Diagnosis of Biliary Duct Obstruction by Magnetic Resonance Imaging Cholangiography

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ABSTRACT

Magnetic resonance cholangiopancreatography (MRCP) is a valuable method for the evaluation of Biliary Ducts obstruction and a valuable alternative to endoscopic retrograde cholangiopancreatography (ERCP). It is noninvasive and does not require the use of contrast material or ionizing. To evaluate the accuracy of magnetic resonance (MR) cholangiopancreatography in the diagnosis of Biliary Ducts Obstruction.

this study included 30 patients with biliary obstruction in baqubah hospital in diyala during the period from 1 February 2023 to 1 April 2023 . MRCP performed on a 1.5 T MRI system, using a phased-array body coil. Of 28 patients majority of the case were found 41-60 year age groups. Among 60.7% were male, and 39.3% were female. Predominant symptoms in the study group were jaundice . Overall benign obstruction was more common It was 79.5%, while the malignant was 21.5%.22 patients were suffering from stones in the gallbladder or in the common bile duct. There were also

3 cases of gallbladder cancer, 2 cases of pancreatic head cancer, and 1 case of liver tumor MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies

Keywords: Biliary Duct Obstruction, Imaging Cholangiography

Introduction

The biliary ducts is part of the digestive system. BILE DUCTS are divided into : intrahepatic , extrahepatic .The intrahepatic duct joining with cystic duct (the gallbladder duct) to formed The common bile duct passes through part of the pancreas before it joins with the pancreatic duct and transport bile that helps digest food(fat) into the first part of the small intestine (the duodenum) at the ampulla of Vater [1] .

Biliary obstruction refers to a blockage of any duct that carries bile from the liver and from the gallbladder to the small intestine. This can occur at any of thelevels of the biliary system and can lead to serious complications such as hepatic dysfunction, renal failure, nutritional deficiencies, bleeding problems, and infections The symptoms of biliary obstruction result from the accumulation of bilirubin and alkaline phosphates in the blood . can lead to jaundice and pruritus. Biliary obstructions may be caused by benign or malignant diseases of the alimentary tract. The main cause of benign biliary obstruction is choledocholithiasis due to gallstone formations .[2] Other benign causes include strictures post cholecystectomy, in-flammatory stricture formation secondary to cholangitis, pancreatitis. The malignant process also promotes the formation of biliary strictures Malignant obstructions are most commonly caused by cholangiocarcinoma and pancreatic cancer. Other causes are gallbladder cancer, compression by malignant lymph nodes, and metastasis.[3] Biliary obstruction is common and affects a large portion of the world population, causing significant morbidity and mortality. The most common etiology of biliary obstruction is choledocholithiasis or gallstones, causing extra hepatic bile duct blockage. The most serious manifestation of thisis the development of infection in the bile ducts called cholangitis, which can befatal if not treated promptly.[4]

Magnetic resonance Cholangiopancreatography (MRCP) is a non-invasive imaging technique It requires neither contrast medium injection nor biliary endoscopic intervention; therefore, it completely avoids the formidable complications inherent to conventional cholangiography examinations.[5] able to provide projectional images of the bile ducts. Different sequences, using both breath-hold and non-breath-hold acquisition techniques, have been employed in order to obtain MRCP images. considering both three-dimensional non-breath- hold techniques and two-dimensional breath-hold, multi- slice and thick slab sequences. Clinical applications of MRCP are evaluated, presenting data from both the literature and personal experience. The main indication for MRCP study is represented by the evaluation of common bile duct obstruction, with the aim of assessing the presence of the obstruction (accuracy 85-100%) and, subsequently, its level (accuracy 91-100%) and its cause . The utility of associating conventional MR images to MRCP in malignant strictures, in order to characterize and stage the malignant lesion, is also discussed. Finally, data are presented regarding the indications and the utility of MR- pancreatography in the evaluation of patients with pancreatic duct anomalies and chronic pancreatitis.[6-7]

1.1 Literature Review

In[2019] Mohamed Farouk Aggag et al. The purpose of this article is to describe the protocol for evaluation of obstructive with use of magnetic resonance cholangiopancreatography sequence of MRI and to describe the imaging features of the most common causes of obstructive jaundice primary sclerosing cholangitis, and pancreatic head carcinoma Aim of work: this work aimed to study and evaluate the role of MRCP in patients with biliary obstruction. Patients and Methods: this study included 30 patients with biliary obstruction during the period from December 2017 to October 2018. MRCPwas performed on a 1.5 T MRI system, using a phased-array body coil.

