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Diagnostic Accuracy of Ultrasonography and CT-Scan in Detecting Hepatocellular Carcinoma (HCC)

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Abstract **Original Research Article**

Introduction: Hepatocellular carcinoma (HCC) is a leading cause of cancer-related mortality globally and its early detection plays a vital role in improving patient prognosis and treatment outcomes. Ultrasonography (US) and computed tomography (CT) are key diagnostic tools. While US is cost-effective and widely accessible, CT offers superior sensitivity for detecting small lesions and assessing tumor extent. ***Aim of the study:*** The aim of the study was to evaluate the diagnostic accuracy of ultrasonography (US) and computed tomography (CT) in detecting hepatocellular carcinoma (HCC). ***Methods:*** This cross-sectional study, conducted from June 2007 to May 2008 at BIRDEM, BSMMU, and Gastro liver Hospital in Dhaka, included 30 patients (26 male, 4 females, aged 20-85 years) with clinically suspected hepatocellular carcinoma (HCC). Patients underwent clinical assessment, ultrasound (US), and CT scans for tumor evaluation. The final HCC diagnosis was confirmed by biopsy and histopathology. Sensitivity, accuracy, and predictive values of US and CT were analyzed using SPSS, with a significance level of $p < 0.05$. ***Results:*** In this study of 30 patients, the mean age was 50.89 years, with the most common age group being 31-40 years (29.9%). The majority were male (86.7%). Hepatomegaly (83.3%), upper abdominal pain (66.7%), and weight loss (60%) were the most common clinical features. Biochemical results showed that 33.3% of patients were HBs Ag positive, and 70% had elevated alpha-fetoprotein (AFP). Imaging revealed liver enlargement in 66.7% (USG) and 77.3% (CT) of cases, with CT detecting more multifocal lesions (43.3% vs. 16.7% on USG, $p<0.05$). The combined sensitivity of USG and CT for diagnosing hepatocellular carcinoma (HCC) was 96%, with an accuracy of 83.3%, but specificity was low at 20%. ***Conclusion:*** Ultrasound (USG) and CT are effective for diagnosing hepatocellular carcinoma (HCC) with high sensitivity but low specificity. Combining both improves diagnostic precision, though histopathology remains essential. Future studies with advanced imaging techniques like MRI could enhance diagnosis.

Keywords: Ultrasonography, CT-scan, Hepatocellular, Carcinoma.

INTRODUCTION

Hepatocellular carcinoma (HCC) is the most common form of liver cancer and one of the leading causes of cancer-related mortality worldwide [1]. It is particularly prevalent in Asia, where chronic infections with hepatitis B and C viruses, along with exposure to aflatoxin, are significant risk factors [2]. The global burden of HCC is on the rise, with its incidence almost doubling in the past two decades, largely due to the increasing prevalence of hepatitis C virus (HCV)-induced cirrhosis [3]. HCC typically develops in the context of cirrhosis, with the risk of developing cancer being considerably elevated in patients with liver fibrosis or chronic liver disease. Early detection is critical, as

