"THE ULTRASONOGRAPHIC PATTERN OF FINDINGS SEEN ON HEPATOBILIARY SYSTEM IN PATIENTS WITH JAUNDICE "

BY

DR. NGURE GITHUKU MBChB

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THE ULTRASONOGRAPHIC PATTERN OF FINDINGS SEEN ON HEPATOBILIARY SYSTEM IN PATIENTS WITH JAUNDICE

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BY

DR. NGURE JOHN GITHUKU MBChB, MOI UNIVERSITY

DECLARATION

I, Dr. NGURE GITHUKU declare that the work contained herein is my original idea and has not been presented at any other place to the best of my knowledge.

Signature.....Date.....23/09/09.....

APPROVAL BY SUPERVISOR

This research dissertation has been submitted with my approval as university supervisor.

DR A. AYWAK; MBChB, M.MED. (U.O.N), [redacted] Lecturer

Department of Diagnostic Imaging and Radiation Medicine, **University of Nairobi**

Signature.....**Date**.....06/10/2009.....

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ABBREVIATIONS

US	Ultrasound
ERCP	Endoscopic Retrograde cholangiopacreatography
CT	Computerized Tomography
HBsAg	Hepatitis B surface Antigen
EUS	Endoscopic Ultrasound
CEUS	Contrast Enhanced Ultrasound
FNA	Fine Needle Aspirate
TC SIGN	Triangular Cord Sign
IVC	Inferior Vena Cava
DESIDA	Diethyl imidodiacetic Acid
99m TC TBIDA	^{99m}Tc -Trimethylbromo-imidodiacetic Acid
PBC	Primary Biliary Cirrhosis
PSC	Primary Sclerosing Cholangitis
IBD	Ischaemic Bowel Disease
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
NASCOP	National AIDS and STI Control Programme
DIH	Drug Induced Hepatitis
DDIRM	Department of Diagnostic Imaging and radiation Medicine
PTC	Percutaneous Transhepatic Cholangiography
KNH	Kenyatta National Hospital
HL	Hodgkins Lymphoma
NHL	Non-Hodgkins Lymphoma
GB	Gall Bladder
TB	Total bilirubin
DB	Direct bilirubin
IB	Indirect bilirubin

ABSTRACT

Background : Jaundice is a common presenting sign for various causes of morbidity and mortality in Kenya. Diagnosing the cause of jaundice needs a multi-displinary approach and various imaging modalities are applied especially to differentiate obstructive versus parenchymal causes and for obstructive causes to identify the site of obstruction. Imaging also provides interventional procedures like biliary drainage and in guided biopsies. Among the various imaging modalities employed include Ultrasonography (US), Computerized Tomography (CT), Magnetic Resonance Cholangiopancreatography (MRCP), Endoscopic Resonance Cholangiopancreatography(ERCP) and Percutaneous Transhepatic Cholangiography(PTC) .

Study objective: To evaluate the ultrasound pattern of findings seen in hepato-biliary system in patients with jaundice, assess their frequency, age distribution and relate the findings to clinical diagnosis

Study design and setting : A descriptive prospective study carried out at Kenyatta National Hospital and DDIRM University of Nairobi radiology departments.

Methodology: A total of 165 patients with clinical and laboratory evidence of jaundice who presented for ultrasound examination and who were eligible for inclusion , were entered prospectively from September 2008 to April 2009. Trans-abdominal ultrasound was carried out to assess the liver, biliary system and the the pancreas for any pathology that could explain the cause of jaundice. Other morphological features were also assessed.

Results: One hundred and sixty five patients were studied by ultrasound (mean age 38, range 0-100 years). The main results in frequency were : normal findings (27), hepatitis(19), metastasis (14), hepatocellular carcinoma(8), liver cirrhosis(12), pancreatic carcinoma (15), gallstones (7), fatty liver(9), gallbladder carcinoma (8) and indeterminate(12). Ancillially investigations done were as follows CT abdomen(22), MRCP(7), DECIDA (1), laboratory tests 27 were positive for hepatitis B and 3 for hepatitis C. HIV positive patients were 24 (14.5%). Surgical exploration was done on 14 patients and biopsies either percutaneous or tissue were done on 32 patients. The main clinical question was on differentiation of obstructive from non-obstructive jaundice, which was achieved in 93% of the cases.

Conclusion: The findings in this study were similar to other studies in the causes of jaundice. Ultrasound was able to differentiate obstructive from non-obstructive jaundice. The myriad causes of diffuse liver disease were not accurately differentiated. In obstructive jaundice, the cause and site of obstruction was not accurately determined by ultrasound.

INTRODUCTION AND BACKGROUND INFORMATION

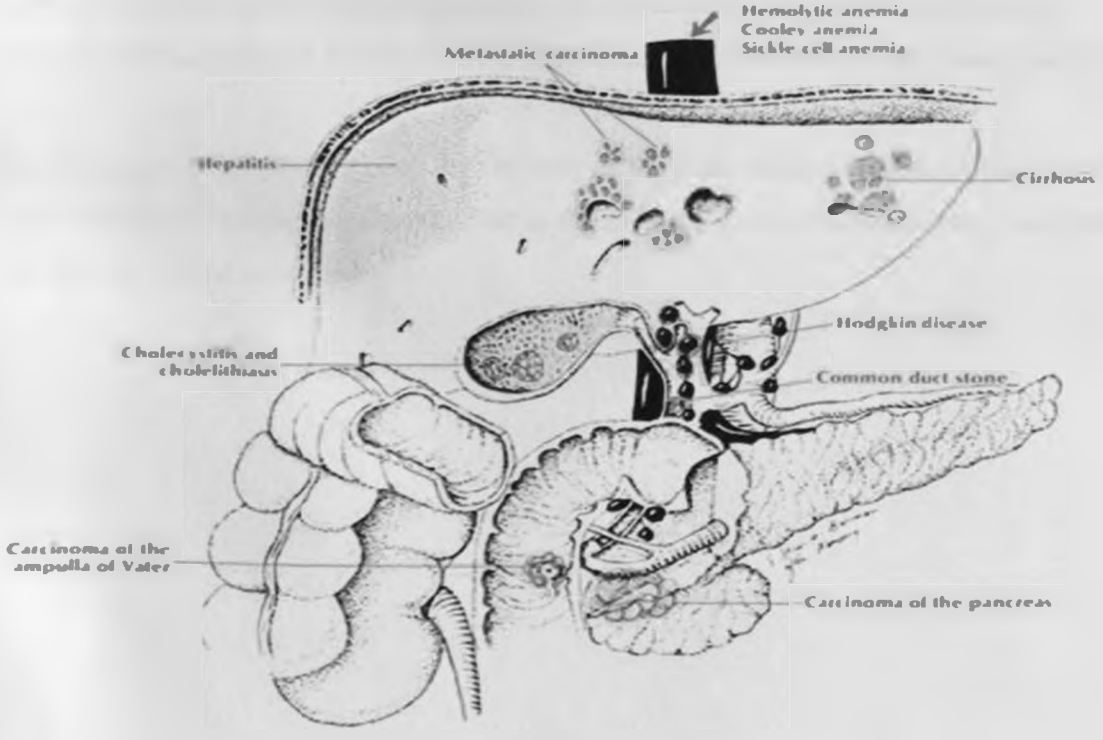
The causes of jaundice can best be established by applying physiology. Jaundice develops from hyperbilirubinemia and may not be noticed until the bilirubin exceeds 3 or 4 mg/dL[1]. Hyperbilirubinemia can be due to an increased production of bilirubin, impaired transport of bilirubin to the liver for excretion, and decreased excretion of bilirubin[1].

Increased production. Bilirubin is produced by the release of hemoglobin from the red cells and its subsequent breakdown. Thus, the hemolytic anemias are the principal cause of this category of jaundice. These include hereditary spherocytosis, sickle cell anaemia, Cooley anemia, septicemia, autoimmune hemolytic anemia, and malaria.

Impaired transport. Congestive cardiac failure (CCF) is the principal cause of this form of jaundice, but it must be advanced enough to cause cardiac cirrhosis.

Decreased excretion. This group of causes of jaundice is divided into conditions in which the liver is unable to transform unconjugated bilirubin to the conjugated form (Gilbert disease, infectious hepatitis, and cirrhosis); conditions in which the liver cannot transfer the conjugated bilirubin into the bile ducts, such as Dubin–Johnson syndrome; and conditions that obstruct the bile ducts, such as common duct stones, cholangitis, chlorpromazine toxicity, and carcinomas of the pancreas and ampulla of Vater.

Fig 1: Schematic diagram showing the various levels of jaundice causation



The prevalence of jaundice varies with age and sex; newborns and older adults are most often affected, it also varies on geographical locations due to different morbidity patterns. In the United Kingdom, the prevalence of jaundice is 3% and most of these subjects have Gilbert's syndrome[2]. In India different states give a varying demographic pattern of jaundice with prevalence ranges of 4% to a high of 12%[3].

Nahum M.S, AND Antonio R.V in a study on trends of liver disease prevalence in Mexico found that liver diseases constituted 6.27% of all the causes of mortality pattern in the year 2000[4]. Bellentani S, Tiribelli C et al in the Dionysos cohort study found that the prevalence of people with signs of chronic liver disease among the general population in northern Italy was 21% and that after further blood workup and ultrasound examination, patients that had persistent liver diseases were 17%. Follow up studies later with a histopathological correlation, the prevalence of the chronic liver diseases was seen to be 8%[5].

Pendino GM, Mariano A et al,in a study titled *Prevalence and etiology of altered liver tests: a population-based survey in a Mediterranean town*, found that in the general population the prevalence of people with altered liver tests was 12.7%. (95% confidence interval of 11.1-14.3)and the prevalence increases with age and is higher among the male gender[6].

Another study by Aram S. and David J. estimated that the prevalence rate of harmful hyperbilirubinemia in general population is 12%[7].

While blood work up is the baseline in investigation, ultrasound has been found to play a major diagnostic role in picking up either associated or underlying liver, biliary and pancreatic pathologies. In study by Gosink BB, ultrasound identified the presences of generalized parenchymal disease in 81% of patients reviewed with intrahepatic jaundice[8].

In this study a brief preview of of the anatomy of the hepatobiliary system that includes the liver, the biliary system and the pancreas as far as bilirubin metabolism, storage and transport is affected will be necessary.

ANATOMY: *DEVELOPMENTAL*[9]

The liver, gallbladder and the biliary duct system arise as a ventral outgrowth from the caudal part of the foregut early in the fourth week forming a Hepatic diverticulum which develops in the ventral mesentery, enlarges rapidly and divides into-:

1. **Pars hepatica (cranial part)** - primordium of the liver, intrahepatic bile ducts and the common hepatic duct

2.**Pars cystica (caudal part)**-gives the cystic diverticulum, the primordium of gallbladder and the cystic duct.

The stalk connecting the hepatic and cystic ducts to the duodenum becomes the common bile duct.

