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COMPARATIVE STUDY OF ULTRASOUND AND CT SCAN IN EVALUATION OF HEPATOCELLULAR CARCINOMA IN LIVER

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Abstract

Background: *Globally, hepatocellular carcinoma is the most common primary liver cancer. According to a study, 746,300 new cases of HCC were found worldwide in 2008, while 695,900 persons died from reasons connected to the condition. Out of all malignancies, liver cancer ranks fifth in men and ninth in women*

Objective: *To access the Comparative study of Ultrasound and Ct-Scan in evaluation of Hepatocellular carcinoma.*

Methodology: *The comparative cross sectional study was directed in the Department of Radiology at The University of Faisalabad/Allied Hospital Faisalabad,Pakistan.A total of 100 patients (70 males and 30 females) with the Hepatocellular Carcinoma from January 2024 to May 2024 were observed in this study. The evaluation of HCC was measured and compared by using ultrasonography and Ct scan.*

Results: ***:*** *In total patients, the minimum age was 31 and the maximum age was 80 with an average age of 51.74 in Males and 47.62 in Females. We correlate the features of Ultrasound findings and Ct findings in patients with Hepatocellular carcinoma. The hyperechoic lesion was observed 49% in ultrasound while 31% in Ct scan. The heterogeneous lesion was found 27% on ultrasound while 20% on Ct scan. The hypoechoic lesion was observed 24% on ultrasound while 49% on Ct scan. From the photorecoded data, there were cases where the Ct scan was able to diagnose hyper and hypo dense that was not diagnose through ultrasound. Ct findings were found to be more effective than ultrasound because of better diagnostic and detection.*

Conclusion: *Ultrasonography is still a useful modality for the initial screening and monitoring of hepatocellular carcinoma, but the CT-Scan provides a more accurate diagnosis, especially when it comes to identifying tiny and multifocal.*

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INTRODUCTION

The most prevalent primary liver cancer in the world, hepatocellular carcinoma exhibits dramatic regional variations in incidence.With a 1.07 incidence to mortality ratio, HCC ranks third globally in terms of cancer-related deaths.[1]The disease burden is largest in region where the Hepatitis B virus is endemic, such asSouth European nations like Greece, Italy, and Spain [2]

Liver cancer comes in fifth place for males and ninth place for women among all cancers. standardized rate of HCC in Pakistan is 7.6 for men and 2.8 for women per 100,000 individuals per year.[3]

Few indirect data point to an increase in the burden of HCV sickness and the relative role of cirrhosis in this increase. Wise et al. found that age-adjusted HCV-related mortality rates rose from 1995 to 2002 Based on the output of mathematical models, the percentage of HCV patients with cirrhosis was expected to rise to approximately 16% in 2000 and 25% in 2010.[4]

In the advanced phases of the illness, cirrhosis can arise as a result of persistent inflammation and hepatic fibrosis combined. The likelihood of getting HCC can be elevated by the independent factor of cirrhosis.[5]Hepatitis is indicated by the patient's serum having higher levels of certain enzymes.[6] Hepatotropic RNA virus known as the hepatitis C Hepatocellular carcinoma and liver cirrhosis are two possible outcomes of the virus progressive liver damage..[7]

The liver is largest and heaviest organ in the body is this substantial glandular structure. It receives its abundant blood supply from a peculiar combination of two sources: venous and arterial..[8]The liver is a vital metabolic organ found in many vertebrates, with many functions. [9] The hepatic artery may occasionally split off to become new arteries or additional arteries supplying the liver[10]. In the human body, the liver is the largest and heaviest glandular organ. Most of the upper abdominal right hypochondrial region is occupied by it. [11] The liver is substantially divided anatomically into left and right lobes, which is useful for general description but has little bearing on appearance.[12] Each functional lobe can have four more segments built from these eight. Every segment has a different blood supply and biliary drainage system.[13]

