Sudan University of Science and Technology

College of Graduate Studies

Characterization of Biliary Confluence Angle in Sudanese Population Using Magnetic Resonance Cholangiopancreatography

توصيف زاوية التقاء الحويصلة المرارية لدي السودانيين بواسطة الرنين المغنطيسي

A thesis Submitted for Partial Fulfillment of M.Sc. Degree in Radiological Imaging Diagnosis

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Dedication

Dedicated this research to my parents, my sisters, my brother, my husband and my friends.

And to everyone help me to complete this research

Acknowledgement

First and always thanks Allah for every thing secondly a great thank to **Dr. Asma Ibrahim Ahmed Elamin** my teacher and my supervisor thirdly a big thanks to all members of MRI centers where my work took place. Finally I continue to be extremely grating full to all those colleagues' family members who have supported me both professionally and personally and who continue to encourage me. Thank without you this moment and all this would never be possible.

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List of Abbreviations

MRCP	Magnetic resonance cholangiopancreatography
ERCP	Endoscopic retrograde cholangiopancreatography
2D	two-dimensional
3D	three-dimensional
SO	sphincter of Oddi
CHD	Common hepatic duct
CA	Confluence angle
RHD	Right hepatic duct
LHD	Left hepatic duct
RAD	Right anterior duct
LPD	Left posterior duct
SSFSE	single-shot fast spin-echo
T1W	T1-weighted
T2W	T2-weighted

Abstract

This study done to characterize the morphology of biliary confluence angle in Sudanese population in normal patient and in patient with obstructive jaundice.

The Characterization of biliary confluence angle may be has a correlation with age, here is a data for morphology of biliary confluence angle in Sudanese population.

Retrospective, Descriptive analytical study to evaluate the Characterization of billary confluence angle in 50 normal and 50 abnormal (patient with obstructive jaundice), in Sudanese patients using Magnetic Resonance Cholangiopancreatography, measuring the size of the angle and detecting if there is a correlation between the biliary confluence angle with age, also the right and left hepatic ducts had measured in both normal and abnormal patients to know if there is a relation between there length and biliary confluence angle at the same level in Magnetic Resonance Cholangiopancreatography. Data statically analyzed using statical package for social sciences SPSS.

There is a weak relation between the billary confluence angle and age, when there is a relation between the billary confluence angle and age in patients with obstructive jaundice.

This study shows the relation in the age of patients with obstructive jaundice with biliary confluence angle is higher than the relation with normal patients, especially with adult patient.

مستخلص الدراسة

هذه دراسة أجريت لتحديد خصائص مورفولوجية زاوية التقاء المرارية في الشعب السوداني في المريض العادي وفي المريض مع اليرقان الانسدادي.

وتوصيف زاوية التقاء الصفراوية قد يكون له علاقة مع التقدم في السن، وهنا هو البيانات لمورفولوجية زاوية التقاء المرارية في الشعب السوداني.

بأثر رجعي دراسة تحليلية، وصفية لتقييم توصيف زاوية التقاء في 50 العادي و 50 غير طبيعي (المريض مع اليرقان الانسدادي)، في المرضى السودانيين باستخدام ، وقياس حجم من زاوية وكشف ما إذا كان هناك علاقة بين زاوية التقاء المرارية مع التقدم في السن، أيضا اليمين واليسار القنوات الكبدية ويقاس في المرضى على حد سواء طبيعية وغير طبيعية لمعرفة ما إذا كانت هناك علاقة بين وجود طول وزاوية التقاء المرارية في نفس المستوى في. تحليل البيانات بشكل ثابت باستخدام حزمة للعلوم الاجتماعية.

هناك علاقة ضعيفة بين زاوية التقاء والعمر، وعندما يكون هناك علاقة بين زاوية التقاء والعمر في المرضى الذين يعانون من اليرقان الانسدادي.

وتبين هذه الدراسة العلاقة في سن المرضى الذين يعانون من اليرقان الانسدادي مع زاوية التقاء المرارية أعلى من العلاقة مع المرضى العادي، وخاصة مع المريض الكبار.

CHAPTER ONE

1.1 Introduction

The live is the second largest (after the skin) organ in the human body and the largest gland (weaning an average of 1500 g). It located in the upper right quadrant of the abdomen, below the diaphragm. The liver is a gland and plays a major role in metabolism and some numerous functions. The liver is reddish-brown shaped organ with four lobes of unequal size and it's connected to two large blood vessels the hepatic artery and portal vein. (Van Hoe 2001).

Magnetic resonance cholangiopancreatography is an application of MRI to the hepatobiliary and pancreatic system. MRCP uses MRI machine with special software to obtain images comparable to the more invasive approach with ERCP (endoscopic retrograde cholangiopancreatography) without the added risks of sedation, pancreatitis, and perforation. (Van Hoe 2001).

There are various techniques available for the visualization of biliary tree. Intravenous cholangiography often does not opacify the intra- and extra hepatic biliary tree and rarely allows a detailed visualization of the duct bifurcation. Endoscopic retrograde cholangiopancreatography (ERCP). Intraoperative cholangiography is also highly accurate; however, it is an invasive procedure and its routine use remains controversial. Magnetic resonance cholangiopancreatography (MRCP) is an excellent non-invasive imaging technique for visualization of detailed biliary anatomy. High-resolution cross-sectional, two-dimensional (2D) and three-dimensional (3D) projection images provide excellent detailed anatomy which is comparable to ERCP and intraoperative cholangiograms. (Gupta, 2010)

1.2 Problems of the study

The usual causes and sources of the visualization of biliary tree. Intravenous cholangiography often does not opacify the intra- and extrahepatic biliary tree and rarely allows a detailed visualization of the duct bifurcation. Endoscopic retrograde cholangiopancreatography (ERCP), although very accurate, is an invasive method for imaging the biliary tree. Intraoperative cholangiography is also highly accurate; however, it is an invasive procedure and its routine use remains controversial. Magnetic resonance cholangiopancreatography (MRCP) is an excellent non-invasive imaging technique for visualization of detailed biliary anatomy (Moore K, 1998)

1.3 Objective

1.3.1 General objective

The aim of the study to analyze the morphometric measurements of biliary confluence angle in Sudanese population in normal and abnormal patients with different age group and gender using MR Cholangiopancreatography.

1.3.2 Specific objectives

To measure the confluence angle dimensions in Sudanese population.

To correlates the result with age, gender.

To compare the results with other population.

To make a reference values for Sudanese population.

To make a comparison between the normal and abnormal(patients with obstructive jaundice) confluence angle in Sudanese population.

To measure the relation between the length of right and left hepatic ducts with the confluence angle in normal and abnormal patient's confluence angle at the same level in MRCP.

1.4 Importance of the study

The role of this study provide and investigation for measurement of biliary confluence angle by using MRCP

1.5 Overview of study

This study will consist of five chapters chapter one deal with the introduction chapter two include literatures review chapter three detailed the materials and methods then chapter four presents the result and chapter five presents the discussion conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Anatomy of liver

The live is the second largest (after the skin) organ in the human body and the largest gland (weaning an average of 1500 g). It located in the upper right quadrant of the abdomen, below the diaphragm. The liver is a gland and plays a major role in metabolism and some numerous functions. The liver is reddish-brown shaped organ with four lobes of unequal size and it's connected to two large blood vessels the hepatic artery and portal vein.(Seale MK 2009).

2.1.1Anatomical review of biliary system

The hepatic ductal apparatus consists of The common hepatic duct, formed by the junction of the right and left hepatic ducts, when the biliary confluence angle is the angle between the right and left hepatic ducts. The gallbladder a reservoir for bile. The bile duct, formed by the junction of common hepatic and cystic ducts. (Seale MK, 2009).

2.1.2 Common hepatic ducts

The main right and left ducts issue from the liver and unite near the right end of the porta hepatis as the common hepatic duct which descends about 3 cm before being joined on its right acute angle by the cystic duct to form the main bile duct. The common hepatic duct lies to the right of hepatic artery and anterior to the portal vein. (Van Hoe, 2001).

2.1.3 Cystic duct

This structure is 3-4 cm long; its passes back, and down to the left from the neck of the gallbladder, joining the common hepatic duct to form the bile duct. it is adherent to the common hepatic duct for a short distance before joining it, usually near the porta hepatis but sometimes lower, in which cases the cystic ducts lies along the lesser omentum's right edge. Its mucosa bears five to 12 crescentic folds, like those in gallbladder's neck. They project obliquely in regular succession, appearing like a spiral valve. When the duct is distended, the spaces between the fold dilate and externally it appears twisted like the neck of gallbladder. (Seale MK, 2009).