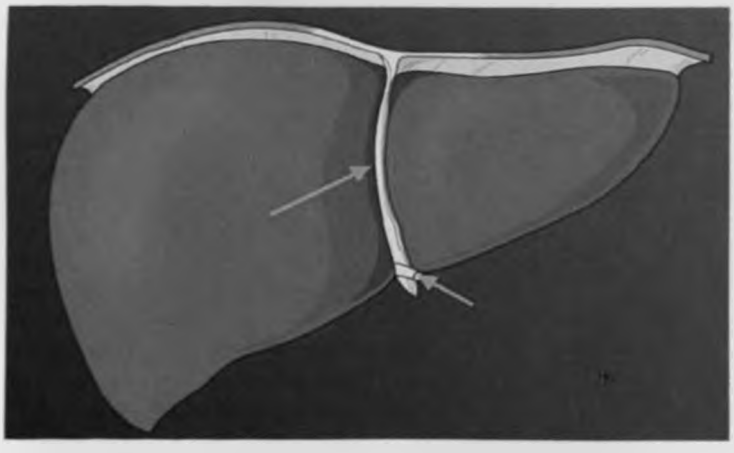
The pancreas develops from both the ventral and the dorsal outgrowth buds from the mesenchyme of the gut.

GROSS ANATOMY: THE LIVER

Liver is the second largest organ in the body and has Over 100 different functions with Bile production that aids in the digestion of fat being one of them.

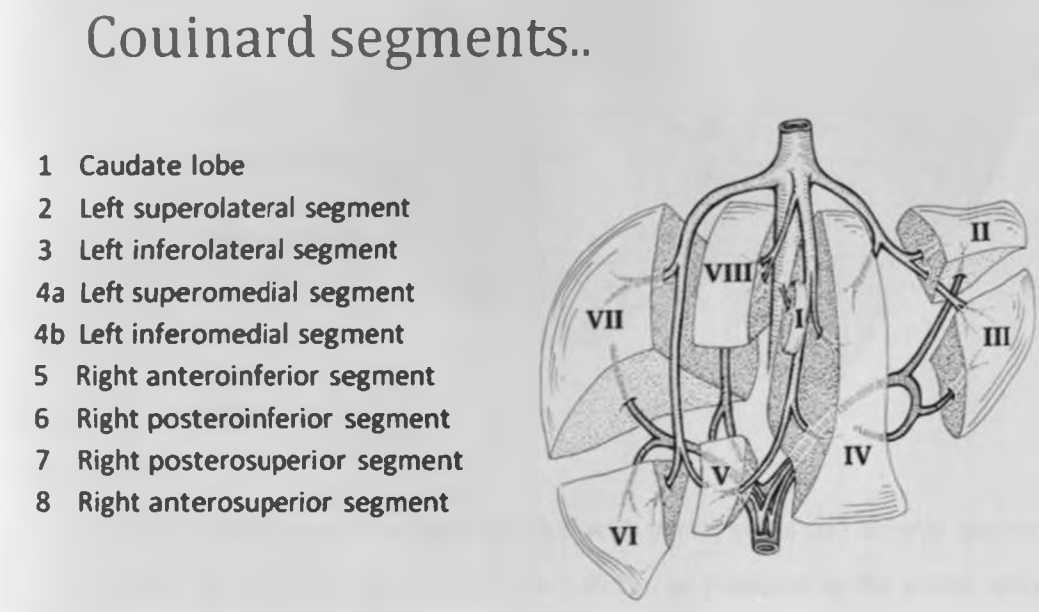
It lies in the right upper quadrant of the abdomen and has two surfaces –diaphragmatic and visceral. Its major landmark is the sagittal groove, a deep notch for the ligamentum teres which runs in the free edge of the falciform ligament, which traditionally divides it into two lobes –left and right. The main feature of the inferior or visceral surface is the porta hepatis, which a central depression for the passage of the portal vein, hepatic artery and common bile duct. Anterior to this is the gallbladder fossa with the quadrate lobe to its left. Posteriorly the caudate lobe separates the porta from the inferior vena cava. Several shallow impressions relate to the shape of adjacent organs, the most significant being that caused by the right kidney.[10,11]

Fig 2: Falciform ligament (arrow) shows division of right and left lobes



A new system of classification –the couinaud's system that is based on vascular distribution divides the liver into eight lobes with the main plane being the cantel line, which is 4cm to the right of attachment of falciform ligament and made up of inferior vena cava and ligamentum venosum. The cantel line not usually directly visualized[10].

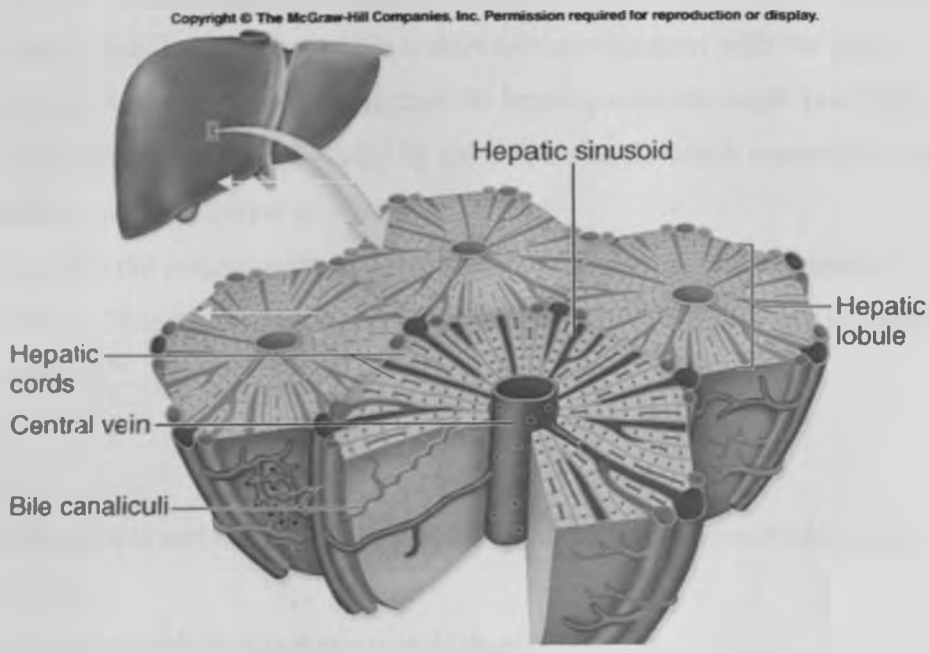
Fig 3: segmental vascular distribution



Structure and vascular supply

Subsegmentally the liver parenchyma is composed of lobules made up of sinusoids around a central draining vein, and bounded at the periphery by the portal tract or 'triad' of branches from the bile duct, portal vein and hepatic artery. At a cellular level, the liver is composed of hepatocytes, undertaking the main metabolic functions, and Kupffer cells, part of the reticuloendothelial system. The liver receives approximately two thirds of its blood supply from the portal vein and one third from the hepatic artery[10]. Blood drains via the hepatic veins to the inferior vena cava (IVC)

Fig 4: The structural arrangement of the liver lobule



BILIARY SYSTEM

This consists:

- The intrahepatic ducts which together with portal veins and hepatic arteries form the portal triad. The ducts may either be anterior or posterior to the portal vein, or tortuous about it.
- The extrahepatic biliary tract consists of:
    1. Right, left and common hepatic ducts
    2. Gallbladder,
    3. Cystic duct and
    4. The Common bile duct

Bile drains from the canalicular and ductular network of the acini.

Drainage is from the smallest interlobular bile ducts to septal bile ducts and then to right and left hepatic ducts before joining the common hepatic duct.

Caudate lobe has its own separate vascular and biliary apparatus.

The extrahepatic ducts

The right and left hepatic ducts fuses at the hilum anterior to the bifurcation of the portal vein to form the common hepatic duct which has a diameter of approximately 6mm[11]. This CHD will then join the cystic duct to form the CBD.

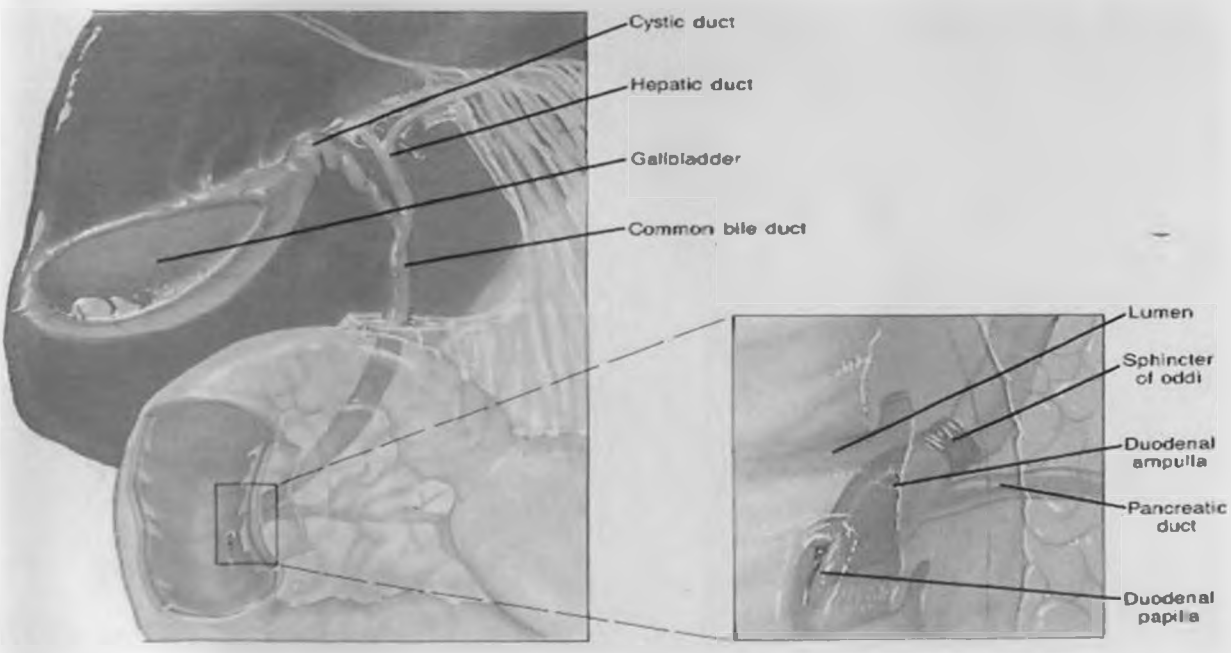
The CBD passes inferiorly and posterior to the first part of the duodenum and the pancreatic head within the hepatoduodenal ligament and lies anterior to the portal vein and to the right of the hepatic artery[10]. It will then terminate in a short common channel with the main pancreatic duct within the wall of the duodenum at the hepatopancreatic ampulla of vater. The ampulla and the two ducts are surrounded by spincteric muscle which controls the bile juice release and known as the sphincter of oddi.

The ampulla opens into the posteromedial wall of the duodenum at the major duodenal papilla approximately 10cm from the pylorus. The CBD measures appr. 8-10cm in length and and 5-6 mm in width[10,11].

The cystic duct

This is appr. 3-4 cm in size and has mucosal folds the spiral valves of heister which helps control the bile release.

