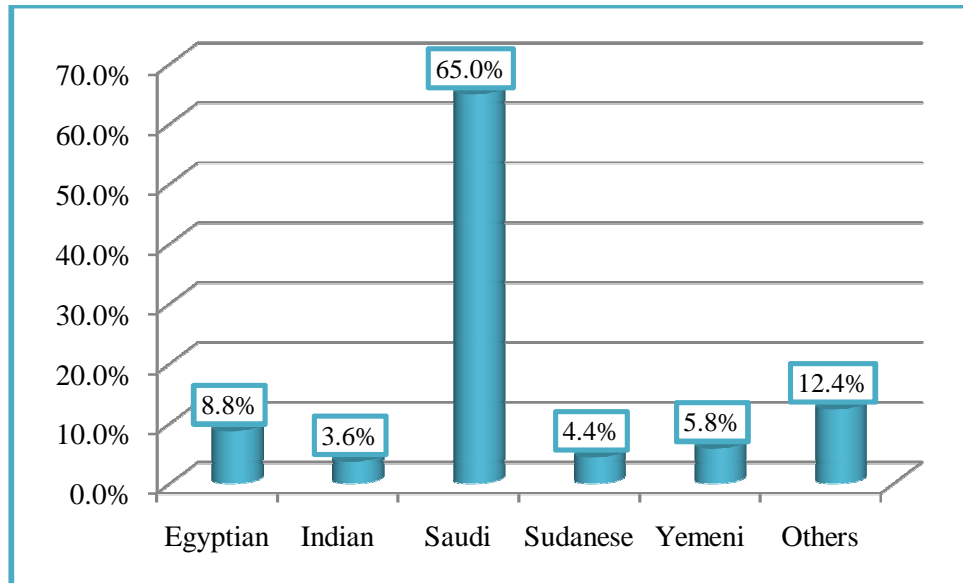


Figure (2): Distribution of the study sample according to (Nationality)

Table (3): Distribution of the study sample according to (Diagnosis)

Diagnosis	Frequency	Percent
Normal biliary tree normal finding	40	29.2%
Normal Biliary /cholecystectomy	5	3.6%
Normal biliary /cholecystitis	6	4.4%
Normal biliary / liver cirrhosis	2	1.5%
Normal biliary /distended gall bladder	6	4.4%
Normal biliary / finding / hepatomegaly	8	5.8%
Normal biliary /Mirizzi syndrome	1	0.7%
Normal biliary /pancreatic lesion	6	4.4%
Normal biliary pancreatitis	9	6.6%
Normal biliary /finding /gall stone	54	39.4%
Total	137	100.0%

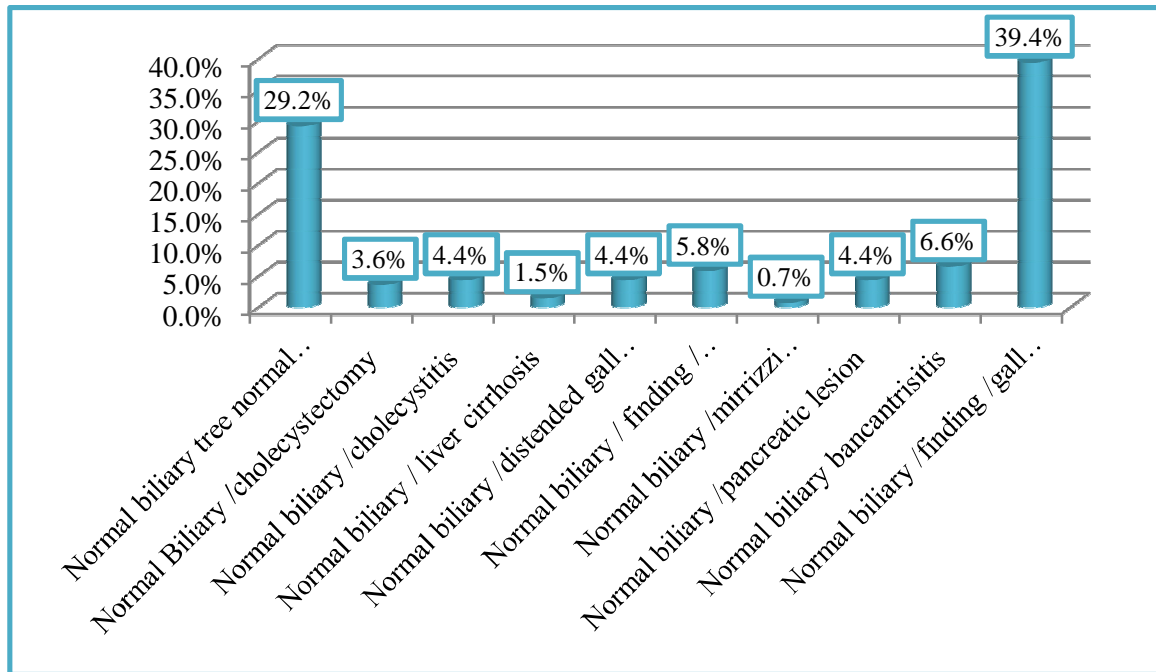


Figure (3): Distribution of the study sample according to (Diagnosis)

