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# Diagnostic Performance of Ultrasonography in Hepatocellular Carcinoma (HCC)

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***Abstract***
***Introduction:*** *Hepatocellular carcinoma (HCC) is a leading cause of cancer-related mortality worldwide, with early detection being crucial for effective treatment. Ultrasonography (US) is widely used as a primary screening tool due to its accessibility and affordability.* ***Aim of the study:*** *The study aimed to evaluate the diagnostic performance of ultrasonography in detecting hepatocellular carcinoma (HCC)* ***Methods:*** *This cross-sectional study was conducted from June 2007 to May 2008 at three hospitals in Dhaka, involving 30 patients (26 males, 4 females) with clinically suspected hepatocellular carcinoma (HCC). All patients underwent ultrasonography (US) for tumor assessment, with findings reviewed by radiologists. The final HCC diagnosis was confirmed through biopsy and histopathology. Sensitivity, specificity, accuracy, and predictive values of US were calculated using SPSS, with significance set at $p < 0.05$.* ***Results:*** *The mean age of the patients was 50.89 years (SE ±3.07), with a male predominance (86.7%). The most common clinical feature was hepatomegaly (83.3%), followed by upper abdominal pain (66.7%) and weight loss (60.0%). USG findings revealed hepatomegaly in 66.7% of cases, with 50% of lesions being hypoechoic. Histopathological correlation showed that USG diagnosed 26 cases as HCC, while histopathology confirmed 25 cases. The sensitivity, specificity, and accuracy of USG in HCC diagnosis were 88%, 20%, and 76.7%, respectively.* ***Conclusion:*** *USG demonstrated high sensitivity but low specificity in HCC diagnosis. While it remains a useful screening tool, histopathological confirmation is crucial for accurate diagnosis.*

***Keywords:*** *Hepatocellular-carcinoma, Ultrasonography, liver-cirrhosis*

## I. INTRODUCTION

The liver is a vital organ responsible for metabolic, detoxifying, synthetic, and storage functions. It is susceptible to various pathological conditions, including hepatocellular carcinoma (HCC), which is the most common primary liver malignancy and a leading cause of cancer-related mortality worldwide.(1) The incidence of HCC is particularly high in Asia, where chronic hepatitis B virus (HBV) infection and aflatoxin exposure are major risk factors.(2) In contrast, in Western countries, hepatitis C virus (HCV) infection and alcohol-induced liver cirrhosis contribute significantly to the disease burden.(3) Early detection of HCC is crucial for improving patient outcomes, as curative treatment options such as liver resection and transplantation are only effective at an early stage. Diagnostic imaging plays a critical role in the detection and evaluation of HCC. Among the various imaging modalities, ultrasonography (US) is widely used as the initial screening tool due to its non-invasive nature, affordability, availability, and absence of ionizing radiation.(4) Ultrasonography enables real-time imaging

and can detect liver lesions as small as 1 cm in diameter. However, its accuracy in diagnosing HCC is influenced by several factors, including operator expertise, patient body habitus, and the presence of underlying liver cirrhosis.(5) The sensitivity of ultrasonography varies, with reported rates ranging from 60% to 90%, and it is often complemented by other imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) for more definitive characterization. (6) Although ultrasonography is highly valuable for surveillance in high-risk populations, its limitations include difficulty in detecting small or infiltrative tumors and in distinguishing HCC from benign hepatic lesions.(7) Advanced techniques such as contrast-enhanced ultrasonography (CEUS) have improved diagnostic accuracy, yet their widespread use remains limited by cost and availability. Given these factors, evaluating the diagnostic performance of ultrasonography in detecting HCC is essential to understanding its strengths and limitations in routine clinical practice. This study aimed to assess the diagnostic performance of ultrasonography in detecting HCC, comparing its sensitivity, specificity, and accuracy with other imaging modalities. By analyzing its effectiveness in different clinical settings, this research seeks to contribute to the optimization of HCC diagnostic protocols, particularly in resource-limited settings where ultrasonography remains the primary screening tool.

## II. METHODS

This cross-sectional study was conducted from June 2007 to May 2008 at BIRDEM, BSMMU, and Gastroliver Hospital, Dhaka, to evaluate the diagnostic performance of ultrasonography (US) in hepatocellular carcinoma (HCC). The study initially included 35 patients (aged 20–85 years) with clinically suspected HCC. After excluding five patients (two refused biopsy, and two lacked biopsy results), 30 patients (26 males, 4 females) were included in the final analysis.All patients underwent a comprehensive clinical assessment, including a detailed history of abdominal pain, jaundice, and weight loss, followed by routine laboratory investigations. Abdominal US was performed to assess tumor characteristics and detect hepatic lesions. US findings were first reviewed by the principal investigator and subsequently confirmed by consultant radiologists. The definitive diagnosis of HCC was established through biopsy and histopathological examination. Ultrasound examinations were performed using Siemens Antares or Medisone SonoAce 8000 systems with 3.5 MHz curvilinear probes. Data were systematically recorded using structured proformas, and statistical analysis was performed using SPSS software. The sensitivity, specificity, accuracy, and predictive values of ultrasonography were calculated to determine its diagnostic performance, with statistical significance set at $p < 0.05$.