Fig 5: Ampulla of vater with cbd and pancreatic duct



THE GALL BLADDER

It is a fibromuscular structure that is pear shaped with a capacity of 30-50 mls and Located within the gall bladder fossa on inferior surface of liver althrough the actual position varies with body habitus. It has a length 7-10 cm with a wall thickness of 2-3mm[12] .

Its function is to store and concentrate bile .

It has the the fundus which is the most anterior and inferior portion and projects on the inferior margin of the liver touching the parietal peritoneum at the tip of the 9th costal cartilage . Other parts are the body, which is in contact with the 1st part of the duodenum and the neck that continues into the cystic duct

THE PANCREAS

As far as jaundice manifestations are affected only the head of pancreas is important in that a mass can compress the CBD with the resultant obstruction to bile flow. These pathologies will be outlined later.

EPIDEMIOLOGY AND LITERATURE REVIEW

Historical perspective

Records detailing jaundice and its treatment are as old as mankind. The ancient Greek postulated that jaundice led to a state of melancholy and that wine taken as a prescription was the best treatment. Hippocrates in 330bc had observed jaundice and prescribed herbs while the ancient Egyptians used wormwood[13].

Jaundice may be due to bile duct obstruction, hepatic parenchymal disease or prehepatic type. In this study all the causes of jaundice were evaluated including the prehepatic (haemolytic) type since its known that haemolytic anaemias can lead to development of gallstones and other hepatobiliary manifestations[14,15]. A patient may have complete obstruction, producing jaundice, or the obstruction may be intermittent, producing symptoms and typical biochemical changes and occurring with or without attacks of jaundice. Alternatively there may be chronic incomplete obstruction, leading ultimately to pathological changes in the bile ducts or liver. Dilatation of the whole biliary tree may be present or, if the obstruction is high, it may only affect the intrahepatic biliary ducts. It is important to remember that there may be no biliary dilatation if:-

- The obstruction has only been present for a short time
- There is secondary biliary cirrhosis due to long-standing obstruction complicated by inflammation and infection
- Lack of dilatation is a specific feature of the disease.

In a patient presenting with jaundice, a thorough clinical history and physical examination and relevant laboratory investigations are mandatory before imaging with various modality where a systematic approach should be adopted.

Many studies have been done to evaluate effectiveness of various modalities. A study by Pasanen PA, noted that when jaundice is obstructive type and the cause is a benign and extrahepatic, ERCP is the most accurate (90%), but when it is malignant then ERCP and CT are comparable (80%). Intrahepatic disease was best noted to be diagnosed by US (100%) and CT (77%)[16]. Munir k, Bori v. et al found that MRCP has a high sensitivity (92%) and almost 100% specificity in lesion site detection and compares very favourably with ultrasound in diagnosis of obstructive jaundice though MRCP is superior in site detection[17].

Ultrasonography is the modality of first choice for distinguishing between patients with dilated and non-dilated bile ducts and in the majority of cases, this distinction will also serve

to differentiate obstructive from non-obstructive jaundice[11]. De cock KM, Dalden JF et al in a study carried out in Kenya, found that ultrasound is extremely reliable in differentiating extrahepatic from intrahepatic jaundice [18] while Dewbury, Joseph AE et al in the study *ultrasound in the evaluation and diagnosis of jaundice* noted that ultrasound made the actual differentiation in 97% and diagnosis of the real cause of the jaundice made in 58%[19].

When ultrasound fails to reveal dilated ducts in the presence of a high clinical suspicion of biliary obstruction, then other imaging tools such as MRCP should be employed. If no obstruction is present a percutaneous liver biopsy should be carried out[11].

The use of ultrasound in discriminating focal lesions is only limited to screening due to its low positive predictive value (74%) as reported by Celle G,Savarino V et al[20].

According to a 2007 study by E. Bjounsson, S Ismael et al [21] the major causes of severe jaundice in adults in Europe are:

- malignancy that accounts for 33.5%,(among this liver metastasis accounts for 34.5%, cholangiocarcinoma 27.5%, cancer head of pancreas 22.5% while primary liver malignancy accounts for 12.1% and others less than 4%)
- alcoholic liver disease that accounts for 16.8%
- bile duct stones accounts for 16.2%
- viral hepatitis 3%
- others is 35%

Another study done in Finland showed a similar trend in that

Malignancy and alcoholic liver disease are the most common causes of severe jaundice, whereas viral hepatitis is a rare cause[16]. In our local settings a study done in KNH on obstructive jaundice by Okoth FA, Wambugu MW et al showed carcinoma head of pancreas accounted for 55%. Others were gallstones 10%, hepatocellular carcinoma 10% and gall bladder tumor 10%[22].

Sonography is 88% accurate in assigning the correct pattern to the corresponding pathology (sensitivity 89%, specificity 86%, p less than 0.001) [23]. The degree of accuracy is dependent on the grade of pathologic severity, with mild disease offering the greatest difficulty; moderate and severe diseases being accurately detected and placed in the correct pattern in all cases.

Key sonographic feature, which helps in the distinction between extrahepatic and intrahepatic cholestasis, is the presence of dilated bile and pancreatic ducts. The absence of dilated pancreatic and biliary ducts suggests intrahepatic cholestasis, and necessitates a medical

work-up including hepatitis serologies, and perhaps percutaneous liver biopsy[11]. One can demonstrate the presence of dilated ducts using either a right upper quadrant ultrasound or a CT scan. The right upper quadrant ultrasound should be the first choice as it is cheap, available and very reliable for demonstrating dilated bile ducts, demonstrating the presence of gallstones in the gallbladder or even gallstones within the bile duct. It is not helpful for delineating carcinomas in the ampulla, as there is too much duodenal air but a study by Jason B., Klapman M.D et al found that endoscopic ultrasound was highly accurate for this type of carcinomas with a negative predictive value of 100% [24].

While appreciating differences in our local African settings, studies showing this epidemiology are scanty and one of the objectives as such will be to show the different epidemiological patterns in Kenya.

CIRRHOSIS

Cirrhosis is the endpoint of a wide variety of chronic disease processes, which cause hepatocellular necrosis leading to hepatic fibrosis and nodular regeneration. The early changes may be detectable only on histological examination and imaging cannot reliably distinguish between micronodular and macronodular cirrhosis or between many of the underlying aetiologies but recognition of a bright liver echo pattern is said to favour micronodular cirrhosis to give positive ultrasound examinations and a normal liver ultrasound features in macronodular cirrhosis according to a study by KC Dewbury and B Clark[25].

As cirrhosis progresses, widespread fibrosis and nodular regeneration develop, along with macroscopic changes of liver morphology. The commonest finding in advanced cirrhosis is atrophy of the posterior segments (VI, VII) of the right lobe. Hypertrophy of the caudate (I) lobe and of lateral segments of the left lobe (II, III) are frequently seen. US can demonstrate clearly the nodularity of the liver margin in advanced cirrhosis, particularly when ascites is present. Pure hepatic fibrosis increases reflectivity, resulting in loss of the margins of the portal vein branches, but does not significantly alter attenuation, a feature used to discriminate fatty infiltration from fibrosis.

The overall texture of the liver becomes coarser or more heterogeneous as cirrhosis progresses, but this is difficult to quantify. The accuracy of ultrasound to diagnose cirrhosis when compared to histology is 79% according to Steinmaurer HJ[26].

VIRAL HEPATITIS

Viral hepatitis is a significant cause of disease worldwide that involves chronic liver inflammation. Data from hospital-based studies puts the prevalence at about 3-5% for persons who may be carriers of HBsAg worldwide[27] , but in the Kenyan settings, a study by F A Okoth in 1994 puts the prevalence of carriers at 4% among blood donors[28].

Various types includes A, B, C, D, E, and F

Hepatitis B is a frequent cause of liver failure and primary liver cancer but over the last decade there is an increased concern with the recognition of hepatitis C infection with rapidly increasing numbers of chronically infected cases, and the related progression to liver failure and development of primary liver cancer. Imaging is relatively nonspecific. In acute hepatitis it can help to exclude other causes of jaundice such as bile duct obstruction. In chronic hepatitis it is useful in monitoring the progression of disease, development of portal venous hypertension and complications such as hepatocellular carcinoma.

On US examination nonspecific decreased reflectivity changes have been reported in acute viral hepatitis although the majority of cases appear to have normal parenchyma. Gallbladder wall thickening is a common finding in acute hepatitis. Differentiating a normal liver with a hepatitis liver through ultrasound is hard to according to Gosink BB, Lemon SK et al[8] and Kurtz AB, Rubin CS et al[29] as there may be no changes.

INFILTRATIVE LIVER DISEASES

- **Fatty liver**

Seen most frequently in alcoholism or alcoholic liver disease, diabetes mellitus, obesity, and prolonged parenteral nutrition. It presents with symptoms of hepatic steatosis that are related to the degree of fat infiltration, the time course of its accumulation, and the underlying cause. Sonographic detection of steatosis is also when a substantial (30% or more) fatty change is present. The findings are that of a firm, nontender, and generally, enlarged hyperechogenic liver. Liver ultrasound is a sensitive method of detecting fatty liver changes even with minimal hepatic dysfunction.[30]

MALIGNANT LESIONS

These have variable presentations some are solid while others are cystic metastases.

Among the metastatic lesions with predominantly cystic appearance are ovarian tumours, carcinoma of the colon, teratoma and metastatic squamous tumours. Although there may be pointers to a malignant cause, such as a thick wall or internal debris, differentiation from an

abscess may be impossible on imaging criteria alone. In these situations guided aspiration to allow cytological examination of the contents is often helpful. But according to a study by Edward Leen[31], this could be a thing of the past since the advent of US contrast agents and new contrast-specific US techniques that have made detection of metastases and lesion characterization improve markedly. The detection of liver metastases using Contrast Enhanced Ultrasound (CEUS) is similar to spiral CT. The ability of contrast US to characterize focal liver lesions is superior to that of CT and at least equivalent to that of MRI[31].

Other metastases are predominantly solid like breast and bone tumours and which may also show calcification while others will present with necrosis and haemorrhage like the testicular tumours.

HEPATOCELLULAR CARCINOMA

Hepatocellular carcinoma (HCC) or hepatoma is the commonest primary malignant neoplasm of the liver. There are many predisposing factors, including direct carcinogens such as aflatoxin, chronic hepatitis and cirrhosis, particularly post-necrotic cirrhosis and haemochromatosis. There is wide geographical variation in incidence, which largely parallels the prevalence of local predisposing conditions, in particular chronic hepatitis B. In western countries the incidence is relatively low but increasing as a result of chronic hepatitis C infection[32].

In cirrhotic livers current imaging modalities have limited sensitivity (60–80%) for small hepatoma (1 cm or less) detection. The 5-year survival of patients with HCC is approximately 30%.US is widely used as a screening tool[33]. Small hepatomas may have a wide range of appearances and be of increased or decreased reflectivity in relation to the adjacent parenchyma

HEPATOBLASTOMA

This may occur at any age but is most common in children under the age of 3 years. It is the third commonest abdominal tumour in childhood, after neuroblastoma and Wilms tumour On imaging, the tumour presents as a large heterogeneous mass but may also appear to be composed of multiple confluent nodules. Punctate calcification is a common finding on US[33].