Table (4): Descriptive Statistics

Descriptive Statistics	Mean \pm S D	Minimum	Maximum
BMI	78.3 \pm 15.2	20.0	157.0
Age	45.5 \pm 16.9	13.0	90.0
Weight	78.3 \pm 15.2	20.0	157.0
Height	164.4 \pm 8.1	132.0	185.0
Biliary angle	83.4 \pm 23.5	36.4	155.6

Table (5): Biliary angle & Gender

Gender	Mean \pm S D	Maximum	Minimum	P-value
Male	80.1 \pm 21.2	142.2	36.4	0.071
Female	87.4 \pm 25.7	155.6	38.1	
Total	83.4 \pm 23.5	155.6	36.4	

Table (6): Biliary angle & Diagnosis

Diagnosis	Mean \pm S D	Maximum	Minimum	P-value
Normal biliary tree normal finding	85.6 \pm 24.3	155.6	41.4	0.163
Normal Biliary /cholecystectomy	81.1 \pm 18.6	98.0	52.4	
Normal biliary /cholecystitis	97.0 \pm 11.6	111.3	80.6	
Normal biliary / liver cirrhosis	60.3 \pm 20.0	74.4	46.1	
Normal biliary /distended gall bladder	76.4 \pm 25.8	101.7	36.4	
Normal biliary / finding / hepatomegaly	96.6 \pm 26.6	142.2	61.7	
Normal biliary /Mirizzi syndrome	103.9 \pm 0.0	103.9	103.9	
Normal biliary /pancreatic lesion	63.8 \pm 16.6	95.4	52.4	
Normal biliary pancreatitis	77.7 \pm 17.4	100.7	44.5	
Normal biliary /finding /gall stone	82.8 \pm 24.0	115.8	36.4	
Total	83.4 \pm 23.5	155.6	36.4	

Table (7): Biliary angle & Nationality

Nationality	Mean \pm S D	Maximum	Minimum	P-value
Egyptian	79.8 \pm 32.7	142.2	46.1	0.958
Indian	75.3 \pm 30.1	108.2	52.4	
Saudi	83.7 \pm 21.8	130.4	36.4	
Sudanese	85.5 \pm 40.6	155.6	47.6	
Yemeni	83.7 \pm 25.9	118.6	56.3	
Others	85.6 \pm 16.7	115.8	59.2	
Total	83.4 \pm 23.5	155.6	36.4	

Table (8): Biliary angle between (BMI, Age, Weight and Height)

Biliary angle	BMI	Age	Weight	Height
Correlation Coefficient	-0.041	-0.193	-0.041	0.041
P-value	0.632	0.024*	0.632	0.632

* The correlation will be Significant at P-value < 0.05.

Table (9): Regression Analysis of Biliary angle & Age

Model	B	95.0% Confidence Interval for B	
		Lower Bound	Upper Bound
(Constant)	95.601	84.285	106.917
Age	-0.269	-0.502	-0.036

Equation:

$$\text{Biliary angle} = 95.6 - 0.269 \text{ Age}$$

$$\text{Determination Coefficient } (R^2) = 3.7\%$$

Interpretation:

(95.6) is mean Biliary angle when (age = 0 year), and the mean of Biliary angle decrease by (0.269) when the age increase by one year.

The determination coefficient means the (3.7%) variation occurs in biliary angle from the age.

Second: dilated biliary

Table (10): Distribution of the study sample according to (Gender)

Gender	Frequency	Percent
Male	10	35.7%
Female	18	64.3%
Total	28	100.0%

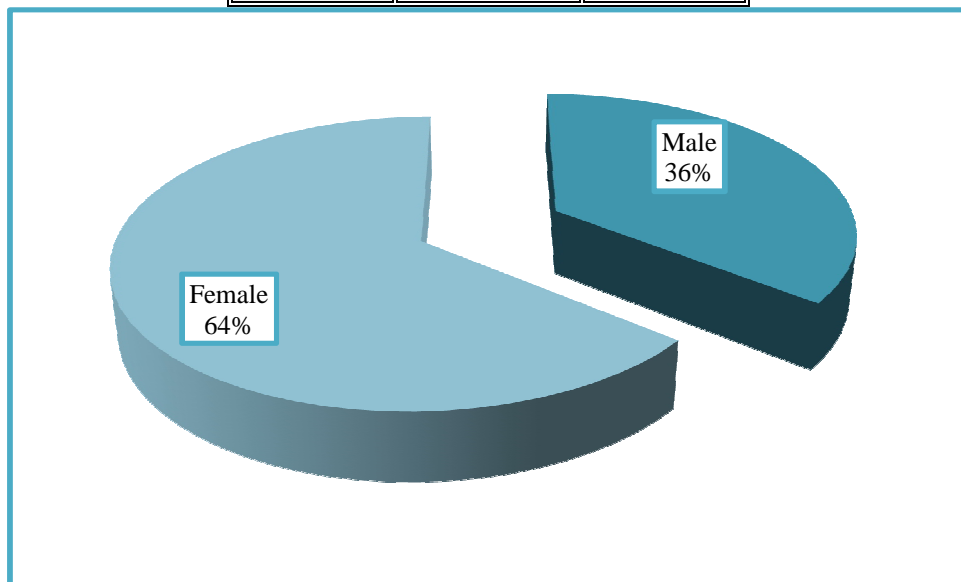


Figure (10): Distribution of the study sample according to (Gender)

