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Assessment of Masses in the Right Upper Quadrant using Ultrasound Imaging: A Comprehensive Diagnostic Approach for Clinical Evaluation in Bangladesh

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ABSTRACT

Ultrasound serves as a pivotal tool in identifying and assessing masses in the right upper quadrant (RUQ) of the abdomen, crucial for determining precise organ involvement, composition, characteristics, and extension into neighboring structures. This cross-sectional prospective study conducted at various medical facilities in Dhaka enrolled 130 patients, utilizing real-time ultrasound with a 3.5 MHz transducer. Among the 100 patients with abnormal sonographic findings, 40% exhibited RUQ masses, predominantly affecting males (75%). Liver masses were most common (75%), including abscesses, hepatocellular carcinomas, secondary lesions, hemangiomas, and simple cysts. Gall bladder masses (10%) mostly consisted of advanced stage carcinomas and polyp-like masses. Right renal masses (15%) comprised simple cysts, severe hydronephrosis, renal cell carcinoma, and angiomyolipoma. Ultrasound emerges as the preferred initial imaging modality for RUQ mass detection, offering high diagnostic accuracy, non-invasiveness, affordability, and widespread availability. While supplementary investigations like serological tests, CT scans, and histopathology may be necessary for definitive diagnoses, ultrasound aids in formulating initial patient management guidelines. Despite its limitations, ultrasound remains popular and highly preferred for RUQ imaging, emphasizing its significance in clinical practice.

Keywords: Right upper quadrant, Masses, Ultrasound imaging, Diagnostic approach, and Clinical evaluation.

INTRODUCTION:

Ultrasound has emerged as the predominant imaging tool in contemporary medicine, serving as a primary means for rapid and effective imaging diagnostics as well as for guiding therapeutic procedures with precision and efficiency (Klibanov & Hossack, 2015). Ultrasound stands as an exceptional imaging tool for detecting and assessing masses involving the organs within the right upper quadrant of the abdomen (Hassani *et al.,* 2012). These masses come to clinical attention through symptomatic patients, incidental discovery during physical examinations, or commonly through diagnostic radiological studies (Kloos *et al.,* 1995). Once a mass is identified, the primary aim is to determine the organ involved and its extension into surrounding structures (Langley & Fidler, 2011).

Given its sensitivity and the remarkable spatial resolution, ultrasound can detect tiny masses, even a few millimeters in diameter, when they exhibit hypo- or hyperechoic properties compared to the

surrounding tissue (Sehgal *et al.,* 2006). Further investigations into a mass hinge upon its initial detection and evaluation via ultrasound. Any abdominal mass signifies an abnormal growth in the abdomen, and assessing such cases through ultrasound facilitates reaching a definitive diagnosis (Milla *et al.,* 2007). Thus, ultrasound was selected as the imaging modality for this study owing to its high diagnostic accuracy, wide acceptability, and lack of irradiation (Guo *et al.,* 2018). Additionally, ultrasound proves non-invasive, cost-effective, readily available, repeatable, and rapid.

Purpose of the Study

This study was conducted with the following objectives

- Determine the location and specific organ involvement of the masses, crucial for diagnostic purposes.
- Identify the types of masses.
- Assess the extent of mass extension into surrounding structures.
- Evaluate the distribution of masses within our population.
- Examine the age and sex distribution among these masses.

Assumption

While various diagnostic modalities exist for diagnosing right upper quadrant masses, CT and MRI are notably expensive, and FNAC poses invasive risks. Conversely, ultrasound emerges as a noninvasive, inexpensive, rapid, and easily accessible method for diagnosing various types of right upper quadrant masses. Although ultrasound alone may not provide a definitive diagnosis for many lesions, combining patient history, physical examinations, and follow-up ultrasound studies renders it the most accepted screening method for abdominal masses.

Hypothesis

The hypothesis posits that ultrasound is an outstanding imaging method for detecting, evaluating, and monitoring right upper quadrant masses.