Results: in all cases, MRCP displayed the different parts of the biliary tract andlocalized the exact site of obstruction in all of the obstructed cases. According to the morphology encountered at the site of obstruction, MRCP was found highly specific in differentiating the calcular, malignant and benign causes of obstruction. Conclusion: MRCP should be the next step following depiction of biliary obstruction by U/S. Consequently in the near future there will be no place for the diagnostic use of the ERCP which shall be then restricted to a therapeutic role.[8]

In [2019] Shaik Farid1 , R et al.objective of the study was to determine the accuracy of MRCP in the evaluation of patients with obstructive jaundice. Method and Materials: In the evaluation of patients with obstructive jaundice, MRCP was conducted in the Department of Radio Diagnosis, Sree Balaji Medical college and Hospital. A total number of twenty five patients suffering from obstructive jaundice of all age groups and either sex were included in this study. Total of Twenty five patients with clinical diagnosis of obstructive jaundice were included in the study. MRCP was done in all the patients Results: A total of twenty five patients suffering from obstructive jaundice underwent MRCP. Out of the twenty five patients, ten patients had benign causes of obstructive jaundice, while fifteen patients had malignant causes of obstructive jaundice. MRCP had an accuracy of 97% in detecting the cause of obstructive jaundice. In diagnosing the site of obstruction MRCP had an accuracy of 100%. Conclusion: In the diagnosis of obstructive jaundice and to know the cause, site and extent of the lesion MRCP being a non invasive, non ionizing procedure seems to be a accurate and better choice.[9]

In [2015] kushwah AP et al . This prospective study was conducted on 50 patients, who were referred to the Radiology Department of NSCB Medical College Hospital, Jabalpur from September 2012 to October 2013 was carried out to modalities magnetic resonance cholangiopancreatography [MRCP]) for

the evaluation of biliary duct system and to the diagnostic MRCP in the patients suspected of obstructive biliary tract pathology. Result: Of 50 patients majority of the case were found 51-60 year age groups. Among 60% were female, and 40% were male. Predominant symptoms in the study group were jaundice in 46 patients (92%). Overall malignant obstruction was more common while MRCP was sensitive in 93.7% and specific in 97% in benign lesion as a cause of obstruction while among malignant lesion as a cause of obstructions MRCP was 97% sensitive and 93.7% specific 98% while it was 100% on MRCP. while only 2 cases were falsely diagnosed by MRCP among all 50 cases. Conclusion: MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies. [10]

In [2014] Anagha Josh et al . The purpose of this article is to describe the protocol for evaluation of obstructive jaundice with use of magnetic resonance cholangiopancreatography sequence of MRI and to describe the imaging features of the most common causes of obstructive jaundice Conclusion In this newer era of imaging where multiple imaging modalities ranging from simple radiograph to most advanced MRI are available, it is the role of radiologist to guide the clinician in selecting the right imaging modality and to answer the questions which are important in patient management. Although ultrasound remains a screening modality for diagnosis of biliary obstruction, it is unable toanswer the true extent and cause of obstructive jaundice requiring the use of another imaging modality like MRCP which scores over ultrasound in the diagnostic accuracy. MRCP can be considered as the new gold standard for the investigation of biliary obstruction. [11]