2.1.4 Bile duc:

The bile duct is formed near the porta hepatis, by the junction of cystic and common hepatic ducts; it is usually about 7.5 cm long and 6 mm in diameter. It is descends posteriorly and slight to the left, anteriorly to the epiploic foramen, at the right border of the lesser omentum, in front and to the right of the portal vein and to the right of the hepatic artery proper. It passes behind the first (superior) part of the duodenum, with the gastroduodenal artery on its left, and then runs in a groove on the superolateral part of the superior head of the posterior surface of the head of pancreas, anterior to the inferior vena cava and sometimes embedded in pancreatic tissue. Lytle (1959) has shown that the duct may be close to the left aspect of the second (descending) part of the duodenum or as much as 2 cm from it and that, even when it is embedded it. Pancreas, a superficial groove marking its position can be palpated behind the descending part of the duodenum, stones in the duct being thus detected. Left of the descending part of the duodenum the bile duct reaches the pancreatic duct; together they enter the duodenal wall where they usually unit to form the hepatopancreatic ampulla, the distal, constricted end of which opens into the part of duoudenum on the summit of the major duodenal papilla, about 8-10 cm from the pylorus. The position of the bile duct is indicated on the anterior abdominal surface by the line starting 5 cm above the transpyloric plane and 2 cm right of the median plane and descending vertically for 7.5 cm. *(*Gray, Henry;2011)

The main supply being from the cystic and posterior superior pancreatoduodenal arteries. These supplies vary, the posterior superior pancreatodudenal artery anastomoses with the posterior branch of the inferior pancreatoduodenal near the hepaticpancreatic ampulla; where this anastomoses is poor, ligation of the superior posterior pancereatoduodenal artery may result in gangrene or stricture of the bile duct. Veins from the upper part of the bile duct and hepatic ducts and from the gallbladder and cystic duct usually enter the liver, while those from the lower part of the bile duct enter the portal vein. Sympathetic and parasympathetic innervations are from coeliac plexus along the hepatic artery and its branches. Fibers from the right phrenic nerve, through communication between the phrenic and coeliac plexuses, appear to reach the gallbladder via the hepatic plexus, thus explaining referred ‘shoulder pain’ in gallbladder pathology.(Van Hoe. 2001).

2.1.5 Variations in bile ducts

The junction of cystic and common hepatic ducts varies in its level from the porta hepatis to behind or even below the duodenum’s first (superior) part; when the junction is low, the two ducts may be connected by fibrous tissue and in cholecystectomy clamping the cystic duct without injuring the common hepatic (or main bile) duct is difficult. Occasionally the cystic duct joins the right hepatic duct; it may passes behind or in the front of the common hepatic duct, joining it on its left surface.Accessory hepatic ducts may emerge, more often from the right lobe, to join the main hepatic duct or, rarely, the gallbladder itself. Failure of canalization of bile duct during development leads to a rare congenital a tresia or stenosis with rapidly fatal results. The bile and pancreatic ducts may open separately into the duodenum or join even before entering its wall. Variations of the ductual arteries are much more common.(Crawford JM2002).

2.1.6 Microstructure of the biliary ducts

The biliary ducts have external fibrous and internal mucous layers. The former is fibrous connective tissues with a few longitudinal oblique and circular smooth muscle cell. The mucous is continues with that of the hepatic ducts, gallbladder and duodenum; like theirs, its epithelium is columnar; many lobulated mucous glands occuar in the wall of these ducts. In the bile ducts are many tubulo-alveolar glands arranged in clusters, secreting mucin, some at least of which is sulphated. (Crawford JM2002).

Circular muscle around the lower part of the main bile duct including the ampulla and terminal pancreatic duct forms the sphincter of the hepatopancreatic ampulla (sphincter of Oddi), comprising muscle at three levels at the end of the bile duct (sphincter ductus cholcdoci), at the end of the pancreatic duct (sphincter ductus pancreatici) and around the ampulla. (Crawford JM, 2002).

Only the muscle at the end of the bile duct is constant. Expulsion of gallbladder contents appears to be under hormonal control. Fat or acid in duodenum probably causes the liberation off CCK. Stimulating the gallbladder to contract. Muscle cells in its wall have surface receptors for this hormone, which can therefore stimulate them to contract directly. In any case, when storage pressure exceeds 100 mm of bile, the gallbladder contracts, the sphincter of Oddi relaxes and bile enters the duodenum. The termination of the united bile and pancreatic ducts is packed with villous, valvular folds of mucosa and muscle cells enter their connective tissue cores (*Henry Vandyke 1858)*.

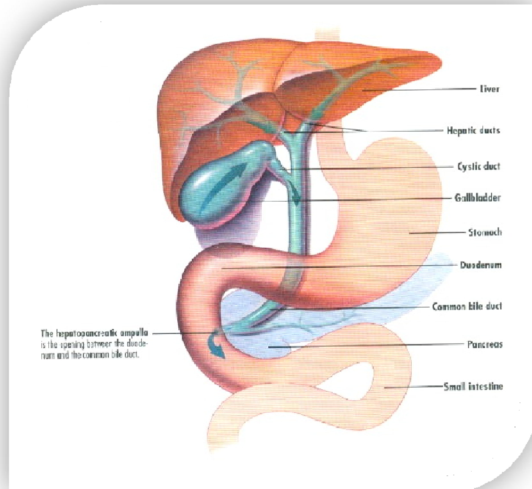

Figure 2.1: Shows anatomical review of biliary system.
(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649.)

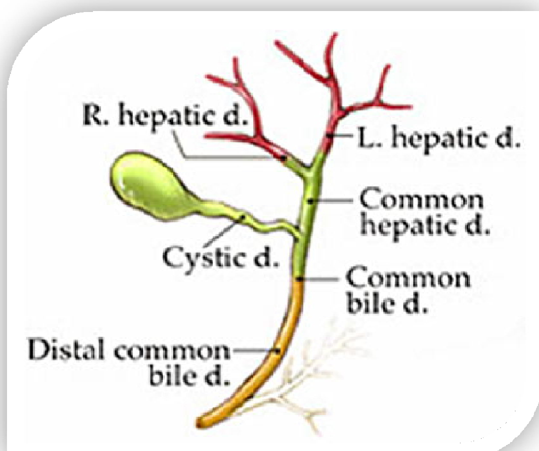

Figure 2.2: Shows anatomical review of biliary system.

(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

2.1.7 Normal anatomy of intrahepatic bile ducts

The interesting part of biliary anatomy is that the individual biliary drainage system is parallel to the portal venous supply system. Therefore, the normal biliary anatomy is similar to portal venous anatomy. The right hepatic duct drains the segments of the right liver lobe (V–VIII). The right hepatic duct has two major branches: The right posterior duct draining the posterior segments, VI and VII, and the right anterior duct draining the anterior segments, V and VIII. The right anterior duct has a more vertical course, whereas the right posterior duct has an almost horizontal course. The right posterior duct usually runs posterior to the right anterior duct and fuses with it from a left (medial) approach to form the right hepatic duct.

The left hepatic duct is formed by segmental tributaries draining segments II-IV [Figure 1.5] [5]

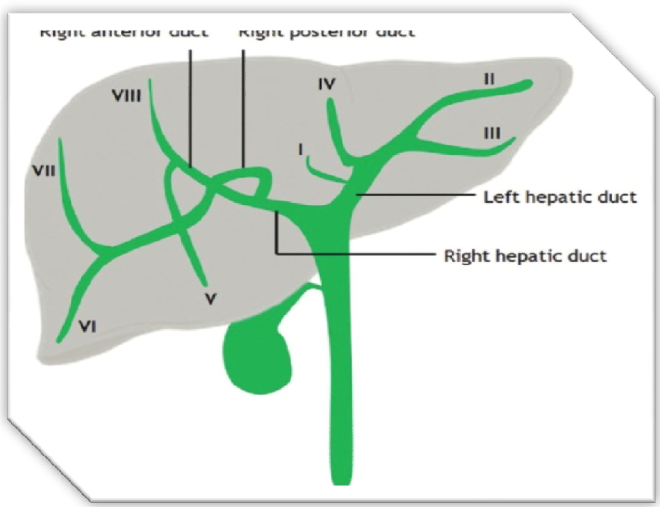

Figure 2.3: Shows Pictorial diagram showing normal biliary anatomy (Catherine Westbrok2014)

