Role of Ultrasound in the Diagnosis and Management of Gall Bladder Diseases

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ABSTRACT:

Background & objective: The majority of published data on the sensitivity and specificity of ultrasound (US) in the diagnosis of gallbladder pathology was conducted over 30 years ago. Since then the quality and resolution of ultrasonography has improved significantly. It is, therefore, essential to asses afresh whether the progression in technology has translated into improved diagnostic accuracy. The present study was undertaken to find the usefulness of US in diagnosing gallbladder diseases with particular reference to cholecystitis and gall bladder carcinoma.

Methods: This cross-sectional observational study was conducted at the Department of Radiology and Imaging, Rajshahi Medical College, Rajshahi in collaboration with the Departments of General Surgery and Histopathology of the same Medical College between July 2016 to June 2018. A total of 128 patients were initially included on the basis of signs and symptoms of gallbladder diseases. All these patients were subjected to abdominal US to achieve a ultrasonic diagnosis of gall bladder disease followed by histopathological examination of biopsy material taken from the gall bladder or specimen of the operated gall bladder. The accuracy of ultrasound in the diagnosis of gall bladder diseases was determined by comparing the ultrasound sound diagnosis with that of histopathological diagnosis. In particular, the role of ultrasound was evaluated in the differentiation of benign gall bladder diseases from those of malignant ones.

Result: Age distribution of the patients shows that over one-third (35.9%) was ≥50 years old followed by 24.9% 40-50 years, 21.9% 30 - 40 years and 16.4% 20 – 30 years old with mean age of the patients being 43.8(range: 18-80) years. Females outnumbered males by roughly 11:9. In terms of BMI, 6.2% were underweight, 16.4% overweight, and 4.7% obese. The predominant complaints reported by the patients were pain in the right upper abdomen (95.3%), epigastric pain (94.7%), abdominal discomfort (96.9%) followed by nausea (75%), low-grade fever (37.5%), jaundice (26.6%) and vomiting (26.6%). Approximately 44% of the patients exhibited anaemia. Nearly half (46.1%) of the patients exhibited sonographic Murphy's sign. Hyperechoic echo character was invariably obtained with 12.5% cases having hypoechoeic character as well. Over 90% of the patients had gall-stones, 62.5% cholecystitis (thickened gall-bladder wall). Ultrasound comment on the type of diseases revealed that 112(87.5%) were benign diseases and 16(12.5%) malignant cases. Approximately 55% of the gall bladder diseases diagnosed by histopathology were cholecystitis. Histopathological comment shows that about 90% of the diseases were benign and the rest (10.2%) were malignant. The sensitivity of ultrasound in diagnosing cholecystitis was 85.9%, while the specificity of the test was 60.9% with overall diagnostic accuracy of the test being 73.4%. The US had a optimum sensitivity (84.6%) and high specificity (95.6%) in diagnosing gall-bladder carcinoma.

Conclusion: The study concluded that US could be considered as the preferred initial imaging technique for patients who are clinically suspected of having acute calculous cholecystitis. It is also a useful imaging modality for diagnosing gall-bladder malignancy. Thus, US can be dependably used in the primary evaluation of heptobilliary pathology.

Key Word: Ultrasound, Gall Bladder Diseases, Cholecystitis, Gall Bladder Malignancy etc.

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INTRODUCTION:

Hepatobiliary disease is a common problem in patients presenting to emergency departments or primary care settings. Unfortunately, clinical examinations and laboratory evaluations lack the necessary sensitivity and specificity to accurately diagnose many of these entities without further testing.[1] Emergency conditions involving the gallbladder & the bile ducts are common radiological challenging problems[2] although imaging provides valuable information 1) for the final diagnosis of acute cholecystitis (as up to 20% of the patients clinically classified as having acute cholecystitis have another disease that does not require surgery), 2) to prevent the patient from complications in case of delayed diagnosis and 3) to detect complications which may urge the surgical treatment.[3]

