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A Cross-Sectional Evaluation of CT and MRI Diagnostic Accuracy in Detecting Hepatocellular Carcinoma with Emphasis on Small Tumors

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Abstract: Background:Hepatocellular carcinoma (HCC) is the most common primary liver cancer and a major contributor to cancer-related mortality worldwide. Early and accurate detection, especially of small lesions, is crucial for improving patient outcomes.Objective:This study aims to compare the diagnostic accuracy of computed tomography (CT) and magnetic resonance imaging (MRI) in detecting HCC, with particular emphasis on small hepatic lesions. Method: A cross-sectional validation study was conducted on 40 patients in the Radiology Department of Allied Hospital Faisalabad over a period of six months. Patients underwent either CT or MRI according to predefined inclusion criteria. Imaging findings were analyzed using SPSS version 26, assessing sensitivity, lesion size detection, and key diagnostic features such as arterial phase hyperenhancement and washout. Results: MRI demonstrated higher diagnostic accuracy (~82%) compared with CT (~57%), particularly for small lesions (<2 cm), identifying 55.6% of these cases versus 18.8% with CT. MRI also showed greater sensitivity in detecting characteristic vascular patterns of HCC. Although CT was faster and more accessible, it involved radiation exposure and showed lower performance for early-stage lesions.Conclusion: MRI provides superior diagnostic performance compared to CT for the early detection of HCC, especially in high-risk individuals. CT remains valuable in emergency and resource-limited settings. Optimal patient management may be achieved through combined or selective use of both imaging modalities.

Keywords: Hepatocellular carcinoma, CT scan, MRI, liver cancer, early detection.

INTRODUCTION

Hepatocellular carcinoma (HCC) is the leading primary liver malignancy and represents a major global health challenge, with the highest burden seen in East Asia and parts of Africa. Its development is strongly associated with chronic hepatitis B and C infections, cirrhosis, excessive alcohol intake, and metabolic liver diseases such as NAFLD. Most patients develop HCC on a background of cirrhosis, and the disease is more common in males (de Santis, A. 2019).

Early HCC often shows no clear symptoms, which contributes to delays in diagnosis. Fatigue, weight loss, abdominal discomfort, and liver enlargement may appear as the disease progresses. Diagnostic evaluation relies primarily on non-invasive imaging. Multiphasic CT and contrast-enhanced MRI are the standard tools for detecting hallmark features such as arterial phase hyper enhancement and delayed washout. Although alpha-fetoprotein (AFP) can assist in diagnosis, it is not specific enough to be used alone (Altekruse, S. F. *et al.*, 2009).

Recent advances in imaging—including improved contrast techniques and volumetric analysis—have enhanced the ability to identify smaller lesions and assess treatment response. Combined therapeutic approaches like TACE with radiofrequency ablation have also shown better outcomes, underscoring the importance of accurate imaging in treatment planning. Therefore, comparing CT and MRI performance, particularly for small HCC lesions, remains crucial for improving diagnostic accuracy and patient management (Arif-Tiwari, H. *et al.*, 2014).

Imaging plays a central role in identifying and characterizing hepatocellular carcinoma (HCC), particularly in patients with cirrhosis who face a high risk of malignant transformation. Multidetector computed tomography (MDCT) remains widely used because it can clearly display the vascular changes typical of HCC, including increased arterial flow and reduced portal venous supply (Borgheresi, A. *et al.*, 2023). These vascular patterns help distinguish malignant nodules from benign lesions. MRI, on the other hand, provides superior soft-tissue contrast and detailed information on lesion composition, making it especially useful for detecting small or early-stage tumors that may be difficult to

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visualize on other imaging platforms (Bosch, F. X. *et al.*, 2004).

Computed tomography continues to be an essential tool in the initial evaluation and treatment planning of HCC. Its ability to capture the arterial enhancement and washout patterns associated with tumor neovascularization supports reliable diagnosis (Chernyak, V. *et al.*, 2018). The use of structured reporting systems, such as the Liver Imaging Reporting and Data System (LI-RADS), enhances consistency across healthcare centers and improves communication between radiologists and clinicians. While CT is valuable for monitoring disease and assessing treatment response, its diagnostic performance is strengthened when used alongside MRI, which provides additional functional and compositional detail (Di Martino, M. *et al.*, 2013).