GALLSTONES

Gallstones account for 10-15% of people in the adult Western world. The associated risk factors include Increasing age, Positive family history, Sudden weight loss (e.g. after obesity surgery) loss of bile salts (e.g. ileal resection, terminal ileitis Diabetes) and pregnancy. Gallstones are about twice as common in women as in men. In the elderly, the incidence rises to about 20% and the sex incidence is roughly equal after the age of 80[11].

There are three common types of gallstone.

- Cholesterol stones - are usually multiple, small, white or yellow, mulberry-shaped stones but may occur as a larger 'cholesterol solitaire'. There is a strong association with cirrhosis (30%) and gallbladder carcinoma[11].
- Pigment stones - are small (2–5 mm) black or dark brown stones containing the calcium salts of bilirubin, phosphate, carbonate and other ions. These stones have an increased prevalence in haemolytic disorders , in cirrhosis and in some oriental countries (where they tend to be associated with Clonorchis sinensis and Ascaris lumbricoides infestations).
- Mixed stones-These are the most common type and are often multiple and faceted.

Gallstones may be diagnosed on a plain radiograph if they are radio-opaque or during ultrasonography. Many are discovered in patients in whom their presence is suspected because of symptoms related to acute or chronic cholecystitis, pancreatitis or biliary obstruction. Of patients with silent gallstones, about half remain symptomless over a 10-year follow-up period.

Ultrasound is the best method to demonstrate stones[34]. Definite gallstones are seen as echogenic mobile areas within the gallbladder with acoustic shadowing. Sometimes stones are not mobile, in which case they are not easy to discriminate from polyps, and very small ones may be missed or fail to throw a helpful acoustic shadow. Ultrasonography can also allow measurement of the diameter of the common bile duct and show the liver and hepatic bile ducts[34], but it can only identify with certainty about half of any stones in the common bile duct[35]. If the ultrasound scan findings are negative but with a high level of suspicion, such as in a patient with upper abdominal pain and abnormal liver function tests, it is worth repeating the investigation after an interval. This may pick up stones, which were previously missed. In a study done by PC Hessler, DS Hill et al the reported ultrasound imaging findings state an accuracy rate for positive diagnosis of 98.6%[36].

CHOLECYSTITIS

This is inflammation of the gallbladder and may be acute or chronic. It is usually but not invariably, associated with stones.

Types:

Acute calculous cholecystitis

This results from cystic duct obstruction by a gallstone although the demonstration of gallstones on ultrasound does not constitute proof of acute cholecystitis. A constellation of signs at ultrasound examination that includes distension, tenderness, wall thickening and pericholecystic fluid in the presence of gallbladder stones are strongly suggestive of acute cholecystitis[37]. In these patients it is important to examine the liver for signs of hepatic abscess and the bile ducts for signs of obstruction.

According to a study by Bingener J; Schwesinger WH et al, Ultrasound exhibited a sensitivity of 60% for the diagnosis of acute cholecystitis compared to the findings at operation and 52% relative to the histological findings. Specificity for acute cholecystitis diagnosed on ultrasound examination was 77% compared to findings at operation and 71% relative to histological findings [38].

Acalculous cholecystitis

This is uncommon but probably underrecognized[6]. It occurs particularly in the ICU setting as a result of bacteraemia, especially following extensive burns, severe trauma, clostridial infections, polyarteritis and steroid treatment. Two specific forms include the very rare acute typhoid cholecystitis, which usually occurs at the end of the second week of a typhoid infection or later, and the even rarer actinomycotic cholecystitis

Chronic cholecystitis

This is the most common gallbladder disease and its association with gallstones is virtually constant. The gallbladder is often contracted and its wall is thickened and occasionally calcified ('porcelain gallbladder'). The bile is turbid and often contains sediment of debris, the so-called 'biliary sludge' or 'mud'. In some situations this sludge contains large amounts of calcium, sufficient to be evident on plain radiographs; it is then called 'limy bile'.

Ultrasound is the most commonly used investigation and will demonstrate a thick-walled, contracted gallbladder containing stones demonstrating the classical **'WES' sign**[39,40] [Wall, Echogenic and Shadowing

PANCREATIC MASS

The commonest pancreatic masses is ductal adenocarcinoma. Approximately 70% of these arise in the head, neck, or uncinate process, with the remainder arising in the body or tail. If the mass is sufficiently large it will distort the outline of the gland but small masses may only be detected by virtue of their different imaging characteristics compared with normal pancreatic tissue. On ultrasound the tumour has a lower reflectivity than adjacent pancreatic tissue.

In both the UK and the USA pancreatic carcinoma is the fourth commonest cause of cancer death[41]. It is an aggressive malignant disease that engenders a local desmoplastic response and has a propensity to constrict or obstruct adjacent ducts or vessels.

Ultrasound (transabdominal, endoscopic, and laparoscopic), CT, MRI, and ECRP may, under different circumstances, each have a role in the diagnosis of ductal adenocarcinoma. In practice, because it is inexpensive and widely available, transabdominal ultrasound is frequently the first imaging investigation carried out in patients with pancreatic carcinoma, particularly in those who present with nonspecific abdominal pain or jaundice[42]. It is highly accurate in differentiating obstructive from non-obstructive causes of jaundice, and with meticulous technique very small pancreatic tumours may be detected. Improvements in the field of sonography has seen EUS become a valuable diagnostic and staging tool with high specificity (100%) and sensitivity (81.7%) especially when coupled with fine needle aspirate (FNA)[43].

BILIARY ATRESIA (BA)

The urgency in evaluation of the infant with prolonged neonatal jaundice is primarily to exclude BA. Good outcome depends on early diagnosis and surgery to establish drainage before the onset of liver cirrhosis. The infant presents in the neonatal period with persisting (slightly fluctuating) icterus, pale stools and conjugated hyperbilirubinaemia. It occurs slightly more frequently in females. According to D A Kelly and A Stanton the prevalence BA is 0.6% in the uk[44].

The aetiology of BA is uncertain but it is thought to be a progressive obliterative inflammatory process of uncertain origin, affecting the extrahepatic biliary tree and progressing centrally towards the intrahepatic interlobar ducts.

Ultrasonically, the liver is normal initially but with progression becomes large and coarse, with increased periportal reflectivity. Unlike obstructive jaundice in the older child or adult, the biliary tree in BA does not usually distend or dilate, due to the obliterative inflammatory

process. The gallbladder is usually absent or rudimentary. The presence of a gallbladder does not exclude BA (visible but small in 20%). According to a study by P. Farrant, B Meire et al with use of a high frequency probe one should identify the gall bladder in over 90% of cases(sensitivity 92% and specificity of 96.7%)[45]. The presence of a normal-sized gallbladder, which distends with fasting and contracts with feeding, suggests a diagnosis other than BA. The presence of a 'triangular cord' and absent or small gallbladder are high predictors of BA. The triangular cord sign (TC sign) is a sensitive and specific tool in prompt diagnosis of extrahepatic biliary atresia[48] . This sign refers to a highly reflective focus at the hilum of the liver, which represents the obliterated fibrosed biliary tree.

Associated abnormalities in BA occur in 10%: preduodenal portal vein, choledochal cyst, azygous continuation of the IVC, polysplenia, trisomy 13 and situs inversus.

To distinguish true obstructive BA from severe cholestasis leading to an obstructive pattern, a 99m Tc-TBIDA scintigram should be performed[11].

GILBERTS DISEASE

Gilbert's syndrome is a finding, not a disease. It is found in about 5 per cent of the population and is due to raised levels bilirubin in the blood. In the US, the rate of Gilbert syndrome in the United States is 3-7% of the population while in Africans the genes for its prevalence have been reported at a massive 36% according to sandeep m[46]. It is said to be the most common inherited cause of unconjugated hyperbilirubinemia, and frequently coexists with other conditions associated with unconjugated hyperbilirubinemia, such as thalassemia, glucose-6-phosphate deficiency and Crigler-Najjar syndrome[47]. Gilbert's syndrome is an autosomal recessive condition characterized by intermittent jaundice in the absence of hemolysis or underlying liver disease. The hyperbilirubinemia is mild and, by definition, less than 6 mg/dL. However, most patients exhibit levels of less than 3 mg/dL[46]. Considerable daily and seasonal variations are observed, and bilirubin levels occasionally may be normal in as many as one third of patients. The syndrome may be precipitated by dehydration, fasting, menstrual periods, or stress, such as an intercurrent illness or vigorous exercise. Patients may report vague abdominal discomfort and general fatigue for which no cause is found. These episodes resolve spontaneously, and no treatment is required except supportive care imaging in this condition is rarely indicated.

HIV INFECTION AND AIDS

HIV infection/AIDS is a global pandemic, with cases reported from virtually every country. The current estimate of the number of cases of HIV infection among adults worldwide is ~37 million, two-thirds of whom are in sub-Saharan Africa; 50% of cases are women. In addition, an estimated 2.5 million children younger than age 15 are living with HIV/AIDS. In Kenya, the prevalence of HIV/AIDS has been put at 6% by NASCOP[48]. Many patients with this condition will present with liver problems as a complication. According to N Chalasani, C M Wilcox[49], the prevalence of jaundice among HIV /AIDS patients was found to be 7%. The most common causes of jaundice were drug-induced hepatitis (31%), and alcoholic liver disease (13%). Opportunistic infections or neoplasms were identified as the cause of jaundice in 30%; other causes were intrahepatic (11%) and extrahepatic diseases (19%). Multiple potential causes were seen in 8.3% of patients. Abdominal ultrasonography (US) and computed tomography (CT) are helpful in suggesting the underlying cause of disease.

DRUG INDUCED HEPATITIS (DIH)

Drug-induced hepatitis involves inflammation of the liver caused by toxic exposure to certain medications, vitamins, herbal remedies, or food supplements. Usually, the toxicity occurs after taking the causative agent for several months, or from an overdose of a medication such as acetaminophen[50].

The main drugs implicated are anti-infectious, psychotropic, hypolipidemic agents, and nonsteroidal anti-inflammatory drugs (NSAIDs). The incidence and seriousness of drug-induced hepatitis are largely underestimated in the general population. According to a French study there was a massive 16 times difference between the number of patients reported with DIH and the ones picked out in a study[51].

Drug-induced hepatitis is generally divided into two categories: acute hepatitis in which the drug or a metabolite destroys a vital target in the cell; immunoallergic hepatitis in which the drug triggers an adverse immune response directed against the liver[49,50]. Liver failure is a possible but rare complication of drug-induced hepatitis. The prevalence of jaundice supposed to be due to anti TB drugs induced hepatitis is 8.9% and observed mostly within 2 weeks of time, after anti TB initiation[52].