MATERIALS AND METHODS:

This study followed a cross-sectional prospective design and focused on patients presenting with masses in the right upper quadrant.

Permission for the Study

Approval was obtained from the relevant department for the study. All participating patients were briefed about the study's nature and willingly agreed to take part. Verbal consent was acquired from guardians as necessary.

Population of the Study

Patients were selected based on a meticulous examination of detailed histories and symptoms associated with right upper quadrant masses, aiming to gather comprehensive information (Obayda *et al.,* 2023; Mohammadiounotikandi & Babaeitarkami, 2024).

Inclusion Criteria

1. All age groups were included.
2. Both sexes were considered.
3. Patients exhibiting clinical manifestations of right upper quadrant masses, such as upper abdominal pain, palpable mass, fever, weight loss, or ascites, were included.

Exclusion Criteria

Patients displaying symptoms attributed to causes other than upper quadrant masses were excluded.

Method

Each patient with a right upper quadrant mass underwent examination using a real-time ultrasound machine equipped with a 3.5 MHz probe for adults and a 5 MHz probe for children.

Instruments

Samsung FPS 30D, Philips Afinity 70G, Mindray real-time ultrasound machines were utilized for patient examinations.

Preparation

Patients were examined under fasting conditions of either overnight or 6 to 8 hours. They were positioned supine, in right and left decubitus positions, and occasionally in a partially upright or erect position as required. Coupling gel was applied over the abdomen.

History and Clinical Examination

Comprehensive histories were recorded, and physical examinations were conducted.

Scanning Technique

Patients underwent scanning in longitudinal (sagittal), transverse, and oblique planes, including scans through intercostal and subcostal spaces. The transducer was moved with slow rocking motions in all planes to achieve optimal visualization of abdominal organs. Patients were instructed to take a deep breath and hold it during scanning.

Diagnosis

Ultrasound findings were correlated with clinical, serological, computed tomography (CT), and histo-pathological reports.

Data Analysis

Data analysis was performed using a computer.

RESULTS:

Compiled Results

In a cohort of 100 cases, 40 (40.0%) patients displayed sonographic features indicating masses in the right upper quadrant, with diagnoses substantiated by historical data, physical examinations, and additional investigations. Among these 40 patients, 30 (75.0%) were male, while 10 (25.0%) were female. The study encompassed all age groups. Clinical manifestations included upper abdominal pain in 36 (78.26%) cases, fever in 16 (34.78%), swelling in 6 (13.04%), anorexia in 25 (54.34%), weight loss in 19 (41.21%), ascites in 6 (13.04%), jaundice in 10 (21.73%), and hepatomegaly in 25 (54.34%) (Nawreen *et al.,* 2023). Regarding positive sonographic findings, the liver was implicated in 30 (75.0%) cases, the gallbladder in 4 (10.0%) cases, and the right kidney in 6 (15.0%) cases. Among the 30 (75.0%) instances of liver masses, diagnoses comprised 10 (33.33%) cases of abscess, 10 (33.33%) of hepatocellular carcinoma (HCC), 3 (10.0%) secondary lesions, 3 (10.0%) hemangiomas, and 4 (12.0%) simple cysts. Among the 4 (8.69%) gallbladder mass cases, 3 (75.0%) exhibited stones, while one presented a small polyp-like mass without stones. Of the 6 (15.0%) right renal masses, diagnoses included 2 (33.32%) cases of simple cysts, 2 (33.32%) instances of severe hydronephrosis, 1 (16.66%) renal cell carcinoma, and 1 (16.66%) angiomyolipoma.

Table 1: Distribution of patient according to positive and negative sonographic findings of Right Upper Quadrant (RUQ) mass (n=100).

Sonographic Findings	No. of Cases	(%) Percentage
Positive	40	40.0%
Negative	60	60.0%
Total	**100**	**100.0%**

(n=number of patients)

Among the 100 patients examined, 40 (40.0%) exhibited positive sonographic findings indicative of masses in the right upper quadrant (RUQ). The remaining 60 (60.0%) patients did not display any positive sonographic features of RUQ masses.