In[2010] F. MACCIONI et al. (MRCP) is a valuable method for the evaluation of biliary and pancreatic diseases and a valuable alternative to endoscopic retrograde cholangiopancreatography(ERCP).it is noninvasive and does not require the use of contrast material or ionizing radiation. Currently, MRCP is widely performed as a primary imaging modality for the assessment of obstructive jaundice and other benign or malignant biliopancreatic ducts

abnormalities. The primary MRCP application is the evaluation of biliary obstructions due to choledocholithiasis, iatrogenic strictures, cholangiocarcinoma or pancreatic carcinoma. Whenever needed, the MRCP may be completed with a conventional contrast-enhanced magnetic resonance imaging (MRI) of the upper abdomen and functional studies as well, thusproviding a functional study of the pancreas and biliary system. More recent applications include the possibility of 3D reconstructions and the use of hepatobiliary contrast agents, that provide a higher definition of the biliary tree,both in pathologic and normal conditions. Conclusions: In the next years therole of MRCP will further expand, due to the availability of faster sequences, 3D imaging and functional studies.[12]

1.2 General Objective

To evaluate the accuracy of magnetic resonance (MR) cholangiography in the diagnosis of bile duct obstruction.

1.3 specific objectives

Firstly , to distinguish between the types of obstruction. Secondly , Find the benefits MRI in diagnosis the different types of obstruction

2.1 Biliary Ducts Anatomy

The bile ducts are a tubular anatomical part of the human digestive system, andthe pathway through which bile (a juice that helps digest food) flows from the liver to the duodenum is as follows: Hepatocytes pass through the ducts between the hepatocytes to the center of the acini, to join the small bile ducts (Fig.1). Small bile ducts inside The right and left lobes of the liver join to form two larger ducts that emerge from the lower surface of the liver as the right and left hepatic ducts [1]. These two bile ducts immediately join to form one bile duct called the common hepatic duct. The common hepatic duct merges with the cystic duct from the gallbladder to form the common bile duct [13]. Thelatter opens into the descending part of duodenum called ampulla of Vater . This papilla is located 7 to 10 cm below the pyloric opening from the stomach. In general, the biliary tract is divided into three parts: the intrahepatic bile ducts, the extrahepatic bile ducts, and the gallbladder[14]

Intrahepatic Bile Ducts; The biliary drainage of the right and left lobes of liver is into the right and left intrahepatic bile ducts, respectively. The right hepatic duct is formed from

the unification of the right posterior and right anterior segmental ducts. The left hepatic duct is formed by the unification of the three segmental ducts draining in the left side of the liver. The left hepatic duct crosses the base of segment IV in a horizontal direction to join the right hepatic duct and form the common hepatic duct.[15]

Extrahepatic bile ducts; The common hepatic duct is joined by the cystic duct (from the gallbladder) to form the common bile duct .The common bile duct travels initially in the free edge of the lesser omentum, then courses posteriorly to the duodenum and pancreas to unite with the main pancreatic duct to form the ampulla of Vater, which drains at the major duodenal papillae on the medial wall of the D2 segment of the duodenum .[16]

The gallbladder is a pear-shaped musculomembranous sac located along the undersurface of the liver. It functions to accumulate and concentrate bile between meals. The normal adult gallbladder measures from 7- 10 cm in lengthand 3-4 cm in transverse diameter 6. The gallbladder communicates with the rest of the biliary system by way of the cystic duct, with bidirectional drainageof bile to and from the common hepatic duct. it may be divided into the following segments : fundus _body _neck[17]