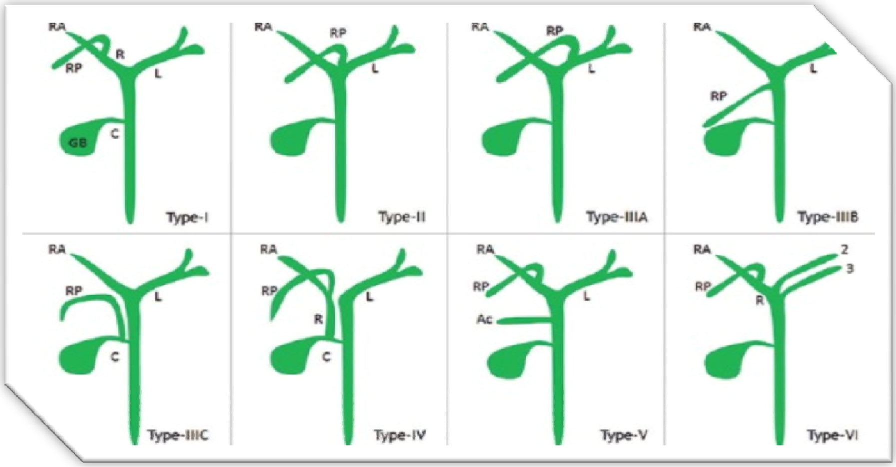

Figure 2.4: Shows pictorial diagram showing variations in the right biliary ductal system

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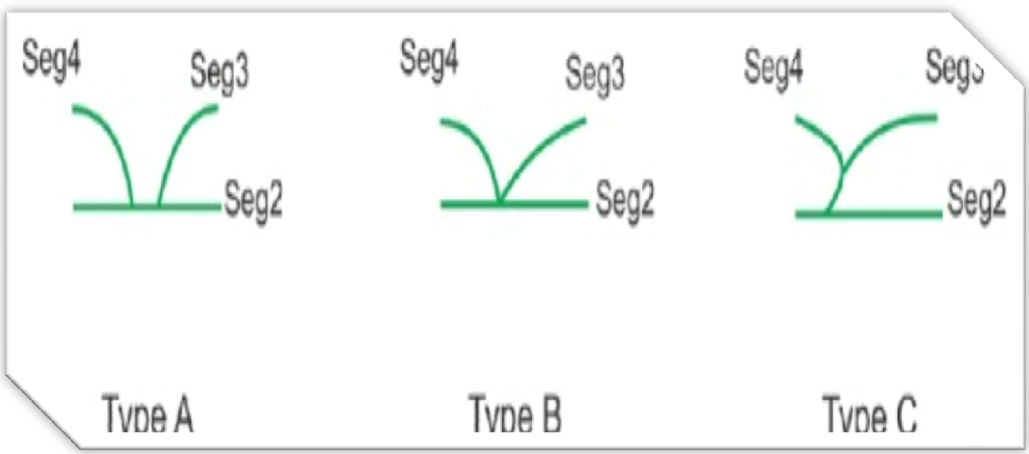

Figure 2.5: Shows Pictorial diagram showing variations in the left biliary ductal system.

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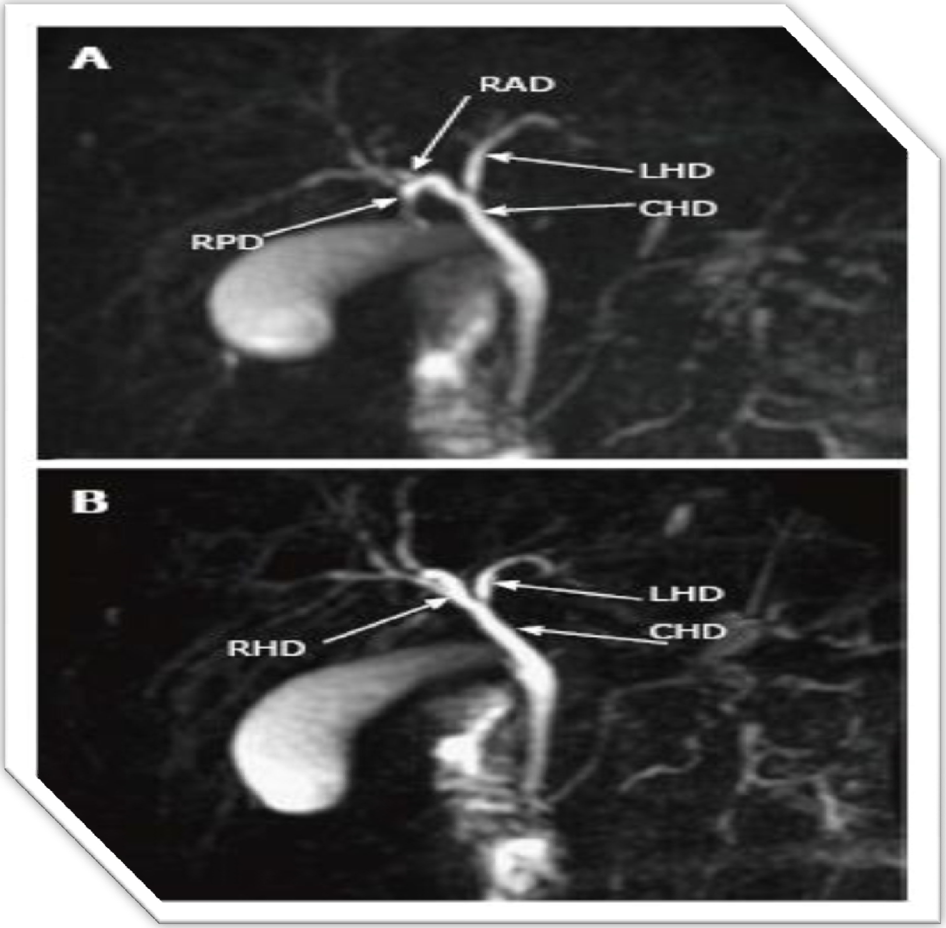

Figure 2.6: Shows Thick slab magnetic resonance cholangiopancreatography images in different coronal planes demonstrates the normal biliary anatomy where right hepatic duct is formed by fusion of the right anterior duct and right posterior duct. The RHD then joins the LHD to form the CHD. RHD: Right hepatic duct; RAD: Right anterior duct; RPD: Right posterior duct; LHD: Left hepatic duct; CHD: Common hepatic duct; CA: Confluence angle.
(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

2.2 Review about MRCP

Magnetic resonance cholangiopancreatography is an application of MRI to the hepatobiliary and pancreatic system. MRCP uses MRI machine with special software to obtain images comparable to the more invasive approach with ERCP (endoscopic retrograde cholangiopancreatography) without the added risks of sedation, pancreatitis, and perforation.(Handbook of MRI technique2014)

There are various techniques available for the visualization of biliary tree. Intravenous cholangiography often does not opacify the intra- and extra hepatic biliary tree and rarely allows a detailed visualization of the duct bifurcation. Endoscopic retrograde cholangiopancreatography (ERCP), although very accurate, is an invasive method for imaging the biliary tree. Intraoperative cholangiography is also highly accurate; however, it is an invasive procedure and its routine use remains controversial. Magnetic resonance cholangiopancreatography (MRCP) is an excellent non-invasive imaging technique for visualization of detailed biliary anatomy. High-resolution cross-sectional, two-dimensional (2D) and three-dimensional (3D) projection images provide excellent detailed anatomy which is comparable to ERCP and intraoperative cholangiograms. (Handbook of MRI technique2014)

2.2.1 MRCP technique

All MR cholangiopancreatography in radiology department were obtained with a body phased-array coil with eight elements, centered below the xiphoid process, was used for signal reception. It is routinely acquire coronal and axial T2-weighted (T2W) single-shot fast spin-echo (FSE) sequences, axial respiratory-triggered fat-suppressed T2W FSE sequence, and axial breath-hold T1-weighted (T1W) dual-echo spoiled gradient recalled-echo sequence (Seale MK, Catalano 2009).

MRCP is performed by using a respiratory-triggered high-spatial-resolution isotropic 3D fast-recovery FSE sequence with parallel imaging in axial and oblique coronal planes, which provides high signal-to noise ratio and excellent spatial resolution (1-mm isotropic voxels) in a relatively short acquisition time (repetition time- one respiratory cycle, echo time- 700 ms, echo space- 8.5 ms, matrix- 320 × 256, section thickness- 1.4 mm, zero-fill interpolation to 0.7, 40-70 sections, receiver bandwidth- 25 kHz, acquisition time- 3-7 min, array spatial sensitivity encoding factor two, actual voxel dimensions (mm) isotropic at 1.4 - 1.4 - 1.4 interpolated to 0.7 - 0.7 - 0.7). In addition, 2D half-Fourier single-shot FSE sequence is implemented in thick-slab and multi-section modes (image acquisition parameters: Relaxation time- 2.800 ms, effective TE- 750 ms, image matrix- 384 × 256, field of view- 200 × 200 mm, refocusing flip angle- 180°) (Berlin: Springer; 2001).