Ultrasound (US) is the preferred imaging examination for the diagnosis of acute cholecystitis and is the first method used when the clinical presentation is suggestive of biliary pathology because of its high sensitivity at the detection of GB stones, its real-time character, and its speed and portability. The main findings of acute calculous cholecystitis on US include in addition to the presence of stones: distension of the gallbladder lumen, gallbladder wall thickening, a positive US Murphy sign, pericholecystic fluid.[4,5] Ultrasound has the best sensitivity and specificity for evaluating patients with suspected gallstones.[6] As reported in the literature,[7] some ultrasonographic findings are more strongly associated with acute cholecystitis than others: a positive Murphy's sign (pain is provoked by either the transducer or the sonographer's palpation under guidance, in the exact area of the gallbladder) is reported to have sensitivity as high as 88%.[8,9] Ralls et al.[10] report that one of the most important advantages of ultrasound over other imaging techniques in the investigation of acute cholecystitis is the ability to assess for a sonographic Murphy sign, which is a reliable indicator of acute cholecystitis with a sensitivity of 92%. An increased gallbladder wall thickness of > 3.5 mm has been found to be a reliable and independent predictor of acute cholecystitis.[11] Visualization of gallbladder wall thickening in the presence of gallstones using ultrasound has a positive predictive value of 95% for the diagnosis of acute cholecystitis.[10]

Carcinoma of gallbladder is a malignant condition but it is not uncommon in our country. Conventionally, carcinoma gallbladder is diagnosed on the basis of medical history; abdominal examination and using modern imaging techniques like transabdominal ultrasonography of upper abdomen. Transabdominal sonography has been found to be useful in suggesting the preoperative diagnosis of carcinoma,[12] although studies regarding its diagnostic accuracy are rare. The present study was conducted to determine the usefulness of US in diagnosing gallbladder diseases with particular reference to cholecystitis and gall bladder carcinoma.

METHODS:

This cross-sectional observational study was conducted at the Department of Radiology and Imaging, Rajshahi Medical College, Rajshahi in collaboration with the Departments of General Surgery and Histopathology of the same Medical College over a period of 2 years from July 2016 to June 2018. A total o 135 patients (ranging from 40 - 80 years) were initially included on the basis of signs and symptoms of gallbladder diseases (such as upper abdominal pain, jaundice, low grade fever, weight loss and upper abdominal mass) and underwent USG for preoperative radiological diagnosis, its extension and operability. Of them 7 were minors (< 18 years old) and were excluded from the study leaving 128 for final evaluation. All these patients were subjected to abdominal ultrasound to achieve a ultrasonic diagnosis of gall bladder disease followed by histopathological examination of biopsy material taken from the gall bladder or specimen of the operated gall bladder.

The accuracy of ultrasound in the diagnosis of gall bladder diseases was determined by comparing the ultrasound sound diagnosis with that of histopathological diagnosis. In particular, the role of ultrasound was evaluated in the differentiation of benign gall bladder diseases from those of

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malignant ones. The statistical analyses were performed using computer software SPSS (Statistical Package for Social Sciences), version 11.5 and the test statistics used to analyse the data were descriptive statistics

RESULT:

The ultrasound diagnosis revealed 80 with acute cholecystitis 16 with carcinoma of gall bladder, while histopathology diagnosed 64 as cholecystitis and 13 as malignancy of gallbladder. Age distribution of the patients shows that over one-third (35.9%) was 50 or > 50 years old followed by 24.9% 40 – 50 years, 21.9% 30 - 40 years and 16.4% 20 – 30 years old. The mean age of the patients was 43.8 years and the youngest and the oldest patients were 18 and 80 years old respectively. Females outnumbered males by roughly 11:9 (Table I). About 72% of patients had normal BMI, 6.2% underweight, 16.4% overweight, and 4.7% obese. The mean BMI was 23.3 kg/m^2 and the lowest and the highest BMI were 13.3 and 44.7 kg/m^2 (Table II).

The predominant complaints reported by the patients were pain in the right upper abdomen (95.3%), epigastric pain (94.7%), abdominal discomfort (96.9%) followed by nausea (75%), low-grade fever (37.5%), jaundice (26.6%) and vomiting (26.6%), yellow colouration of conjunctiva (25.8%), dark urine (18%), weight loss (17.2%). Approximately 44% of the patients exhibited anaemia (Table III). Nearly half (46.1%) of the patients exhibited sonographic Murphy's sign and in 10.9% cases presence of a mass was detected. Hyperechoeic echo character was invariably obtained with 12.5% cases having hypooechoeic character as well (Table IV).

Over 90% of the patients had gall-stones, 62.5% cholecystitis (thickened gall-bladder wall), 3.1% empyema gall-bladder, 7.8% sludge, 10.9% dilated common bile duct & 39.1% pericholecystic fluid (Table-V). Ultrasound comment on the type of diseases revealed that 112 (87.5%) were benign diseases and 16 (12.5%) malignant cases (Fig.1). Approximately 55% of the gall bladder diseases diagnosed by histopathology were cholecystitis,

35% were pericholecystic fluid and 4.7% were sludge (Table VI). Histopathological comment shows that about 90% of the diseases were benign and the rest (10.2%) were malignant (Fig.2).