small HCC lesions, particularly those measuring 3 cm or less, have a better prognosis when treated at an early stage through surgical resection or liver transplantation [4]. Diagnosis of HCC requires a combination of clinical, laboratory, and imaging findings. Among the imaging modalities, ultrasonography (US) and computed tomography (CT) scans are widely used for both screening and diagnostic purposes. Ultrasonography, being a non-invasive, widely accessible, and cost-effective technique, is often the first-line imaging tool in liver disease management [5,6]. It provides real-time visualization and can detect liver tumors, but its diagnostic accuracy is highly dependent on the operator's experience, the patient's body habitus, and the presence of underlying liver conditions such as cirrhosis [7,8]. On the other hand, CT scans, particularly with contrast enhancement, offer superior spatial resolution and are considered the gold standard for detecting HCC and evaluating its extent and vascular invasion [9]. The sensitivity of ultrasound in detecting HCC is generally high for larger lesions but diminishes for small tumors, especially those less than 2 cm in size. Conversely, CT scans are more sensitive in identifying smaller lesions and can provide detailed information on tumor size, number, and vascular involvement. Biphasic CT scans, which include both arterial and portal venous phases, have improved sensitivity and are especially useful in identifying hypervascular tumors, a characteristic of most HCCs [10]. However, despite the advantages of CT, it is more expensive, involves radiation exposure, and may require intravenous contrast agents, which may not be suitable for all patients, particularly those with poor renal function. A variety of studies have compared the diagnostic performance of the US and CT in detecting HCC, revealing that CT tends to have a higher sensitivity and specificity than the US. For example, a study comparing ultrasound and CT in 37 patients with suspected HCC found that CT was more accurate in determining the extent of liver involvement and detecting extrahepatic spread [11]. However, ultrasound remains a valuable tool in screening and monitoring high-risk patients, especially in resource-limited settings where CT is not always accessible. This study aimed to compare the diagnostic accuracy of ultrasonography and CT scans in detecting HCC, focusing on their ability to define tumor morphology, detect small lesions, and assess vascular invasion. Given the rising incidence of HCC and its potential for early intervention, understanding the strengths and limitations of each imaging modality is essential for improving early detection and patient outcomes.

METHODS

This cross-sectional study was conducted from June 2007 to May 2008, at BIRDEM, BSMMU, and Gastroliver Hospital, Dhaka, involving 35 patients (20-85 years) with clinically suspected hepatocellular carcinoma (HCC). After excluding 5 patients (2 refused biopsy, 2 lacked biopsy results), 30 patients (26 male, 4 female) were included. Patients underwent clinical assessment, including a history of abdominal pain, jaundice, and weight loss, followed by routine investigations. Abdominal ultrasound (US) and CT scans were performed for preoperative confirmation and evaluation of tumor characteristics. US and CT findings were reviewed by the principal investigator and confirmed by consultant radiologists. The final HCC diagnosis was confirmed through biopsy and histopathology. Ultrasound was conducted using Siemens Antares or Medisone Sono Ace 8000 with 3.5 MHz curvilinear probes. CT scans were performed with a Somatom Emotion Duo using a triple-phase protocol. Data were collected using structured proformas, and statistical analysis was performed with SPSS. Sensitivity, accuracy, and predictive values of US and CT were calculated, with a significance level set at $p < 0.05$.

Inclusion Criteria:

- Clinically suspected hepatic neoplasm.
- Patients aged 20-85 years.
- Patients who underwent both ultrasound (US) and CT scan of the hepatobiliary system.

Exclusion Criteria:

- Patients who refused to undergo biopsy.
- Patients with unavailable histopathology results.
- Patients with incomplete clinical or diagnostic data.

RESULTS

Table 1: Age group distribution of the study subjects (n=30)

Age Group(years)	No. of Patients (n=30)	Percentage
<20	1	3.3
21-30	2	6.7
31-40	9	29.9
41-50	4	13.3
51-60	7	23.3
61-70	6	20
>70	1	3.3
Mean ±SE	50.89+ 3.07	
Range (Min, Max)	(20-85) years	

Age distribution of the patients (n=30). A total of 30 cases were included in the study. The mean age was 50.89 years with a standard error of mean (SE) +3.07 years and their age ranged from 20 to 85 years. Maximum number was found in the age group of 31-40.