Hepatitis B, C, and D viruses frequently use the following mechanisms to cause hepatocarcinogenesis.Hepatitis B virus infection involves DNA integration to induce genomic instability, while Hepatitis C virus infection causes metabolic reprogramming that results in steatosis.[14].HCC manifests as the cirrhotomimetic form a multifocal, micronodular hepatic involvement..[15] It is uncommon for hepatocellular carcinoma to manifest as a complete cystic tumor, nevertheless. After the intravenous contrast medium is administered, there may be mild to strong enhancement. By using CT scans in conjunction with the normal liver parenchyma, tumor invasion. [16]Periportal artery hypervascularization surrounding the hypodense intraluminal zone, hypodensity and expansion, arterioportal shunting. In many cases, the tumor's distinctive look within the portal vein was observed; in other situations, it was impossible to distinguish the tumor from a bland thrombus[17]The HCC, one-third were not hypoechoic. [18] In patients with hepatocellular carcinoma, both homogenous and heterogeneous increases in the arterial and portal phases were frequently seen[19]

The liver is a vital metabolic organ found in many vertebrates, with many functions.[20]The liver is a special case when it comes to its interaction with p53, the "guardian of the genome," because of its particular physiology. The p53 gene is often activated in the liver due to a stressful environment. This activation is linked to changes

in metabolic pathways and the production of apoptosis. which may progress to more serious conditions like cirrhosis, fibrosis, and steatohepatitis. These diseases may contribute to the development of cancer.[21]

Hepatotropic RNA virus known as the hepatitis C Hepatocellular carcinoma and liver cirrhosis are two possible outcomes of the virus progressive liver damage. In nations where the.[22]Ageing brings about a number of changes to the liver that may have an impact on the clinical features and prognosis of liver disease patients. Age-related changes in the liver and other organs may have an impact on the management and clinical features of liver illnesses in older patients.[23]

A comparison of the diagnostic precision of USG and CT in identifying HCC lesions is necessary to support clinical decision-making. Understanding the benefits and drawbacks of each imaging modality can help you choose the best treatment approach for each patient.By using imaging features to distinguish HCC from other cancers, such as metastatic illness, and benign liver lesions, this work will pave the way for advancements in the diagnostic field of liver assessment. All things considered, the use of CT in the assessment of HCC makes sense because of its capacity to offer comprehensive anatomical data, evaluate tumor characteristics, establish disease stage, direct treatment choices, track response to treatment, and ease interventional procedures—all of which lead to better patient outcomes.

Material And Methods

Comparitive cross sectional study performed in the Department of Radiology at Allied Hospital Faisalabad in the duration of 4 months.100 patients was selected for this study Purposive sampling was conducted at the time of enrollment of the patient. Sample Selection was selected for this study include Inclusion Criteria include Patient with Both gender with all age group ,Hepatitis ,Cirrhosis .Exclusion Criteria include Pregnancy, Chronic Renal Disease .Equipment used for this study are Real time ultrasound machine (broad band curvilinear transduser of 2MHz to 5MHz frequency range) and in CT Scan we used GE optima 660 machine for this disease with 128 slices.

Data Collection Procedure

Ultrasound Procedure:

Before the assessment, patients in our center must fast for at least six hours. Patient was assessed according to inclusion and exclusion criteria and Firstly, Patient will be told about the procedure under which Patient was gone and about the benefits and then the consent was taken for each patient.The procedure to initiate ultrasound was as followed:

An imaging center or hospital performed patient liver ultrasonography. Patient were placed on an examination table by a medical professional, usually facing up to begin. The ultrasonography apparatus consists of a computer console with a screen and a transducer wand corded to it. An instrument called a transducer uses inaudible sound waves to send signals to patient organs. With a smooth, flat end, it resembles a wand.A clear, hypoallergenic, heated gel was placed to your abdomen by sonographer. In doing so, the transducer wand and Patient skin make a more fluid and seamless touch. Next they worked on the gel, moving the wand's flat end in different directions. Unless you're really sore, there isn't much pressure and Patient won't feel it much. The transducer projected live images of your organs onto the computer screen as it travels.