Magnetic resonance imaging has become increasingly important in the assessment of liver tumors due to its advanced anatomical and functional capabilities. In cirrhotic patients, dynamic contrast-enhanced MRI enables precise visualization of intratumoral blood flow, improving early detection of malignancy (El-Serag, H. B. 2012). MRI also offers insights into fat content, hemorrhage, and cellular density—features that support treatment planning and differentiation between benign and malignant nodules. Because of these advantages, MRI is often recommended for routine surveillance and diagnostic workup in high-risk populations (Forner, A. *et al.*, 2018).

Recent developments in MRI, including diffusion-weighted imaging and hepatocyte-specific contrast agents, have further improved its diagnostic accuracy. These techniques allow radiologists to evaluate tissue properties beyond vascular behavior, offering a more comprehensive assessment of tumor biology (Guo, J. *et al.*, 2016). Although CT remains a valuable modality, especially for rapid evaluation, MRI provides more detailed characterization of HCC and is increasingly regarded as the preferred method for confirming diagnosis and defining disease extent. Together, these imaging advances contribute to more effective detection, staging, and management of hepatocellular carcinoma (Ashoori, N. *et al.*, 2012).

Hepatocellular carcinoma (HCC) is a common and aggressive form of liver cancer, and early detection remains essential for improving patient survival. Imaging plays a central role in diagnosis, especially for individuals with cirrhosis who are at high risk of developing HCC (Jemal, A. 2011). Research consistently shows that ultrasound alone is insufficient for identifying early-stage tumors, making cross-sectional imaging—particularly CT and MRI—the preferred tools for accurate detection, staging, and treatment planning (Kim, Y. Y. 2022). These imaging modalities reveal characteristic enhancement patterns that help differentiate malignant nodules from benign liver lesions, thereby supporting timely access to curative therapies such as resection, transplantation, or ablation (Lertpipopmetha, K. *et al.*, 2016).

Computed tomography (CT), especially multidetector CT (MDCT), is widely used as a second-line and confirmatory imaging modality. Studies have demonstrated that CT effectively detects neovascularization patterns typical of HCC, including arterial phase hyper enhancement and portal venous washout. It also provides thin-slice, high-resolution images suitable for evaluating vascular invasion, metastasis, and surgical planning (Llovet, J. M. *et al.*, 2024). Despite these strengths, CT still faces challenges in identifying small or early-stage tumors, and its sensitivity decreases for lesions under 2 cm. Additional limitations include exposure to ionizing radiation and the use of iodinated contrast agents, which may pose risks to patients with renal impairment or advanced liver disease (Nadarevic, T. *et al.*, 2021).

Magnetic resonance imaging (MRI) offers superior soft-tissue contrast and functional imaging capabilities, making it more sensitive than CT for detecting small HCC lesions and distinguishing them from benign nodules. Dynamic contrast-enhanced MRI, diffusion-weighted imaging, and hepatobiliary phase sequences with specialized contrast agents significantly improve diagnostic accuracy, especially in cirrhotic livers (Pratt, M. S. 2015). Multiple studies have shown that MRI achieves higher sensitivity, specificity, and negative predictive value than CT, particularly for tumors measuring 1–2 cm. Although MRI is advantageous for long-term surveillance and early detection, its limitations include higher cost, longer scan times, susceptibility to motion artifacts, and restricted use in patients with certain implants or severe claustrophobia (Szklaruk, J. *et al.*, 2003).

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Comparative analyses consistently indicate that both CT and MRI play essential but complementary roles in the diagnosis of hepatocellular carcinoma. CT offers rapid acquisition, wide availability, and strong performance in staging and vascular assessment, while MRI provides superior lesion characterization and better detection of small or early HCC. In clinical practice, the choice of modality often depends on patient-specific factors, institutional resources, and the purpose of evaluation. Ultimately, combining CT and MRI findings leads to a more accurate diagnosis, improved treatment planning, and better overall management of patients with hepatocellular carcinoma.