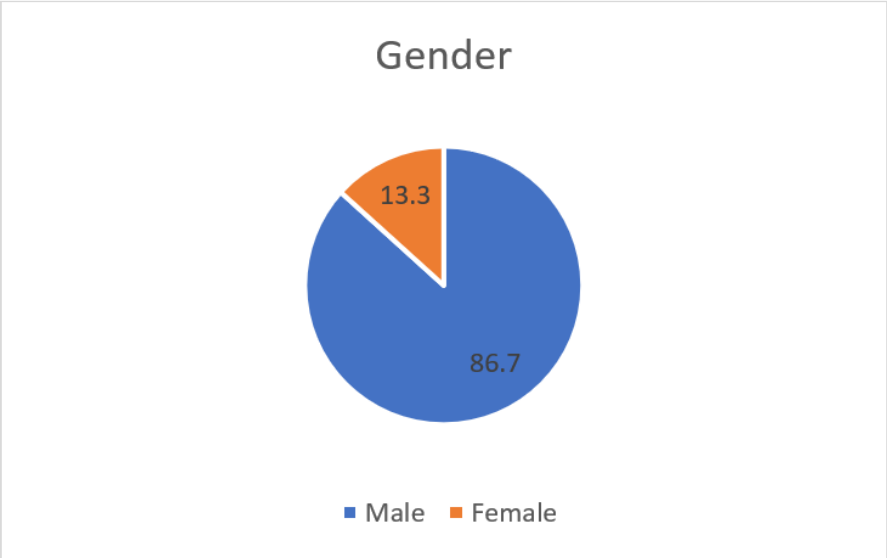

Figure 1: Sex Distribution of the study subjects(n=30)

This study was carried out in 30 subjects. They were divided into male and female groups. Out of which 86.7% were male and the rest 13.3% were female patients.

Table 2: Clinical features of the study subjects (n=30)

Clinical feature	No. of patients	Percentage
Hepatomegaly	25	83
Upper abdominal pain	20	66.7
History of weight loss	18	60
Anorexia	17	56.7
Nausea/Vomiting	13	43.3
Jaundice	12	40
Ascites	9	30

The highest percentage of patients (83.3%) had hepatomegaly, 66.7% upper abdominal pain, 60.0% had a history of weight loss 56.7% had anorexia, 43.3% had nausea /vomiting, 40.0% had jaundice, and 30.0% had ascitis.

Table 3: Distribution of patients according to biochemical parameter (n=30)

Parameter	No. of patients (n=30)	Percentage
HBS Ag		
Positive	10	33.3
Negative	20	66.7
Alphafeto Protein (AFP)		
Increased	21	70
Normal	9	30
Normal Range	<20 ng/ml	
HCC:	400 ng/ml	

Among 30 clinically suspected cases of hepatocellular carcinoma (HCC), 10(33.3%) patients were HBS Ag positive and the rest 20(66.7%) were HBS Ag negative. Alphafeto protein (AFP) was increased in 21(70.0%) and normal in 9(30.0%) patients. It is observed that there is a strong association between HBs Ag positivity and the incidence of HCC.

Table 4: Assessment of liver size at USG and CT scan (n=30)

Liver size	USG		CT		P value
Enlarged	n	%	n	%	0.281
Contracted	20	66.7	22	73.3	
Normal	6	20	2	6.7	
Total	30	100	30	100	

Chi square=2.50, df=2, p=0.281, NS=Not significant
Not significant (p> 0.05) with the chi-square test

A total of thirty patients were examined by USG and CT scan. It was found that in 66.7% of cases liver was enlarged in size, in 13.3% of cases it was contracted, and in 20.0% of cases it was normal at USG and In CT scan 77.3% of cases liver was enlarged in size, in 20.0% of cases it was contracted and in 6.7% cases it was normal. The difference was statistically insignificant (p>0.05) in chi square test.

Table 5: Distribution of patients according to the number lesions detected by USG and CT (n=-30)

	Single		Multifocal		Diffuse	
	n	%	n	%	n	%
USG	22	73.3	5	16.7	3	10
CT	15	50	13	43.3	2	6.7

It was observed that 22(73.3%) and 15(50.0%) lesions were single detected by USG and CT scan respectively. Multifocal lesions were 5(16.7%) detected by USG and 13(43.3%) detected by CT scan. Diffuse lesion was observed 3(10.0%) and 2(6.7%) detected by USG and CT scans respectively. Multi-focal lesion detection was statistically significant (p<0.05) between the CT scan and USG in the Z test, other lesions were not significant (p>0.05).