Table (11): Distribution of the study sample according to (Diagnosis)

Diagnosis	Frequency	Percent
Biliary dilatation / cholecystectomy	5	17.9%
Dilated biliary normal find	9	32.1%
Biliary dilatation /distended gall bladder	4	14.3%
Biliary dilatation / gall stone	10	35.7%
Total	28	100.0%

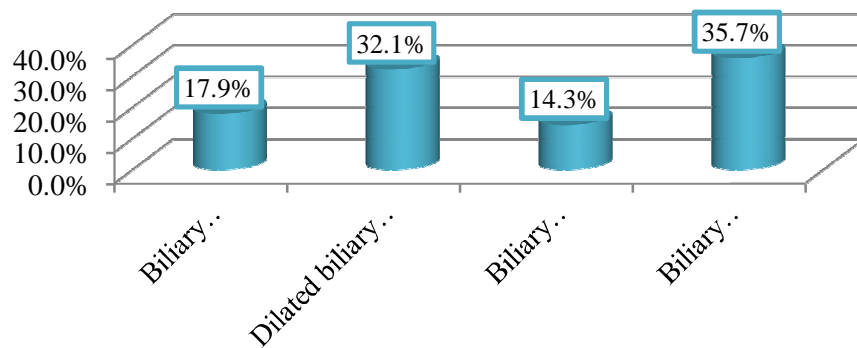


Figure (11): Distribution of the study sample according to (Diagnosis)

Table (12): Distribution of the study sample according to (Nationality)

Nationality	Frequency	Percent
Saudi	20	71.4%
Non Saudi	8	28.6%
Total	28	100.0%

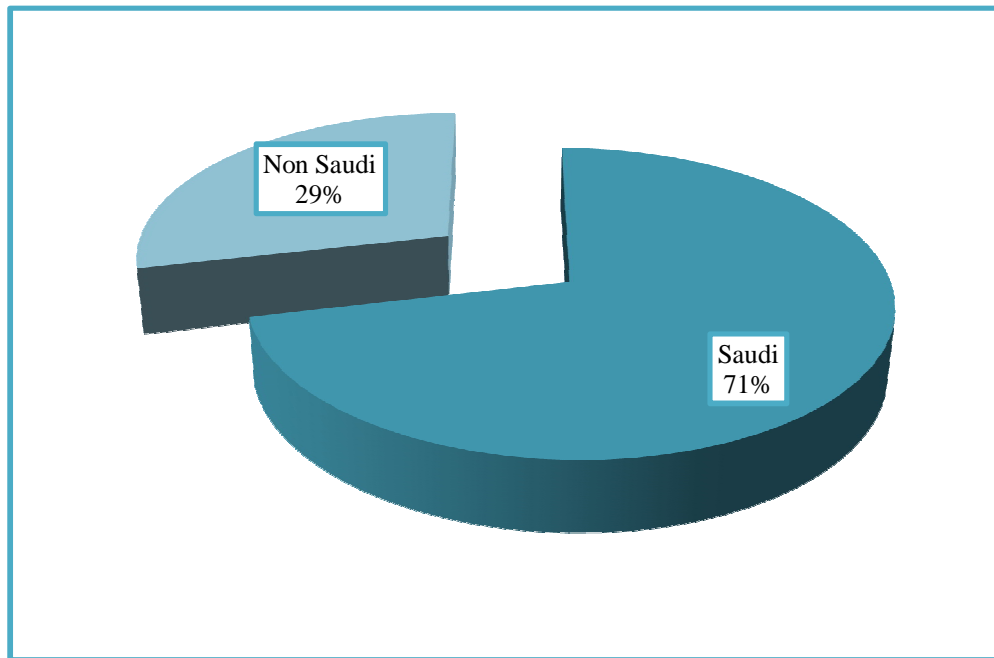


Figure (12): Distribution of the study sample according to (Nationality)

Table (13): Descriptive Statistics

Descriptive Statistics	Mean \pm S D	Minimum	Maximum
BMI	60.8 \pm 18.4	22.0	97.0
Age	55.9 \pm 21.8	12.0	89.0
Weight	60.8 \pm 18.4	22.0	97.0
Height	154.9 \pm 10.3	128.0	171.0
Biliary angle	79.1 \pm 20.2	38.8	134.8