2.3 Physiological review of biliary system

The biliary tract collects, stores, concentrates, and delivers bile secreted by the liver. Its motility is controlled by neurohormonal mechanisms with the vagus and splanchnic nerves and the hormone cholecystokinin playing key roles. These neurohormonal mechanisms integrate the motility of the gallbladder and sphincter of Oddi (SO) with the gastrointestinal tract in the fasting and digestive phases. During fasting most of the hepatic bile is diverted toward the gallbladder by the resistance of the SO. The gallbladder allows the gradual entry of bile relaxing by passive and active mechanisms. During the digestive phase the gallbladder contracts, and the SO relaxes allowing bile to be released into the duodenum for the digestion and absorption of fats. Pathological processes manifested by recurrent episodes of upper abdominal pain affect both the gallbladder and SO. The gallbladder motility and cytoprotective functions are impaired by lithogenic hepatic bile with excess cholesterol allowing the hydrophobic bile salts to induce chronic cholecystitis. Laparoscopic cholecystectomy is the standard treatment. Three types of SO dyskinesia also cause biliary pain. Their pathophysiology is not completely known (Taoka H. 2000).

The biliary tract is functionally integrated with the digestive tract by neurohormonal mechanisms in the fasting and digestive phases. The liver secretes bile continuously into the intrahepatic ducts flowing into the extrahepatic ducts. The gallbladder is filled with the aid of the sphincter of Oddi (SO) where the bile is stored and concentrated in the fasting state and emptied during all three phases of the digestive periods. In the interdigestive3period about 10% of the hepatic bile can drain into the duodenum occurring during intervals between the phasic contractions of the sphincter of Oddi (diastolic periods) when the secreted bile raise the ductal pressures above the sphincter of Oddi basal pressures.The remaining 90% of bile is redirected toward the cystic duct to be stored in the gallbladder. The entry of bile distends the gallbladder by passive and active mechanisms. In the digestive period strong gallbladder contractions and sphincter of Oddi relaxation lead to the high rates of bile discharge flowing into the common bile duct and duodenum. During this period, the gallbladder motor activity like the rest of the gastrointestinal tract is influenced by the three phases of digestive process: cephalic, antral, and duodenal. The cephalic phase is initiated by stimuli that activate the central nervous system, as individuals are exposed to olfactory, visual, and the taste of food. This phase is mediated by preganglionic vagal fibers that synapse with postganglionic cholinergic neurons. It is estimated that as much as 30–40% of the gallbladder bile may be emptied during this phase (Crawford JM. 2002).

2.4 pathology

2.4.1 Abnormal variation in biliary confluence angle

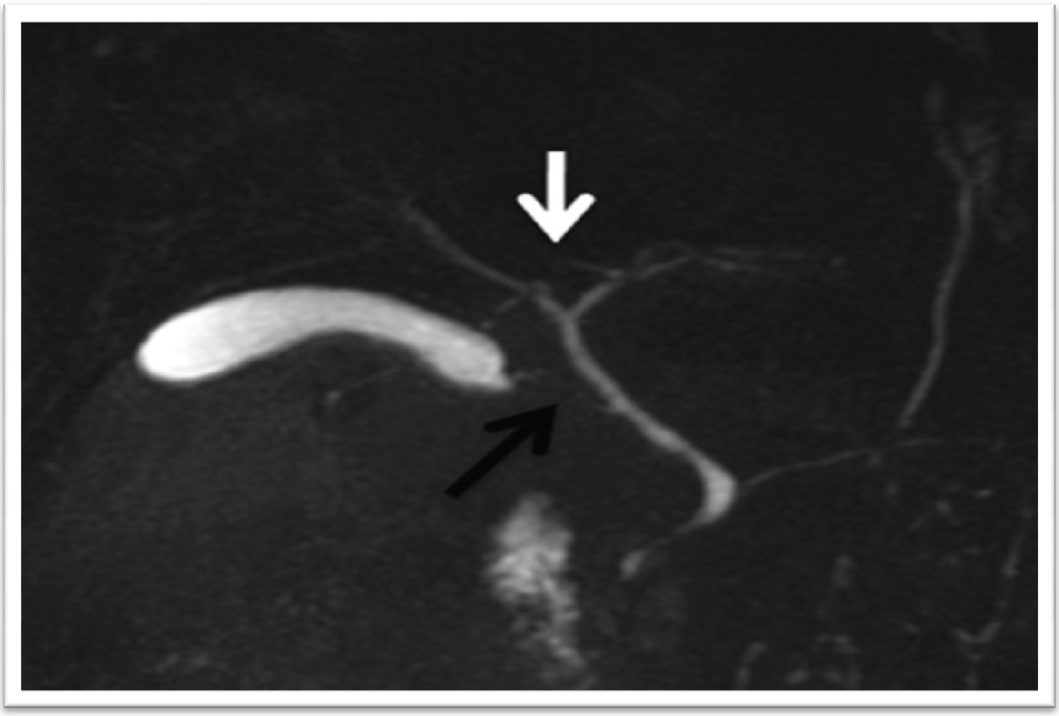

Figure 2.7: Shows coronal MRCP image showing fusion of the right anterior and right posterior ducts to form the right hepatic duct. Primary confluence (white arrow) is formed by fusion of the right and left hepatic ducts.

http://dergiler.ankara.edu.tr/dergiler/36/1357/15649.

Figure 2.8: Shows trifurcation anomaly (Type II): Projective coronal MRCP image showing trifurcation anomaly of biliary tree in the form of right anterior, right posterior, and left hepatic duct, forming the primary confluence (arrow).

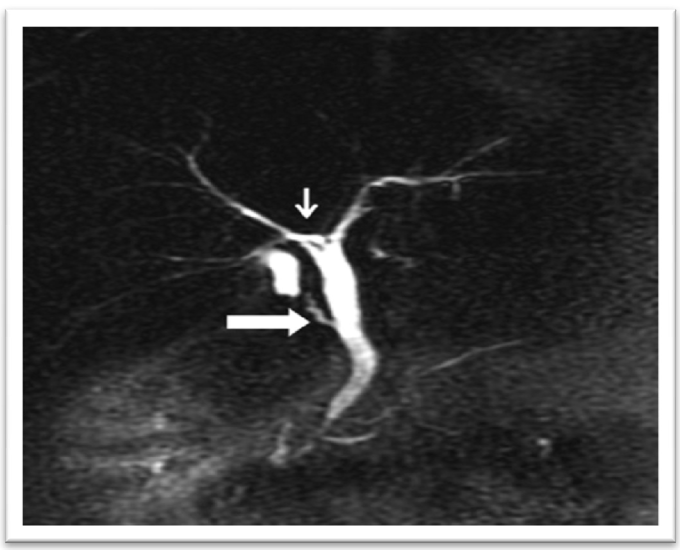

Figure 2.9: Shows crossover anomaly with spiral course of the cystic duct: Coronal MRCP image showing right posterior duct opening into the left hepatic duct (arrow)

Figure 2.10: Shows coronal MRCP image showing aberrant opening of right posterior duct into left hepatic duct (arrow) and accessory right hepatic duct opening into common hepatic duct (curved arrow).

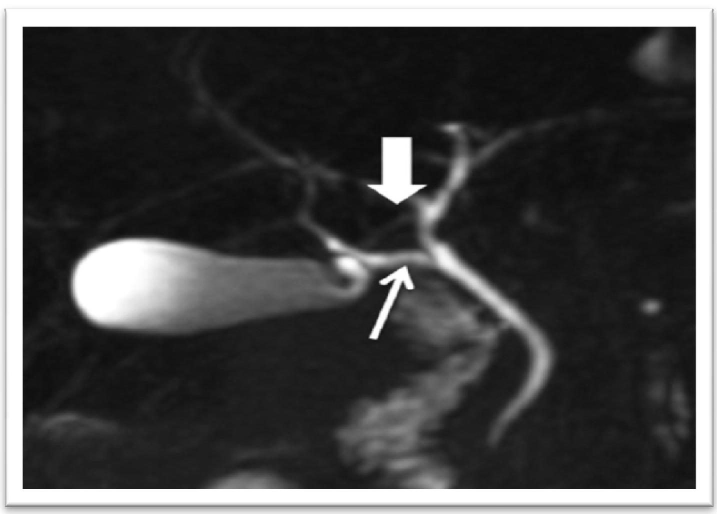

Figure 2.11: Shows coronal MRCP image showing aberrant opening of right posterior sectoral duct into common bile duct (arrow). High insertion of cystic duct is seen opening at the confluence (arrowhead).