Table 2: Distribution of RUQ masses according to age (n=40).

Age Group	No. of Case	(%) Percentage
Below 20 years	1	2.17
21 to 30	3	6.52
31 to 40	10	25
41 to 50	12	30
51 to 60	10	21.74
61 to 70	3	7.5
71 to 80	1	2.17
Total	**40**	**100**

Table 2 presents the distribution of RUQ masses categorized by age groups. The incidence of RUQ masses was notably higher within the age bracket ranging from 31 to 50 years, followed by the age group between 51 to 60 years. Among the 40 cases diagnosed positively via sonography, 30 (75%) were male, while 10 (25%) were female.

Table 3: Distribution of sonographically diagnosed RUQ masses according to sex (n=40).

Sex	No. of Case	(%) Percentage
Male	30	75.0
Female	10	25.0
Total	**40**	**100**

Table 4: Distribution of patients according to clinical features associated with RUQ masses (n=40).

Clinical Feature	No. of Case	(%) Percentage
Pain	7	17.5
Fever	4	10.0
Swelling	3	7.5
Anorexia	5	12.5
Weight Loss	7	17.5
Hepatomegaly	6	15.0
Ascites	3	7.5
Jaundice	5	12.5

Within the 40 cases (40%) identified, the breakdown of associated symptoms was as follows: 7 (17.5%) patients experienced pain, 4 (10.0%) had fever, 3 (7.5%) exhibited swelling, 5 (12.5%) reported anorexia, 7 (17.5%) presented with weight loss, 7 (15.0%) showed signs of hepatomegaly, 3 (7.5%) had ascites, and 5 (12.5%) displayed jaundice.

Table 5: Distribution of sonographically diagnosed RUQ masses according to organ involvement (n=40).

Organ	No. of Cases	(%) Percentage
Liver	30	75
Gallbladder	4	10
Right Kidney	6	15
Total	**40**	**100**

Within the 40 (40%) cases diagnosed positively through sonography, organ involvement was observed as follows: 30 (75%) patients had liver masses, 4 (10%) displayed gallbladder masses, and 6 (15%) presented with right renal masses.

Table 6: Distribution of sonographically diagnosed different type of liver masses (n=30).

Types of masses	No. of Case	(%) Percentage
Hepatic Abscess	10	33.33
Hepatocellular Carcinoma	10	33.33
Secondaries	3	10.0
Haemangioma	3	10.0
Simple Cyst	4	12.0
Total	**30**	**100**

Among the 30 (75%) cases of liver masses, the breakdown of specific diagnoses was as follows: 10 (33.33%) cases were abscesses, another 10 (33.33%) were diagnosed as hepatocellular carcinoma (HCC), 3 (10.0%) were identified as secondary lesions, 3 (10.0%) were diagnosed as hemangiomas, and 4 (12.0%) were characterized as simple cysts.

Table 7: Distribution of sonographically diagnosed different type of renal masses (n=6).

Types of masses	No. of Case	(%) Percentage
Simple Cyst	2	33.32
Severe Hydronephrosis	2	33.32
Renal Cell Carcinoma	1	16.66
Angiomyolipoma	1	16.67
Total	**6**	**100**

Among the 6 (13.05%) cases of renal masses, the categorization by specific diagnoses was as follows: 2 (33.32%) cases were identified as simple cysts, another 2 (33.32%) cases were diagnosed as severe hydronephrosis, 1 (16.66%) case was determined to be renal cell carcinoma, and 1 (16.67%) case was categorized as angiomyolipoma.