Table (14): Biliary angle & Gender

Gender	Mean \pm S D	Maximum	Minimum	P-value
Male	78.0 \pm 15.4	105.7	63.8	0.830
Female	79.7 \pm 22.8	134.8	38.8	
Total	79.1 \pm 20.2	134.8	38.8	

Table (15): Biliary angle & Diagnosis

Diagnosis	Mean \pm S D	Maximum	Minimum	P-value
Biliary dilatation / cholecystectomy	85.2 \pm 28.1	134.8	65.5	0.460
Dilated biliary normal find	75.0 \pm 22.7	104.8	38.8	
Biliary dilatation /distended gall bladder	67.9 \pm 15.5	88.5	55.5	
Biliary dilatation / gall stone	84.2 \pm 14.5	108.9	65.0	
Total	79.1 \pm 20.2	134.8	38.8	

Table (16): Biliary angle & Nationality

Nationality	Mean \pm S D	Maximum	Minimum	P-value
Saudi	79.4 \pm 21.7	134.8	38.8	0.913
Non Saudi	78.4 \pm 16.9	108.9	65.0	
Total	79.1 \pm 20.2	134.8	38.8	

Table (17): correlation between Biliary angle (BMI, Age, Weight, and Height)

Biliary angle	BMI	Age	Weight	Height
Correlation Coefficient	-0.140	-0.216	-0.140	0.156
P-value	0.477	0.270	0.477	0.429

Comparison between Normal (not dilated) & dilated

Table (18) Comparison between Normal & dilated (Biliary angle)

Type	N	Mean \pm S D	P-value
Normal	137.0	83.4 \pm 23.5	0.376
Disease	28.0	79.1 \pm 20.2	

Table (19) Normal biliary tree normal finding & dilated biliary normal find

Diagnosis	N	Mean \pm S D	P-value
Normal biliary tree normal finding	40.0	85.6 \pm 24.3	0.241
Dilated biliary normal find	9.0	75.0 \pm 22.7	

Table (20) Normal Biliary /cholecystectomy & dilated biliary /cholecystectomy

Diagnosis	N	Mean \pm S D	P-value
Normal Biliary /cholecystectomy	5.0	81.1 \pm 18.6	0.796
Biliary dilatation /cholecystectomy	5.0	85.2 \pm 28.1	

Table (21) Normal biliary /distended gall bladder & biliary dilatation /distended gall bladder

Diagnosis	N	Mean \pm S D	P-value
Normal biliary /distended gall bladder	6.0	76.4 \pm 25.8	0.572
Biliary dilatation /distended gall bladder	4.0	67.9 \pm 15.5	

Table (22) Normal biliary /finding /gall stone & biliary dilatation / gall stone

Diagnosis	N	Mean \pm S D	P-value
Normal biliary /finding /gall stone	54.0	82.8 \pm 24.0	0.854
Biliary dilatation / gall stone	10.0	84.2 \pm 14.5	

Chapter Five

Discussion, conclusion, and recommendation

Chapter five

Discussion, conclusion, and recommendation

5.1 DISCUSSION

5.1.1 Normal biliary ducts (not dilated)

This study aimed to find out the mean biliary confluence angle in the individual had normal biliary ducts diameter and the measurement change related to gender, age, weight, height, body mass index, and numerous Hepato-Pancreato-biliary disorder (liver cirrhosis, hepatomegaly, pancreatic lesions, pancreatitis, gallstones, distended gallbladder, cholecystitis, and cholecystectomy, and Mirizzi syndrome).

The data acquired over a hundred thirty seven patients with normal biliary duct and twenty-eight patients with dilated biliary ducts.

In the present study, data sample with normal biliary duct distributed according to their gender, summarized in table (1). The male patient represented a high frequency 76 patient (55.5%) mean SD 80.1 ± 21.2 range (142.2 -36.4) table (5). Female 61 patients (44.5%) table (1). Mean SD 87.4 ± 25.7 ranges (155.6-38.1) table (5).

The correlation between normal biliary confluence angle measurement and patient gender: P value (0.071). Therefore, we recognized that there was no significant correlation between gender and biliary angle. This result in concordance with research of Nuray Haliloglu in 2010, which explained that there No statistically significant correlation was found between biliary confluence angle and gender .On the other hand Hung et al (2011) expound that the CBD diameter not significantly affected by the patients' gender.

As the research performed in KSA in Suleiman fakeeh hospital, so the Saudi patient represented as high frequency in data distribution samples according to their nationality, which summarized in table (2). As Saudi (89) patient 65.0%. Mean SD 83.7 ± 21.8 ranges 130.4-36.4 table (7).

