Vol. 5 No. 1 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Hameed et al., 2026

Comparative Study of Ultrasound and Triphasic Computed Tomography for the Detection and Staging of Hepatocellular Carcinoma

Ayesha Hameed*
Student, Medical Imaging Technology, Institute of Allied Health Sciences, FMH College of Medicine & Dentistry, Lahore. Correspondence Author Email: ayeshaansari0034@gmail.com

Rimsha Badar
FMH College of Medicine and Dentistry Institute of Allied Health Sciences, Lahore.

Sheikh Danial Hanan
Pakistan Kidney and liver Institute and Research Centre (PKLI), Lahore.

Sidra Inam
FMH College of Medicine and Dentistry Institute of Allied Health Sciences, Lahore.

Mehak Naveed
FMH College of Medicine and Dentistry Institute of Allied Health Sciences, Lahore.

Iman Azam
FMH College of Medicine and Dentistry Institute of Allied Health Sciences, Lahore.

Author Details

Received on 20 Feb 2026

Accepted on 15 March 2026

Published on 16 March 2026

Corresponding E-mails & Authors*:
Ayesha Hameed
ayeshaansari0034@gmail.com

Abstract

Objective: This study objective was to correlate the diagnostic efficacy of ultrasound and triphasic computed tomography (CT) for the detection and staging of hepatocellular carcinoma (HCC). **Method:** This study was conducted at the Radiology department of Fatima Memorial Hospital Shadman, Lahore. A total of 29 patients aged 40 – 82 years were included in this study. Data was analyzed by using IBM-SPSS V-26, with significance level set at $p < 0.05$. **Result:** According to my study, out of 29 patients, 24 patients were detected with hepatocellular carcinoma (HCC) in which 82.75% cases detected on triphasic computed tomography while only 31.0% cases were detected by ultrasound due to low sensitivity. A significant number of cases 68.9% were not detected on ultrasound but detected on CT and 5 were normal with focal lesions suspected on ultrasound. In the analysis of diagnostic performance, ultrasound demonstrate sensitivity of 83.3% (95% CI), and PPV of 80.0%

with 0.0% Specificity and NPO due to small number of cases with wide 95% CI and the overall diagnostic accuracy of the ultrasound against triphasic CT was 69.0%. The patient with advanced stage disease (Stage III) were more predominant then early stage disease. **Conclusion:** Ultrasound has lower sensitivity for detection but can be useful as first line screening test. Triphasic CT is crucial for accurate diagnosis and staging of hepatocellular carcinoma (HCC) by using TNM staging system. In high risk population the advanced-stage disease need classified surveillance programs.

KEYWORDS: Ultrasonography, Computed Tomography, Hepatocellular, Carcinoma, Tumor Staging

INTRODUCTION:

Hepatocellular carcinoma is also known as Hepatoma, it is the most prevalent type of primary liver cancer and a substantial global health issue because of its mortality rate. Approximately, HCC accounts for about 75% - 80% of all liver cancers globally (1). On a global ranking, it is the 7th most frequent primary neoplasm and also the 2nd underlying cause of the deaths (2). The incidence of HCC is about 2 to 3 times higher in males than in females (3). The global burden of major risk factors that influence the evolution of HCC are chronic infections (such as hepatitis B and hepatitis C virus), non-alcoholic fatty liver disease (NAFLD), smoking, type 2 diabetes and obesity (4). Patients with HCC mostly appear as asymptomatic and mostly the symptoms are evident in severe stages while in symptomatic patients, HCC present at an early stage with triad of weight loss, pain in right upper quadrant and palpable mass. Other symptoms include ascites jaundice, fever, hepatomegaly, and hepatic bruise (5). The diagnosis of HCC is firmly correlated with the staging of the tumor. The patients who are diagnosed at early stage have survival rate of 5 years rather than those who are diagnosed at an advance age which is 2 years (6).

In contrast to majority solid organs neoplasm, that require histopathological examination. In high risk population, HCC is exceptional in it that it can be assessed non-invasively only by imaging (7). The type of imaging method use depends on the factors, including lesion size, availability of imaging equipment, and clinical expertise (8). Ultrasound (US)-the real-time imaging, is widely used as first-line imaging because it is non-invasive, economical, and readily accessible, and has non-ionizing radiation. It plays

a crucial role, not only in the detection but also in the characterization of focal hepatic lesion (9). The sensitivity of ultrasound is lower for early stage lesion and lesion <2cm. In over 20% of high risk patients of HCC in-vivo imaging of liver on ultrasound may be restricted due to complex structure and heterogeneous echotexture of the parenchyma (10).