TABLE I. Distribution of patients by their demographic variables

Demographic variables	Frequency	Percentage	Mean ± SEM (range)
Age (yrs)			
< 20	2	1.6	
20 – 30	21	16.4	
30 – 40	28	21.9	43.8 ± 14.4
40 – 50	31	24.2	(18-80)
≥ 50	46	35.9	
Sex			
Male	59	43.7	---
Female	76	56.3	---

TABLE II. Distribution of patients by their demographic variables

BMI (kg/m2)	Frequency	Percentage	Mean ± SEM (range)
< 18.5 (Underweight)	8	6.2	
18.5-25 (Normal)	92	71.9	
25-30 (Overweight)	21	16.4	23.3 ± 3.8
30-40 (Obese)	6	4.7	(13.3-44.7)
≥ 40 (Morbidly obese)	1	0.8	

TABLE III. Distribution of the patient by their clinical characteristics

Clinical characteristics	Frequency	Percentage
Pain in the right upper abdomen	122	95.3
Epigastric pain	121	94.7
Abdominal discomfort	124	96.9
Low grade fever	48	37.5
Jaundice	34	26.6
Nausea	96	75.0
Vomiting	34	26.6
Diarrhoea	7	5.5
Yellow coloration of conjunctiva	33	25.8
Dark urine	23	18.0
Anaemia	56	43.8
Weight loss	22	17.2
Presence of a mass in the right hypochondrium	13	10.2

TABLE IV: Distribution of the patients by their USG findings

USG findings	Frequency	Percentage
Presence of a mass	14	10.9
Sonographic Murphy's sign	59	46.1
Echo characteristics		
Hypooechoeic	16	12.5
Hyperechoeic	128	100.0

TABLE V: Distribution of the patients by their diseases diagnosed by USG (n = 128*)

Diseases diagnosed by USG	Frequency	Percentage
Gallstones	117	91.4
Cholecystitis / Thickcncd gall-bladder wall	80	62.5
Empyema Gall-bladder	4	3.1
Sludge	10	7.8
Dilated common bile duct	14	10.9
Pericholecystic fluid	50	39.1
Air in the gallbladder wall	1	0.8

*Total will not correspond to 100% for multiple diagnosis in the same individual
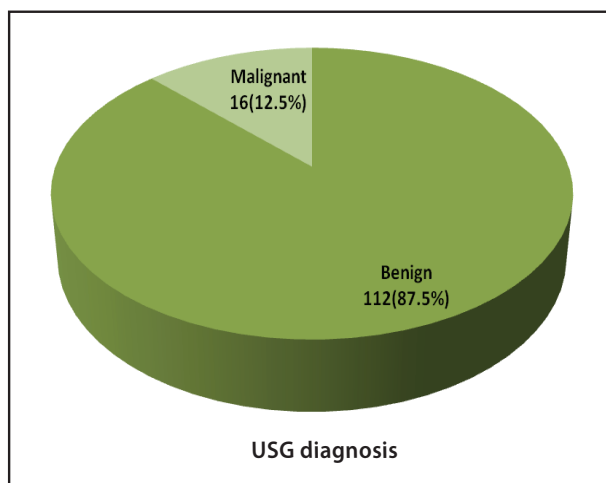

USG diagnosis

Fig. 1: Distribution of patients by type of diseases diagnosed (n = 128)

TABLE VI : Distribution of the patient by their histological findings

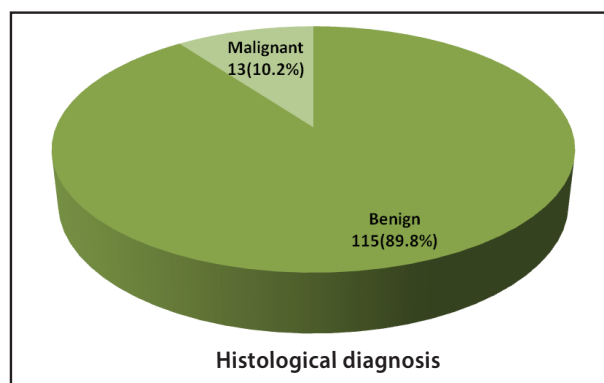| Histological findings	Frequency	Percentage
Cholecystitis / Thickened gall-bladder wall	70	54.7
Sludge	6	4.7
Pericholecystic fluid	45	35.2