Egyptian presented as 12 patient (8.8%) table (2). means SD 79.8 ± 32.7 range 142.2-46.1 table (7). The Yemeni patient represented as 8 patient (5.8%) table (2), mean SD 83.7 ± 25.9 ranged 118.6-56.3 table (7). Sudanese presented as 6 patient (4.4%) table (2). mean SD 85.5 ± 40.6 ranged 155.6-47.6 table (7). Indian presented as 5 patient (3.6%) table (2). mean SD 75.3 ± 30.1 ranged 108.2-52.4 table (7). In addition, different other nationalities represented as 17 patient (12.4%) table (2); mean SD 85.6 ± 16.7 range (115.6, 36.4) tables (7).

Correlation between confluence angle measurement and patient nationality P value 0.958. Show that there was no significant correlation between change in biliary measurement and patient nationality. This result in concordance with Chen et al (2012) result, which explained that the average Taiwanese patients' CBD of 4.6 mm as measured by MRI is well within the range of currently, reported range values of normal CBD diameter, and appears to be unrelated to the race of the patients.

In this study BMI, mean SD 78.3 ± 15.2 range (20.0- 157.0) table (9). The P value 0.623. Table (7) shows that there was no significant correlation between change in biliary confluence angle measurement and changes in BMI.

The gallstone prevalence as high frequency in the present study as 54 patient (39%) table (3), mean SD 82.8 ± 24.0 range (115.6 -36.4) table (6). In addition, normal Hepato-pancreato-biliary finds 40 patients (29.2%). mean SD 85.6 ± 24.3 ranged (155.6- 41.4) table (6). Data sample presented with Pancreatitis distributed as {9} patient (6.6%). table (2) mean SD 77.7 ± 17.4 . range (100.7-44.5), table (6).

And hepatomegaly represented as 8 patient (5.8%), mean SD 96.6 ± 26.6 range 142.2-61.7 table (6). data samples distributed according to incidence of pancreatic lesion 9 patient (4.4%), table (3), mean SD 63.8 ± 16.6 range 95.4-52.4 table (6). the distribution of data sample presented with gallbladder distention as 9 patients (4.4%), table (3). In the present study patient with cholecystitis nine patients (4.4%) table (3), Means SD 97.0 ± 11.6 range 111.3- 80.6-degree table (6). Distribution of patient undergo

cholecystectomy 5 patient (3.6%), table (3). mean SD 81.1 ± 18.6 (range 98.0-52.4), table (6). in this study Liver cirrhosis represented as two patients (1.5%), means SD 60.3 ± 20.0 range (74.4 -46.1) table (6). Mirizzi syndrome reported as only one patient (0.7%) table (3). Mean SD 103.9 ± 0.0 range (103.9-103.9), table (6).

The variation in biliary confluence angle measurement in data samples with normal biliary duct and different Hepato-pancreato-biliary pathological conditions summarized in table (6), P value 0.163. Therefore, the statistical analysis shows that there no significant correlation between biliary confluence angle measurement and different pathological conditions. this in concordance with (Chen et al 2012) result in which some pathological disorder include (fasting blood sugar levels, serum cholesterol, presence of hepatitis B or C, and portal vein diameters show no statistically significant effect on the CBD diameter.

on the present study weight mean SD 78.3 ± 15.2 range (20-175) table (9) P value 0.639 table (7), height mean SD 164.4 ± 8.1 cm range) 132-185 cm table (9) P value 0.632 table (7) .

The correlation between normal biliary confluence angle measurements and the patient BMI, weight, and height the P value 0.623, 0.639, and 0.632 respectively table (4) a show that there was no significant correlation between change in biliary confluence angle measurement and changes in BMI, weight and height. Moreover, these results in concordance with the result obtained Nuray et al. (2009) which had the same results on BMI, weight, and height. However, their result differs on the effect of age on the biliary confluence angle.

The effect of age on common bile duct –as part of biliary system- had a great attention on several researchers; In the present study the mean SD of the patient age 45.5 ± 16.9 -year (range 13-90 year) table (4) P value 0.024 table (8) therefore, there was significant correlation between change in biliary confluence angle and patient age. This result versus the result of Nuray et al.(2009) which explained that the values for the biliary confluence angle ranged widely in normal subjects. In addition,

age, gender, and body mass index did not appear to have an effect on the confluence angle

On the other hand, Chen et al (2012) reported that as patients' age increases from the third to the eighth decade of life, the average CBD diameters also increase in an approximately linear fashion. This trend summarized by the equation $\text{CBD size} = 0.64 * \text{age (in decades)} + 1.52$ with $(R^2) = 0.62$. Furthermore Ropert et al (2000) published a research on the common bile measurement in elderly population over 1018 patient all of them elder than 60 years old detected by abdominal US , the results demonstrated a small although statistically significant increase in the caliber of common bile duct with increasing age. In the same direction Hung. et al (2011) published, a research compared the diameters of proximal and distal common bile duct using MRCP. Their result explained that the CBD diameters in both the proximal and distal segments was been correlated significantly with the patient age the CBD diameters was not been significantly affected by the patients' gender

On the other hand, Kialian et al. (1995) as cited by Chen et al (2012) observed that the longitudinal smooth muscle bands and its intervening connective tissues fragments with increasing age accompanied by loss of reticulo-endothelial network of the ductal wall, and suggest this may be the mechanism behind the age-related biliary dilatation .

