Sudan University for Science and Technology

Collage of Graduate Studies

Detection of Biliary System Obstruction using Magnetic Resonance Cholangio-Pancreatography and Ultrasonography

الكشف عن أسباب انسداد الجهاز المراري بواسطة الرنين المغنطيسي والموجات فوق الصوتية

A thesis Submitted For Partial Fulfillment for the ward of M.Sc. Degree in Diagnostic Radiological Technology

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الآية

"يرفع الله الذين ءامنوا منكم والذين اوتوا العلم درجات والله بما تعملون خبير "

صدق الله العظيم

سورة المجادلة الآية (11).

Dedication

To my parents

To my friend (Asrar Alkhair)

To any one hope my success.

Acknowledgement

I would like to thank Dr. Mona Ahmed Mohammed for her help and supervising.

My thanks extend to all my collages in medical field for their help in both Ibn sena and Soba universal hospitals.

Abstract:

This is prospective study to measure CBD, CHD, GB and cystic duct by U/S and MRCP and to test the accuracy of each modality in diagnosing causes of biliary system obstruction.

The study was done in Khartoum state hospitals (Ibn sena-Soba on february2018), 52 patients were tested by both U/S and MRCP.

Using U/S 3.5MHz prom, TR (1500-200ms), TI (110-150ms), TE (240-300ms), FOV (300mm) and slice sickness 1mm, those examinations were performed using siemens (0.32T) permanent magnetom, Phillips (2.5T) and siemens (1.5T), the examinations were done by U/S using Fukuda, Toshiba and Sheimadzo machines.

Ducts were measured by two technologists in each hospital and images diagnosed by two radiologists and two sonologists.

measurements were done for CBD, cystic duct and GB, the causes of obstructive jaundice were detected as CBD stones, cystic duct stones, GB stones, GB mass and Ca-head of pancreas.

The accuracy test was applied to determine the accuracy of each modality and it found that MRCP is the most accurate in measuring CBD (70.8%) while for U/S is (29.2%) and CA (61.1%), while for U/S is (38.9%), but U/S is most accurate in measuring GB (100%) and cystic duct stone (55.6%), while for MRICP (44.4%). As well as the most effected age group is 31-40 years (76.5%).

المستخلص:

أجريت هذه الدراسة لقياس القناة الصفراوية العامة، القناة الكبدية العامة، الحويصلة الصفراوية والقناة الكيسية كما أجريت لتقييم دقة كل من الموجات فوق الصوتية والرنين المغنطيسي في تشخيص أسباب انسداد القنوات المرارية في حالة وجود اليرقان الانسدادي وعدمه.

أجريت الدراسة في مستشفيات ولاية الخرطوم (ابن سينا– سوبا الجامعي– فبراير 2018) لعدد 52 مريض من الذكور والإناث تم فحصهم بالموجات فوق الصوتية والرنين المغنطيسي.

باستخدام تردد 3.5 ميقاهيرز وتقنية الرنين المغنطيسي باستخدام زمن الراحة الأول والثاني بتكرار نبضات (155–2000مل ثانية)، زمن استقبال نبضة (240–300 مل ثانية)، زمن انقلاب (110–150 مل ثانية) ومساحة تعريض (300مم) وسمك مقطع (1مم).

أجريت الفحوصات باستخدام جهاز رنين مغنطيسي ماركة سيمنز بقوة مجال (0.32 تيسلا) وفليبس (1.5 تيسلا)، كذلك جهاز موجات فوق الصوتية فكودا، توشيبا وشيمارزو.

تم تشخيص الصور تحت الدراسة بقياس القنوات بواسطة عدد (2) تقني وعدد (1) اخصائي واخصائي موجات صوتية.

تم القياس للقناة الصفرواية العامة والقناة الكيسية والحويصلة الصفراوية وتم تشخيص أسباب اليرقان الانسدادي ووجد أن الأسباب هي الحصوات وسرطان رأس البنكرياس وأورام القنوات المرارية.

تم تطبيق اختبار لإيجاد درجة الدقة وخلصت الدراسة إلى أن تقنية الرنين المغنطيسي أكثر دقة من الموجات فوق الصوتية في قياس القناة الكبدية العامة (70.8%) في حين كان ذلك (29.2%) للموجات الصوتية وسرطان رأس البنكرياس (61.1%) و (38.9%) للموجات الصوتية، بينما الموجات فوق الصوتية أكثر دقة في قياس القناة الصفراوية وذلك بنسبة (100%) الحويصلة الصفراوية والقناة الكيسية (55.6%) و (44.4%) للرنين المغنطيسي. كما أن أكثر الفئات عرضة للمرض هي (31–40) سنة وذلك بنسبة (76.5%).

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List of abbreviation

MRCP:	Magnetic Resonance Cholangio Pancreatography.
U/S:	Ultra Sound.
CBD:	Common Bile Duct.
CHD:	Common Hepatic Duct.
GB:	Gall Bladder.
ERCP:	Endoscopic Retrograte Cholangio Pancreatography.
mm:	Millimeter.
ms:	Millisecond.
MHZ:	Mega Herz.
TE:	Time to Echo.
TI:	Inversion Time.
TR:	Repetition Time.
T1:	Spin-lattice relaxation time.
T2:	Spin-Spin relaxation time.
RT:	Right.
LT:	left.
DM:	Diabetic Meatus
HTN:	Hypertensive

Chapter one
Introduction

Chapter one

Introduction

1.1 Introduction:

Biliary obstruction may be due to tumors like (Cancer head of pancreas) and stones (GB stones and CBD stones).

Causes of jaundice can be classified into pre-hepatic, hepatic and post hepatic, magnetic resonance cholangiopancretografy (MRCP) is being used increasingly in the evaluation of patient with jaundice.

Early report suggested that the (MRCP) diagnosis of obstructed jaundice is dependent on demonstration of dilated intrahepatic biliary ducts, the problem is one of differniating non-obstructive from obstructive jaundice.

(MRCP) often demonstrate dilation of extra hepatic biliary tree as well as intra hepatic duct.

(MRCP) can help in the identification of subject of patients who required immediate intervention.

And it can save patients from unnecessary ERCP.

The use of MRCP as second line imaging tool complementing ultrasound can improve the management of patient who have suspected biliary obstruction (Lippin Cott, 2007).

1.2 Problem of the study:

Obstructive jaundice is fatal disease effect the productive age groups.

Although the ultrasound in the most common diagnostic examination, there no definite criteria that confirm its accuracy rather than other modalities, there for

MRCP compared with U/S will confirm and show obstructive causes as well as it will increase diagnostic value.

1.3 Objectives of the study

General objectives:

To study biliary obstruction by MRCP and U/S

Specific objectives:

- To detect the cause of obstruction

- To measure and locate the stones

- To correlate the presence of stones and obstructive jaundice.

1.4 Importance of the study:

This study will enhance diagnosis and cause of biliary obstruction as well as this will facilitate the selection of the best modality.

Chapter two

Literature Review and previous studies

Chapter two

Literature Review

2.1 Anatomy:

The biliary tree is composed of the intra hepatic ducts, common hepatic duct (CHD) and common bile duct (CBD).

The CHD is defined as the portion of the extra hepatic bile duct distal to main RT and LT ducts and proximal to insertion of the cystic duct, the length of CHD is variable.

The cystic duct and CHD travel caudally to form CBD, the mean diameter of CHD is 4 mm, (Con Lon, 1998).