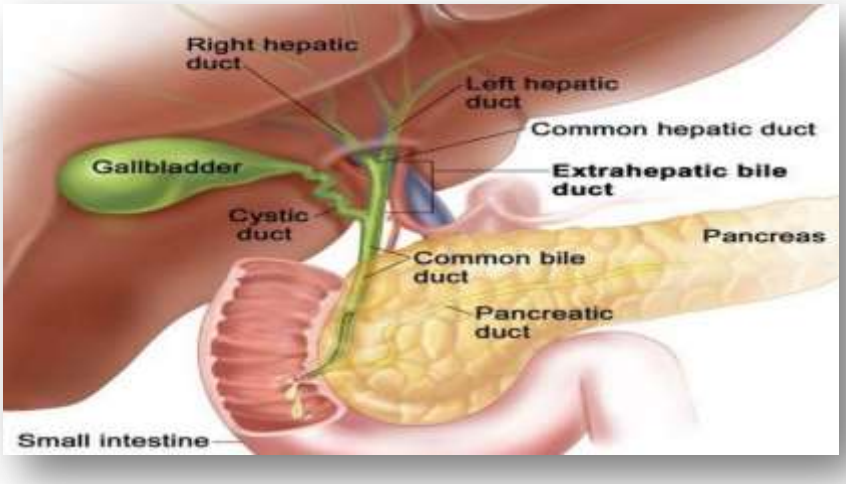

Figure 1; normal anatomy of biliary ducts

2.2.1 biliary ducts obstruction

Bile duct obstruction refers to impaired flow of bile (bile is a substance that contains bile salts, bilirubin, and cholesterol and is constantly synthesized in hepatic hepatocytes) from the liver to the small intestine due to a buildup of bilirubin and cholesterol in the blood. Bile obstruction affects a large portion of the population worldwide, with High rates of morbidity and mortality. The mostcommon causes of bile duct obstruction are gallstones which cause a common obstruction of the bile duct, which presents as pain, nausea/vomiting, andjaundice [18] Choledocholithiasis malignancies are the most frequent cause of extrahepatic obstruction. In addition, benign strictures, papillary stenosis,

metastatic lymph nodes in liver hilus, and primary sclerosing cholangitis may lead to bile duct obstruction.[19]

2.2.3 Causes

Some of the most common causes of bile duct obstruction include:

-Gallstones

Gallstones are common cause of bile duct obstruction. They can form whenthere is a chemical imbalance It leads to high levels of cholesterol in the blood, so stones are formed in the gallbladder. If they are large enough, they may blocka bile duct as they pass through the biliary system.[21]

-Bile duct or pancreatic cancer

Bile duct cancer refers to all cancers that develop within the biliary system. The resulting tumors may block a bile duct. Pancreatic cancers can cause a bile duct obstruction if the tumor enters the intestine. Cancers that have started elsewhere in the body may also spread to the biliary system where they can cause an obstruction.

-Injury

A blockage can sometimes result from an injury that occurs during a medical procedure, such as gallbladder surgery or endoscopy.

2.3 MRI Scan

Magnetic resonance imaging (MRI) is a unique and powerful diagnostic tool thatprovides images without ionizing radiation and, that uses strong magnetic fields and radio waves to produce detailed images of the inside of the body .can be themodality to properly assess and diagnose some pathologies[22] fig [2]

2.3.1 The MRI Consist Of ;

An MRI system consists of four major components:

* a main magnet formed by superconducting coils

* gradient coils

*radiofrequency (RF) coils

*computer system [24]

2.3.2 Basic Principles and terms of MRI Scanning

resonance phenomenon can be described by both classical and quantum mechanical approaches. Magnetic resonance imaging is based on the techniquesof nuclear magnetic resonance The Most of the human body is made up of water molecules, which consist of hydrogen and oxygen atoms. At the centre of each hydrogen atom is an even smaller particle called a proton. Protons are like tiny magnets and are very sensitive to magnetic

fields. When you lie under the powerful scanner magnets, the protons in your body line up in the same direction, in the same way that a magnet can pull the needle of a compass. You will not be able to feel this. Short bursts of radio waves are then sent to certain areas of the body, knocking the protons out of alignment.

When the radio waves are turned off, the protons realign. This sends out radio signals, which are picked up by receivers. These signals provide information about the exact location of the protons in the body. They also help to distinguishbetween the various types of tissue in the body, because the protons in different types of tissue realign at different speeds and produce distinct signals.