The research question that is focused on the comparative diagnostic accuracy of CT and MRI in detecting hepatocellular carcinoma, particularly in identifying small hepatic lesions (<2 cm) and to compare the effectiveness of CT scan and MRI in detecting hepatocellular carcinoma (HCC).

MATERIAL AND METHODS

Study Design:

A cross-sectional validation study. This study was conducted at Radiology Department of Allied Hospital Faisalabad. The study was completed in 6 months. Total of 40 patients were included in this study. The Sampling Technique Convenient sampling technique was used.

Sample Selection

Inclusion criteria:

- Patients with ascites, hepatitis infection, and with or without cirrhosis, whom USG findings were not enough, so they were typically referred for CT or MRI for further evaluation and diagnosis.
- Patients from 14 years to 60 of age were included.
- Both genders (male and female) were included in this study.

Exclusion criteria:

- Patients who have allergy to contrast media and impaired renal function were excluded from this study.
- Patients less than 14 years were excluded.
- In case of CT, pregnant women were excluded due to radiation exposure risks to the fetus.
- For MRI, patients with metal implants and claustrophobic patients (if sedation is not possible) were also excluded.

EQUIPMENT

Magnetic resonance Imaging (MRI):

The 1.5 Tesla strength GE Signa Voyager MRI systems generate high quality images with clear soft tissue contrast and it produces accurate anatomical details. Its 70 cm wide bore helps patients feel more comfortable and reduces claustrophobia. The system‘s Total Digital Imaging technology can process signals from up to 65 channels, leading to a 25% boost in signal-to-noise ratio and improves image quality. It uses advanced techniques like 3D PROMO and PROPELLER to cut down on artifacts from patient movement. It allows reliable scans even in tough situations. The AIR™ Recon DL technology also sharpens images. It cuts scan times, making the process more efficient. These qualities make the GE Signa Voyager good for imaging the abdomen, brain, muscles and bones.

Computed Tomography (CT) Scan:

The GE Optima CT660 128-slice scanner provides high-resolution imaging (0.625 resolutions) with great diagnostic accuracy. It has a 70 cm wide bore making it comfortable for many different patients. The system uses Adaptive Statistical Iterative Reconstruction (ASiR) technology to reduce radiation dose by up to 40% without losing image quality. With a rotation speed of 0.35 seconds and 40 mm detector coverage per rotation, it captures thin slices rapidly, enhancing spatial resolution and lessens motion artifacts. The scanner's design In modules and advanced applications make it effective for imaging the abdomen, heart, and cancer.

Data collection procedure:

We collected our data according to data collection sheets, based on our inclusion and exclusion criteria.

Data analysis procedure:

The collected data was analyzed using SPSS (statistical package for social science) version 26, to evaluate the accuracy of CT and MRI in the diagnosis of HCC.

ABDOMINAL MRI

Patient Preparation

Patients provided informed consent and were instructed to fast for 4–6 hours prior to the scan. Metal objects, including implants contraindicated for MRI, were screened and removed. Patients changed into gowns, remained well-hydrated, and had renal function (urea/creatinine) verified before contrast use. Allergy history, especially to

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gadolinium, and claustrophobia were assessed. Diabetic patients withheld metformin on the day of the scan. Headphones were provided for breath-hold communication.

Contrast Administration

A 22G IV cannula was inserted, and patency was confirmed with a 5 mL saline test dose. Gadolinium contrast was administered manually at standard flow: **1.5 mL/kg for adults** and **1 mL/kg for pediatric patients,** followed by saline flush.

Patient Positioning

Patients were positioned supine with arms raised to reduce motion artifacts. The mid-sagittal line was aligned with the scanner light, and the field of view extended from the nipple line to the iliac crest. A dedicated body coil was placed over the abdomen and pelvis.