Case No: 1

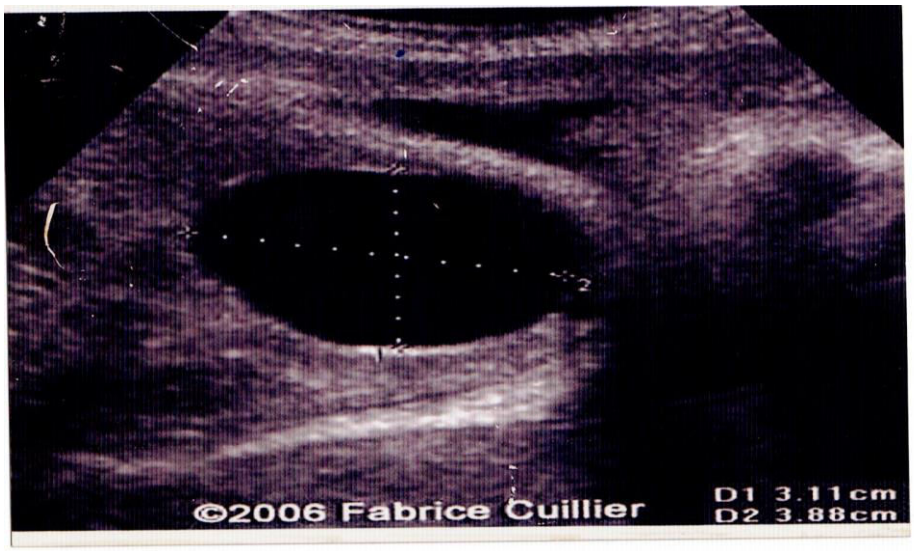

Fig. 1: Shows a heterogeneous mass in right lobe of the liver.

History

A 38-year-old female patient was referred to the hospital for an upper abdominal ultrasound due to complaints of epigastric pain, heartburn, and anorexia. Sonographic findings, revealed a normal-sized liver. Within the left lobe of the liver, a well-defined, thin-walled cystic mass devoid of internal echoes was observed. The cyst exhibited no septa or solid components and contained thin, clear fluid. Its dimensions measured 3.1x3.8 cm in diameter, with posterior enhancement noted. The gall bladder, biliary tree, and pancreas appeared normal (Donnelly *et al.,* 2011).

Diagnosis

A simple cyst within the right lobe of the liver.

Case No: 2

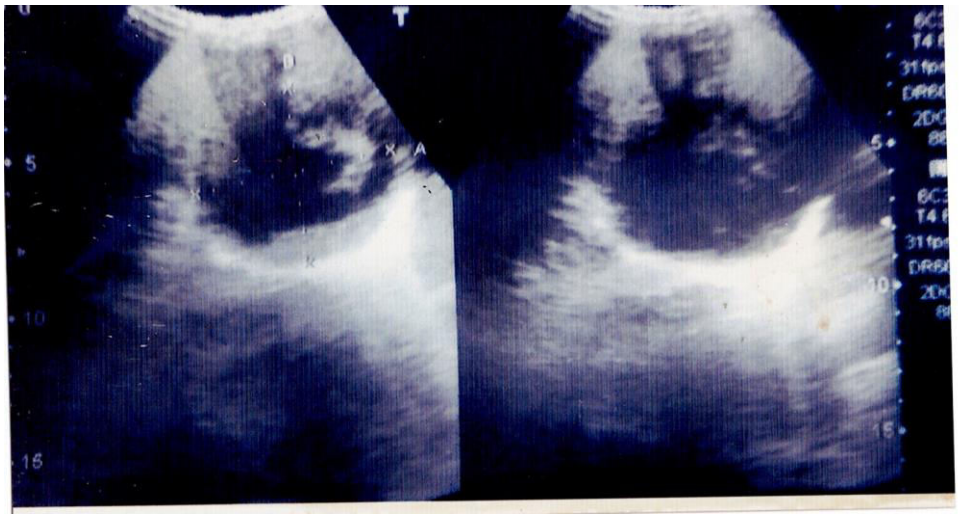

Fig. 2: Shows a hypoechoic lesion in right lobe of the liver.