The unsynchronized spins cause the combined electromagnetic signal to decay with time, a phenomenon called relaxation. A slice is selected applying a gradient in a particular direction (X, Y or Z). Magnetic resonance signals are then formed by means of the application of magnetic field gradients along three different directions. Finally, the signals are acquired and Fourier transformed to form a two-dimensional or three-dimensional image. Important parameters determining the image quality such as signal-to-noise ratio, contrast and resolution are discussed too. A review of the most widely utilised imaging techniques is given including ultra- fast sequences. In simple terms, MRI imagescan be considered as a map of proton energy within tissues of the body. A variety of MRI images can be produced which emphasise different tissue types, in particular those that contain a large amount of fat or water. Bright areas on anMRI image represent high 'signal' given off by protons in the body during the scanning process.[25]

White areas on an MRI image = high signal(hyper intense)Black areas on MRI image=low signal(hypo intense)

Gray areas on an MRI image= iso intense

2.4 MRCP Cholangiopancreatography

It is a medical diagnostic technique that uses photography to view the bile ducts and pancreas, and it is a non-invasive method. This technique helps in diagnosing diseases of the biliary tract [26] MRI technology has allowed extensive use of time-weighted second-pulse MRI applications. [27] showing

elevated signals of still fluids or active components in the gallbladder and pancreatic bile ducts, with low signals of surrounding tissues. Magnetic resonance imaging (MRCP) is a special type of magnetic resonance imaging (MRI) scan that produces detailed images of the organs of the liver, bile ducts, and pancreas, Including the liver, gallbladder, bile ducts, pancreas, and pancreatic duct. Magnetic resonance imaging (MRI) is a test that does not use contrast.[28]

2.4.1 Technique and protocols

No exogenous contrast medium is administered to the patient. Fasting for 4hours prior to the examination is required to reduce gastroduodenal secretions, reduce bowel peristalsis (and related motion artifact) and to promote distension of the gallbladder. MRCP is performed on a 1.5 T or superior MRI system, usinga phased-array body coil.The technique exploits the fluid which is present in the biliary and pancreatic ducts as an intrinsic contrast medium by acquiring the images using heavily T2-weighted sequences. Since the fluid-filled structures inthe abdomen have a long T2 relaxation time as compared to the surroundingsoft tissue, these structures appear hyper intense against the surrounding non- fluid-containing tissues on a heavily T2-weighted sequence and can easily be distinguished.[29]

3.1 Patient And Method

In this prospective study group , using devices MRI from baqubah hospital in diyala and some private clinics, with total number of cases 30 [17 male .13 female] patients including female and male who suffering from Biliary Ducts obstruction during short period from 1 February 2023 to 1 April 2023 , the criteria for age , Gender, location ,and type of obstruction.[2 cases were excluded due to contraindications .overweight ,implants metal]

Equipment ;

all MRCP with MRI patients: 1.5 T units (Philips medical systems) machine wasused for the study. All patients were imaged with a body phased-array receives coil. Slice thickness was 1 cm with a 37″ field of view and 256 × 192 matrix were taken from right dome of diaphragm to lower edge of liver following are sequence used after the localizer: T2SSFSE-axial/coronal, axial T2FRFSE, 2D FIESTA axial/coronal, coronal 3D FSE (respirated

trigged),Additional; T1-axial/ coronal and 3D reconstruction was performed by MIPpost-processing Mean performances time was 30-45 min.

3.2 The inclusion criteria

1- was that the patient be clinically diagnosed as suffering from obstructive jaundice and patient referred to the Department of Radio Diagnosis for further investigation.

2- All samples are male and female for old and young patients.

3.3 The Exclusion criteria

1- All patients having cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic implants.

2- Patients having history of claustrophobia

Table 1; Gantt chart of the research plan

	2023-2-1 - 2023-4-1				
Milestone	**1^{st} – 3^{rd} week**	**4^{th} week**	**5^{th} – 6^{th} week**	**7^{th}- 8^{th} week**	**9^{th} – 10^{th} week**

To choose the title of research andto write a proposal					
Submission of proposal to the facultyand preparation of presentation					
Collection of data					
Process analyses and interpret					
Final report submission and outcome presentation					

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