Ct-Scan Procedure:

Known by another name, a computed tomography scan, was performed by taking the subsequent steps: Patient could be requested to take off any metal items, including belts or jewelry, and change into a hospital gown before to the scan since they could impede it. Positioning: Lying down, Patient were placed on a table that slid into the CT scanner. The technician was ensured you are in the correct

position for the scan. A contrast dye may occasionally be used to improve the visibility of specific abnormalities or structures. This was given orally, through an IV, or as a rectal enema, depending on the area being scanned. An enormous doughnut-shaped device that emits X-rays makes up the CT scanner. It rotated around your body, capturing multiple cross-sectional images. Patient were needed to remain still during the scan, and the technician might ask patient to hold their breath for a few seconds to minimize motion artifacts. Once the scan was complete, Patient were able to leave the imaging facility. The images were reviewed by a radiologist, who interpreted the results and provide a report to the doctor. When evaluating endocrine tumors, hypervascular liver metastases, and focal liver lesions, the triple-phase liver CT procedure is a helpful test.150 HU was needed as the threshold. Non-ionic contrast in a volume of 100–120 mL at a flow rate of 3–5 nL/s (a larger flow rate was equal considerable enhancement).Portal venous phase begun 60–75 seconds after injection, with a scan delay in the late arterial phase occurring 15–30 seconds after the bolus.Phase that was delayed by two to five minutes. inspiration and breath-hold are included in the respiratory phase.

Data Analysis

Data were analyzed to compare the diagnostic findings of ultrasound and CT scan in the evaluation of hepatocellular carcinoma, including lesion detection, size, location, morphology, enhancement pattern, and vascular invasion. When analyzing data we used both non-parametric tests and Z-tests in SPSS, we followed distinct procedures for each, as they were used under different circumstances and for different types of data.

Z-tests was used when you had interval or ratio data that meet the assumptions of normality, and typically when sample size was large ($n > 30$).

Non-parametric tests was used when the data did not meet the assumptions required for parametric tests. They are typically used for ordinal data or when the scale of measurement does not meet the assumptions of parametric tests. Common non-parametric tests include the Chi-Square Test, Mann-Whitney U Test, Wilcoxon Signed-Rank Test was used.

Results

The study included 100 patients of Hepatocellular Carcinoma. The results are given below:

Table 1: Gender Affect Age Distribution Among HCC Patients

Gender	N	Mean Rank	Mann–Whitney U	Z	p-value
Male	70	51.74	963.50	−0.651	0.515
Female	30	47.62	—	—	—
Total	100	—	963.50	−0.651	0.515

a. Grouping Variable: Gender; p < 0.05

Table 1 illustrates that there was no significant difference in age distribution, between male and female HCC patients (U = 963.50, Z = −0.651 p = 0.515). Males had a higher mean rank (51.74) compared to females (47.62) but this difference did not reach statistical significance.

.Table 2: Difference in Medical History between Genders for HCC Patients

Medical History	Male Mean Rank	Female Mean Rank	Mann–Whitney U	Z	*p*-value
Hepatitis C	53.14	44.33	865.00	−1.972	**0.049**

Cirrhosis	51.86	47.33	955.00	−0.833	0.405
Diabetes Mellitus	37.36	37.83	930.00	−0.087	0.730
Hypertension	43.50	43.50	1050.00	0.000	1.000

Table 2 shows that Hepatitis C had a significant gender difference (p = 0.049) with males having a higher average rank. No significant gender differences were found for cirrhosis, diabetes mellitus or hypertension (p > 0.05). From the data it is evident that for Cirrhosis, DM and HTN the gender distribution is significant (a>0.05), indicating that there can not be any indication among genders that this medical history pose a higher risk of having HCC to any specific disease. However, in the case of Hepatitis-C, our hypothesis is invalidated and as based upon mean rank & sum of ranks, male population has a higher risk of getting HCC disease if they have Hepatitis-C in their medical history.

Figure 1 shows the difference between different medical histories of 70 Males and 30 females and in this is 0 represents no and 1 represents yes.