The CBD is defined as abortion of extra hepatic duct that extend from junction of cystic duct and CHD to level of ampulla of vator where it joint main pancreatic duct, the mean diameter of CBD is 6mm, (Con Lon, 1998).

The gallbladder is round or oval structure located on the inferior margin of the liver the normal GB wall is (1-3mm).

The lymphatic drainge pathways from GB and bile duct include the: cystic duct node and retro-portal node, (Con Lon, 1998).

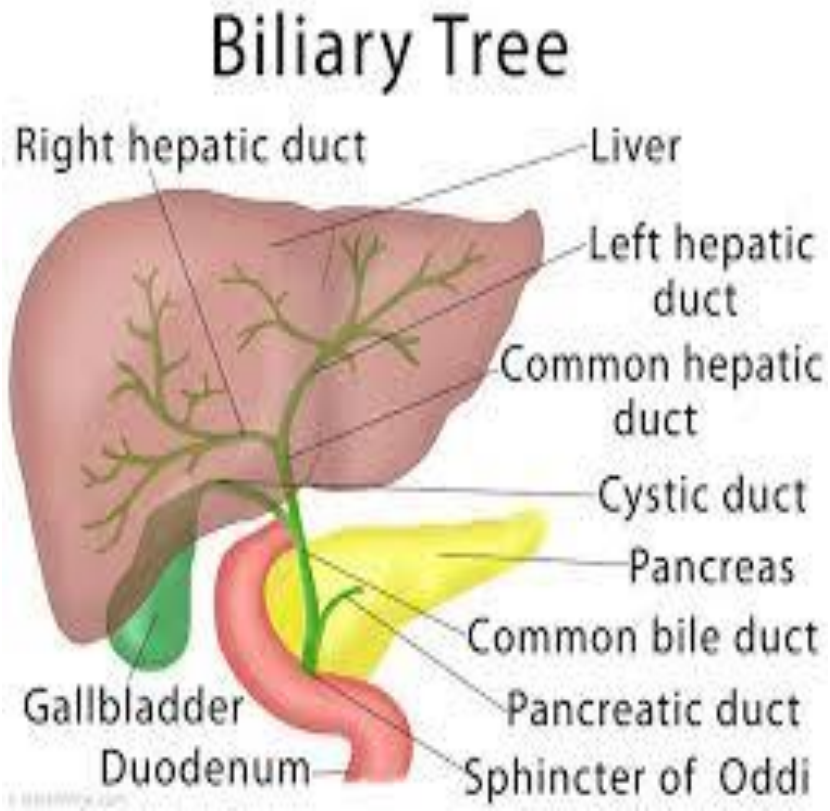

Fig. (2.1): Anatomy of libiary system

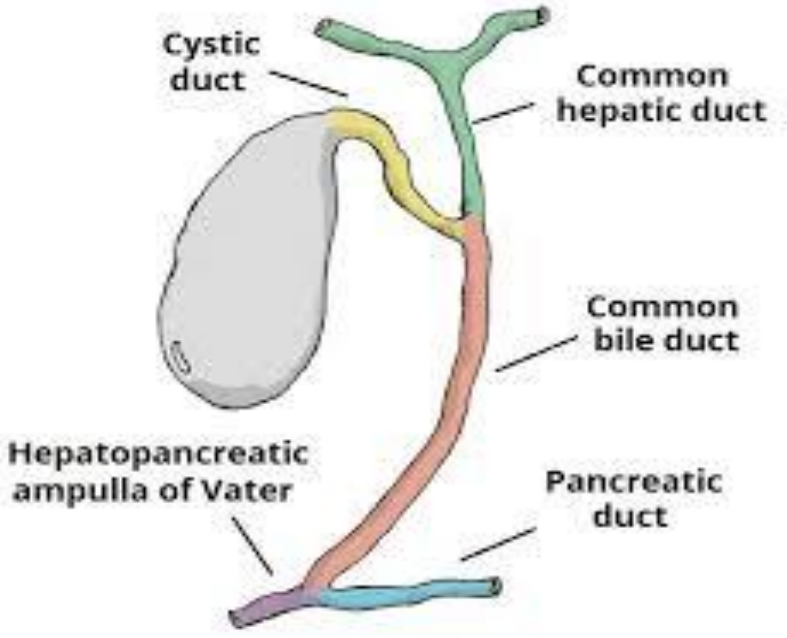

Fig. (2.2): Anatomy of libiary system

2.2 Function of the biliary cyst:

about 50% of bile produce by liver stored in GB when foods is eaten GB is contract and release stored bile into dudenum the bile is used to help the body digest food at time GB contract and push the bile into CBD that carry it to small intestine.

Bile contain water, cholesterol, fats, bile salt, proteins and bilirubin, (Consine, 2003).

The cystic duct carries the bile to and from GB and CBD, (Consine, 2003).

2.3 Pathology of the biliary system:

2.3.1 Gall Stone

Types of Gall stone:

1- Choledrtol Stone:

- Pure; (10%).
- Mixed (90%)

2- Pigment Stone:

Risk Factor of Cholesterol Stone:

- Female
- Obesity
- Diabetic meatus
- Pregnancy.

Carcinoma of gall bladder:

- Age (60-70)
- Sex: mostly female.
- Etiology

Clinical features:

1- Right upper qutral pain.

2- Anorexia

3- Jaundice

4- Hepatomegaly.

2.3.2 Cholngio Carcinoma:

Carcinoma of the bile duct equally both sex increase incidence in ulcerative Colitis.

2.3.3 Jaundice:

It is important topic for examination because patient may have acute of chronic liver disease

Mechanism of jaundice:

Production: increase bilirubin in blood may arise in 4 ways:

1- Over production

2- Decrease hepatic up take

3- Decrease hepatic conjugation

4- Disturbance of excretion

Types of jaundice.

- Hemolytic jaundice
- Congental hyper bilirubinema
- Cholestasis jaundice.

Cholestatic jaundice

Types:

1- Hepatocellular jaundice

- Causes-
- Viral hepatitis
- Cirrhosis

2- Obstructive jaundice

Causes:

- Common duct stone.

- Carcinma of:
  - Head of pancreas.
  - Ampulla.
  - Bile duct, (Mohammed Enam, 2004).

2.4 Imaging of the billiary tract:

Sonography is the primary imaging modality in the evaluation of gallbladder disease, it has sensibility (87-90) of detecting biliary obstruction.

One of the most disadvantage of MRCP is in an ability to assess bile ducts strictures.

2.5 image appearance in MRCP and U/S:

2.5.1 MRCP appearance:

The normal intra-hepatic bile duct not visible on conventional T1 and T2 weighted images but they are routinely visible on gadolinium enhance images.

The normal extra hepatic ducts frequently seen on routine T1 and T2 weighted images,

But they are best visualized on T2 weighted image and gadolinium enhance image.

Various studies were published last year's J formos and etal in 1997 in 3D MRCP for evaluation of biliary obstruction to assess diagnostic value of MRCP in diagnosis of cause of biliary obstruction.

In 1994 3D MRCP performed on 31 patients with abdominal pain and biliary obstruction, (James, 2004).

2.5.2 Sonographic appearance of the biliary:

Patient must be fast at least (8-12) hr before U/S examination GB identified as sonolucend structure located anterior to Rt kidney, small echogenic folds of GB seen clearly, large GB has been detected in Pt with diabetes and pancereatitis.

On transverse scan the common bile duct, hepatic artery and portal vein have been referred to (Mickey Mouse sign), (Consine, 2003).