History

A 58-year-old male patient was referred to the hospital for an upper abdominal ultrasound due to complaints of right upper abdominal pain, sweating, and anorexia. Sonographic examination, revealed a liver of normal size. Within the postero-superior aspect of the right lobe, a complex lesion was observed, characterized as cystic with an internal organized solid component. The lesion had an irregular border and measured approximately 6.5x 6.1 cm in diameter. The rest of the liver parenchymal echotexture appeared uniform.

Diagnosis

A space-occupying lesion (SOL) in the right lobe of the liver, likely indicative of an abscess.

Case No: 3

Fig. 3: Shows a highly echogenic mass in right lobe of the liver.

History

A 30-year-old female patient visited the center for an ultrasonographic examination of the upper abdomen, reporting complaints of epigastric fullness, heartburn, and nausea. Sonographic examination, revealed a liver of normal size with a homogeneous echotexture. A well-defined, mostly round, hyperechoic, and homogeneous mass measuring 1.38x 1.32 cm in diameter was observed within the right lobe of the liver.

Diagnosis

A space-occupying lesion (SOL) in the right lobe of the liver, most likely indicative of a haemangioma.

Case No: 4

Fig. 4: Shows multiple hypoechoic lesions throughout the liver.

History

A 54-year-old male patient was referred to the hospital for a whole abdominal ultrasonography due to complaints of upper abdominal pain, specifically on the right side, along with anorexia and weight loss. Sonographic examination indicated a liver of normal size. Multiple focal lesions of varying sizes were detected throughout the entirety of the liver. The gallbladder, biliary tree, pancreas, spleen, kidneys, and urinary bladder appeared normal, but the prostate showed mild enlargement.

Diagnosis

Multiple space-occupying lesions (SOL) in the liver, suspected to be secondary lesions.

Case No: 5

Fig. 5: Shows a heterogeneous mass in right lobe of the liver.

History

A 60-year-old male patient visited the hospital for a sonographic examination of the hepatobiliary system, presenting complaints of pain, anorexia, a lump in the right upper abdomen, and weight loss. Sonographic assessment, revealed an enlarged liver measuring 19.5 cm in the midclavicular line, displaying homogeneous echotexture. Additionally, a large irregular heterogeneous lesion measuring 11.6x9.0 cm in diameter was identified in the upper part of the right lobe of the liver. Other examined areas, including the gallbladder, biliary tree, pancreas, spleen, right kidney, inferior vena cava, and portal vein, appeared normal.

Diagnosis

A space-occupying lesion (SOL) in the right lobe of the liver, most likely indicative of Hepatocellular Carcinoma (HCC).

Case No: 6

Fig. 6: Shows a cirrhotic liver with a heterogeneous mass.

History

A 57-year-old male patient arrived at the hospital for a whole abdominal ultrasonography, reporting pain, abdominal swelling, anorexia, nausea, weight loss, and jaundice. Ultrasound findings, revealed a small, shrunken liver with an inhomogeneous echotexture and an irregular inferior border. A discrete mass measuring 7.1x7.1 cm with mixed echogenicity was observed in the right lobe of the liver. Additionally, the spleen appeared enlarged, accompanied by dilated splenic vessels. Extensive free fluid accumulation was noted within the abdominal cavity.

Diagnosis

A mass detected in a cirrhotic liver, suspected to be indicative of Hepatocellular Carcinoma (HCC).