**Inclusion Criteria:**

- Clinically suspected hepatic neoplasm.
- Patients aged 20–85 years.
- Patients who underwent ultrasonography of the hepatobiliary system.

**Exclusion Criteria:**

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

## III. RESULTS

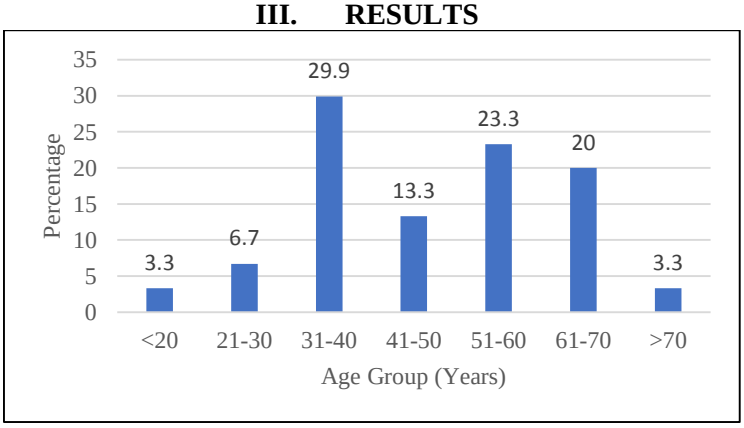


**Figure 1:** Age group distribution of the study subjects (n=30)

In this figure, 30 cases were analyzed with a mean age of 50.89 years (SE ±3.07). Ages ranged from 20 to 85, with the highest number of cases in the 31 to 40 age group

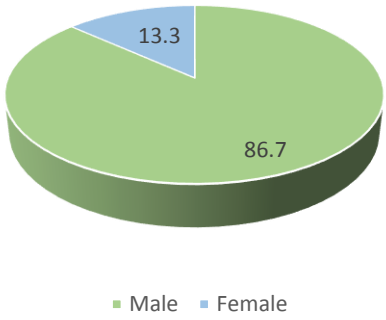


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**Figure 2:** Sex Distribution of the study subjects(n=30)

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 1:** 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 |

According to this table, the highest percentage of patients (83.3%) had hepatomegaly, 66.7% had 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 ascites.

**Table 2:** Assessment of liver size at USG (n=30)

| Liver size | USG | |
|---|---|---|
| Enlarged | n | % |
| Contracted | 20 | 66.7 |
| Normal | 6 | 20 |
| Total | 30 | 100 |

A total of thirty patients were examined by USG to assess liver size. It was found that in 66.7% of cases, the liver was enlarged, in 13.3% of cases, it was contracted, and in 20.0% of cases, it was normal.

**Table 3:** Ultrasonographic echogenicity(n=30)

| **USG** | **No. of patients** | **Percentage** |
|---|---|---|
| **Echogenicity** | | |
| Hypo echoic | 15 | 50 |
| Hyper echoic | 3 | 10 |
| Mixed echogenicity | 12 | 40 |

Among 30 cases 3 patterns of echogenicity were found at ultrasound scan. 15(50.0%) lesion was hypoechoic, 3(10.0%) hyperechoic and 12(40.0%) was of mixed echogenicity

**Table 4:** USG and histopathological correlation of HCC

| USG diagnosis | Histopathology | | Total |
|---|---|---|---|
| | +ve for HCC | -ve for HCC | |
| +ve for HCC | 22 | 4 | 26 |
| -ve for HCC | 3 | 1 | 4 |
| Total | 25 | 5 | 30 |

The patients having HCC diagnosed by USG were correlated with the histopathological diagnosis. Out of 30 cases; 26 cases were diagnosed as HCC and 4 cases were negative for HCC in USG findings. Whereas histopathological reports detected 25 cases as HCC and 5 cases as non-HCC lesions.

**Table 5:** Sensitivity, accuracy, positive and negative prediction values of USG as diagnosis modality in evaluation of HCC(n=30)

| Validity test | Percentage |
|---|---|
| Sensitivity | 88 |
| Specificity | 20 |
| Accuracy | 76.7 |
| Positive prediction value | 84.6 |
| Negative prediction value | 25 |

This table shows the diagnostic validity of ultrasound (USG) in HCC evaluation (n=30) shows a sensitivity of 88%, specificity of 20%, accuracy of 76.7%, positive predictive value of 84.6%, and negative predictive value of 25%.