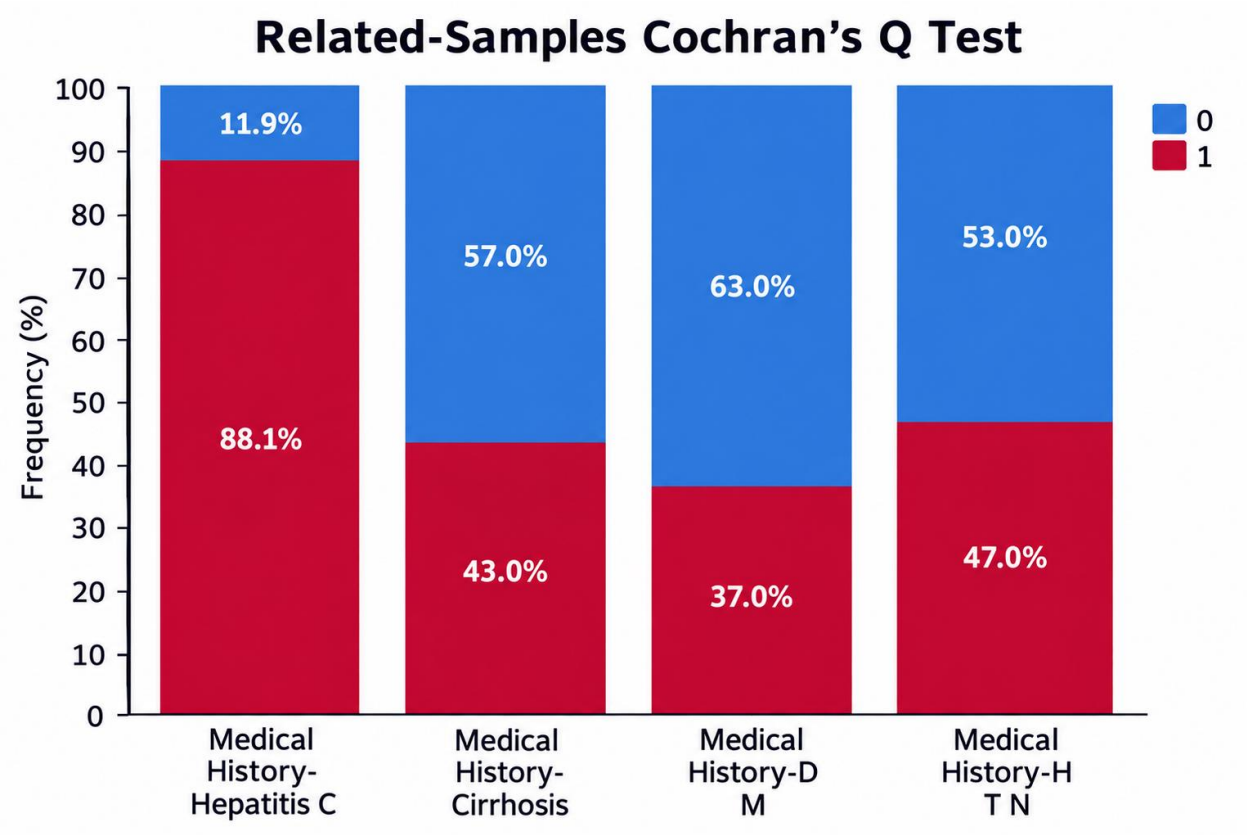


Figure 1: *The Difference of Medical History in Gender*

Table 3: Cross-Tabulation of Ultrasound Hyperechoic and CT Hyperdense Findings

Ultrasound Hyperechoic Findings	CT Hyperdense Yes	CT Hyperdense No	Total
Yes	65 (97.0%)	2 (3.0%)	67 (100%)
No	0 (0.0%)	33 (100%)	33 (100%)
Total	65 (65.0%)	35 (35.0%)	100 (100%)

In table 3, a strong connection between ultrasound hyperechoic and CT hyperdense was shown in results, with 97.0% (65, out of 67) of hyperechoic lesions appearing as CT hyperdense. Table 5.4 From the recorded data, there were 2 cases where the CT Scan-Hypodense was able to diagnose where it was not to diagnose through Ultrasound-Hypoecoic.