On sagital scan the Rt hepatic artery passes posterior to common duct, the common duct seen anterior to portal vein, the portal vein seen as sonolucent structure anterior to IVC.

A further advance U/S techniques performed in previous studies. Young choiet in 2015 diagnostic U/S of bile duct include doppler color flow imaging power mode, a new technique contrast enhanced ultrasonography added for diagnostic U/S of bile duct disease, (Sandara, 2001).

Previous Studies:

Kilander (2008), study on progresses of patient with jaundice, reported that patients' of (30-40) is the most effected group.

James (2018), Obstructive jaundice, (30) cases with history of cholocy stectomy, found that varied etiology is one of the main causes of obstruction

Ayman Ahmed (2010), Study of biliary system by MRCP and U/S in cases of obstructive jaundice, resulted to MRCP is more accurate than U/S in detecting obstructive jaundice depending on cause of obstructive.

Chapter three
Materials and Methods

Chapter three

Materials and Methods

This is prospective study to evaluate the MRCP and U/S in diagnosing the cause of biliary system obstruction, as well as to find out the best modility to demonstrate anatomical structure.

3.1 Materials:

3.1.1 Patient:

The populatic study consisted of (50) patient male and female their age between (20-40) yrs they were clinically have obstructive or non-obstructive jaundice due to CBD stone or Ca-head of pancreas.

3.1.2 Equipment:-

The images were taken by MRI machines include:

SEMENS AG2006-GE1’5T- body coil.

And also taken by U/S machine include: Trans abdominal probe 3’5 MHZ-Toshiba-Sheimodzeu.

3.2 Area of the study:-

The study was done in khartoum state hospitals: Ibn-senaa, Soba universal hospital- Dar El- alag hospital.

3.3 Method of data collection:

The data were collected from pt. sent to MRI and U/S and also collected from data collection sheet which divided to: Age, Gender, family history, obstructive or Non-DM-H.T.

The technique use in MRCP is:

Coronal single shot breath hold.

Using parameter TR(1500-2000)ms , TI(110-150)ms , TE(240-300)ms, slice thickness(1)mm and for abdominal U/S: transverse scan were performed to identify GB and to separate it from small stones pt must be in up RT position.

3.4 method of data analysis:

Comparative and relationship analytical methods are executed using the SPSS statistical program based on descriptive statistics and comparative hypothesis tests (0.05 sig. level), to demonstrate the differences between patients in (**obstructive jaundice)** according to their (age, gender, DM and HTN).

Chi-square test is used to study the hypothesis which states there are no significant differences between patients in (obstructive jaundice).

Chapter Four

Results

Chapter Four

Results

In this chapter, the researcher deals with the application of statistical processes under which the data be analyzed to conclude the results.

Table 4.1: distribution of participants according to gender:

Gender	Frequency	Percent
Male	18	34.6
Female	34	65.4
Total	**52**	**100.0**

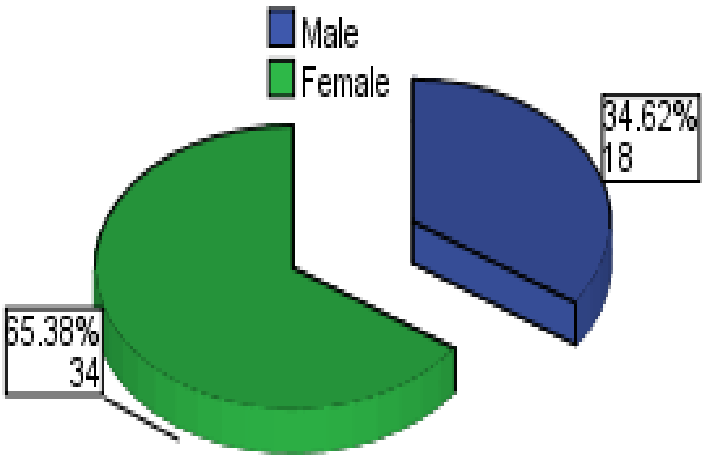

Figure 4.1: distribution of participants according to gender

Table 4.2: distribution of participants according to age:

Age	Frequency	Percent
20-30 Years	6	11.5
31-40 Years	17	32.7
41-50 Years	11	21.2
51-60 Years	7	13.5
61-70 Years	9	17.3
More than 70 Years	2	3.8
Total	**52**	**100.0**

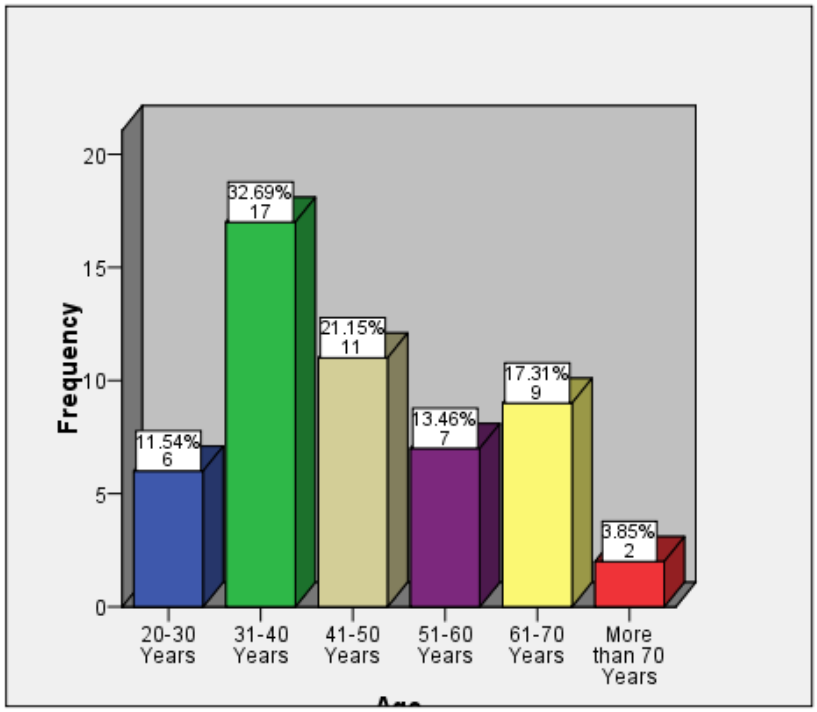

Figure 4.2: distribution of participants according to age

Table 4.3: distribution of participants with obstructive jaundice:

Obstructive jaundice	Frequency	Percent
+ve	36	69.2
-ve	16	30.8
Total	**52**	**100.0**

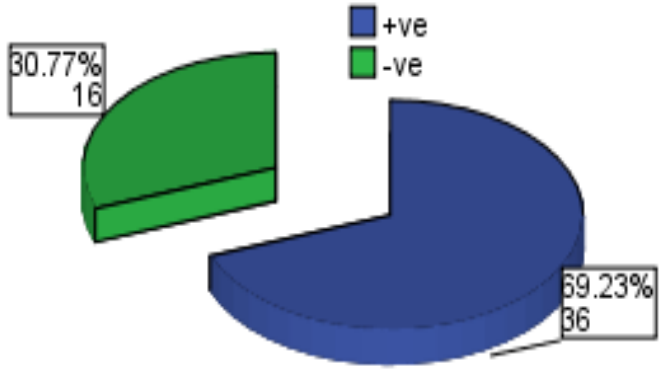

Figure 4.3: distribution of participants to obstructive jaundice

Table 4.4: distribution of participants with develop Diabetic Meatus:

DM	Frequency	Percent
+ve	4	7.7
-ve	48	92.3
Total	**52**	**100.0**

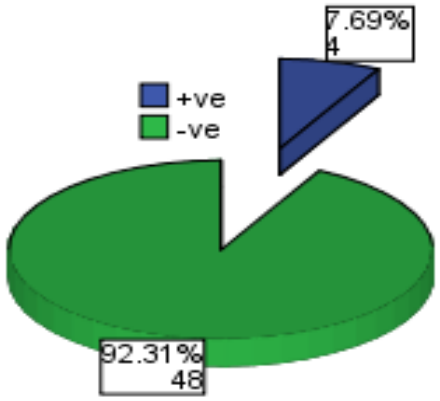

Figure 4.4: distribution of participants to develop Diabetic Meatus

Table 4.5: distribution of participants to develop HTN:

HTN	Frequency	Percent
+ve	6	11.5
-ve	46	88.5
Total	**52**	**100.0**

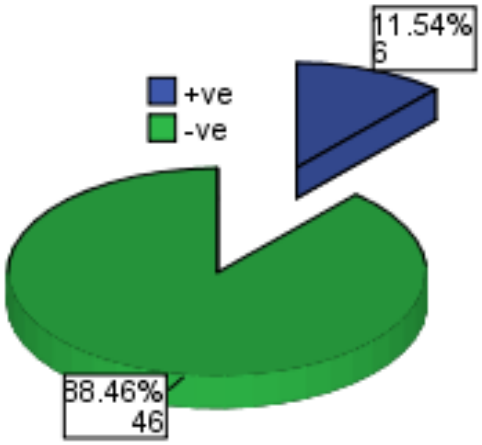

Figure 4.5: distribution of participants to develop HTN

Table 4.6: Chi-square test for association between obstructive jaundice and age:

			Age					
			20-30 Years	31-40 Years	41-50 Years	51-60 Years	61-70 Years	More than 70 Years
Obstructive jaundice	+ve	N	3	13	7	4	7	2
		%	50.0%	76.5%	63.6%	57.1%	77.8%	100.0%
	-ve	N	3	4	4	3	2	0
		%	50.0%	23.5%	36.4%	42.9%	22.2%	.0%
Total		**N**	**6**	**17**	**11**	**7**	**9**	**2**
		%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.299	5	0.654
Likelihood Ratio	3.809	5	0.577

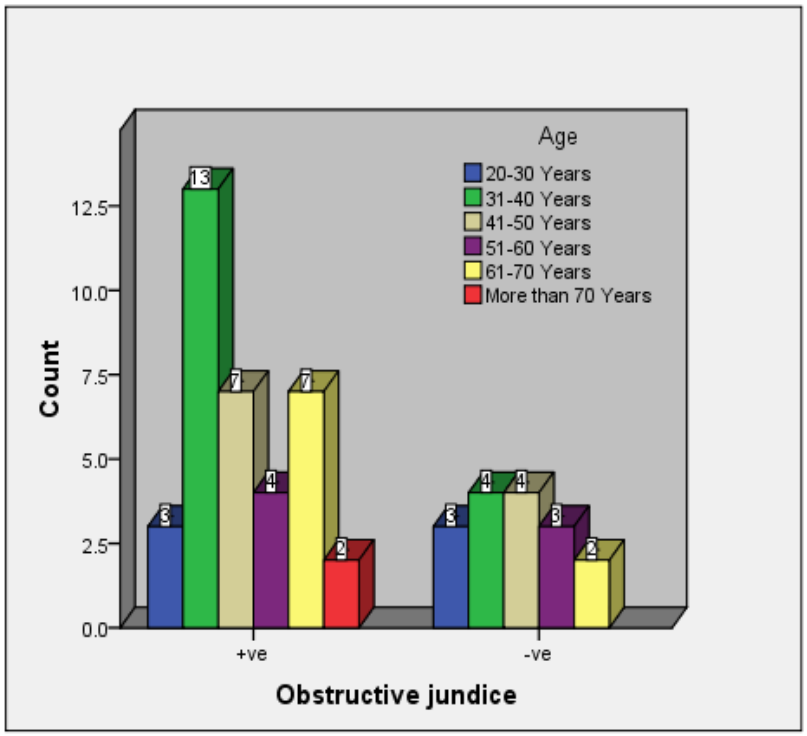

Figure 4.6: distribution of obstructive jaundice with respect to age

Table 4.7: Chi-square test for association between obstructive jaundice and gender:

			Gender	
			Male	Female
Obstructive jaundice	+ve	N	15	21
		%	83.3%	61.8%
	-ve	N	3	13
		%	16.7%	38.2%
Total		**N**	**18**	**34**
		%	**100.0%**	**100.0%**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.570	1	0.109
Likelihood Ratio	2.739	1	0.098

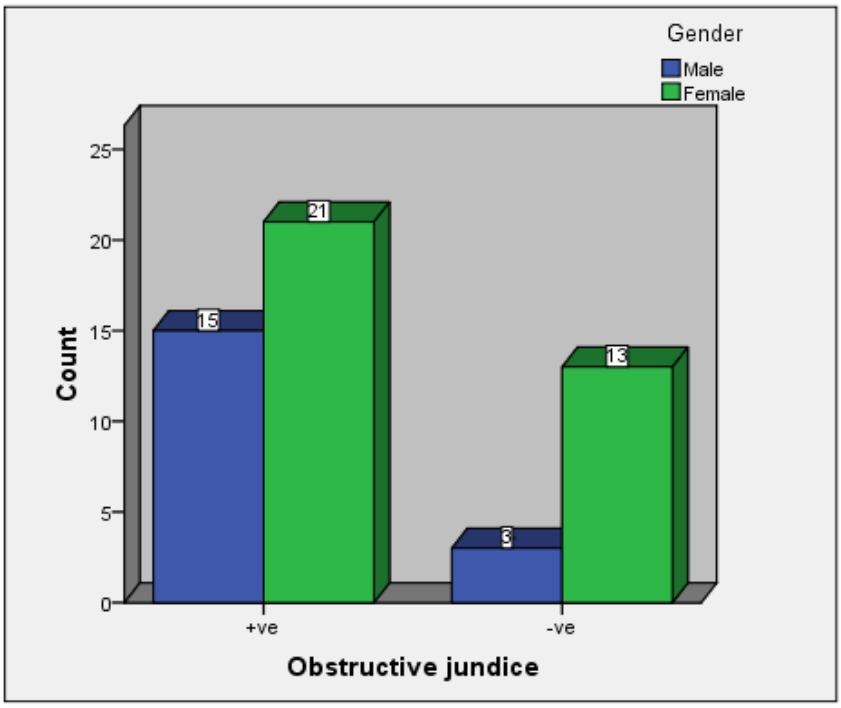

Figure 4.7: distribution of obstructive jaundice with respect to gender

Table 4.8: Chi-square test for association between obstructive jaundice and diabetes:

			DM	
			+ve	-ve
Obstructive jaundice	+ve	N	2	34
		%	50.0%	70.8%
	-ve	N	2	14
		%	50.0%	29.2%
Total		N	**4**	**48**
		%	**100.0%**	**100.0%**

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.752	1	0.386
Likelihood Ratio	0.699	1	0.403