The present study clued that the biliary confluence angle acute or diverging angle; (range 36.4-155.6) degree the mean value 83.4 ± 23.5 these result in concordance with data collected by Nuray et al. (2009), their research done over 40 patient (range 51-155) degrees, the mean biliary angle 87.87 ± 22.92 degree . Therefore in this study changes in biliary angle measurement determined by the equation [Biliary angle = $95.6 - 0.269 \text{ Age}$]. This mean, the value of biliary angle for any patient determined by subtraction a constant (0.269) multiplied by the patient age from 95.6: In different way, the biliary angle will be 95.6 when the patient age was zero ; from these issues we understand that the biliary angle will decrease while the patient became old. Determination coefficient (R^2) = 3.7%. The determination coefficient means the (3.7%) variation occurs in

biliary angle from the age. These explain why some individual the biliary confluence angle measured more than 95.6 degree.

5.1.2 Dilated biliary ducts

The luminal size of extrahepatic duct should consider as a single part of the entire assessment of biliary tree that must also include intrahepatic and pancreatic ducts. Harrow (2010), Abnormal IHBD is present when duct diameter exceeds 40% of diameter of adjacent intrahepatic portal veins and when they appear as parallel tubes coursing together Upadhyay (2010).

Dilated biliary duct group measured over 28 patients. the distribution of data according to their gender: the female as higher frequency 18 patient 64.3% table (10), mean SD 79.7 ± 22.8 range 134.8-38.8 table (14) male 10 patient (35.7%) figure (10) . mean SD 78.0 ± 15.4 range (105.7-63.8) table (14). P value 0.830 , thus there was no significant correlation between biliary confluence angle in patient with dilated biliary ducts and patient gender this result in concordance with Hung et al (2011) results that diameters of proximal and distal CBD were not affected by the sex of patients..

Data distributed according to diagnosis as gallstone had high frequency: 10 patient (35.7%), SD 84.2 ± 14.5 ranges (108.8-65.0) table (4)

Nonspecific biliary dilatation defined as biliary dilatation without evidence of obstructive disease Upadhyay (2010). This, presented as Dilated biliary with normal Hepato-pancreatic finds as 9 patient (32.1%) table (2), mean SD 75.0 ± 22.7 range (104-38.8) table (6).

the distribution of data samples with Cholecystectomy as 5 patient (17.9 %) table (2), mean SD 85.2 ± 28.1 range (134.8-65.5), table (6) and Distended gall bladder as 4 patient 14.3%.table (2) mean SD 67.9 ± 15.5 range 88.5-55.5 .table (6)

The correlation between dilated biliary confluence angle measurement and patient with different pathological condition P value 0.460. Therefore, there were no significant correlation between biliary confluence angle in-patient with dilated biliary ducts and diagnosis. This result in concordance with the

result gained from correlation between normal biliary and different pathological condition.

Data sample grouped according to nationality table (11) as Saudi and non-Saudi. Saudi patient had high frequency 20 patients (71.4%). Mean SD 79.4 ± 21.7 degree (range 134.8-38.8). Non-Saudi as 8 patient. mean SD 78.4 ± 16.9 (range 108.9- 65.0) table (15) P value 0.913 so there was no significant correlation between the biliary confluence angle in patient with dilated biliary ducts and their nationalities .This result in concordance with the result gained from correlation between normal biliary and the patient nationality.

The Variation of dilated biliary confluence angle measurement in samples grouped according to BMI, age, weight and height. Demonstrated as; BMI mean SD 60.8 ± 18.4 range (22.0-97.0) P value 0.140. The age mean SD 55.9 ± 21.8 ranges (12.0-89.0) and P value 0.270. There was no significant correlation between change on dilated biliary confluence measurement and change in patient age. In addition, Weight mean SD 60.8 ± 18.4 ranges (22.0-97.0) and P value 0.477 and height mean SD 154.9 ± 10.3 (range 128.0-171.0) P values 0.429. From the previous analytical information, we found that: there was no significant correlation between change on dilated biliary confluence measurement and change in BMI, age, weight, and height.

5.1.3 Comparisons between normal and dilated

This section, compare between biliary confluences angles in normal and dilated biliary ducts in same Hepato-pancreato-biliary pathological condition.

The variation on the biliary confluence angle measurement in patient normal biliary and dilated biliary in patient had normal Hepato-pancreato-biliary finds summarized in table (18) as normal biliary 40 patient mean SD 85.6 ± 24.3 and dilated biliary normal finds 9 patient mean SD 75.0 ± 22.7 . P value 0.241 this mean there was no significant correlation in biliary angle between normal and dilated biliary group according to normal Hepato-pancreatic finds.