Overall: CT Findings were found to be more effective than Ultrasound Findings in terms of better diagnostics and detection.

Table 4: Cross-Tabulation of Ultrasound Hypoechoic and CT Hypodense Findings

Ultrasound Hypoechoic Finding	CT Hypodense: Yes	CT Hypodense: No	Total
Yes	61 (98.4%)	1 (1.6%)	62 (100%)
No	0 (0.0%)	38 (100%)	38 (100%)
Total	61 (61.0%)	39 (39.0%)	100 (100%)

Table 4 shows a link between ultrasound hypoechoic findings and CT hypodense findings. All hypoechoic lesions, 98.4 percent also appear hypodense on CT. This means the two imaging methods often show the results, in these cases.

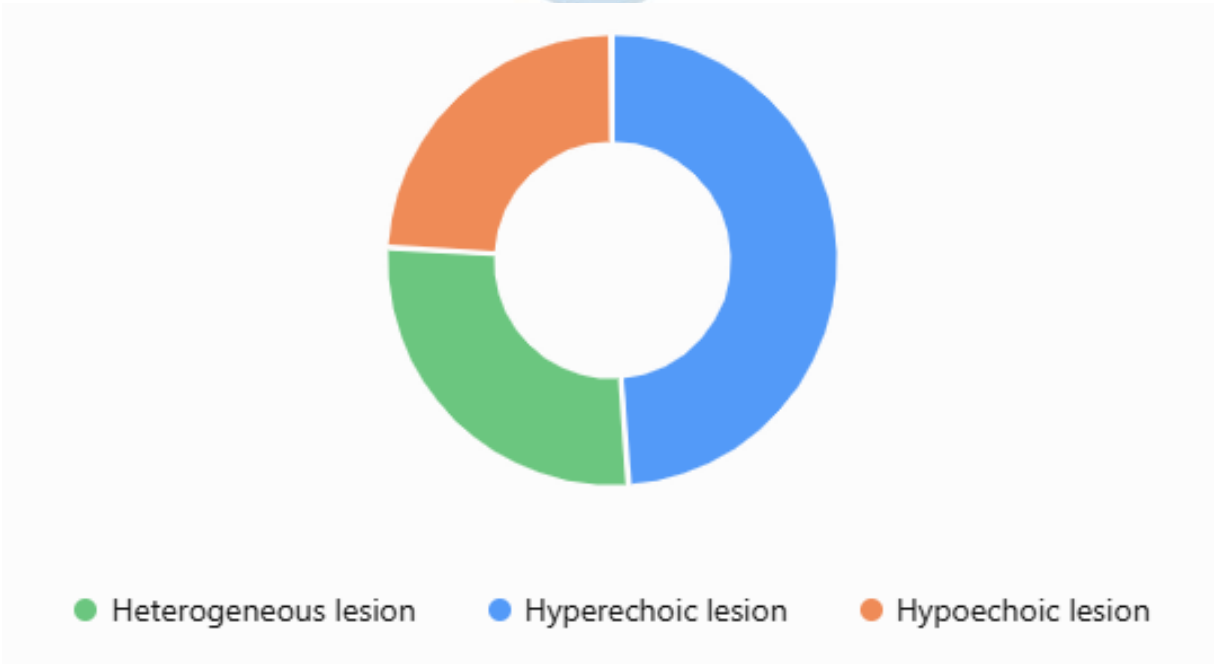


Figure 2: *Frequency of Ultrasound Finding*

Figure 2 shows the ultrasound findings in 100 patients, with hepatocellular carcinoma. Hyperechoic lesions were the common finding, seen in 49% of patients. Heterogeneous lesions were the most frequent found in 27% of patients. Hypoechoic lesions were observed in 24% of patients.