Computed tomography (CT) especially triphasic CT (also known as multiphasic contrast-enhanced CT) a cross-sectional imaging that gives detailed morphological and vascular assessment of hepatic focal lesions (11). In triphasic CT, the images are taken at the Arterial phase, portal venous phase, and delayed phase for vascular pattern visualization of HCC (12,13). This is crucial for the differentiation of HCC from other hepatic lesions, to identify small lesions, and to determine the extent of hepatic spread (14) Contrast CT has a higher detection rate for HCC <2cmin diameter, i.e., 56% than ultrasound, i.e., 52%. The detection rate of HCC ⩽3cm in diameter by contrast CT is 100% and 85% for ultrasound. Triphasic CT not only detects lesions but also provides information for tumor staging that includes evaluation of tumor size, quantity, location of lesions, vascular invasion, regional lymph nodes involvement, and metastasis through the Tumor-Node-Metastasis (TNM) staging system (15). While ultrasound is routinely used as first line screening test and CT is vital for the detection of hepatocellular carcinoma. However, there is limited comparative studies on their utility in the TNM staging (16,17,18). The study aimed to assess accuracy, sensitivity, and specificity of both imaging modalities (ultrasound and CT), for the detection of hepatic lesions and to determine tumor stage through TNM staging system.

PATIENTS AND METHODS:

This study was conducted from September 2025 to December 2025 at the Radiology Department of Fatima Memorial Hospital, Lahore after the approval of Institutional Review Board of FMH College of Medicine and Dentistry. The sample size of this study involved 29 patients including both male and female (19). Patients with the history of pain in right upper quadrant, jaundice, palpable mass, weight loss were included while patients with prior HCC treatment such as surgery, pregnant or lactating women were excluded from this study. Since this was a retrospective study, it did not require direct contact with patients so, the individual inform consent was not needed. An abdominal

ultrasound was performed on TOSHIBA machine using 3-5 MHz convex probe by a radiologist. Examination was executed in supine position and left lateral position. CT scan was also performed on TOSHIBA 16-Slice machine by using tri-phasic protocol that include arterial phase (20-25 sec), portal venous washout (60-70 sec) and delayed phase (180 sec) followed by intravenous iodinated contrast media (1.5-2ml/kg at 3-4ml/s). Staging was allocated by Tumor-Node-Metastasis (TNM) staging according to the AJCC 8th edition system.

The data was analyzed by using IBM-SPSS V-26 software. Most appropriate statistical tool was used to analyze the data, after approval from IRB. To compare the accuracy of ultrasound and CT scan and the detection and staging of HCC chi-square (χ^2) test was used. A p-value <5% was taken for statistical significance.

RESULTS & FINDING:

This study involved 29 patients out of which 21 were males (72.4%) and 8 were females (27.6%). The mean age of all patients was 59.72±10.882 years of age group 40-82 years (Table 1).

Table 1: *Demographic Summary (n=29)*

Characteristics	n	Percentage
Male	21	72.4%
Female	8	27.6%
Mean age	59.72±10.882 years	
Age range	40-82 years	

On ultrasonography, focal lesions were seen in about 25 patients (86.2%), the echogenicity of these lesions demonstrated that hyperechoic lesions were in present in 10 patients (34.5%), hypoechoic lesions in 9 patients (31.0%), and isoechoic lesions in 6 patients (20.7%) while no focal lesions present in 4 patients (13.8%). Lesion margins were ill defined in 9 patients (31.0%) and well-defined in 16 patients (55.2%).

On triphasic CT, arterial phase enhancement was seen in 22 patients (75.9%), and portal venous/ delayed phase washout in 23 patients (79.3%). Extrahepatic spread was found in 5 patients (17.2%). A total of 24 patients were detected with hepatocellular carcinoma (HCC) in which 82.75% cases detected on triphasic computed tomography while only 31.0% cases were detected by ultrasound due to low sensitivity. A significant

number of cases 68.9% were not detected on ultrasound but detected on CT and 5 were normal with focal lesions suspected on ultrasound (Table 2).

Table 2: *Lesion detection by ultrasound and triphasic CT (n=29)*

Detection Category	n	Percentage
Detected by triphasic CT	20	68.9%
Detected by USG only	5	17.2%
Detected by both USG and CT	4	13.7%

Triphasic CT: Triphasic computed tomography, USG: ultrasonography

According to the TNM staging system evaluated by triphasic CT 17.24% patients had stage 0, 6.9% patients had stage I, 17.24% had stage II, 6.9% had stage IIIA, 24% had stage IIIB, 10.3% had stage IVA, 13.7% had stage IVB.