Table 6: USG and CT (combined) correlation with histopathology(n=30)

USG and CT diagnosis	Histopathology		Total
	+ve for HCC	-ve for HCC	
+ve for HCC	24	4	28
-ve for HCC	1	1	2
Total	25	5	30

The patients having HCC diagnosed by USG and CT scan (combined) were correlated with the histopathological diagnosis. Out of 30 cases, 28 cases had findings suggestive of HCC and 2 cases were negative for HCC in USG and CT scan (combined) findings. Whereas histopathological examination detected 25 cases as HCC and 5 cases were negative for HCC.

Table 7: Validity of USG and CT (combined) as a diagnostic modality in the evaluation of HCC by calculating sensitivity, specificity, accuracy, and positive and negative prediction values (n=30)

Validity test	Percentage
Sensitivity	96
Specificity	20
Accuracy	83.3
Positive prediction value	85.7
Negative prediction value	50

This table presents the validity of combined ultrasound (USG) and CT scan as diagnostic modalities in evaluating hepatocellular carcinoma (HCC) in 30 patients. The sensitivity of the combined modalities is 96%, indicating a high ability to correctly identify those with HCC. However, specificity is relatively low at 20%, suggesting a higher rate of false positives. The accuracy is 83.3%, reflecting the overall correctness of the combined tests. The positive predictive value is 85.7%, meaning that a positive result is likely to be accurate, while the negative predictive value is 50%, indicating a moderate likelihood that a negative result accurately excludes HCC.

Table 8: Sensitivity, accuracy, positive and negative prediction values of CT scan and USG as a diagnostic modality in evaluation (n=30)

Modalities	Sensitivity (%)	Specificity (%)	Accuracy (%)	Positive predictive value (%)	Negative predictive value (%)
CT	92	20	80	85.2	33.3
USG	88	20	76.7	84.6	25

In this table, the diagnostic performance of the CT scan and USG for evaluating HCC (n=30) is compared. CT scan had a sensitivity of 92%, accuracy of 80%, PPV of 85.2%, and NPV of 33.3%, while USG showed a sensitivity of 88%, accuracy of 76.7%, PPV of 84.6%, and NPV of 25%. Both modalities had low specificity around 20%.