Table 1: drugs associated with liver damage

Hydralazine – oral	Isoniazid Halothane
Alcohol Oral contraceptives	Androgens Valproic acid
Chlorpromazine – oral Phenytoin	Chlorpromazine - injectable Carbamazepine - oral
Allopurinol - oral Carbamazepine - oral	Acetaminophen Methotrexate

OTHERS

Biliary hypoplasia (alagille syndrome)

Choledochal cyst

Caroli's disease (type v choledochal cyst)

Neonatal hepatitis

Primary biliary cirrhosis

Primary sclerosing cholangitis

Unconjugated hyperbilirubinemia eg sickle cell disease

Gilberts disease

Neonatal jaundice

Malaria

HIV infection and AIDS

JUSTIFICATION

Jaundice is a potentially deadly condition that affects a substantial population in Kenya. Often liver failure ensues and the causes of jaundice that ultimately leads to acute or chronic liver failure are commonly encountered ranging from infectious eg hepatitis, drugs induced, carcinomas, gall stones among many others.

Ultrasound is commonly employed in the investigation of jaundice. It is a readily available imaging tool which has an advantage of being relatively cheap, non-invasive and uses non-ionising radiation. Its use as a baseline for diagnosis of hepatobiliary pathology is already established. To the best of my knowledge no study has been recorded locally evaluating the patterns of findings in jaundiced patients as seen by ultrasound. This study aims to establish the distinction of the various jaundice causing diseases as seen on ultrasound through the differential ultrasonographic patterns. It will also try to establish any anatomical structural abnormalities that may have led to development of jaundice. Ultimately the study will provide the statistical data on the incidence and distribution of various diseases that lead to jaundice and hence aim at identifying the various ways in which patient management could be improved.

RESEARCH QUESTION

What are the significant ultrasonographic findings that can help to distinguish the various hepatobiliary pathologies seen locally in patients who present with jaundice?

BROAD OBJECTIVE

To evaluate the ultrasound pattern of findings seen in hepatic and biliary systems in patients with jaundice in Kenyatta national hospital and DDIRM

SPECIFIC OBJECTIVES

1. To describe the various hepatobiliary system ultrasound findings seen in jaundiced patients.
2. To determine the frequency, age and sex distribution of the various hepatobiliary pathology.
3. To correlate the clinical and ultrasonographic findings in the diagnosis of cause of jaundice.

STUDY DESIGN AND METHODOLOGY

STUDY AREA

This study was conducted at the radiology departments of Kenyatta National Hospital and University of Nairobi.

STUDY POPULATION

The study population consisted of all the patients who were sent to Kenyatta National Hospital and University of Nairobi radiology departments for abdominal ultrasound examination for evaluation of the cause of jaundice.

STUDY DESIGN

This was a descriptive prospective study.

SAMPLE SIZE DETERMINATION

At confidence interval of 95% and a margin error of 5% and prevalence rate of hepatobiliary diseases as seen in patients with altered liver functional tests at 12% the sample size was calculated by the formula:

$$n = \frac{z^2\, p\,(1-p)}{d^2}$$

Where **n** = desired sample size

z = standard normal distribution

p = known prevalence rate for the factor of interest under study

d = the level of significant desired

When this formula is applied at d = 0.05, z = 1.96, and p = 12 %

$$n = \frac{1.96^2 * 0.12(1-0.12)}{0.05^2}$$

$$n = 162$$

The actual sample size was 165 subjects that was evaluated in the proposed six months of data collection.

SAMPLING METHOD

All ultrasound examination of consenting patients who met the inclusion criteria were studied consecutively for the period extending from September 2008 to April 2009.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria

All Patients with clinically observable, and diagnosed to have jaundice and who gave informed consent.

Exclusion criteria

Patients who declined participation in the study.

Control of bias

All patients attended to during this period were included except if the patient declined participation. Ultrasound examination was done by the researcher in collaboration with consultant radiologists.

STUDY LIMITATIONS

Some patients were unable to undergo further investigations or surgical exploration to determine the proof of the cause of jaundice for comparison with the ultrasound diagnosis. A few patients were also lost on follow up as they opted to receive further treatment at different institutions. Challenges were also encountered in obese patients and those with much duodenal gas.

Inadequate patient information and inaccessibility of laboratory investigations was also a hindrance.

ETHICAL CONSIDERATION

This study was conducted with due regard for patients rights and confidentiality. The patients names were not used in the study in order to maintain confidentiality.

Before commencement of this study, the proposal was submitted to the ethical committee of KNH for approval.

Signed consent was required before recruiting patients into the study.

The results obtained from this study was treated with confidentiality and results used for academic and clinical improvement purposes only and to this end the results will be submitted to the KNH ethical committee to assist them form a database for future study and reference

MATERIALS AND PROCEDURE

The patient's history and any laboratory investigations done was recorded.

Ultrasonography was performed using machines in the two departments: General Electric ultrasound machine and Philips ultrasound machine which have almost a similar software and hardware applications.

Examinations were carried out with a real time transducer of 3.5-5MHZ that have colour Doppler facilities.

The principal investigator carried out the ultrasound examination on the patient with clinical diagnosis of jaundice. Abdominal ultrasound examinations were carried out with the patient in supine position. The liver and the biliary system scanned in sagittal, transverse and oblique position. The gall bladder was also be assessed in a semi-erect position especially if cholelithiasis was the suspected diagnosis. To this end patient were required to have fasted for six hours in order for the GB to be full and the neonates for four hours.

The liver parenchyma was assessed for changes in size, consistency, margins and echogenicity. Biliary ducts both the intrahepatic ducts and the extrahepatic ducts were identified and any pathology and their diameter measured, if they were dilated and thus the presence of obstructive jaundice the CHD was taken to be more than 4mm in diameter and the CBD more than 8mm in diameter.

The gall bladder was assessed for masses, wall thickening, shadowing and any other changes. Colour Doppler was used to differentiate the ducts from hepatic vessel. The pancreas was be assessed for any masses and ancillary pathologies.

The examinations were repeated by qualified radiologists in the two departments KNH and DDIRM, most of whom have had over five years of experience as radiologists and perform various ultrasound examinations on daily basis. The results were then compared and a further discussion by a panel that included the principal investigator, the qualified radiologist who assisted in the examination and my supervisor who on top of many years of experience is also a sonologist by subspecialisation was carried out especially on contentious cases and the final radiological diagnosis was agreed upon.

The proof for the the cause of jaundice where possible was determined by the other methods applied like serological analysis, biopsy, abdominal CT scans, MRCP, radionuclide studies, surgical exploration and histopathology.

The results of these tests were interpreted independently of sonographic findings to avoid bias.

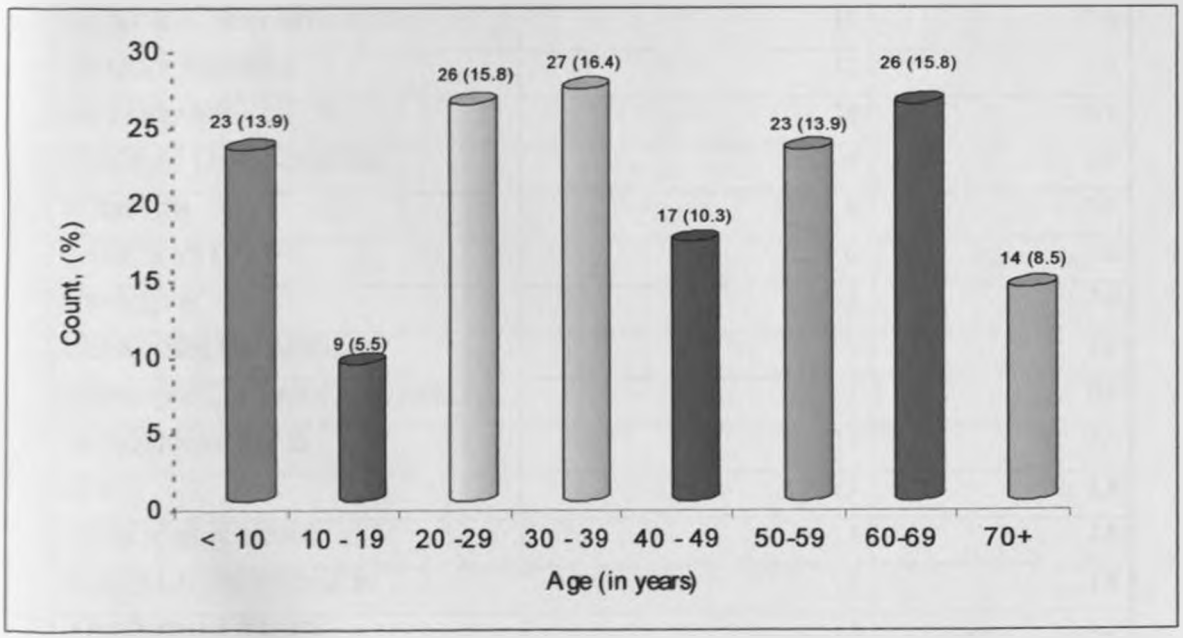
DATA AND RESULT PRESENTATION.

Statistical package for social scientist (SPSS version 11.5) program was used in data processing with the help of a stastitian.

One hundred and sixty five patients were recruited into the study in which 100(60.6%) were female and 65(39.4%) were male. Pediatric patients (<13 years) were 28 (17%). The median age was 38 years and all this patients had laboratory evidence of jaundice. They were entered prospectively into the study from September 2008 to April 2009. Abdominal ultrasound was carried out on all this patients with the aim of finding the cause of jaundice.

Fifty patients had surgical jaundice among these 14 patients were operated in KNH, the rest were either lost on follow up as they had come privately to the university or were followed up conservatively in the clinic. Among the medical jaundice, only 18 had liver biopsy carried out. MRCP was carried out on 7 patients while 22 had abdominal CT scan performed.

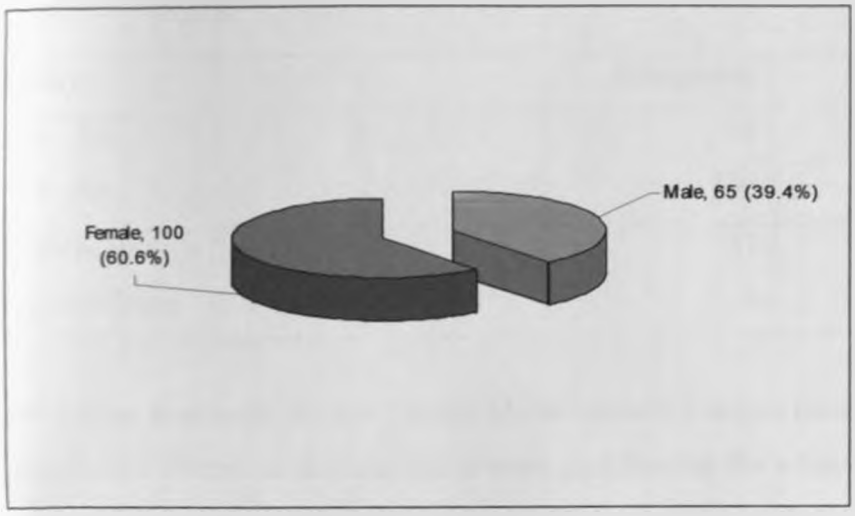
Figure 6: Distribution by Age



The total number of patients was 165. There was an almost normal curve distribution in all age groups and only people of 10-19 showed relatively lower values.