Histological diagnosis

Fig. 2 : Histological type of diseases (n = 128)

The sensitivity of ultrasound in correctly diagnosing cholecystitis was 85.9%, while the specificity of the test in correctly ruling out those who did not have cholecystitis was 60.9%. The positive and negative predictive values (PPVs) of the test were 68.8% and 81.2% respectively. The percentage of false positive and false negative yielded by the test were 31.2% and 18.8% respectively. The overall diagnostic accuracy of the test was 73.4%. The sensitivity of Ultrasound in correctly diagnosing carcinoma of gall bladder was 84.6%, while the specificity of the test in correctly differentiating those who did not have carcinoma was 95.6%. The positive and negative predictive values (PPVs) of the test were 68.7% and 98.2% respectively. The percentage of false positive and false negative as yielded by the test were 31.2% and 1.8% respectively. The overall diagnostic accuracy of the test was 94.5%.

DISCUSSION:

Acute cholecystitis accounts for 3–10% of all patients with abdominal pain and is the most common cause of acute abdominal pain in the right upper quadrant, especially in the elderly patients.[13] In the present study as well 95% of the patients presented with upper abdominal or epigastric pain and discomfort. The sensitivity of ultrasound in diagnosing cholecystitis was 85.9%, while the specificity of the test was 60.9%. The positive and negative predictive values (PPVs) of the test were 68.8% and 81.2% respectively. The overall diagnostic accuracy of the test was 73.4%. Although cholescintigraphy still has the highest

sensitivity & specificity (96% and 90%) in patients who are suspected of having acute cholecystitis, sonography is still used as the initial imaging technique for evaluating patients with suspected gallbladder (GB) disease because of its high sensitivity at the detection of GB stones, its real-time character, and its speed and portability.[14] Because of a combination of reasons including logistic drawbacks, broad imaging capability and clinician referral pattern (especially in the emergency setting) the use of cholescintigraphy is limited in clinical practice.[6] CT is particularly useful for evaluating the many complications of acute cholecystitis, such as emphysematous cholecystitis, gangrenous cholecystitis, hemorrhage, & gallstone ileus.[15,16] Moreover CT is also useful in making the specific diagnosis when obesity or gaseous distention limit the use of US.

Thus, US has emerged as the first-line imaging modality for the diagnosis of acute calculous cholecystitis. In cholescintigraphic procedure the examination time takes up to several hours, whereas a full abdominal US examination is readily available, can be performed in 10-15 minutes, and allows for assessment of pain localized to the gallbladder region (sonographic Murphy sign).[17] Furthermore, cholescintigraphy provides information confined to the hepatobilliary tract, whereas US can be useful in diagnosing other pathologic conditions responsible for the abdominal complaints. Cholescintigraphy also carries the burden of ionizing radiation whereas US imaging do not.[18]

As the role of ultrasound in the differentiation of gall-bladder carcinoma from the benign diseases was evaluated, it was revealed that the imaging modality has optimum sensitivity (84.6%) and high specificity (95.6%). The positive and negative predictive values of the test were 93.9 and 71.4% respectively, while the diagnostic accuracy of the test was 90%. Ghafoor et al[19] conducted a similar study in the BIRDEM, who found a somewhat higher sensitivity (93.9%) but a much lower specificity (71.4%). Yeh[20] reported 84.6% accuracy of US in the diagnosis of the gallbladder carcinoma. Courtney & Townsend.[21] described that sensitivity

of ultrasound in the detection of gallbladder carcinoma ranges from 70-100%. Although the overall prognosis for this tumor remains poor, ultrasonogram may facilitate early detection of these tumours when they are still localized. Thus, survival time of the patients can be increased by early removal of tumors.

CONCLUSION:

Summarising the findings of the study it can be concluded that US could be considered the preferred initial imaging technique for patients who are clinically suspected of having acute calculous cholecystitis. It is also a useful imaging modality for diagnosing gall-bladder malignancy. However, it is not suitable for evaluating the complications of acute cholecystitis, such as emphysematous cholecystitis, gangrenous cholecystitis, hemorrhage, and gallstone ileus and for detecting extension of tumor and involvement of surrounding structures including lymph nodes and hepatodudenal ligament which are essential for determining its resectability. Thus, US can be confidently used in the primary evaluation and management of patients suspected of heptobilliary pathology.

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