In the analysis of diagnostic performance, ultrasound demonstrate sensitivity of 83.3% (95% CI: 64.1–93.3%), specificity was 0.0% (95% CI: 0.0–43.4%), as any of the 5 CT-negative cases were unclassifiable on ultrasound as negative, PPV was 80.0% (95% CI: 60.9–91.1%), NPV was 0.0% (95% CI: 0.0–49.0%), suggesting that ultrasound was unable to rule out the existance of hepatic lesions in this group of study. The overall diagnostic accuracy of the ultrasound against triphasic CT was 69.0% (Table 3).

Table 3: *Diagnostic performance of USG with triphasic CT (n=29)*

Parameter	Value	Percentage
Sensitivity	83.3%	64.1–93.3%
Specificity	0.0%	0.0–43.4%
Positive Predictive Value (PPV)	80.0%	60.9–91.1%
Negative Predictive Value (NPV)	0.0%	0.0–49.0%
Overall Diagnostic Accuracy	69.0%	

NPV and specificity were 0.0% as there were small number of negative cases with wide CI of 95% and these estimate should be interrupted cautiously.

DISCUSSION:

Incidence of hepatocellular carcinoma is very high >20 per 100,000 individual each year in Asia (20). Patients with the liver cirrhosis, diabetes, hepatitis, and fatty liver disease are at risk of early development of HCC. Routinely imaging test such as abdominal ultrasound shows hepatic focal lesions and masses (8)(18). Ultrasound can be used as

first line imaging test but CT showed high efficacy for the detection and staging of HCC. The HCC is very common in males as compare to female followed by 72% and 29% compared to 74% in males and 26% in females as stated by Abboud Y et al (21).

In a study by Bialecki ES et al, which summarize the clinical practice for the diagnosis of HCC. He described the surveillance in high risk population and early detection through AFP test and ultrasound and their combined sensitivity was very high but the sensitivity of ultrasound alone was very low as 35% while the sensitivity of triphasic CT was very high as 88% (22). In another study by Aslam A et al total 261 patients were taken out of which 228 were diagnosed with HCC. The diagnosis shows CT had high sensitivity of 96%, specificity of 88.4%, accuracy of 95.78%, PPV of 98.70%, and NPV of 73.33% to diagnose the malignant lesion as compared to ultrasound which has low sensitivity to detect malignant lesion(16). Mostly the sensitivity of ultrasound is low in fatty liver (with or without obesity). Fat cause attenuation of ultrasound beam and induce less penetration of beam. Thus the distant parts (such as posterior and superior part) are not well located. The presence of multiple nodules in cirrhotic patients, complicates the diagnosis of suspected HCC (23).

CONCLUSION:

This study concludes that most of the patients afflicted with clinically suspected HCC had advanced-stage disease, mainly Stage IIIB. Triphasic CT showed that it is an imaging modality of choice for accurate diagnosis of HCC as the sensitivity and PPV of ultrasound were assessed to be 83% and 80%. Regarding effectiveness of diagnosis, the NPV and specificity were 0.0% as there were small number of negative cases with wide CI of 95%. These findings show that CT is more impactful than ultrasound in the detection of HCC.

ACKNOWLEDGEMENT:

The authors acknowledge the support of the staff of Radiology Department of FMH, Lahore during data collection.

DISCLAIMER:

This manuscript was a part of Bsc (Hons) MIT final year research and thesis project. This manuscript is original and has not been submitted to another journal or published previously.

CONFLICT OF INTEREST:

None to declare.

FUNDING DISCLOSURE:

None.

REFERENCES:

1. Asia S eastern, Asia S central. Global Epidemiology of Hepatocellular Carcinoma. J Clin Exp Hepatol [Internet]. 2025;15(2):102446. Available from: https://doi.org/10.1016/j.jceh.2024.102446
2. Lampimukhi M, Qassim T, Venu R, Pakhala N, Mylavarapu S, Perera T, et al. A Review Of Incidence And Related Risk Factors In The Development Of Hepatocellular Carcinoma. 2023;15(11).
3. Nevola R, Tortorella G, Rosato V, Rinaldi L, Imbriani S, Perillo P, et al. Gender Differences in the Pathogenesis and Risk Factors of Hepatocellular Carcinoma. 2023;1–25.
4. Baecker A, Liu X, La C, Zhang Z Feng. Worldwide Incidence Of Hepatocellular Carcinoma Cases Attributable to Major Risk Factors. 2018;2012.
5. Manuscript A. NIH Public Access. 2010;12(5):759–66.
6. Qurat Ul Ain Arif, Mahwish Jabeen, Ummara Siddiqui, Tariq Mahmood Irshad, Muhammad Babar Khan, Sadia Tahir. Diagnostic Accuracy of Ultrasound in Detecting Hepatocellular Carcinoma Keeping Histopathology as Gold Standard. Ann PIMS-Shaheed Zulfiqar Ali Bhutto Med Univ [Internet]. 2021 May 19;17(2):168–73. Available from: https://www.apims.net/apims/article/view/368
7. Jiang H yu, Chen J, Xia C chao, Cao L kun, Duan T, Song B, et al. Noninvasive imaging of hepatocellular carcinoma : From diagnosis to prognosis. 2018;24(22):2348–62.
8. Candita G, Rossi S, Cwiklinska K, Fanni SC, Cioni D, Lencioni R, et al. Imaging Diagnosis of Hepatocellular Carcinoma : A State-of-the-Art Review. 2023;
9. Tanaka H. Current role of ultrasound in the diagnosis of hepatocellular carcinoma. J Med Ultrason [Internet]. 2020;47(2):239–55. Available from: https://doi.org/10.1007/s10396-020-01012-y
10. Park HJ, Kim SY. Imaging Modalities for Hepatocellular Carcinoma Surveillance :

Expanding Horizons beyond Ultrasound. 2020;20(2):99–105.

11. Jain G, Verma S, Bansal R, Gupta PK, Garg V. Characterization of Focal Hepatic Lesions: A Comparative Study of Ultrasound versus Computed Tomography. IOSR J Dent Med Sci. 2016;15(February 2017):44–51.
12. Heimbach JK, Kulik LM, Finn RS, Sirlin CB, Abecassis MM, Roberts LR, et al. AASLD Guidelines for the Treatment of Hepatocellular Carcinoma. 2018;67(1):358–80.
13. Saito J, Kim SR, Kudo M, Imoto S, Ando K, Nakajima T, et al. Well-differentiated Hepatocellular Carcinoma Detected as Hypovascularity by Only CT during Hepatic Arteriography a b c. 2012;885–90.
14. Lim JH, Choi D, Kim SH, Lee SJ, Lee WJ, Kim S. Detection of Hepatocellular Carcinoma : Value of Adding Delayed Phase Imaging to Dual-Phase Helical CT. 2002;(July):67–73.
15. Szklaruk J, Silverman PM, Charnsangavej C. Imaging in the Diagnosis , Staging , Treatment , and Surveillance of Hepatocellular Carcinoma. 2003;(February):441–54.
16. Aslam A, Nazir M, Zain ul Abidin S, Fatima Z, Yousaf Farooq SM, Zia S, et al. Diagnostic Accuracy of Ultrasound for Benign and Malignant Hepatic Masses Taking Computed Tomography as Gold Standard. Pakistan J Heal Sci [Internet]. 2022 Nov 30;59–63. Available from: https://www.thejas.com.pk/index.php/pjhs/article/view/269
17. Liu Q, Li X, Yang KL, Sun SW, Xu X, Qu K, et al. Liver Tumor Imaging Staging: A Multi-Institutional Study Of A Preoperative Staging Tool For Hepatocellular Carcinoma. Abdom Radiol. 2025;1–20.
18. Study C sectional. Comparative Analysis of CT and Ultrasound for the Diagnosis. 2025;8(1):31–8.
19. F P, M O, M M, S H, E S, J L, et al. Diagnostic Accuracy of Ultrasonography and CT-Scan in Detecting Hepatocellular Carcinoma (HCC). SAS J Med [Internet]. 2025 Mar 15;11(03):192–998. Available from: https://saspublishers.com/media/articles/SASJM_113_192-198.pdf
20. Venook AP, Papandreou C, Fururse J, Ladron de Guevara L. The Incidence Of Epidemiology Of Hepatocellular Cacrcinoma: a Global and Regional Perspective. The O ncologist. 2010;15(suppl 4):5–13.

21. Abboud Y, Ismail M, Khan H, Medina-morales E, Alsakarneh S, Jaber F. Hepatocellular Carcinoma Incidence and Mortality in the USA by Sex , Age , and Race : A Nationwide Analysis of Two Decades. 2024;12(2):172–81. Available from: https://www.doi.org/10.14218/JCTH.2023.00356
22. Bialecki ES, Bisceglie AMDI. Diagnosis of hepatocellular carcinoma. Hpb J [Internet]. 2005;7(1):26–34. Available from: http://dx.doi.org/10.1080/13651820410024049
23. Sherman M, Sherman M. Limitations of screening for hepatocellular carcinoma Limitations of screening for hepatocellular carcinoma. 2014;0923.