The median age was 38 years the range was 2 wk to 100 years.

Figure 7: Distribution by Sex



Females were more as compared to the males (60.6%:39.4%)

Table 2: Distribution as per Clinical Diagnosis

CLINICAL DIAGNOSIS	NUMBER OF PATIENTS	PERCENT
OBSTRUCTIVE JAUNDICE	43	26.1
HIV	17	10.3
CIRRHOSIS	13	7.9
JAUNDICE NON-SPECIFIED	13	7.9
BILIARY ATRESIA	12	7.3
METASTASIS	10	6.1
CHRONIC LIVER DISEASE	9	5.5
RUQ PAIN	9	5.5
CHOLECYSTITIS	6	3.6
HEPATITIS	5	3.0
HEPATOSPLENOMEGALY	5	3.0
HEPATOCELLULAR CARCINOMA	5	0.6
ABDOMINAL MASS	4	2.4
CCF	3	1.8
HEPATOBLASTOMA	3	1.8
PORTAL HYPERTENSION	3	1.8
ABDOMINAL PAINS	2	1.2
SICKLE CELL DISEASE	2	1.2
OTHERS	5	3
Total	**165**	**100**

Obstructive jaundice 43(26.1%) was the common indication for the ultrasound scan mainly to differentiate with non-obstructive type.

Table 3: Past Medical History (n = 165)

History	Frequency	Per cent
• Yes	31	18.8
• No	134	81.2
On Medication	11	35.5
Surgical History	4	12.9

HIV+ before were two; Protein Energy Malnutrition 2, Cardiac failure 3, Known Cancers 6, Alcoholism 2. Others on medications or were on follow up for a known diagnosis.

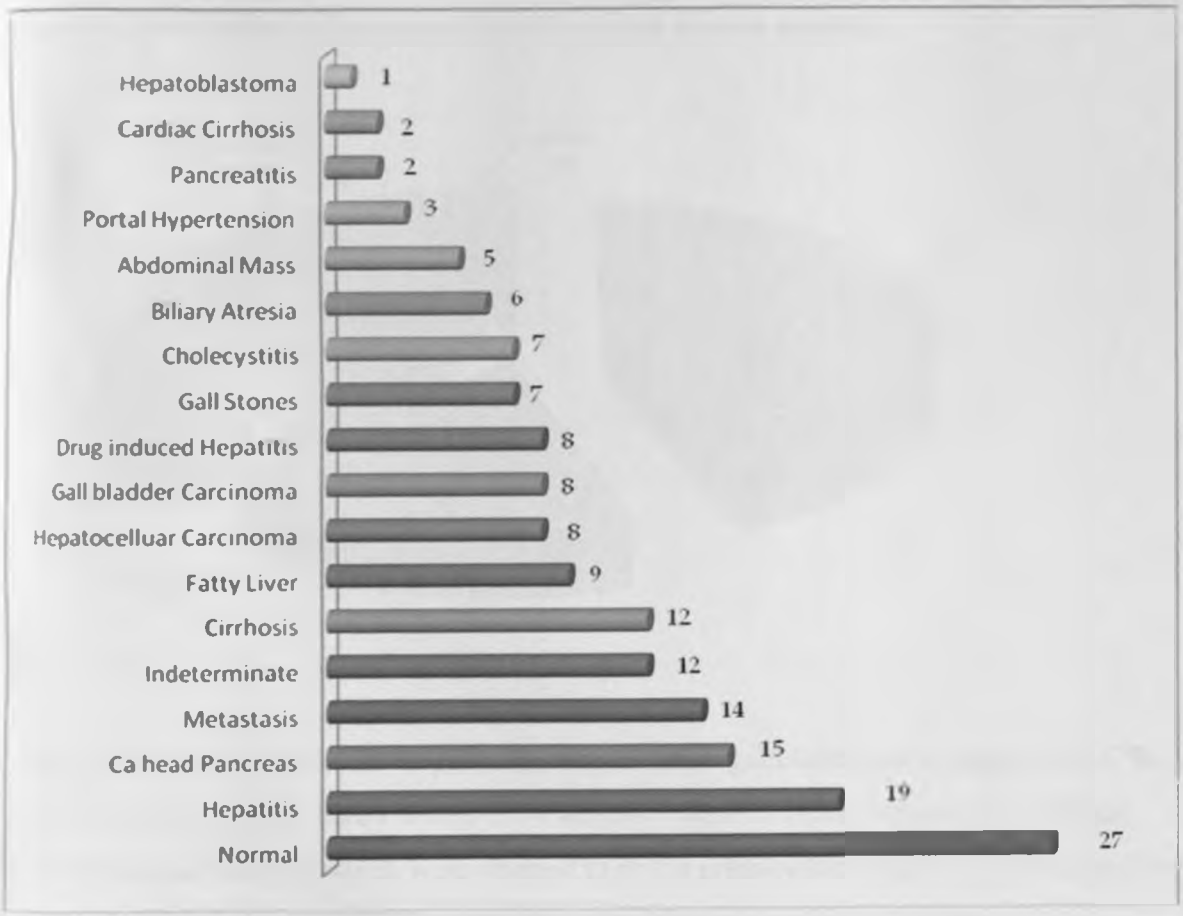
Table 4: Final diagnosis as shown by ultrasound

Ultrasound Diagnosis	Frequency	Percent
Normal	27	16.4
Hepatitis	19	11.5
Ca head Pancreas	15	9.1
Metastasis	14	8.5
Indeterminate	12	7.3
Cirrhosis	12	7.3
Fatty Liver	9	5.5
Hepatocellular Carcinoma	8	4.8
Gall bladder Carcinoma	8	4.8
Drug induced Hepatitis	8	4.8
Gall Stones	7	4.2
Cholecystitis	7	4.2
Billiary Atresia	6	3.6
Abdominal Mass	5	3.0
Portal hypertension	3	1.8
Pancreatitis	2	1.2
Cardiac Cirrhosis	2	1.2
Hepatoblastoma	1	0.6
Total	**165**	**100**

No hepato-biliary sonographic abnormalities were seen in 27 patients despite the presence of jaundice. Hepatitis had a frequency of 19 patients through by laboratory tests there were 26 confirmed cases for Hepatitis B and 3 for Hepatitis C.

Fourteen patients had metastasis of which 6 had a known primary while 12 others had features of cirrhosis but none underwent liver biopsy. Twelve others were indeterminate by ultrasound and further imaging with other modalities was suggested.

Figure 8: distribution of patients as per sonographic findings

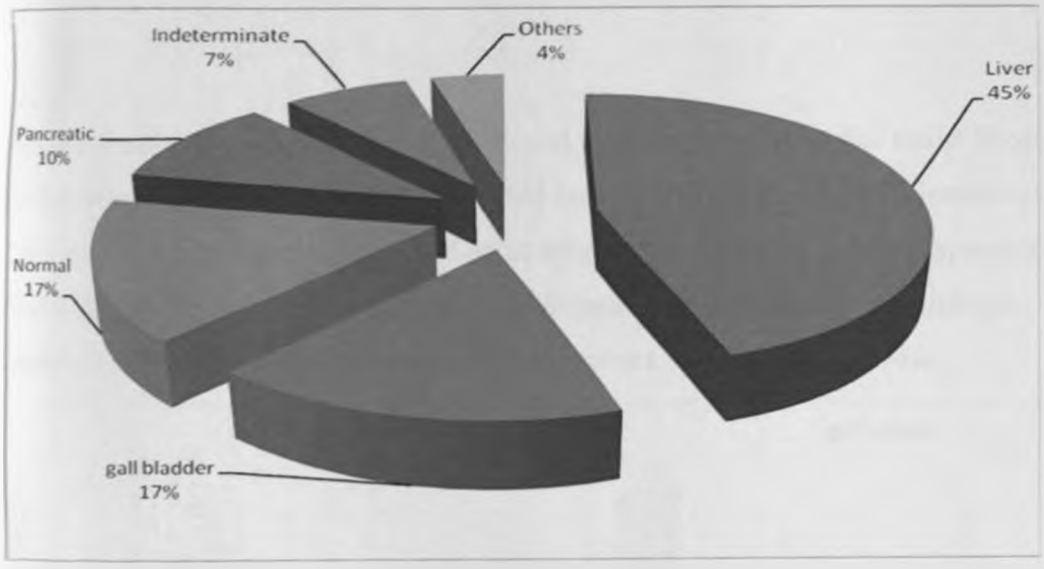


Patients with malignancies were 31 where majority had carcinoma head of pancreas or Ampulla of Vater masses. Fourteen of these were further evaluated by other modalities such as CT, MRCP or surgical exploration. Six children had features suggestive of biliary atresia, 3 of these underwent liver biopsy while 1 also had RNI DESIDA study. This was the only case that was proven to be biliary atresia through both biopsy and RNI . Among the other 3 patients whom ultrasound had suggested BA, 1 died while in the ward, 1 was HIV +ve and could not undergo liver biopsy while the other could not afford the costs of these studies. Nine patients had gallstones among which 4 had acute or chronic cholecystitis on surgery.

In 12 patients, there was pathology either of the liver or biliary system but the exact nature could not be determined by ultrasound and were labelled as indeterminate and the report dispersed as chronic liver disease or obstructive jaundice and further imaging modalities were suggested with possible biopsy.

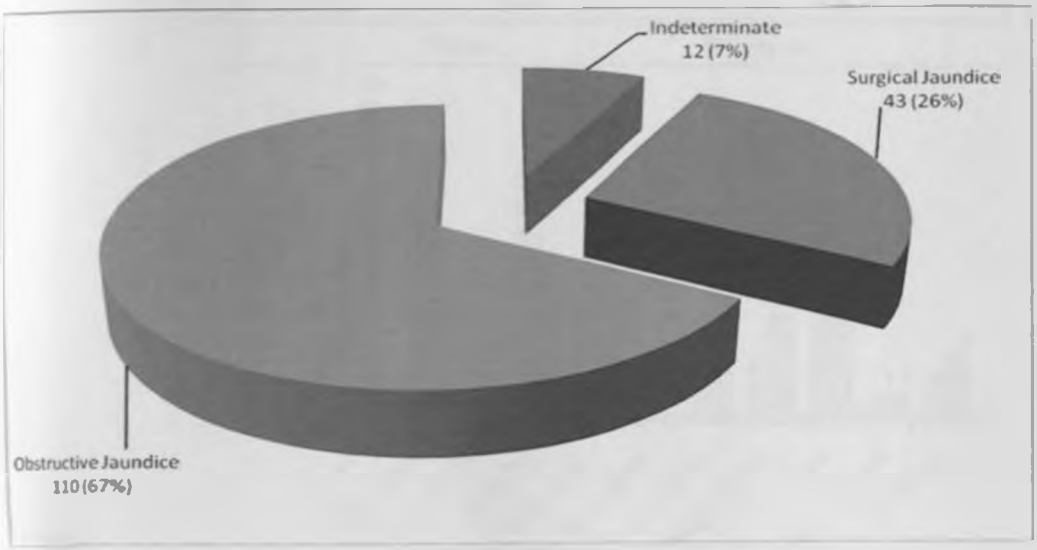
Drug induced hepatitis was seen in 7 patients mainly suggested by decreased echogenic pattern that was collaborated with the history of the drugs intake of which they were mainly ARVS or anti-TBs and of note was that all of these patients were on commencement phase of these drugs of mostly less than a month.