DISCUSSION

Hepatocellular carcinoma (HCC) is a leading cause of cancer-related mortality globally, and its early detection plays a vital role in improving patient prognosis and treatment outcomes [1]. The present study aimed to evaluate the diagnostic accuracy of ultrasonography (USG) and computed tomography (CT) in detecting HCC, utilizing histopathological examination as the gold standard. The results demonstrated that both USG and CT scans are valuable tools in diagnosing HCC, with high sensitivity but relatively low specificity, as supported by previous studies [11]. In our study, the mean age of the patients was 50.89 years, with a wide range from 20 to 85 years. This is consistent with existing literature, which suggests that HCC primarily affects individuals in the 5th to 7th decades of life [12,13]. Our findings also revealed a higher prevalence of HCC in males, with 86.7% of the patients being male. This aligns with the well-established gender disparity, as HCC is more common in men, with male-to-female ratios varying between 2:1 and 4:1, depending on the region.The clinical features observed in our study were consistent with those reported in the literature [14]. Hepatomegaly was the most common clinical finding, present in 83.3% of patients. Upper abdominal pain (66.7%) and weight loss (60.0%) were also frequently reported, reflecting the advanced stage of the disease in the majority of patients at the time of diagnosis. Other symptoms such as anorexia, nausea/vomiting, jaundice, and ascites were observed in varying frequencies, mirroring the common presentations in patients with HCC [15,16]. These findings emphasize the need for timely diagnostic investigations in patients presenting with such symptoms, especially in high-risk groups. In our study, 33.3% of patients tested positive for hepatitis B surface antigen (HBsAg), and 70% had elevated alpha-fetoprotein (AFP) levels. The strong association between HBsAg positivity and HCC incidence observed in our study aligns with previous findings that chronic hepatitis B infection is a major risk factor for HCC development [17,18]. AFP, a well-established biomarker for HCC, was elevated in 70% of cases in our cohort, further supporting its utility in the early detection of HCC [19]. The comparison of liver size between USG and CT scans revealed that liver enlargement was detected in 66.7% of cases by USG and 77.3% by CT scan, but the difference between the two modalities was statistically insignificant ($p>0.05$). This finding suggests that both modalities are comparable in detecting liver enlargement, which is a common feature of HCC. However, given that CT is more sensitive in identifying other features like vascular invasion and tumor morphology, it remains the preferred modality for staging and assessing HCC [20]. In our study, single lesions were more frequently detected by USG (73.3%) than by CT scan (50%). On the other hand, CT scans detected multifocal lesions in 43.3% of patients, compared to 16.7% detected by USG. This discrepancy is in line with previous studies indicating that CT scans have a higher sensitivity for detecting multiple lesions due to their ability to provide detailed cross-sectional imaging [21]. The statistically significant difference in the detection of multifocal lesions between USG and CT ($p<0.05$) further highlights the superior diagnostic accuracy of CT in evaluating HCC. The combined findings of USG and CT correlated well with histopathological results, correctly identifying 28 out of 30 patients as having HCC. This high concordance underscores the value of these imaging modalities in diagnosing HCC and their potential role in clinical practice as part of a diagnostic workup. Histopathological examination remains the gold standard; however, USG and CT scans are often utilized as initial non-invasive diagnostic tools in settings where biopsy may not be feasible [21]. The combined sensitivity of USG and CT for detecting HCC in our study was 96%, which is comparable to previous studies [22]. However, the specificity of 20% indicates a high rate of false-positive results. The relatively low specificity may be attributed to the nonspecific nature of findings such as liver enlargement, which can occur in a variety of liver diseases. The positive predictive value (PPV) of 85.7% suggests that when these imaging modalities indicate HCC, the diagnosis is highly likely to be accurate. Conversely, the negative predictive value (NPV) of 50% indicates that a negative result does not reliably rule out the disease, highlighting the importance of histopathological confirmation in cases with negative imaging results. Both USG and CT performed similarly in terms of sensitivity, with CT having a slightly higher sensitivity (92%) compared to USG (88%). However, both modalities had low specificity (20%), which is consistent with previous reports that both USG and CT scans may have limited ability to differentiate between HCC and other liver diseases [23]. The accuracy of CT (80%) was slightly higher than that of USG (76.7%), suggesting that CT may be a better option in patients with suspected HCC.

Limitation of the Study

The study was conducted at a single tertiary hospital, which may limit the generalizability of the

findings to the broader population, and further research with a larger sample size from multiple centers is recommended.

CONCLUSION

For the diagnosis of hepatocellular carcinoma (HCC), both ultrasound (USG) and computed tomography (CT) serve as key imaging modalities. They are particularly useful due to their high sensitivity, though they are hindered by relatively low specificity. Despite CT showing a slight advantage in terms of sensitivity and diagnostic accuracy, both USG and CT complement each other, enhancing overall diagnostic precision when used together. Given their limitations in specificity, histopathological examination remains essential, especially in cases where imaging results do not indicate HCC. Future research, including studies with larger patient cohorts and the integration of advanced imaging methods like magnetic resonance imaging (MRI), could provide more definitive insights into the most effective diagnostic strategy for HCC.

RECOMMENDATION

Given the high sensitivity of both ultrasonography (US) and computed tomography (CT) in detecting hepatocellular carcinoma (HCC), it is recommended to use a combined approach for enhanced diagnostic accuracy. However, due to the low specificity observed, histopathological examination remains crucial for confirmation. Future studies should consider incorporating larger patient cohorts and exploring the role of advanced imaging techniques such as magnetic resonance imaging (MRI) to improve diagnostic precision and early detection of HCC.

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