The variation on the biliary confluence angle measurement in patient normal biliary and dilated biliary in patient had previous cholecystectomy summarized in table (19) as normal biliary 5 patient mean SD 81.1 ± 18.6 and dilated biliary 5 patient mean SD 85.2 ± 28.1 . The P value 0.796; this mean there were no significant correlation in biliary angle between normal biliary and dilated biliary group according to history of cholecystectomy.

The variation of the biliary confluence angle measurement in patient with normal and dilated biliary in patient had distended gallbladder summarized in table (20) as normal biliary 6 patient mean SD 76.4 ± 25.8 and dilated biliary 4 patient mean SD 67.9 ± 15.5 . The P value 0.572; this mean there were no significant correlation in biliary angle between normal biliary and dilated biliary group according to distended gallbladder.

The variation on the biliary confluence angle measurement in patient normal biliary and dilated biliary in patient had gallstone summarized in table (21) as normal biliary 54 patient mean SD 82.8 ± 24.0 and dilated biliary 10 patient mean SD 84.2 ± 14.5 . the P value 0.854 ; this mean there were no significant correlation in biliary angle between normal biliary and dilated biliary in patient grouped according to gallstone .The previous information explained that there was no significant correlation in biliary confluence measurements between normal and dilated biliary ducts within different pathological condition. This result versus with which Hung et al (2011) report, that the proximal CBD diameter in the disease group seemed significantly larger than that of the normal group ($p < 0.001$). For the distal CBD, the disease group is also significantly larger than the normal group ($p < 0.001$)

5. 2 Conclusions

The study concluded that MRCP could evaluate and assess the biliary confluence angle in dilated and non-dilated ducts. MR images can diagnose the underlying causes. Dependency upon this angle is not beneficial for diagnosis of prediction of diseases. No significant relation found between the genders, weight, height, BMI, race, biliary system diseases and the biliary confluence angle but a significant relation

detected with the age. A new equation for angle prediction was established.

5. 3 Recommendations

On the final the author recommended that, a restricted research must perform on the effects of malignant biliary dilatation with or without biliary obstruction on the biliary confluence angle.

In addition, a future research suggested cluing the effect of ductal disease on the biliary confluence angle.

Appendixes

Appendixes



Figure A. A 30-year-old male patient. Have a normal intrahepatic ducts, and common bile duct. Biliary confluence angle 45.00 degree



Appendix (B). A 47 female, MRCP image show dilated intrahepatic biliary duct. The biliary angle 85.45

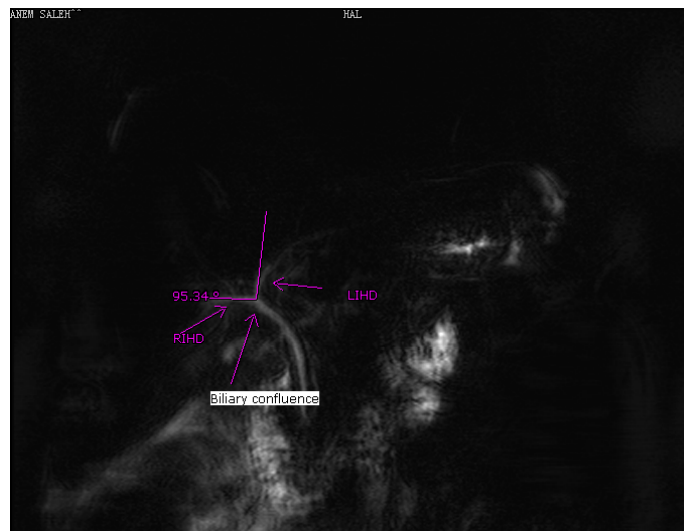


Figure C. A 51 year old, the MRCP shows normal intrahepatic biliary ducts with noncalcularcholecystitis. Biliary angle 95.6

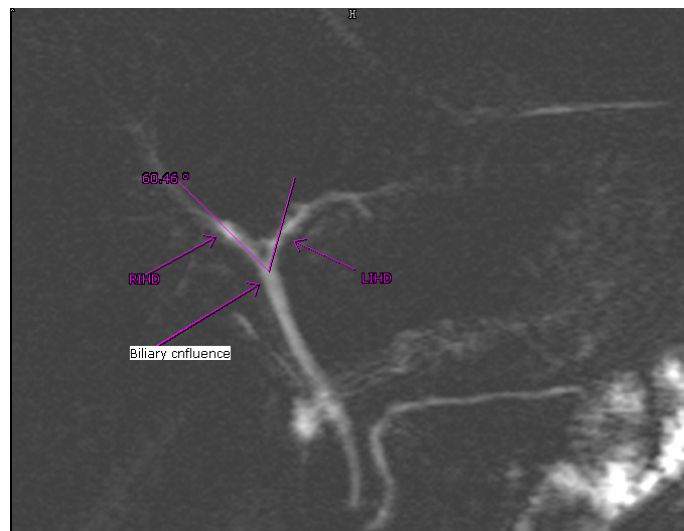


Figure .D. Male patient 34 year old). His MRCP show normal intrahepatic biliary ducts. The biliary angle 80.45