Figure 9: Distribution as per organ by ultrasound disease patterns



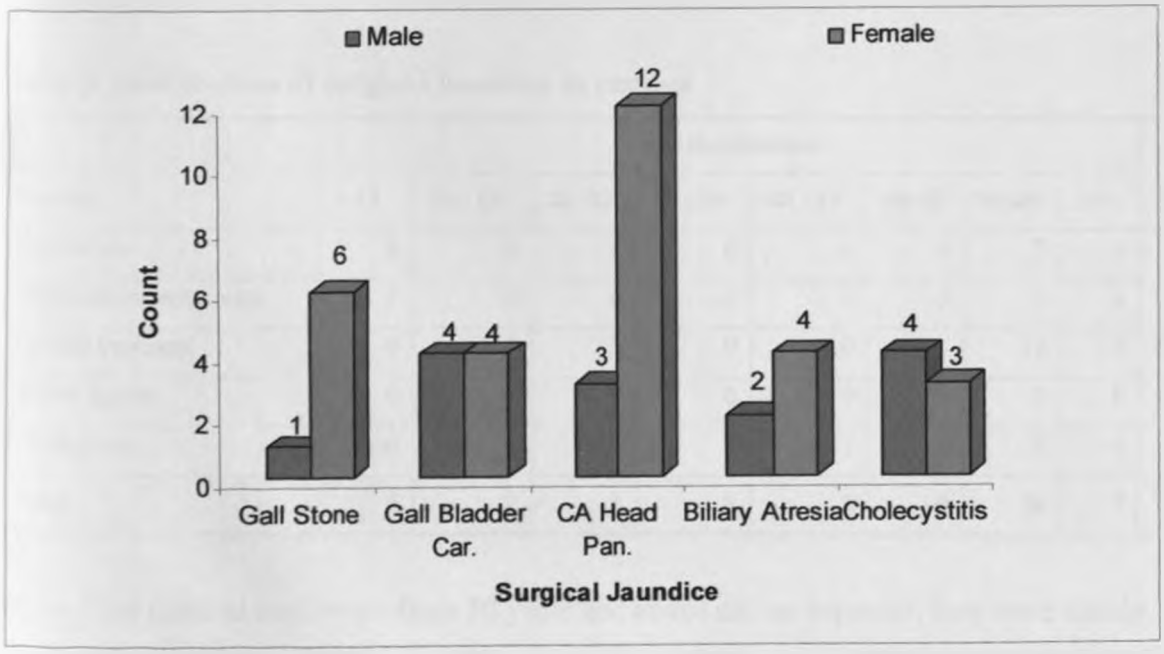
Liver findings constituted 45% of patients sampled while gallbladder pathologies were 17%. Patients with pancreatic diseases were 10% while 7% were of indeterminate sites. 4% had other abdominal findings which were deemed to be the primary pathologies but with possible affection of the liver leading to jaundice. These mainly were abdominal masses.

Figure 10: Distribution of jaundice by ultrasound disease patterns



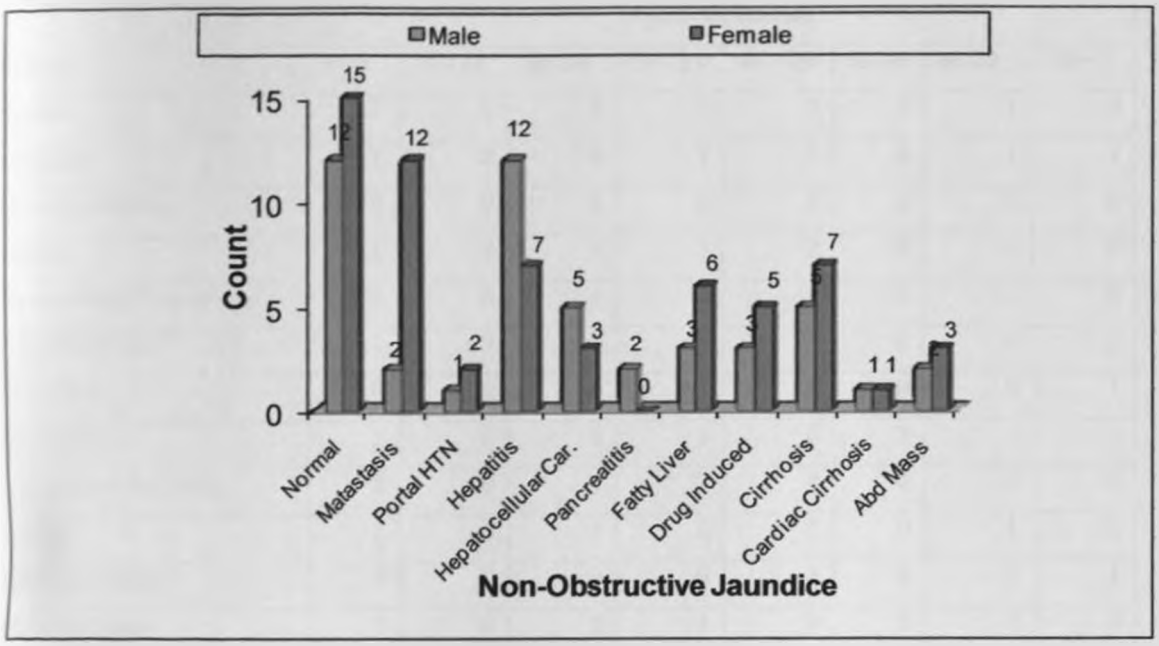
Non-obstructive jaundice constituted 67% and were the majority in this study. Biopsy and further imaging were done on a few selected cases. Obstructive (surgical) jaundice cases were 26% and were subsequently followed up in surgical units where some had laparotomy and biopsy plus other imaging modalities. Twelve patients had indeterminate findings.

Figure 11: Distribution of surgical cases as per sex P-VALUE=0.26



15 patients had ca head of pancreas of which 12 were female whereas in patients with gallstones only 1 was male while gallbladder carcinoma had an equal sex distribution but as shown by the p-value (0.26) sex was not a significant determinant in this study.

Figure 12: Distribution of medical cases as per sex P-value=0.261



Many patients had medical jaundice and the normal findings are included in medical type since there was the presence of jaundice and ultrasound was able to accurately discriminate surgical and medical jaundice.

Table 5: Distribution of surgical jaundice as per age

	Age distribution								
Surgical	**< 10**	**10 - 19**	**20 -29**	**30 - 39**	**40 - 49**	**50-59**	**60-69**	**70+**	**P-value**
Gall Stones	0	0	2	0	1	0	3	1	
Gall bladder Carcinoma	0	0	0	0	0	5	3	0	
Ca head Pancreas	0	0	0	0	0	3	10	2	<0.001
Biliary Atresia	6	0	0	0	0	0	0	0	
Cholecystitis	0	2	0	3	1	1	0	0	
Total	**6**	**2**	**2**	**3**	**2**	**9**	**16**	**3**	

Most of the surgical cases were from 50 years and above and as expected, they were mainly carcinoma and gallstones. There were 6 cases suspected biliary atresia from the 12 clinically suspected but only one was proven by biopsy and DESIDA study.

Table 6: Distribution of medical jaundice as per age

	Age Distribution								
Medical	**< 10**	**10 - 19**	**20 -29**	**30 - 39**	**40 - 49**	**50-59**	**60-69**	**70+**	**P-value**
Normal	7	3	7	5	3	1	1	0	
Metastasis	1	0	0	3	1	4	1	4	
Portal hypertension	0	0	0	0	0	3	0	0	
Hepatitis	1	4	4	5	2	0	1	2	
Hepatocellular Carcinoma	0	0	1	0	1	1	5	0	<0.001
Hepatoblastoma	1	0	0	0	0	0	0	0	
Pancreatitis	0	0	0	1	0	0	0	1	
Fatty Liver	1	0	0	3	0	3	1	1	
Drug induced Hepatitis	0	0	1	3	4	0	0	0	
Cirrhosis	1	0	3	2	3	0	1	2	
Cardiac Cirrhosis	0	0	0	0	1	0	0	1	
Abdominal mass	3	0	0	1	0	1	0	0	
Total	15	7	16	23	15	13	10	11	

Most of the normal cases had almost a equal age curve distribution whereas metastasis were in the above 50 years group with only one under 10 years. Hepatitis was seen to affect the 15-40 years group mainly. Liver cirrhosis was noted to affect the 20-50 years group more as also was seen in the drug-induced hepatitis. There was one case of a 2 year old boy which was proven to be hepatoblastoma. Hepatocellular carcinoma was seen in mainly the over 60 years group. The 12 indeterminate cases are not included in the above statistics.

DISCUSSION

Jaundice is often a delayed manifestation of liver, gallbladder or pancreatic pathologies. Ultrasound has been shown to be accurate in determining the organ affected and has a high accuracy in differentiating obstructive versus the non-obstructive jaundice. This study was able to accurately distinct the two types of jaundice in 93% of cases and compares well to two studies by Durab khan et al[53] and Peter matzen et al[54] which quotes ultrasound accuracy to be above 96%. Only 7% of the sampled patients could not be determined despite the presence of ultrasonographic liver markers such as changes in echogenicity, hepatomegaly and concomitant gallbladder pathologies like non-obstructive calculi. This also compares well with MRCP, which has an accuracy level of 96% according to Pavolene, laghi et al[55] but ultrasound is noted to be poor as concerns the cause and site of obstruction when compared to MRCP according to Munir et al[56] and Shanmugam et al[57].

Twenty seven patients (16.4%) were noted to have normal findings despite the stringent analysis of the liver, GB, and the pancreas. This could be explained by the fact that ultrasonographic changes which are mainly anatomical trails biochemical or immunological changes as evidenced by hepatitis findings where 29 patients had positive immunoassays but only 19 were shown to have ultrasonographic hepatitis findings. Non-visualization of gallbladder or its lack of distention despite adequate fast was noted in over 60% of the patients where hepatitis was suggested. This could be a high indicator of acute hepatitis possibly due to destruction of hepatocytes and was also noted in over 50% of patients studied by Sudhamsu KC in kathmandu[58]. Only 3 patients (16%) of the total number of patients with hepatitis showed the classical starry sky appearance. Ten patients were ultrasonographically normal despite positive titers for hepatitis. Main findings noted in hepatitis included decreased echopattern and moderate hepatomegaly with no interference of beam penetration.

Most of the medical jaundice was was shown to affect the middle age group more than the rest especially in hepatitis, liver cirrhosis and drug induced hepatitis. HIV patients showed non-specific findings on the evaluated systems like generalized increase in gall bladder wall, a mixed echogenic liver and adenopathy.

The cases noted to have cirrhosis showed irregular ragged margins with a small sized liver. Ascites was a common ancillary finding suggesting the chronicity of the underlying liver disease.