## IV. DISCUSSION

Hepatocellular carcinoma (HCC) is a significant public health issue, with rising incidence rates globally. In Bangladesh, the burden of liver cancer is increasing, particularly in cirrhotic patients. (4) The diagnosis of HCC can be challenging, and ultrasonography (USG) is often employed as a first-line diagnostic tool. This study aimed to assess the diagnostic performance of ultrasonography in the detection of HCC, comparing it with histopathological findings and evaluating its sensitivity, specificity, and predictive values. The results from this study revealed that the mean age of the patients was 50.89 years, with a range spanning from 20 to 85 years. The highest number of patients (29.9%) belonged to the 31-40 age group. This age range corresponds with findings from other studies that identify middle-aged adults as the most affected by HCC, often due to chronic liver diseases such as hepatitis B and C, which are prevalent in Bangladesh. (8) The predominance of males (86.7%) in this study is consistent with previous research, as liver cancer shows a higher incidence in males compared to females, which might be due to factors such as alcohol consumption and a higher prevalence of hepatitis B and C among men. (9) Regarding clinical symptoms, hepatomegaly was the most common clinical feature (83.3%) observed in patients, followed by upper abdominal pain (66.7%), and weight loss (60%). These symptoms are typical in patients with HCC, as liver enlargement and pain are common indicators of liver pathology. Jaundice (40%) and ascites (30%) were less frequent, suggesting that many of the patients were in early to intermediate stages of HCC when these symptoms were observed. This distribution of symptoms aligns with the literature on HCC clinical presentations, where symptoms often appear late in the disease course. (10,11) Ultrasonography is widely used for the assessment of liver size and parenchymal changes in patients with suspected liver disease. In this study, 66.7% of patients showed liver enlargement, consistent with the findings of Wajid et al. (2018), who reported that liver enlargement is frequently observed in patients with HCC.(12) However, the presence of a contracted liver (13.3%) was also noted in a subset of patients, which could be due to cirrhosis, a common precursor to HCC.(13) The role of USG in identifying cirrhosis remains controversial, as ultrasound may miss early signs or fail to distinguish between different stages of cirrhosis, which can be crucial for staging HCC.(14). In terms of ultrasonographic findings, this study showed that the majority of lesions (50%) were hypoechoic, while 40% had mixed echogenicity, and 10% were hyperechoic. Hypoechoic lesions often suggest malignancy, as they may represent necrotic or infiltrative HCC lesions, while mixed echogenicity may indicate a heterogeneous tumor structure.(15) The diagnostic accuracy of USG in detecting HCC was evaluated using histopathology as the gold standard. The sensitivity of USG in detecting HCC was found to be 88%, with a specificity of 20%, indicating

that while USG is good at detecting HCC in positive cases, it is less reliable in excluding the disease in patients with negative findings. This suggests that USG may not be sufficient as a sole diagnostic modality for HCC, especially in patients with suspected early-stage tumors or those with cirrhosis.(16) The positive predictive value (PPV) was 84.6%, which means that a positive USG result strongly indicates the presence of HCC. However, the low % negative predictive value (NPV) of 25% indicates that negative USG findings should be confirmed with more sensitive diagnostic methods such as biopsy or CT/MRI. These findings suggest that USG remains a useful tool in the initial evaluation of patients with suspected HCC, especially when combined with other diagnostic modalities such as CT, MRI, or histopathology. The high sensitivity (88%) and relatively high PPV (84.6%) make USG an effective screening tool for detecting HCC in high-risk populations, such as those with a history of chronic liver disease or cirrhosis. However, due to the low specificity (20%) and NPV (25%), USG should not be used as a standalone diagnostic tool, and further investigations are required for confirmation. while ultrasonography is a valuable non-invasive tool in the diagnosis of HCC, its limitations in terms of specificity and negative predictive value indicate that it should be used in conjunction with other diagnostic techniques. Further research with larger sample sizes and the inclusion of additional imaging modalities such as MRI could help refine the diagnostic approach for HCC.

***Limitation of the Study:***

The limitation of the study is the small sample size, which may impact the generalizability of the findings.

## V. CONCLUSION

This study highlights that ultrasonography (USG) is an important diagnostic tool for the detection of hepatocellular carcinoma (HCC). While USG can effectively identify HCC, its limitations in specificity and negative predictive value suggest that it may not be sufficient to rule out the disease in patients with negative results. Therefore, while USG can serve as a valuable initial screening method, it is crucial to incorporate additional diagnostic techniques, such as CT, MRI, or histopathology, for confirmation and to ensure a more accurate diagnosis.

## VI. RECOMMENDATION

It is recommended to use USG as a first-line screening tool for HCC, especially in high-risk populations, but to follow up with more advanced imaging techniques like CT or MRI for confirmation. Given the limitations of USG in ruling out HCC, histopathological examination should be used to verify suspicious lesions. Further research and advancements in USG technology could improve its diagnostic accuracy, and a multi-modal approach should be adopted for comprehensive evaluation and early detection of HCC.

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