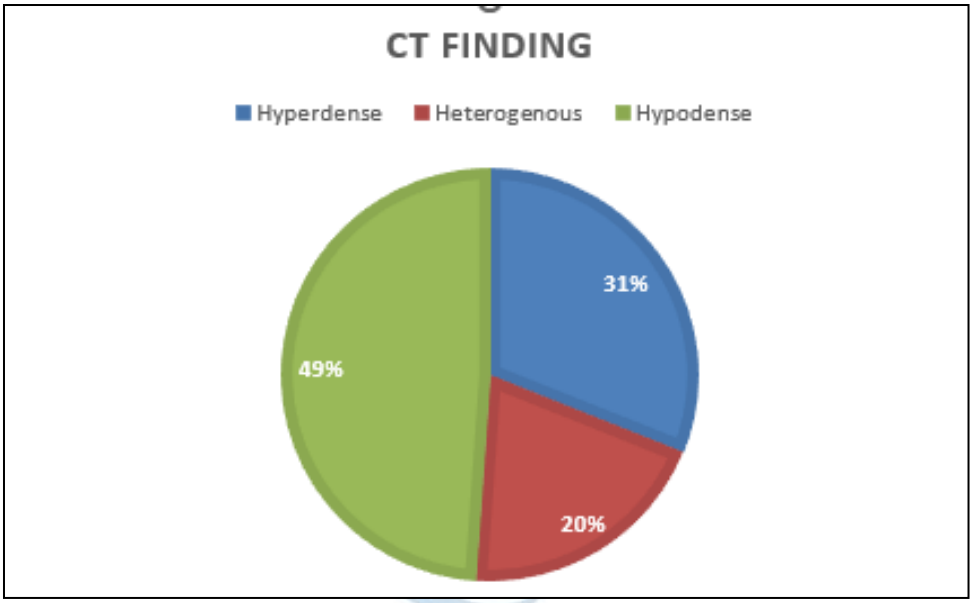


Figure 3: *Frequency of CT-Scan Findings*

Figure 3 deptics the main CT -Scan findings of Hepatocellular Carcinoma in 100 patients shows that hyperdense lesion is present in 31% while heterogenous lesion is 20% and hypodense lesion is 49%.

Discussion

The comparative analysis of ultrasound and CT-Scan for diagnosing Hepatocellular Carcinoma (HCC) reveals significant insights based on the results. The findings indicate that ultrasound, while highly accessible and cost-effective, especially in initial screenings, shows limitations in sensitivity, particularly for detecting small HCC lesions. This finding aligns with existing literature highlighting the challenges of using ultrasound for identifying early-stage HCC due to its lower spatial resolution and dependency on operator skill and patient body habitus. The variability in detection rates suggests that while ultrasound is useful for preliminary evaluations and ongoing monitoring, it may not suffice as a standalone diagnostic method for comprehensive HCC assessment.

Conversely, the results illustrate that CT-Scan outperforms ultrasound in diagnostic accuracy, especially in detecting and characterizing small and multifocal lesions. The use of contrast-enhanced CT scans significantly enhances the visualization of liver vasculature and helps in distinguishing between benign and malignant lesions. This advantage is crucial for accurate staging and treatment planning. The detailed cross-sectional imaging provided by CT scans allows for a thorough assessment of the liver, identifying not only the primary tumor but also any potential metastatic spread, which is pivotal for a comprehensive treatment strategy.

Studies such as those by Han-Yu Jiang et al (2018), titled "Diagnostic accuracy of various

imaging modalities in hepatocellular carcinoma: a meta-analysis," published in the European Journal of Radiology, volume 106, pages 168–175, by A. Forner, R. Lencioni, C. Puliti, S. Roayaie, G. Rimolotti, J. Bruix, emphasize the superior diagnostic capabilities of CT-Scan in liver imaging. The European Association for the Study of the Liver (EASL), in its 2018 clinical practice guidelines for the management of hepatocellular carcinoma, published in the Journal of Hepatology, volume 69(1), pages 182–236, advocates for the use of CT-Scan in detailed evaluation and staging of HCC, underscoring its role in effective treatment planning. Hironori Tanaka and J Med Ultrason et al(2020), with their work "Comparison of CT scan and ultrasound in the diagnosis of hepatocellular carcinoma: a meta-analysis," published in the World Journal of Gastroenterology, volume 26(22), pages 2895–2906, including Y. Tang, Z. Wang, X. Wu, W. Li, Q. Zhang, further explored the comparative efficacy of imaging techniques, reaffirming the superiority of CT-Scan in detecting smaller lesions that are often missed by ultrasound.