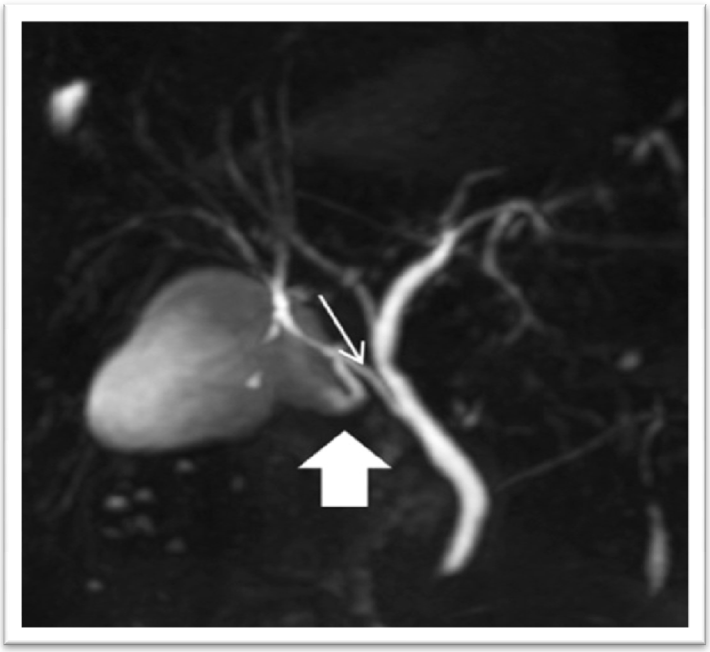

Figure 2.12: Shows cystic duct opening into the right posterior duct: Coronal MRCP image showing anomalous opening of the cystic duct into the right posterior sectoral duct (arrowhead). Also, there is aberrant opening of right posterior duct into common hepatic duct (arrow). Primary confluence is formed by right anterior duct and left hepatic duct with narrow biliary confluence angle.).

(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

Figure 2.13: Shows narrow biliary confluence angle: Coronal MRCP image showing narrow biliary confluence angle (curved arrow) and high cystic duct insertion (arrow).(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

2.5 Previous studies

A study conducted by Nuray *et al*, (2006) aimed to evaluate the mean biliary confluence angle on magnetic resonance cholangiopancreatography (MRCP) images and to determine whether there is a relation between the angle and age, gender, and body mass index of the subjects. A total of 40 patients who denied a history of prior liver surgery, and in whom MRCP excluded bile duct variations, biliary diseases or chronic parenchymal liver disease were enrolled. There were 18 women and 22 men aged 22-86 years (mean age 51 years). MRCP was performed on a 1.0 Tesla MR System using phased array coil and 2 dimensional single-shot-fast spin-echo (SSFSE) sequence, it thick slabs (40 mm) in the oblique coronal plane were obtained centering the common bile duct. Data were analyzed at the workstation and the confluence angle was measured independently by 2 observers on 3 successive coronal oblique thick-collimation images where the angle is widest. They showed that the average body mass index was 26.8 kg/m (range 17.9-42.2 kg/m). 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 was found between biliary confluence angle and age, gender or body mass index ($p>0.05$). 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. In their study of 40 adults, the mean angle of the biliary confluence was about 86 degrees (http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

Another study done by Eman *et al*, in 2014 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 to correlate the angle with the patients age, gender, nationality, height, weight and body mass index (BMI).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 biliray 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 benifectual for diagnosis or prediction of diseases (Eman Abdul Rahman Mohammed Altai, Caroline Edward Ayad, Elsafi Ahmed Abdalla, 2014).

Another study conducted by Rnia *et al* in (2011) in Khartoum Sudan, aimed to Measure the Biliary confluence angle in obstructive Jaundice caused by stones and investigated the variability of the angle by age, using Magnetic resonance cholangiopancreatography (MRCP), The study population was drawn from the patients referred to MRCP for various symptoms (epigastric pain, RT hypoconderia pain. A total of 89 patients (56 women and 33men, average age 42.33 16.7) who were diagnosed as obstructive jaundice caused by stones were included and in whom MRCP shows biliary diseases or chronic parenchyma liver disease were excluded. The confluence angle was measured independently by 2 observers on coronal oblique thick-collimation images where the angle is optimum and the mean values were noted. The mean value was found to be 90.39 20.3. No statistically significant correlation was found between biliary confluence angle and age (Fadle,Rania Ahmed Mohamed.Measurement of Biliary confluence angle in obstructive Jaundice using Magnetic resonance Imaging/Rania Ahmed Mohamed Fadle 2013).

CHAPTER THREE

MATERIAL AND METHOD

3.1 materials:

3.1.1 A study design

Descriptive analytical study.

3.1.2 Study area and duration

3.1.3 Study area

The study was conducted in Sudan, Khartoum state, in the following hospitals:

Al zaytona specialized hospital (Toshiba).

Royal care hospital (Toshiba).

Dar al elaj specialized hospital (Philips).

3.1.4 Study duration

From December 2016 to February 2017.

3.1.5 Exclusion criteria

Non Sudanese patients.

Traumatic patient.

3.1.6Variable under study

Age, gender.

3.1.7 Equipment

Body phased-array

Earplugs/headphones.

Immobilization pads and straps.

3.2 Methods

3.2.1 MRI technique OF MRCP

3.2.1.1Patient positioning

All patients lied supine on the examination couch with the RC bellows securely attached. The patients were positioned so that the longitudinal alignment light lied in the midline, and the horizontal alignment light passed through the level of the third lumbar vertebra, or the lower costal margin.

3.2.2 Data collection tools and technique

All data were collected from previous mentioned hospitals in different ages and genders.

3.2.3 Method of measurement by using MRCP

3.2.3.1 MRCP technique

MR Cholangiopancreatography were obtained with a body phased-array coil with eight elements, centered below the xiphoid process, was used for signal reception. It is routinely acquire coronal and axial T2-weighted (T2W) single-shot fast spin-echo (FSE) sequences, axial respiratory-triggered fat-suppressed T2W FSE sequence, and axial breath-hold T1-weighted (T1W).(Van Hoe2001).

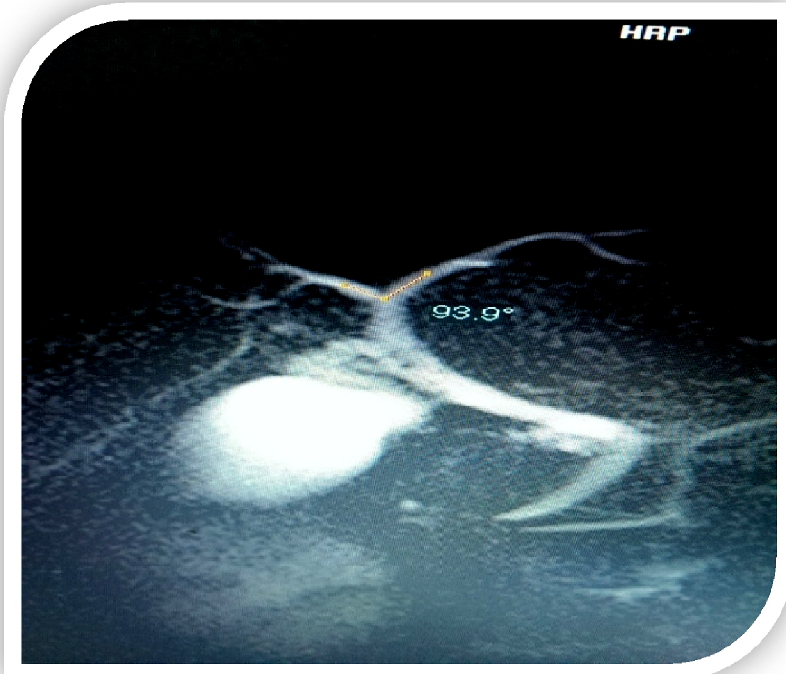

Figure 3.1 Shows the method that obtained to measure the biliary confluence angle).

(http://dergiler.ankara.edu.tr/dergiler/36/1357/15649).

3.2.5 Data analysis

Data will be analyzed using SPSS (statistical presentation system software) for windows version 14.0 evaluation.

3.2.6 Ethical consideration

Clearance from faculty and SUMASRI Institutional Review Board (SIRB) technical and ethical of SUST was approved.

Informed consent was obtained by chief of radiology department and from each hospital.

Patient information privacy and confidentiality.

CHAPTER FOUR

RESULTS

4.1 Results

Table 4.1: Shows statistical parameters for biliary confluence angle for normal patients.