There were 8 cases of hepatocellular carcinoma where the findings were that of either multiple masses of mixed echopattern or a generalized mass with irregular margins. Only 3

out of 5 cases that underwent percutaneous ultrasound-guided biopsy were found to be hepatocellular carcinoma while the rest were reported as macronodular ciorrhosis showing a low specificity of ultrasound, which correlates well with a study done by D.Rubens [59].

Among the surgical jaundice cases carcinoma of the pancreas accounted for the highest frequency (15 patients). This has also been seen in other studies done [60,61]. A local study by Ngosewe[62] for his postgraduate dissertation in 2008 noted that among the adult population, pancreatic carcinomas accounted for 60% of surgical jaundice. In this study there were more females with pancreatic carcinomas through the sample size (15) was too small to derive a statistically significant conclusion. The only peculiar finding was that 3 of these patients were diabetic even before the diagnosis of carcinoma. All these patients with pancreatic carcinoma were over 50 years.

Gallstones accounted for 7 patients and only one was male. In one indeterminate case, MRCP was able to demonstrate a stone at the Ampulla of vater possibly showing that while ultrasound is highly specific to differentiate obstructive versus non-obstructive type, the site and cause of obstruction is still a challenge especially if it is distal to cystic duct . This correlates with studies by Shanmugam et al[57] and Rajendra et al[63] and a local study done by Ngoseywe[62]. Another notable finding was that 2 patients with gallstones were below 30 years possibly suggesting lifestyle changes. This has also been noted in a prior study done in German by Kratzer W et al [64].

The only cause of surgical jaundice in the pediatrician population noted in this study was biliary atresia. The pediatricians who were the main clinicians who referred these children had suspected 12 cases but after ultrasound examination only 6 had suggestive features of BA and RNI and biopsy were recommended where only one case was proven. This findings by ultrasound compares well with the finding noted in a study by Gerald S, Richard C et al[65] where it was recommended that both ultrasound and RNI should be complimentary. Suggestions have been made the findings of a triangular cord sign together with non-visualization of the gallbladder which in this study was the major basis for ultrasonic diagnosis is a highly specific sign for Biliary atresia[66]. Nevertheless ultrasound has been shown by this study to have a screening role for neonatal jaundice as 6 children were accurately diagnosed not have BA despite the clinical suspicion and this compares well with the conclusion drawn by[67]. The one patient proven to have BA underwent both DESIDA and biopsy analysis.

Gallbladder carcinoma was also noted to have a high frequency(19%) among the surgical type of jaundice. The findings were that of a mass engulfing the gallbladder fossa or a localized gallbladder wall thickening through the site of obstruction was not established by this study as has been suggested by other studies[68]

In the study ultrasound reliably correlated with the clinical findings given in the request forms in terms of the nature of jaundice- whether direct bilirubin or indirect bilirubin that also aids in differentiating surgical versus medical jaundice. There were several bilirubin equivocal cases where the clinicians either wanted ultrasonographic differentiation of the type of jaundice for further evaluation by the specific displines or were seeking clarification on complications of these pathologies, which are well addressed in this study. However many of the request forms had scanty information with the only statement being jaundice query cause. Inspite of this, the findings in this study stresses the role of ultrasound being the initial screening tool for patients with jaundice.

CONCLUSION

The results of this study have demonstrated that jaundice affects all age groups with no gender predilection. They have also shown that ultrasound is an accurate imaging modality when differentiating obstructive versus non-obstructive jaundice conforming to other studies which quote an accuracy of over 95%.

The study has also demonstrated the epidemiological disease patterns as seen locally for patients seen with jaundice where hepatitis is the commonest among the non-obstructive type and cancer of the pancreas being commonest in the obstructive type.

It has also been shown from this study that a number of patients with jaundice do not necessarily have ultrasound abnormal findings. Differentiation of the various diffuse liver diseases is not easy by use of ultrasound alone as has been shown by the few biopsy results that were done through ultrasound guidance.

There is a need for multi diagnostic approach towards the diagnosis of the cause and in case of obstructive jaundice the site or level of obstruction. Other modalities such as CT scan and MRCP were shown by this study to be more accurate in determining the site.

Nevertheless, ultrasound should be the first imaging of choice for investigation of patients with jaundice.

RECOMMENDATION

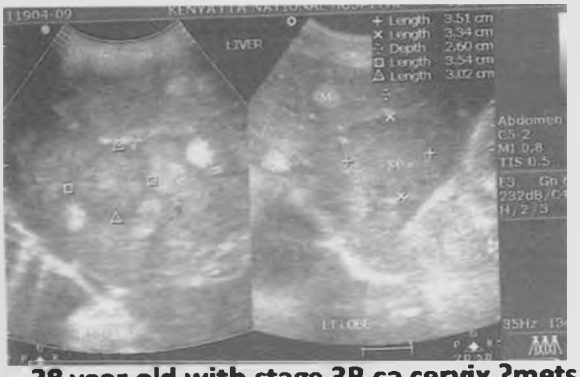
- Ultrasound should be the imaging modality of first choice in evaluating patients with jaundice as it adequately differentiates surgical from medical jaundice as has been shown by the results of this study.
- Ultrasound has also been shown to have a high specificity for the detection of gallbladder pathologies and hence should be the modality of choice in evaluation of patients who present with right upper quadrant pain.
- When ultrasound is inconclusive or normal and jaundice persists other imaging modalities should be employed. Nevertheless its use should be encouraged as the initial screening of choice not only due to its relative availability, lack of ionizing radiation and a lower cost but also due to its high accuracy in determining the nature of jaundice before other modalities are employed.
- Limitation of ultrasound in obese patients, poorly prepared patients and user variability should however be noted.

Above 59 year old female who had cancer head of pancreas with dilated ducts. The CBD size is 1.9cm. biopsy proved an adenocarcinoma

Below Liver cirrhosis two cases: baby girl 8 year old initially thought to be malignancy

23 year old female

68 year old female with GB mass

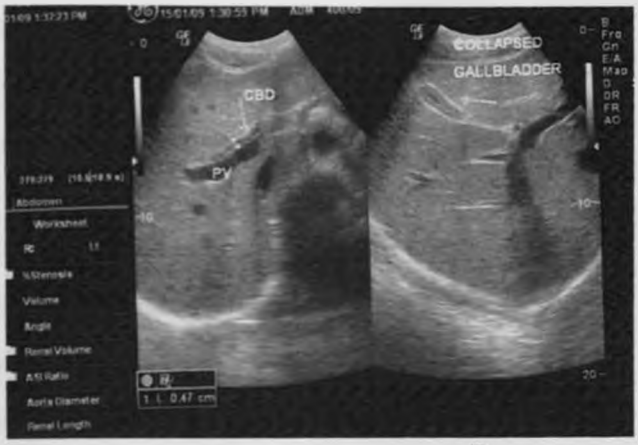


38 year old with stage 3B ca cervix ?mets

40 years HIV +ve male GB wall thickening

49 years male ? Macronodular cirrhosis

A



B

C

A- 52 years female with gall stones was also HIV +ve

B- 29 year old male who had persistently collapsed GB despite a 4 hour repeat scan there was no starry sky appearance but Hepatitis was suggested and serology was reactive for both hepatitis B and C

C- 66 year old male with mass at ampulla of vater there were dilated billiary ducts and a dilated pancreatic duct as shown

49 year old female patient with dilated tortuous ducts, the cause and site of obstruction was not noted but MRCP was done and a gall stone impacted at the distal CBD near ampulla of vater was noted as the filling defect shown below

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APPENDIX A: OUESTIONNAIRE

QUESTIONNAIRE (DATA COLLECTION FORM)

1) Patients number

2) Age

3) Sex m

4) Past medical history yes no

Use of medications, eg anti-TB, ARV'S yes no

IF yes type duration

surgical history yes

others(specify)----------

5) Presenting symptom/sign

Jaundice TB DB IB duration

6) ultrasound findings

liver

Echogenicity

Beam penetration

liver size

Liver margins

Ancillary abnormality

BILIARY SYSTEM

Contents (none, stone, sludge, others)

Wall thickness (normal, generalized, localized)

Bile ducts size ----Intrahepatic normal ☐ dilated ☐

-----Extrahepatic normal ☐ dilated ☐

Ancillary abnormality

Pancreas

Normal

Mass- localized

Diffuse pathology

Ancillary abnormality

Diagnostic impression on cause of jaundice ☐

7) Supplementary findings

- Serology -HBsAg ☐

  -HIV ☐

- PTC ----------
- Percutaneous liver biopsy----------
- MRCP----------
- ERCP----------
- Surgical----------
- Any other done(specify)----------

APPENDIX B: (English)

CONSENT FORM

My name is Dr. Ngure J. G, a Master of Medicine student at the Department of Diagnostic Radiology, University of Nairobi. I am doing a study on the liver and gall bladder diseases in patients with yellowness of the eyes and the accuracy of ultrasound in diagnosing these diseases, and would wish to recruit you to participate. The information you will give and the examination findings will be handled with utmost confidentiality.

Your name will not be included, except the serial number. The results of the study will be used to improve the diagnosis and management of cases of jaundice. Please note that you are not obliged to participate and you have a right to decline or withdraw from the study.

If you accept please to participate in this study sign below

Signature: _____

Date: _____

I certify that the patient has understood and consented participation in the study

Dr Ngure G.

Signature: _____

Date: _____

APPENDIX B (KISWAHILI)

Maelezo Ya Kibali Cha Mgonjwa

Jina langu ni Dr Ngure J. G. Mimi ni daktari na pia mwanafunzi katika Chuo kikuu cha Nairobi. Ninafanya uchunguzi zaidi wa maini na viungo vilivyo karibu. Kwa maana wewe upo hapa kupigwa picha ya tumbo , ningeomba ruhusa yako ili tuyatumie majibu yako katika uchunguzi wangu.

Majibu yoyote ambayo tutapokea kutoka kwa uchunguzi wako ni ya siri. Jina lako halitawekwa kwenye uchunguzi wetu ila nambari ya fomu tu.

Majibu ya huu uchunguzi wako na ya wengine yatasaidia kuboresha matibabu ya magonjwa ya maini humu nchini.

Naelewa ya kwamba sio lazima nihusike katika huu utafiti, na pia naweza kubadili nia yangu kuhusu kuendelea kushiriki.

Kama unakubali kushiriki, tafadhali weka sahihi yako hapa chini:

Sahihi----------

Tarehe----------

Ninathibitisha ya kwamba muhusika ameelewa na kukubali kushiriki kwa utafiti huu.

Daktari Ngure G.

Sahihi ----------

Tarehe ----------

APPENDIX C: BUDGETARY JUSTIFICATION

BUDGET

No.	Requirement	Cost (Kshs)
1	Stationary, photocopying, typing	20,000
2	Secretarial services	3,000
3	Data analysis	15,000
4	Printing and scanning documents	14,000
6	Binding	5,000
7	Data collection	14,000
8	Transport	5,500
9	Contingency	20,000
	TOTAL	**95,500**

The above expenses will be met by the researcher.

The contingency allocation provided is to cater for any unforeseen expenditure