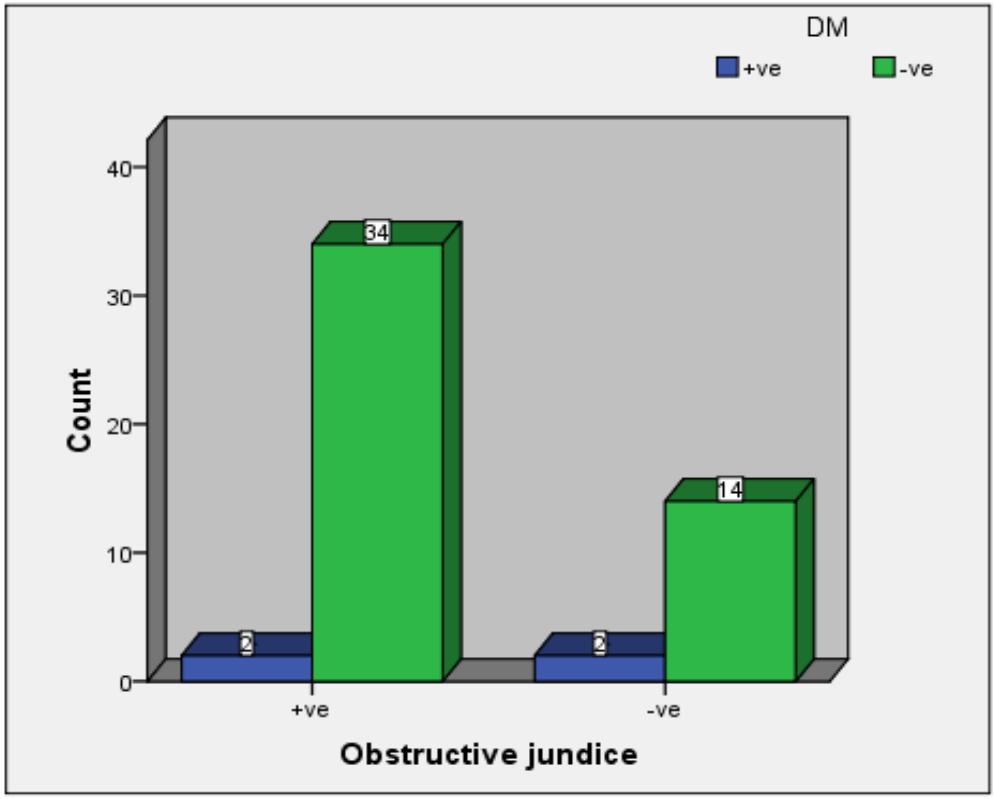

Figure 4.8: distribution of obstructive jaundice with respect to diabetes

Table 4.9: Chi-square test for association between obstructive jaundice and hypertension:

			HTN	
			+ve	-ve
Obstructive jaundice	+ve	N	4	32
		%	66.7%	69.6%
	-ve	N	2	14
		%	33.3%	30.4%
Total		**N**	**6**	**46**
		%	**100.0%**	**100.0%**

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.021	1	0.885
Likelihood Ratio	0.021	1	0.886

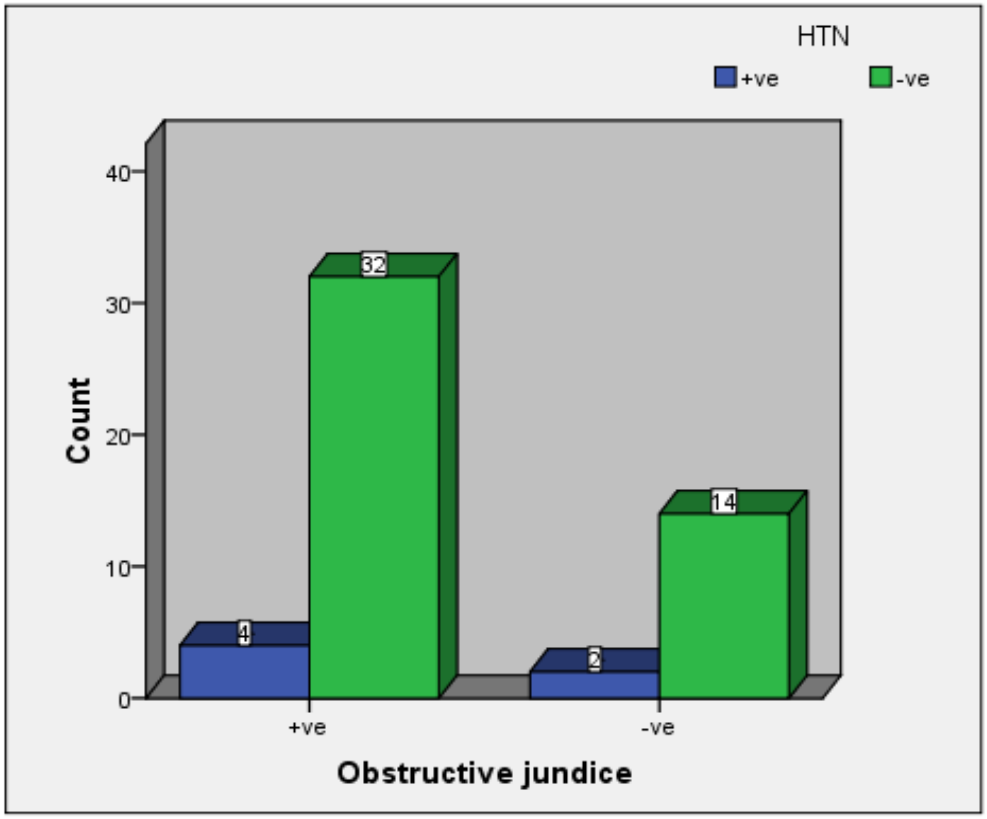

Figure 4.9: distribution of obstructive jaundice with respect to hypertension

Table 4.10: Chi-square test for association between obstructive jaundice causes and its diagnosing method:

			Finding		
			MRCP	U/S	Total
Cause	CBD stone	N	17	7	24
		%	70.8%	29.2%	100.0%
	Ca-head Pancreas	N	11	7	18
		%	61.1%	38.9%	100.0%
	Cystic duct stone	N	4	5	9
		%	44.4%	55.6%	100.0%
	GB stone	N	0	7	7
		%	.0%	100.0%	100.0%
	GB mass	N	4	7	11
		%	36.4%	63.6%	100.0%
	Undetected	N	0	3	3
		%	.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.985	5	0.007
Likelihood Ratio	19.996	5	0.001

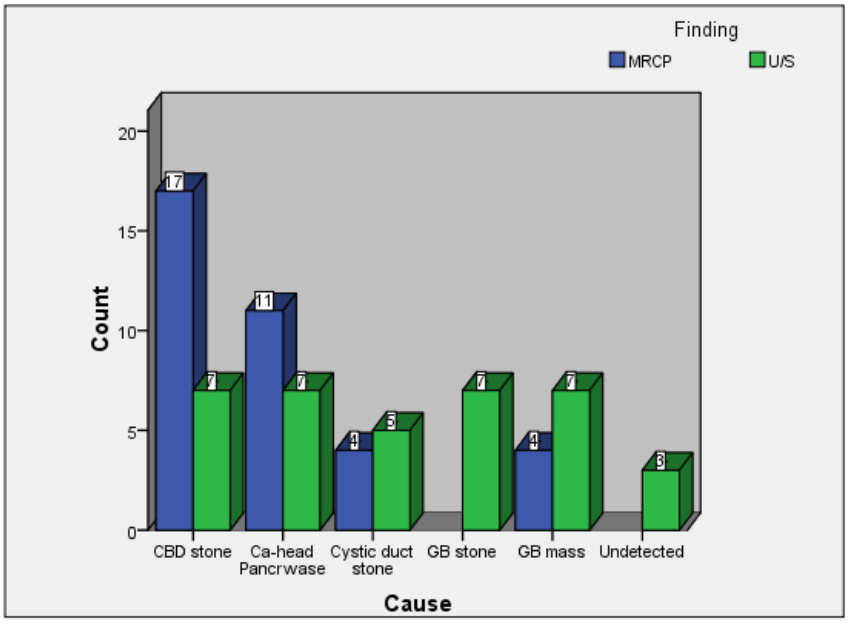

Figure 4.10: distribution of obstructive jaundice diagnosing method with respect to its causes

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

1-5 Discussion:

This is prospective study was done to identify the accuracy of U/S and MRCP in diagnosis causes of biliary obstruction P-value show statistical significance of U/S and MRCP.