	Mean	STD	Min	Max
Age	43.4	16.39	11	75
Confluence Angle	91.94	16.6	40	130
Lt hepatic duct	35.9	15.31	11	86
Rt hepatic duct	32.26	8.3	8	43

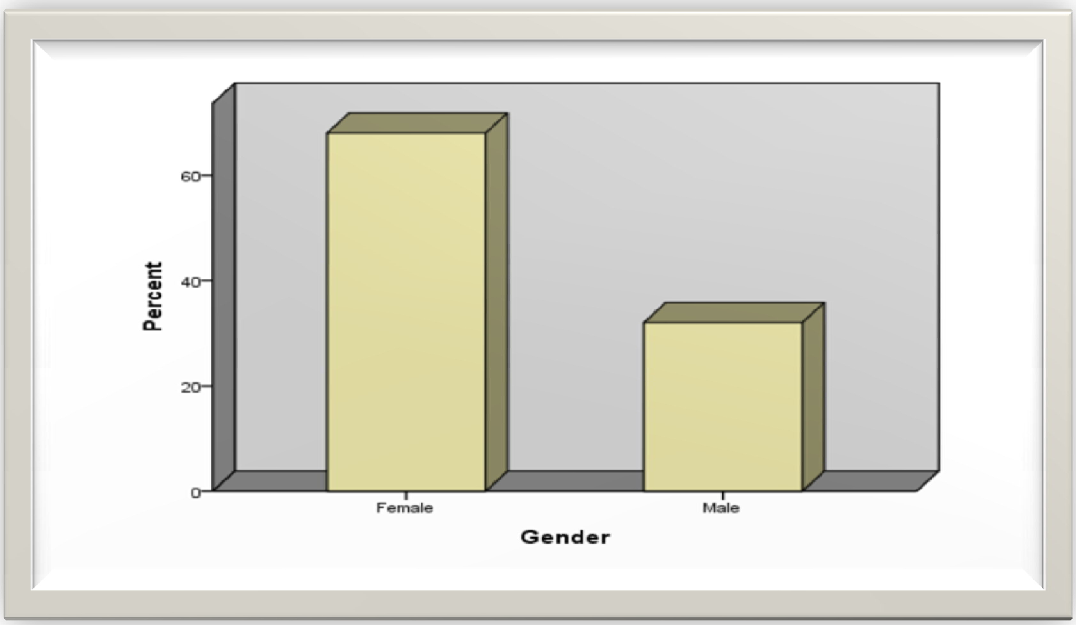

Figure 4.1: Shows a comparison between male and female normal patients.

Table 4.2: Shows statistical parameters for biliary confluence Angle of abnormal patients.

	Mean	STD	Min	Max
Age	84.52	17.59	13	85
Confluence Angle	112.34	19.53	69	450
Lt hepatic duct	42.82	15.37	11	78
Rt hepatic duct	26.08	8.15	9	44

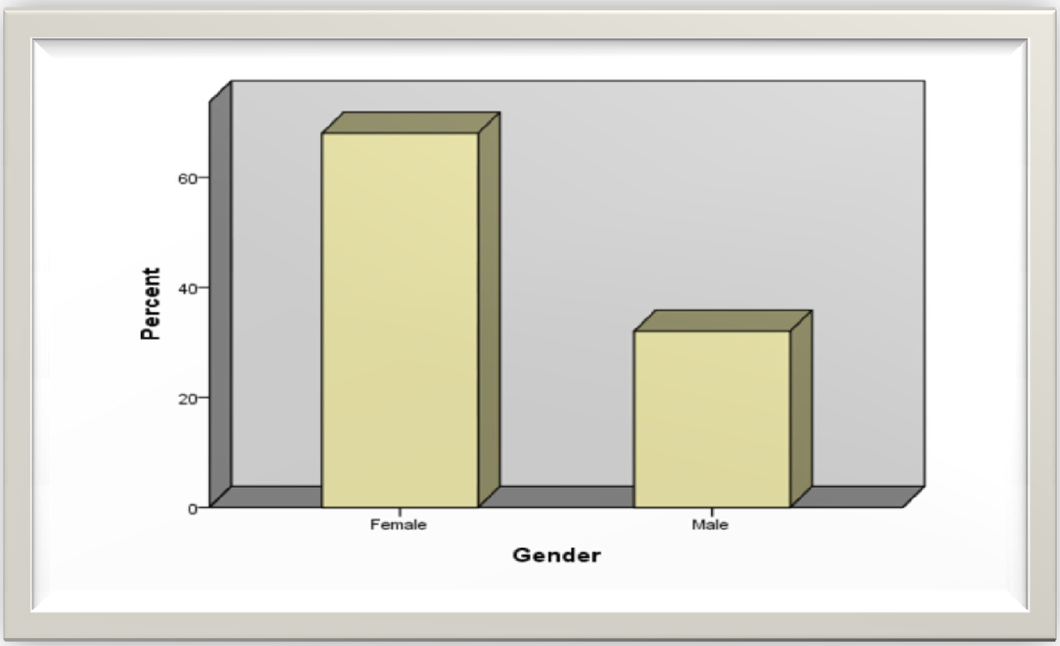

Figure 4.2: Shows a comparison between Male and Female patient for abnormal patients.

Table 4.3: Shows correlation between patient age and normal biliary confluence angle.

	p-value
Normal and abnormal confluence angle	0.005

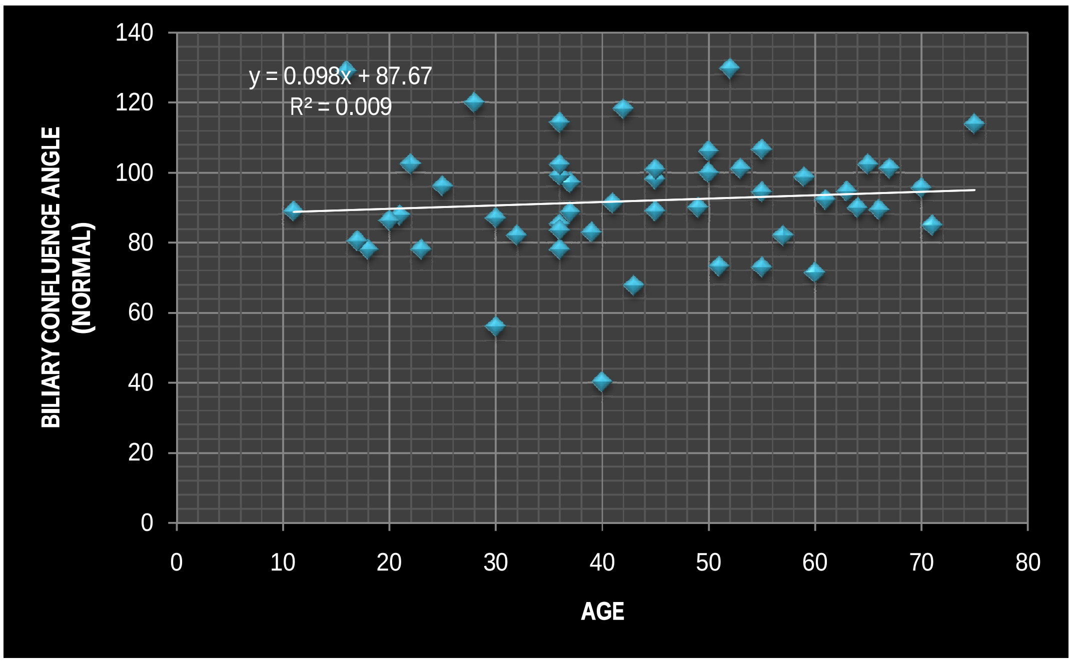

Figure 4.3: Shows correlation between patient age and normal biliary confluence angle.

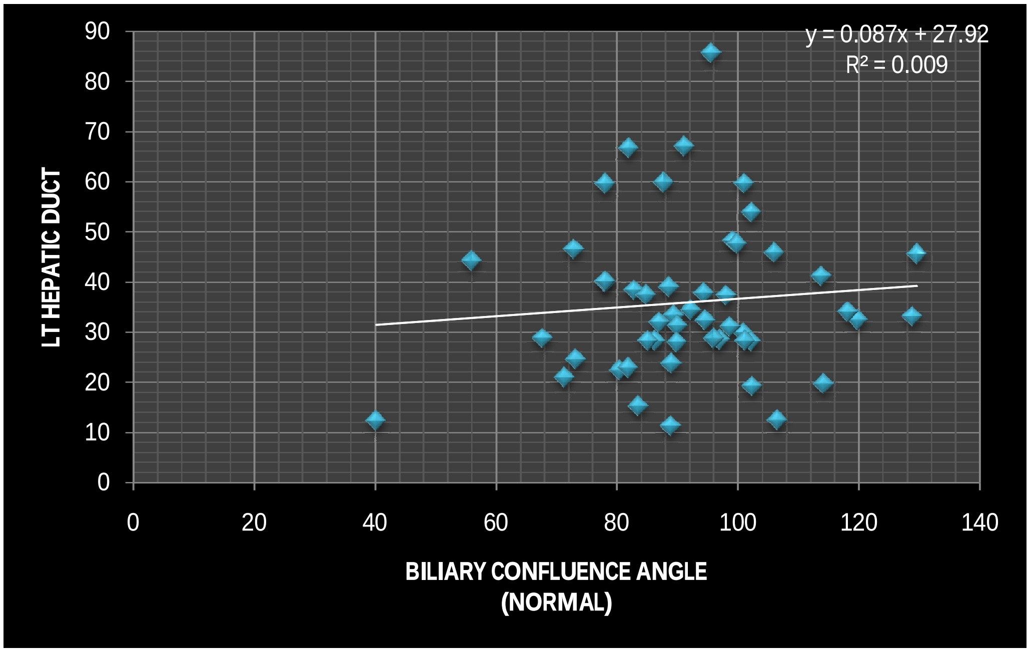

Figure 4.4: Shows correlation between left hepatic duct and normal biliary confluence angle.