Case No: 7

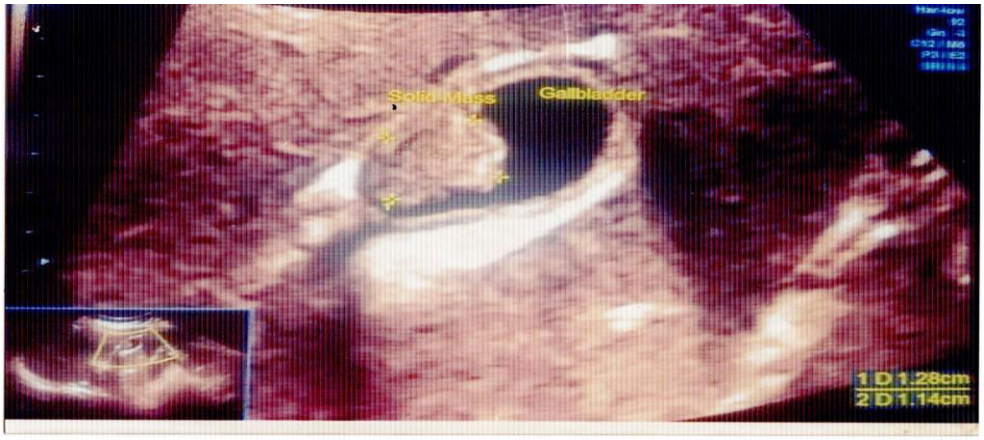

Fig. 7: Shows gall bladder mass.

History

A 47-year-old male patient was referred to the hospital for an ultrasonography of the upper abdomen due to right upper quadrant pain and post-meal vomiting. Sonographic examination, revealed the majority of the gallbladder lumen being occupied by an irregularly outlined echogenic solid mass

measuring 1.28x1.14 cm in diameter. Additionally, thickening of the gallbladder walls was noted.

Diagnosis
Gallbladder Mass.

Case No: 8

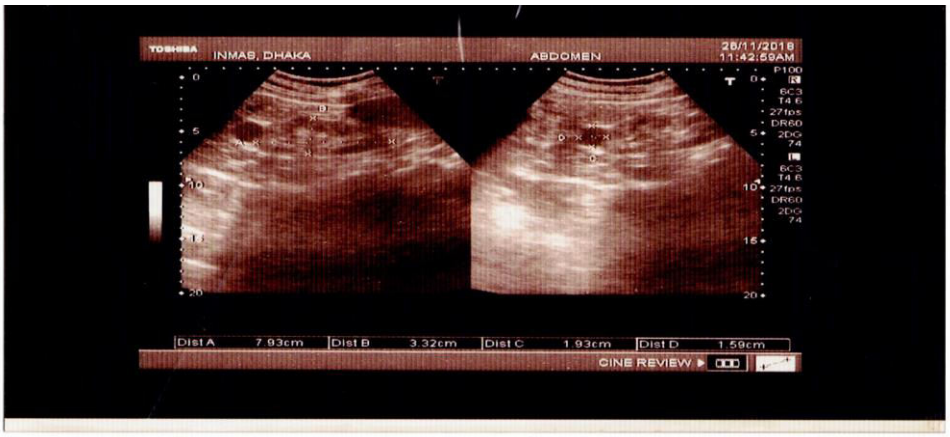

Fig. 8: Shows a cystic mass on upper pole of the right kidney.

History
A 65-year-old female patient visited the hospital for a whole abdominal ultrasonography, reporting dull pain in the right lumbar region. The patient had a medical history of diabetes mellitus and hypertension. Sonographic examination revealed the right kidney to be smaller in size (7.9x3.3 cm) but positioned normally. The renal parenchyma appeared echogenic, with ill-defined cortex and medulla. However, the pelvi-calyceal system showed no dilation. A thin-walled, round cyst measuring 1.9x 1.5 cm in diameter was identified in the lower pole of the right kidney. No internal echoes were observed, and posterior enhancement was present. Other organs examined, including the liver, gall-bladder, biliary tree, pancreas, spleen, left kidney, urinary bladder, and prostate, appeared normal.

Diagnosis
A small, simple right renal cortical cyst, measuring 2 cm in diameter.