Most (65.4%) of participants are females, since (34.6%) of them are males, (Table (4.1) and figure (4.1)).

Patients of 31-40 years old were the most (32.7%) participants and (21.2%) of them were 41-50 years, since (17.3%) of them were 61-70, (13.5%) of them were 51-60 and (11.5%) of them were 20-30 years old, while only (3.8%) of were more than 70 years old, (Table (4.2) and figure (4.2)).

Most (69.2%) of participants were obstructive jaundice positive, while (30.8%) of them didn't develop obstructive jaundice, (Table (4.3) and figure (4.3)) as same as Kilender, (2018).

Only (7.7%) of participants were diabetics, while the majority (92.3%) of them were not, (Table (4.4) and figure (4.4)).

Only (11.5%) of participants were hypertensive, while the majority (88.5%) of them were not, (Table (4.5) and figure (4.5)).

Similarly most of participants for all age groups (50%, 76.5%, 63.6%, 57.1% and 77.8%), respectively for 20-30, 31-40, 41-50, 50-60, 60-70 and more than 70 years old were positive, while (50%, 23.5%, 36.4%, 42.9%, and 22.2%) of them were negative, were obstructive jaundice positive. The probability of the chi-square test statistic (Likelihood Ratio) is Sig. = 0.577, which is greater than the alpha level of

significance of 0.05. Thus the hypothesis that differences in “obstructive jaundice development” is related to age is not supported and obstructive jaundice is independent on age, (From the table (4.6) and figure (4.6)), as the same as (Ayman Ahmed 2010).

The study found that (83.3% and 61.8%) of both fame and female participants, respectively were obstructive jaundice positive while (16.7% and 38.2%) of them were negative. The probability of the chi-square test statistic (Likelihood Ratio) is Sig. = 0.098, which is greater than the alpha level of significance of 0.05. Thus the hypothesis that differences in “obstructive jaundice development” is related to gender is not supported and obstructive jaundice is independent on gender, (table (4.7) and figure (4.7)).

(50%, 70.8%) of both diabetics and non-diabetics participants, respectively were obstructive jaundice positive, while (50%, and 29.2%) of them were negative. The probability of the chi-square test statistic (Likelihood Ratio) is Sig. = 0.403, which is greater than the alpha level of significance of 0.05. Thus the hypothesis that differences in “obstructive jaundice development” is related to diabetes is not supported and obstructive jaundice is independent on diabetes, (table (4.8) and figure (4.8)).

Most (66.7%, 69.6%) of both hypertensive and non-hypertensive participants respectively were obstructive jaundice positive, while (33.3% and 30.4%) of them were negative. The probability of the chi-square test statistic (Likelihood Ratio) is Sig. = 0.886, which is greater than the alpha level of significance of 0.05. Thus the hypothesis that differences in “obstructive jaundice development” is related to hypertension is not supported and obstructive jaundice is independent on hypertension, (table (4.9) and figure (4.9)).

MRCP can diagnose most of obstructive jaundice that caused by (CBD stone, 70.8% compared to 29.2% for U/S or Ca-head Pancreas 61.1% compared to 38.9% for U/S), while U/S can diagnose most of obstructive jaundice that caused by (Cystic duct stone 55.6% compared to 44.4% for MRCP, GB stone 100% compared to 0.00% for MRCP, GB mass 63.6% compared to 36.4% for MRCP or undetected causes 100% compared to 0.00% for MRCP). The probability of the chi-square test statistic (Likelihood Ratio) is Sig. = 0.001, which is less than the alpha level of significance of 0.05. Thus the hypothesis that MRCP and U/S are different in diagnosing “obstructive jaundice development” is related to its cause is supported and obstructive jaundice diagnose is depend on its cause, (table (4.10) and figure (4.10)) as the same results of (Ayman Ahmed, 2010).

5-2 Conclusion:

This study is attempt to identify the accuracy of both U/S and MRCP in detection causes of biliary system obstruction.

The study conclude that MRCP can measure CHD and CBD better than U/S while the later is better in measuring GB and cystic duct as shown in accuracy test, also concluded that DM and HTN have no effect.

5-3 Recommendation:

This study can be extend to include other methods to study anatomy, site and cause of obstruction.

For intra hepatic and CBD examination MRCP is recommended while U/S is recommended in case of GB diseases and measurement.

The study may extend to involve lab investigations using Doppler technique.

Past history of patients must written in MRI request to choose suitable technique.