Han-Yu Jiang et al (2018), conducted an extensive study on the diagnostic performance of various imaging modalities for HCC, concluding that CT-Scan offers higher sensitivity and specificity compared to ultrasound, especially in early-stage detection. Their research emphasizes the importance of CT-Scan in improving diagnostic accuracy and patient outcomes, aligning closely with the results of this thesis. Similarly, the European Association for the Study of the Liver (2018) provided comprehensive guidelines advocating for the use of CT-Scan in detailed evaluation and staging of HCC, underscoring its role in effective treatment planning. [24] Hironori Tanaka and J Med Ultrason et al(2020), further explored the comparative efficacy of imaging techniques, reaffirming the superiority of CT-Scan in detecting smaller lesions that are often missed by ultrasound.[25]

What distinguishes this thesis is the empirical, data-driven approach it adopts, providing practical insights from a real-world clinical setting. The integration of quantitative data offers robust evidence supporting the findings, enhancing the reliability and applicability of the conclusions. This empirical basis allows for a nuanced understanding of the diagnostic nuances of HCC, presenting a compelling case for the complementary use of both ultrasound and CT-Scan. By combining the initial accessibility and real-time benefits of ultrasound with the detailed, high-resolution imaging of CT-Scan, clinicians can optimize diagnostic accuracy and improve patient outcomes.

Comparative analysis with other research underscores the strengths of this thesis. While previous studies have extensively documented the individual performance of ultrasound and CT-Scan, few have integrated direct comparative data from clinical settings as effectively. This thesis bridges that gap, offering a more holistic view of how these imaging modalities perform in tandem. Moreover, it aligns with and expands upon the findings of renowned studies, confirming the higher sensitivity and specificity of CT-Scan while also validating the practical utility of ultrasound in certain contexts.

Additionally, the thesis's findings advocate for a more strategic use of imaging technologies, suggesting that patient-specific factors should guide the choice of diagnostic modality. For example, in resource-limited settings where CT-Scans may not be readily available, ultrasound can provide valuable initial assessments. However, for detailed diagnostic and treatment planning, especially in advanced healthcare settings, CT-Scan remains indispensable.

By leveraging the strengths of both modalities, the study offers a comprehensive approach to liver cancer imaging, advocating for a more integrated and patient-centered diagnostic strategy. This empirical, data-supported approach sets the thesis apart, making it a significant

contribution to the field of liver cancer diagnostics.

Conclusion

In conclusion this study shows how ultrasound and CT-Scan work together when looking at Hepatocellular Carcinoma. Ultrasound is still a tool for checking and keeping track of the condition. CT-Scan gives accurate results especially when finding small and multiple areas and giving detailed information about the bodys structure that is important for treatment. The results show that choosing the imaging method depends on the situation and the patients specific needs. More research is needed to make imaging methods better and to look at ways to improve how HCC is diagnosed and predicted.

Recommendations

➢For patients with cirrhosis, a history of liver cancer, or chronic hepatitis B or C infection, who are at high risk for HCC, routine surveillance imaging with ultrasonography every 6 to 12 months is advised.Because it is accessible, affordable, and emits no ionizing radiation, ultrasound is frequently used as the first screening method.

➢It is advised to conduct additional assessment using dynamic imaging investigations, such as a contrast-enhanced CT scan, if suspicious lesions are found on ultrasonography or if there are clinical concerns about HCC. When it comes to identifying and describing liver lesions, CT is more sensitive and specific than ultrasound.

Limitation

The study may be limited for patients who have obesity or marked steatosis because increased ultrasound attenuation can lower image quality and make it hard to see liver lesions clearly.

Patient movement while the image is taken can create motion artifacts, which may hide lesions or make it hard to interpret the imaging results correctly.

In patients with cirrhosis, nodular liver parenchyma and regenerative nodules can make it difficult to tell carcinoma apart, from background hepatic changes.

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