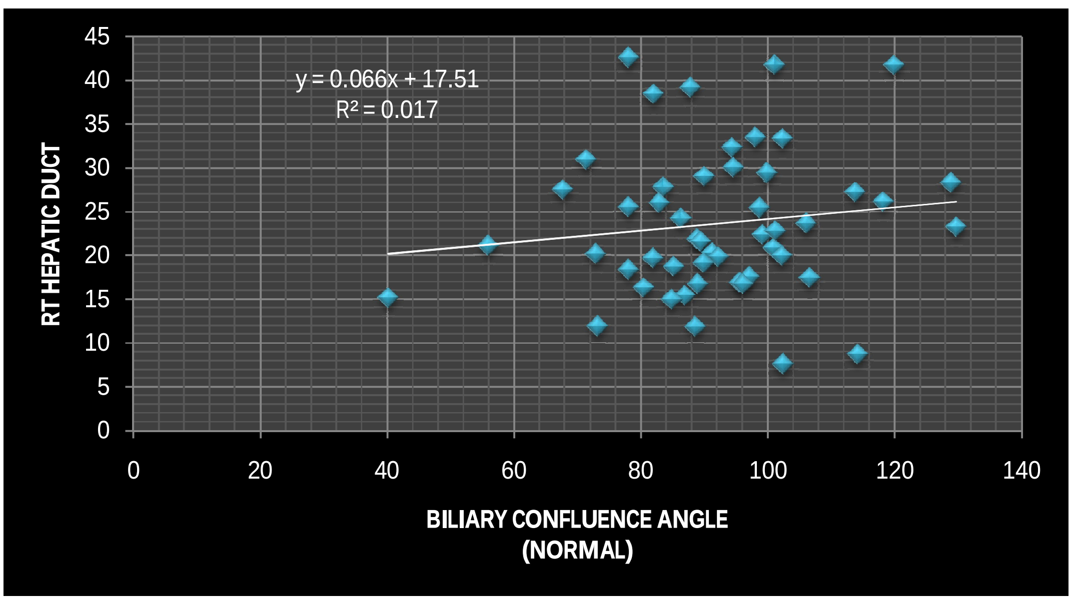

Figure 4.5: Shows correlation between right hepatic duct and normal biliary confluence angle.

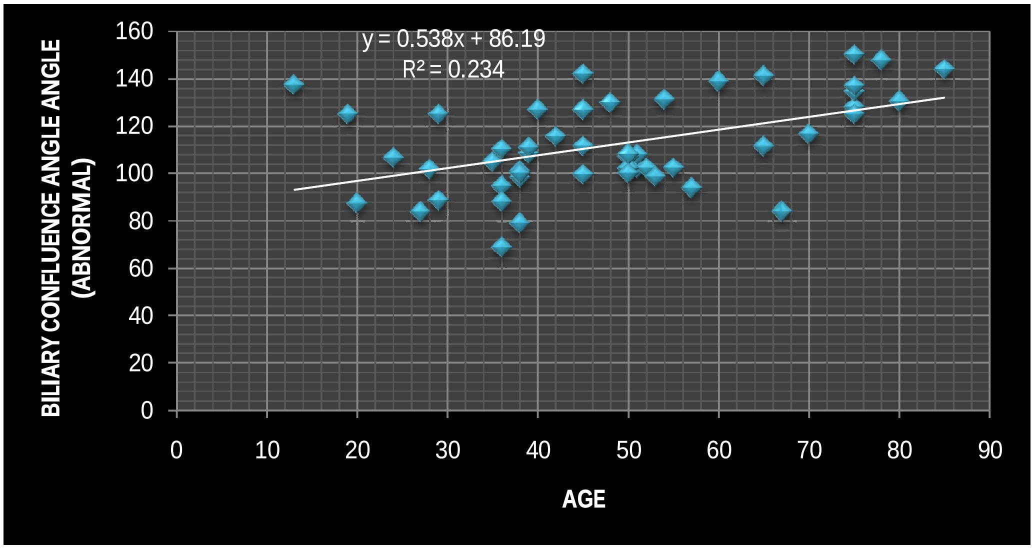

Figure 4.6: Shows correlation between patient age and abnormal biliary confluence

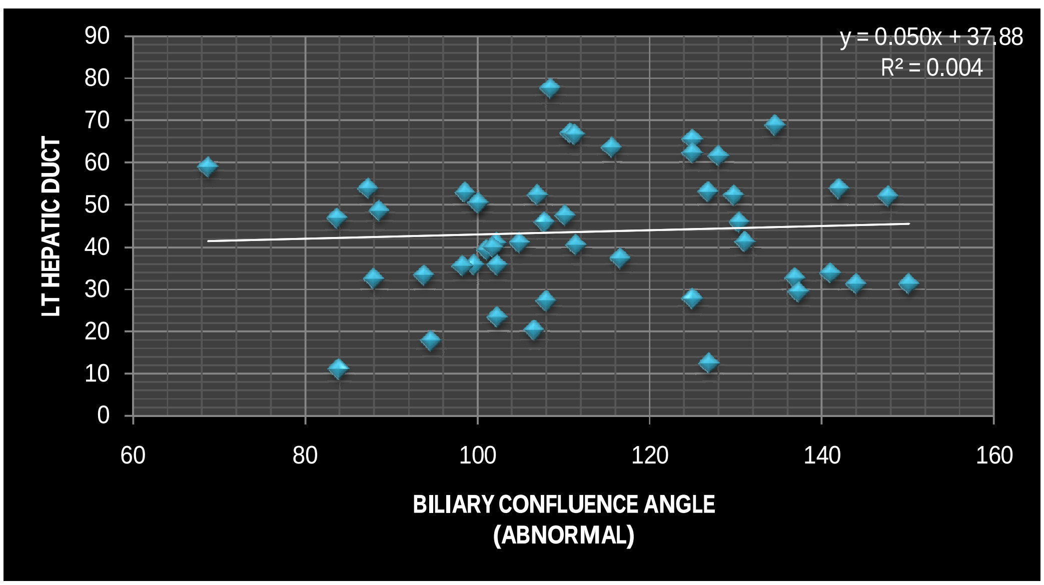

Figure 4.7: Shows correlation between left hepatic duct and abnormal biliary confluence.

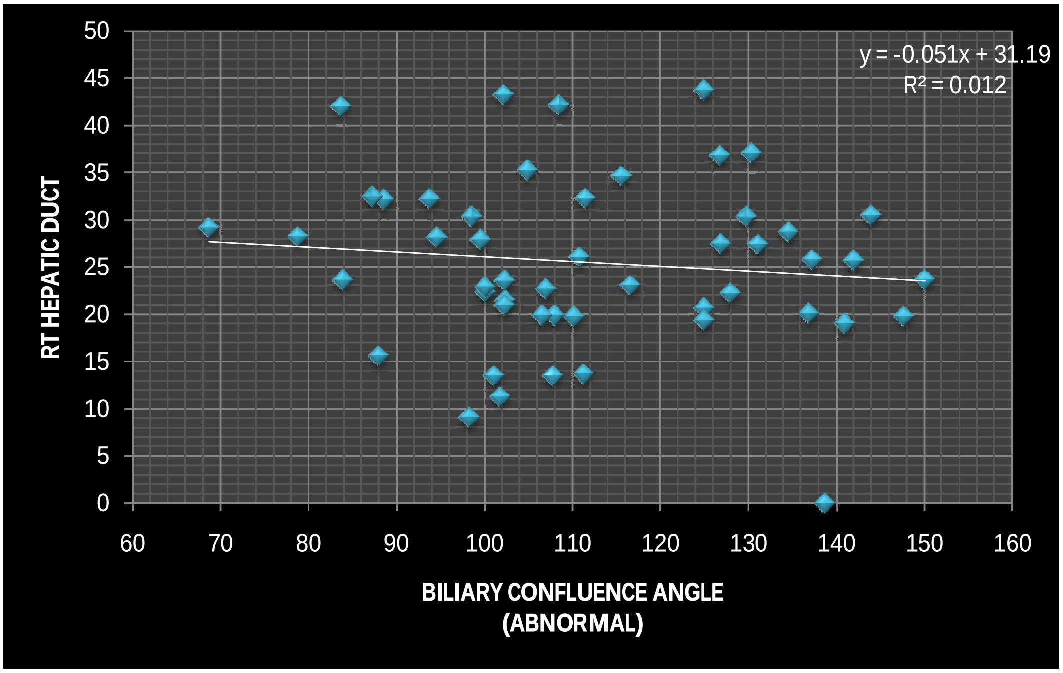

Figure 4.8: Shows correlation between right hepatic duct and abnormal biliary confluence angle.