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Appendices

JCDR

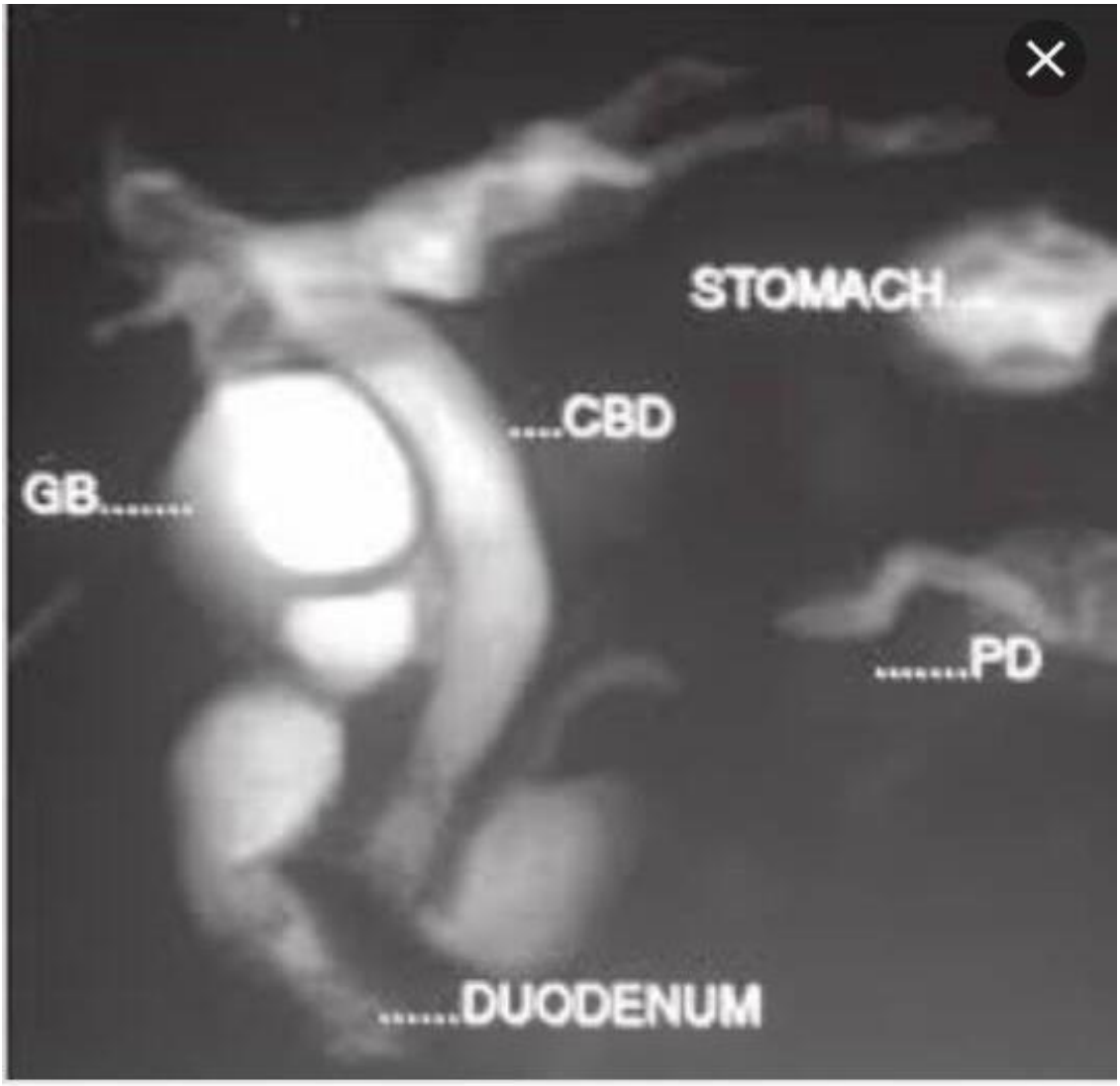
JCDR - Choledocholithiasis, MRCP, ERCP

Coronal MRCP projectional image showing dilated IHBR and CBD till lower end with a meniscus sign in its distal end suggestive of choledocholithiasis,

Ultrasound Image Gallery

A Gallery of High-Resolution, Ultrasound, Color Doppler & 3D ...

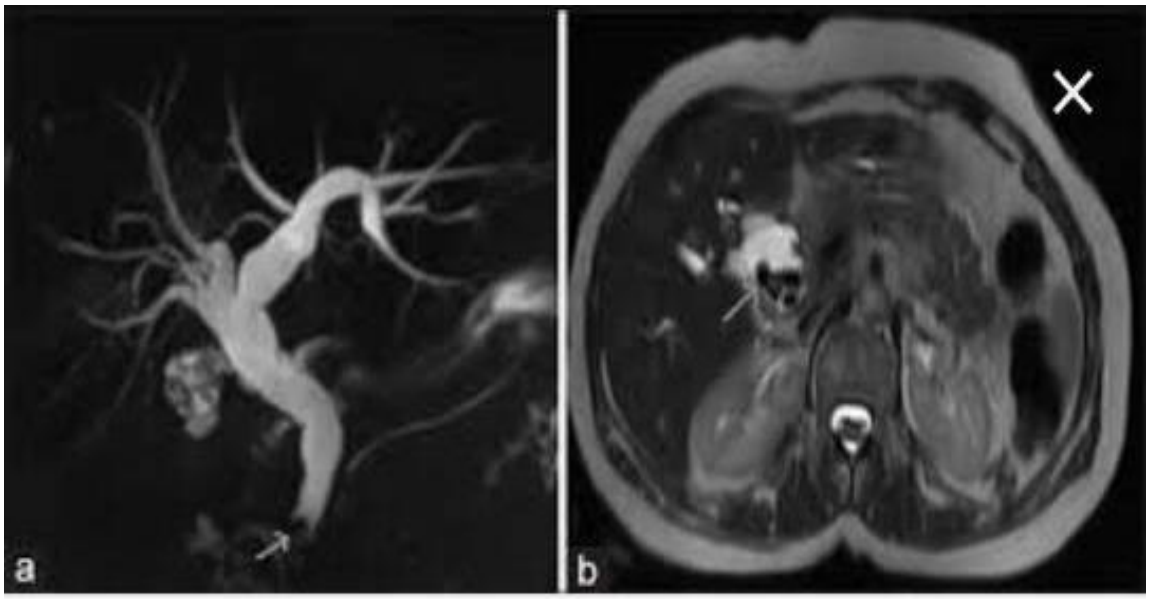
Cholangiocarcinoma of the CBD



ResearchGate

MRCP showing dilated common bile duct with no identifi- able ca...

MRCP showing dilated common bile duct with no identifi- able cause of biliary obstruction GB



West African Journal of Radiology

The value of magnetic resonance cholangiopancreatography in th...

The value of magnetic resonance cholangiopancreatography in the detection of choledocholithiasis Mandelia A, Gupta AK, Verma DK, Sharma S - West Afr J ...

The Radiology Assistant

The Radiology Assistant : Biliary Ducts - pathology

Ultrasound Image Gallery

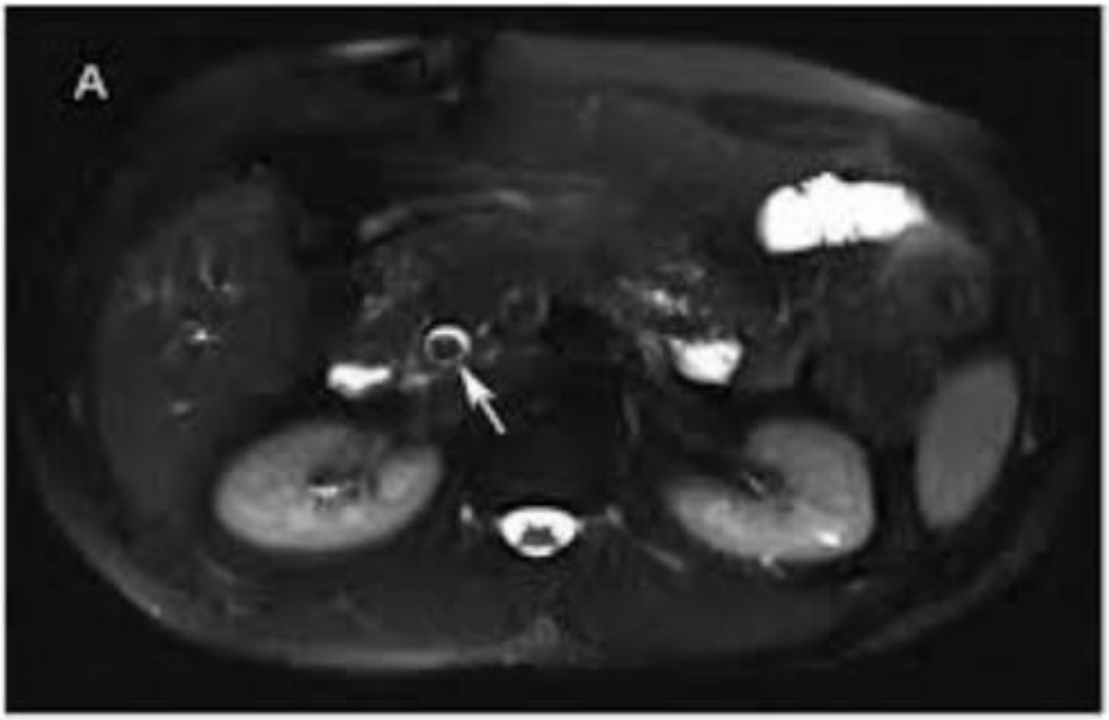
A Gallery of High-Resolution, Ultrasound, Color Doppler & 3D ...