Case No: 9

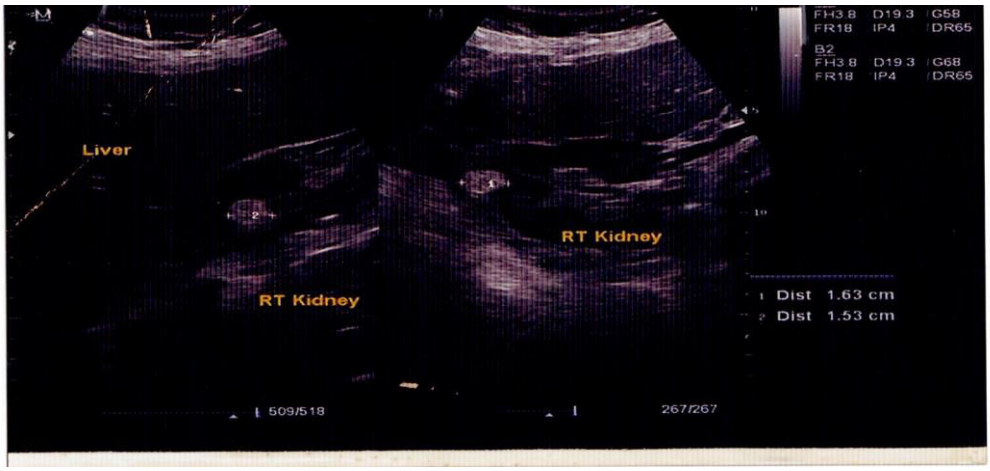

Fig. 9: Shows a highly ecgogenic mass on upper pole of the right kidney.

History
A 47-year-old female underwent an ultrasound examination of the upper abdomen due to complaints of epigastric pain, heartburn, and dyspepsia. Ultrasound findings indicated a normal-sized and shaped right kidney. A well-outlined hyperechoic mass measuring 1.6x1.5 cm was observed on the upper pole of the right kidney. Additionally, mild dilatation of the pelvi-calyceal system was noted.

The liver, gallbladder, biliary tree, pancreas, spleen, and left kidney appeared normal.

A small renal mass on the right side, most likely indicative of angiomyolipoma.

Diagnosis

Case No: 10

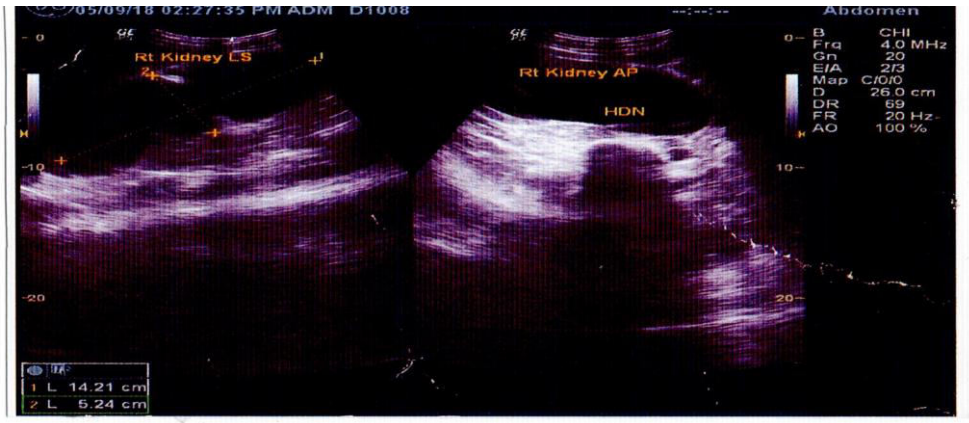

Fig. 10: Shows an anechoic area in the center of right kidney.

History

15-year-old male patient underwent whole abdominal ultrasonography due to complaints of dull pain in the right lumbar region. Ultrasound examination, revealed swollen kidneys. Within the right kidney, a large anechoic area devoid of internal echoes was observed. Additionally, dilation of the pelvi-calyceal system was noted. However, the liver, gallbladder, biliary tree, pancreas, left kidney, urinary bladder, and prostate appeared normal.

Diagnosis

Severe hydronephrosis on the right side.