CHAPTER FIVE

DISCUSSION

5.1 Discussion

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, when the second group was patients with obstructive jaundice.

In the first group the total of 50 normal patients were included in the study, number of male was (16) and female was (34) their mean&±SD were (43.4±16.39 mm), range from (11-75 year), weak statistically significant correlation was found between biliary confluence angle and age or gender (R^2= 0.009). In their study of 50 patients, the mean angle of the biliary confluence was about (91.94±16.6 mm) degrees.

For the same normal patients group the length for the left hepatic duct for male and female mean&±SD were found to be(35.9±15.31), there is a weak statistically significant correlation was found between biliary confluence angle and left hepatic duct (R^2= 0.009).

When the length of right hepatic duct for the same normal patients group in male and female, there mean&±SD were found to be (32.26±8.3), there is a weak statistically significant correlation was found between biliary confluence angle and right hepatic duct (R^2= 0.017).

In the second group the total of 50 abnormal patients with obstructive jaundice were included in the study, the number of male was (16) and numberfemale was (34), range from (13-35) their mean&±SD were found to be (84.52±17.59mm), there is a statistically significant correlation was found between biliary confluence angle and age, (R^2= 0.23), in the study of 50 patients, the mean angle of the biliary abnormal confluence was found to be (112.34±19.53mm) degrees.

For the same normal patients group the length of the left hepatic duct for male and female, their mean&±SD were (42.82±15.37mm), there is a weak statistically significant correlation was found between biliary confluence angle and left hepatic duct (R^2= 0.004).

When the length of the right hepatic duct for the same abnormal patients group in male and female, there mea&±SD were found to be (26.08±8.15mm), there is a weak statistically significant correlation was found between biliary confluence angle and right hepatic duct (R^2= 0.012).

There is significant difference between normal and abnormal confluence angle, the angle in normal was found to be(91.94±16.6 mm) compared to the abnormal confluence angle was found to be (112.34±19.53mm), with a giving p-value of 0.005.

Intrahepatic bile ducts form two large trunks; right and left hepatic ducts which leave the liver at the transverse fissure. The union of these trunks is the common hepatic duct and the biliary confluence angle is the angle between the right and left hepatic ducts. The confluence angle is not measured during the routine MR Cholangiopancreatography (MRCP) readings. However widening of the angle may be relevant when a mass is located in this area. In patients with intrahepatic bile duct diseases like primary sclerosing cholangitis careful attention is paid to the bile duct configuration in order not to miss signs of an early disease (Kawarada Y, Das BC, Taoka H. 2000).

MRCP is widely used as the initial imaging method to evaluate the pancreatobiliary pathologies and it has a high diagnostic accuracy. In patients with suspicion of biliary diseases, MRCP is a good non-invasive alternative to endoscopic retrograde cholangiopancreatography (ERCP) and when interpreting MRCP images the course of the bile ducts can be a clue for hepatic parenchymal changes which may cause dislocation or distortion of the ducts (doi: 10.11648/j.ajhr.2014).

Regarding to the age-related differences there is very weak differences between the age and confluence angle (R^2= 0.009).

However the confluence angle in normal Sudanese population was found to be (91.94±16.6mm), the left hepatic duct was found to be (35.9±15.31mm), when the right hepatic duct was found to be (32.26±8.3mm).

The confluence angle in patients with obstructive jaundice was found to be (112.34mm±19.53), there is a weak relation between the biliary confluence angle with age (R^2= 0.23), the left hepatic duct was found to be (42.82mm±15.37),whenthe right hepatic duct was found to be (26.08mm±8.15).

Actually there is a few studies done about confluence angle in the world, all of them ensured that there is no correlation between confluence angle and age or gender.

Eman *et al* in 2014 had a study about; Characterization of biliary confluence angle in Asian population in KSA evaluating it to correlate the angle with the patients age, gender, nationality,height , weight and body mass index (BMI).in Suleiman Fakeh Hospital in Jeddah KSA, they found thatno significant relation was found between the biliary confluence angle and the selected variables in both normal and dilated ducts.

In 2010 in Ankara University a study was done about;Normal biliary confluence angle in classical junction type assessment with MRCP.The study population was drawn for various indications; including a history of pancreatitis, pancreatic masses, liver hydatid cysts, abnormal cholestasis parameters or suspected biliary disease, test was used to analyze the correlation between the biliary confluence angle and the age, gender, and body mass index of the patients, they found that no statistically significant correlation was found between biliary confluence angle and age, gender or body mass index.

Rania Ahmed Mohamed *et al* in June, 2011 in Sudan, had a study about Measurement of Biliary confluence angle in obstructive Jaundice using Magnetic resonance Imaging, the study aimed to determine the mean biliary confluence angle on MRCP images in obstructive jaundice caused by stones, and investigated the variability of the angle by age.The mean value was found to be 90.39 20.3. No statistically significant correlation was found between biliary confluence angle and age.

5.2 Conclusion

The confluence angle is the angle that union the right hepatic duct with the left hepatic duct in the biliary system, the biliary tract collects, stores, concentrates, and delivers bile secreted by the liver. Its motility is controlled by neurohormonal mechanisms with the vagus and splanchnic nerves and the hormone cholecystokinin playing key roles. These neurohormonal mechanisms integrate the motility of the gallbladder and sphincter of Oddi (SO) with the gastrointestinal tract in the fasting and digestive phases (Kawarada Y, Das BC, Taoka H. 2000).

Magnetic resonance cholangiopancreatography (MRCP) has become the modality of choice for noninvasive evaluation of abnormalities of the biliary tract (Taourel P, Bret PM, Reinhold C, Barkun AN, Atri M1996).

This study is measured the confluence angle in Sudanese population, we found that there is very weaksignificantcorrelation between the confluence angle with age in normal patient ($R^{2=}$ 0.009),when there is a weak significant correlation between the confluence angle with age in patient with obstructive jaundice ($R^{2=}$ 0.23).

5.3 Recommendation

- Large sample size of the study.

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APPENDICES

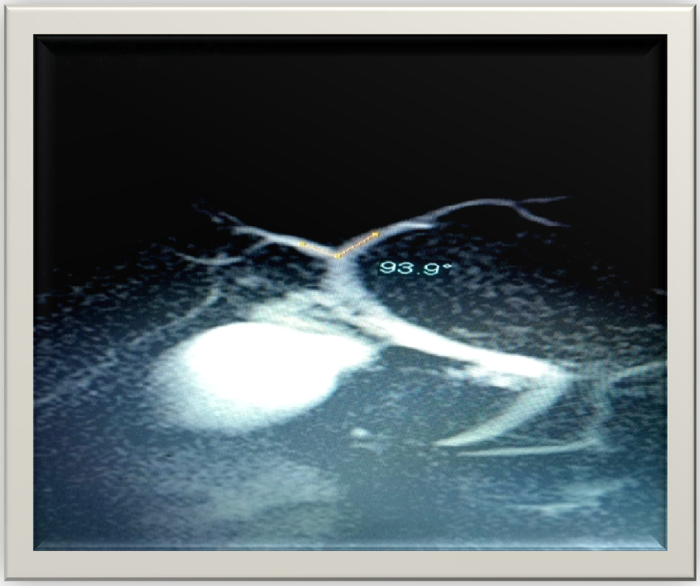

Figure: method obtained for measuring biliary confluence angle

Figure: MRI machine

Sudan university of sciences and technology

Data collection sheet

Study of Characterization of biliary confluence angle in Sudanese population using MR Cholangiopancreatography

Name of hospital
Al zaytona specialized hospital [ ]

Royal care hospital [ ]

Dar al ilaj specialized hospital [ ]

Patient age …….. years

Patient gender: male [ ] Female [ ].

Measurement ofbiliary confluence angle

Confluence angle in normal patients……………

Left hepatic duct for normal patients……………

Right hepatic duct for normal patients…………..

Confluence angle in abnormal patients………….

Left hepatic duct for abnormal patients………….

Right hepatic duct for abnormal patients………...