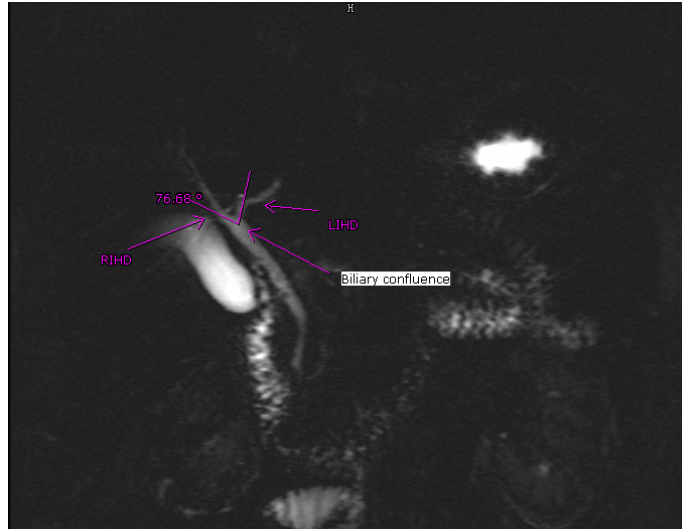


Figure .E. a male 51 year old his MRCP show dilated common bile duct and gallstone. The biliary angle 76.68



Figure F. a male 46 year old his MRCP show normal intrahepatic bile ducts. The biliary angle 80.38

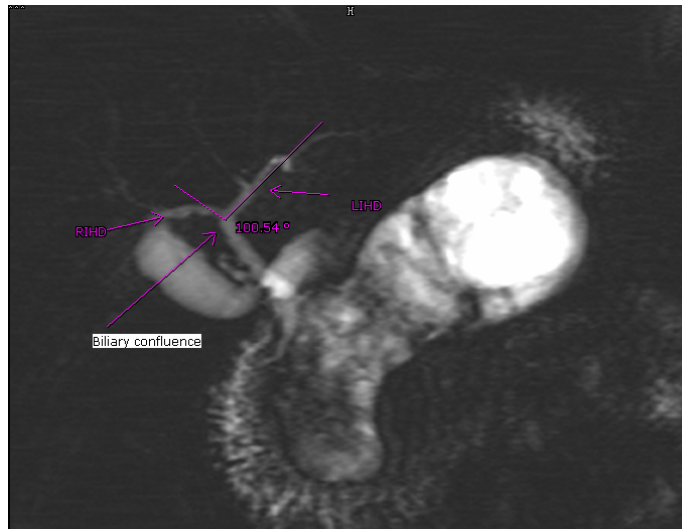


Figure G. A 40-year-old male's MRCP shows normal intrahepatic bile ducts and pancreatitis. The biliary angle 100.56 degree

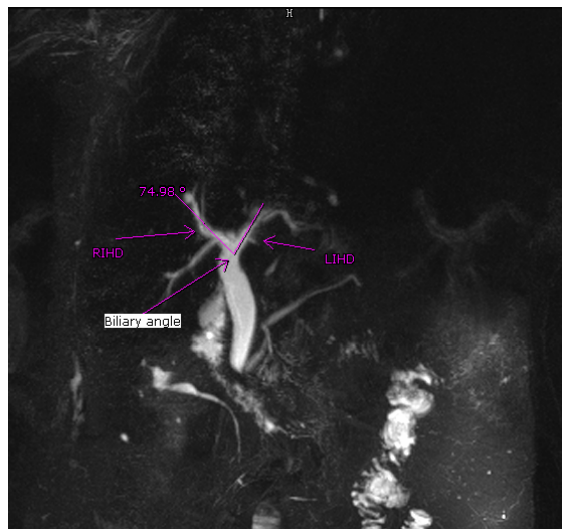


Figure H. An 89-year-old female patient MRCP shows dilated biliary system and cholecystectomy

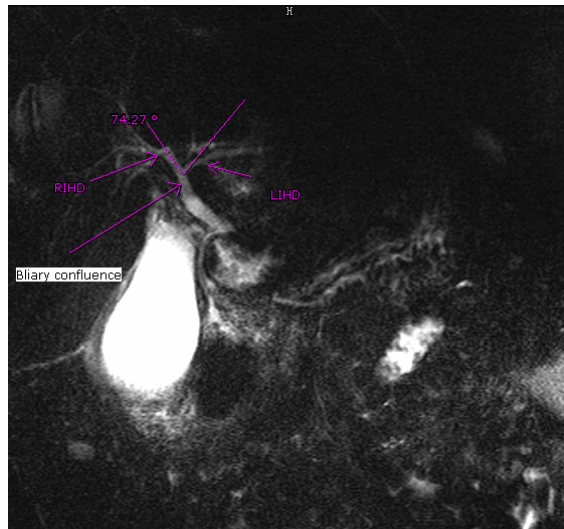


Figure (I). A 60-year-old male with normal biliary ducts MRCP show distended gallbladder. Biliary angle 74.27

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