DISCUSSION:

In this study, 100 patients meeting the inclusion criteria underwent ultrasound evaluations. Among them, 40 (40.0%) patients exhibited abnormal sonographic features, and diagnoses were based on specific sonographic findings correlated with clinical features and laboratory investigations. The clinical presentations and sonographic features of right upper quadrant (RUQ) masses were thoroughly discussed. Patients of all age groups were included, and abnormal sonographic findings were more prevalent between 31 to 60 years of age. Clinical presentations included Right Upper Quadrant pain (17.5%), fever (10.0%), hepatomegaly (15.0%), swelling (7.5%), anorexia (12.5%), weight loss (17.5%), ascites (7.5%), and jaundice (12.5%). Among the sonographically diagnosed RUQ mass cases, the liver was involved in 75.0% of cases, the gallbladder in 10.0%, and the right kidney in 15.0% of cases. Within the 30 liver mass cases, 33.33% were abscesses, 33.33% were hepatocellular carcinomas (HCC), 10.0% were secondary lesions, 10.0% were hemangiomas, and 12.0% were simple cysts. Liver abscesses are common and can be amoebic or pyogenic (Ryder & Beckingham, 2001). Amoebic abscesses are prevalent in tropical climates due to Entamoeba Histolytica, presenting with upper abdominal pain, fever, and other symptoms, while pyogenic abscesses mostly originate from bacterial infections. Ultrasound appearances of pyogenic liver abscesses vary based on stage, initially appearing echogenic and evolving into more spherical, well-defined, and cystic lesions (Ralls *et al.,* 1987). In HCC, there's a strong association with cirrhosis. Chronic hepatitis B or C and cirrhosis predispose individuals to HCC, typically presenting as solid nodules in the liver. Sonographic features, along with elevated alpha-fetoprotein levels, strongly suggest HCC without the necessity of a biopsy (Davis *et al.,* 2008). Hemangiomas, benign neoplasms of the liver, are often asymptomatic, present as solitary lesions with specific sonographic features, and usually require no intervention. Simple hepatic cysts are frequently asymptomatic but might cause symptoms due to their size or hemorrhage. They usually present as thin-walled, echoic structures with posterior enhancement. Liver metastases are more common than primary neoplasms. They present as varying echogenic lesions and often have a primary cancer source. Gallbladder carcinoma is highly malignant, more prevalent in females, often associated with gallstones, and typically diagnosed in advanced stages (Gore and

Shelhamer, 2007). Renal cysts are common, especially in older individuals, often asymptomatic and detected incidentally. Angiomyolipoma's are benign renal tumors, frequently observed in older females, appearing as highly echogenic masses on ultrasound. Renal cell carcinoma, the most common primary renal malignancy in adults, presents with various clinical features and typically appears as hypoechoic solid masses on ultrasound (Goksu *et al.,* 2023). While 30 of the 40 cases were confirmed through other investigations like serological tests, histopathology, CT scans, or follow-up ultrasounds, the remaining 10 cases could not be followed up and confirmed through other methods, leading to incomplete data analysis in those instances.

LIMITATIONS:

The study was conducted within a short timeframe and encountered several limitations, including challenges in patient recruitment, inadequate follow-up, and a lack of correlative investigation methods.

CONCLUSION AND RECOMMENDATIONS:

Ultrasound plays a precise and sensitive role in detecting and assessing RUQ masses. While it doesn't provide definitive diagnoses on its own, it does aid in formulating initial patient management guidelines. However, it's important to note that ultrasound's effectiveness can be operator-dependent and might encounter technical issues. Despite these limitations, its non-invasive nature, cost-effectiveness, and accessibility have made it a popular choice for initial RUQ imaging. This study doesn't fully represent the overall incidence and statistics of this ailment in our country. To achieve a more comprehensive understanding, a larger-scale, extended study spanning a longer duration and involving a broader population base is necessary.

To offer a comprehensive understanding of the ailment's overall incidence and statistics in our country, a more extensive and prolonged study involving a larger patient cohort is recommended. This extended study would help mitigate the limitations observed in this research, providing a more robust and representative analysis.

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CONFLICTS OF INTEREST:

The author's declared there are no conflicts of interest to publish the present work.

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