3-D ultrasound imaging of gall bladder calculi

Medscape eMedicine

Gallbladder Mucocele: Practice Essentials, Background, Pathop...

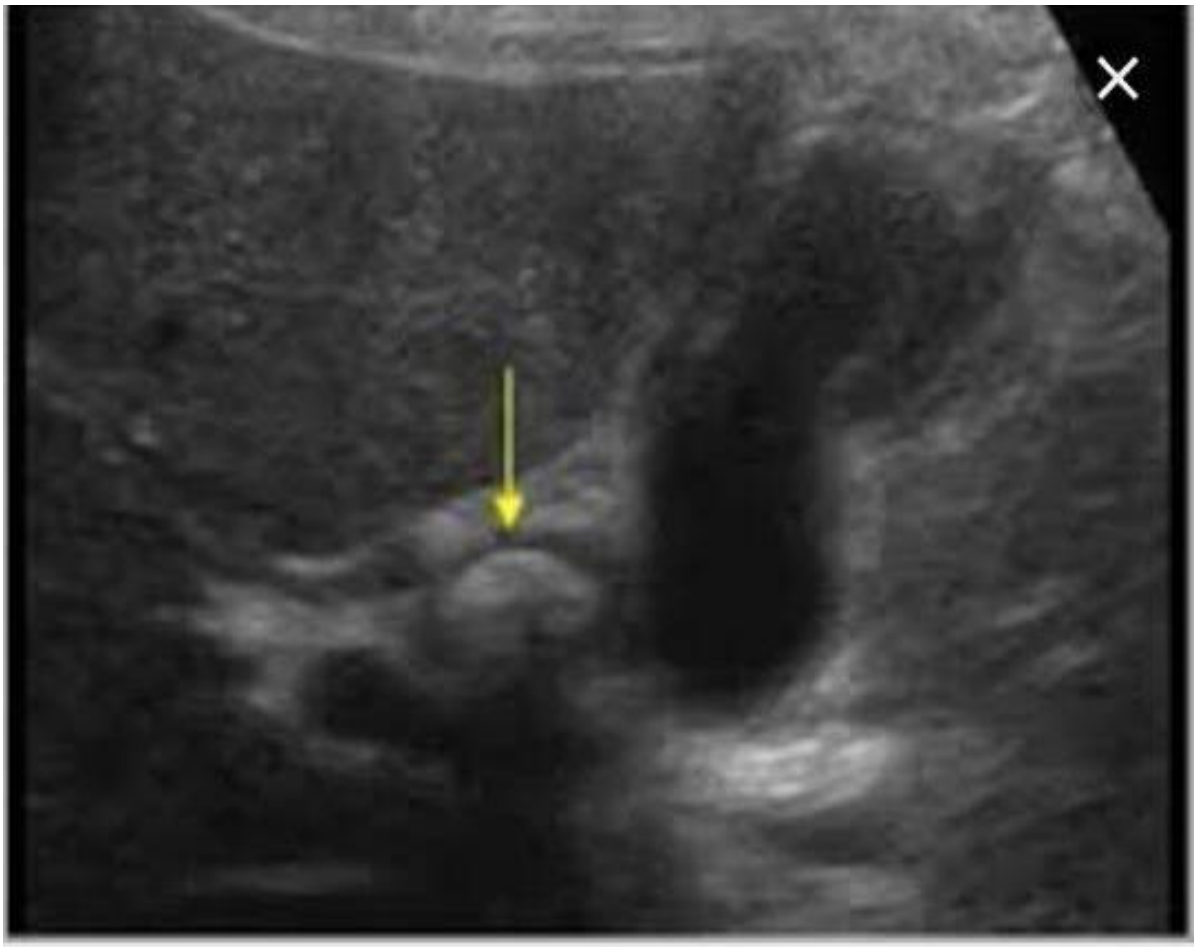
Stone in neck of gallbladder, with postacoustic sh



SlideShare

Obstructive jaundice: concerned investigations

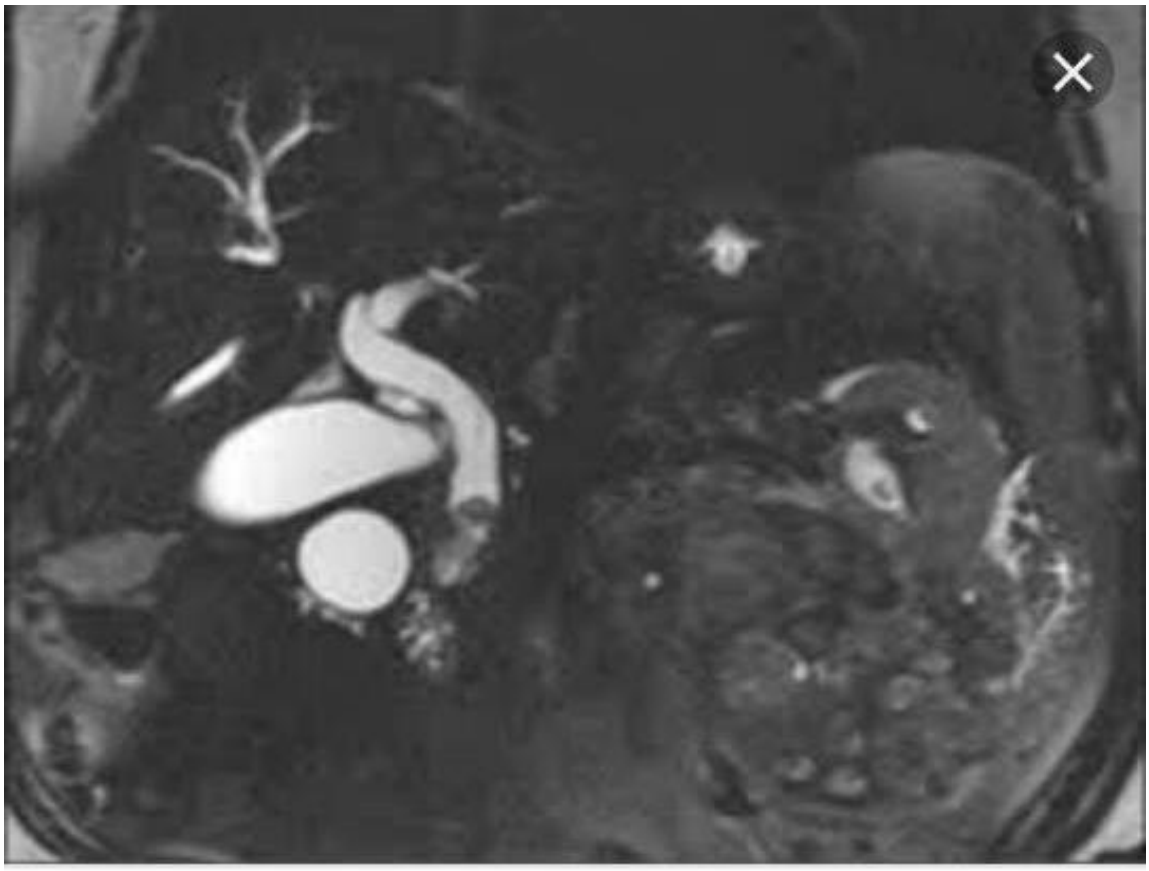
... showing choledocholithiasis; 22. MRCP Showing choledocholithiasis ...



Ultrasound Cases

Ultrasound Cases

Stone in the cystic duct



Open-i

MRCP showing a filling defect in the distal common bile | Open-i

MRCP showing a filling defect in the distal common bile duct with biliary dilation.