MRI Technique

MRI was performed using a **1.5T GE Sigma system.** Localizers for the abdomen and pelvis were acquired, followed by pre-contrast sequences including T1-weighted, T2-weighted fat-suppressed, DWI, and rapid 2D FIESTA images. Scan planning ensured full coverage of the liver, pancreas, kidneys, and pelvis. After administering 0.1 mmol/kg gadolinium at 2 mL/s, dynamic imaging was obtained in arterial, portal venous, and delayed phases. Additional post-contrast fat-saturated T1 images were acquired in axial, coronal, and sagittal planes. DWI and ADC maps were generated. Image reconstruction included MPR and subtraction imaging for lesion characterization.

Image Analysis

Images were reviewed on the workstation using axial, coronal, and sagittal MPRs. DWI and ADC maps aided in distinguishing benign from malignant lesions. Subtraction images assessed enhancement patterns. Vascular and biliary structures were evaluated using MIP and 3D reconstructions. Final interpretation was based on a combined assessment of all sequences.

Abdominal Ct

Patient Preparation

Patients fasted for 4–6 hours and were screened for iodinated contrast allergies and renal function. They removed metallic items and changed into gowns. Female patients were questioned regarding pregnancy. Adequate hydration was ensured.

Contrast Administration

Intravenous iodinated contrast was administered at **2 mL/kg for adults** and **1–1.2 mL/kg for pediatric patients**, using 3 mL/s injection rate for adults and 1.5 mL/s for children. A 20G cannula was used for adults; 22–24G for pediatric patients.

Patient Positioning

Patients were scanned in the supine position with arms raised to minimize artifacts. The liver was centered appropriately within the scan field.

CT Technique

CT was performed using a **GE Optima 128-slice scanner**. A scout image was followed by thin-slice (2–3 mm) helical acquisition with soft-tissue reconstruction. Multiphasic imaging included:

- **Non-contrast phase**
- **Arterial phase (20–30 sec)**
- **Portal venous phase (60–70 sec)**
- **Delayed phase (2–3 min)**

Bolus tracking was used for precise arterial timing. Multiplanar reformations (axial, coronal, sagittal) enhanced the assessment of vascular structures and tumor margins.

Image Analysis

Radiologists evaluated enhancement patterns across all phases, focusing on arterial hyperen hancement and delayed washout typical of HCC. Lesion size, number, location, vascular involvement, and evidence of metastasis were recorded. Prior imaging was reviewed for staging and disease progression.

Ethical Considerations

Written informed consent was obtained from all participants. Radiation exposure was minimized, and pregnant patients were excluded from CT. Renal function and allergy history were assessed to reduce contrast-related risks. MRI contraindications such as metallic implants and severe claustrophobia, were screened. Patient comfort and data confidentiality were strictly maintained. Fair and unbiased patient selection ensured ethical conduct of the study.

RESULTS:

A total of 40 patients were included in this study. Twenty underwent CT and twenty underwent MRI for the diagnosis of hepatocellular carcinoma (HCC). The patients' ages ranged from 10 to 90 years, with males making up 57.5% and females 42.5%. Among all patients, 62.5% of females and 41.7% of males were hepatitis positive in the CT group. For the MRI group, hepatitis showed up in

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77.8% of women and 72.7 % of men. The study found no strong association between gender and hepatitis or between hepatitis and lesion size in either group. A higher percentage of patients with a history of alcohol use also had detectable lesions on both modalities.

In terms of clinical presentation, abdominal pain was frequent complaint, reported in 92.5% of patients across both groups. Other associated symptoms included ascites, liver enlargement and jaundice, with variable distribution. MRI demonstrated a higher diagnostic rate in identifying small lesions (<2mm). Detected them in 55.6% of cases compared to only 18.8% on CT. It also showed greater visualization of findings like arterial phase hyperenhancement and a washout effect. While an important role in HCC detection was played by both modalities, it was proved by MRI to be more effective in early diagnosis, whereas CT was found to be faster and easier to access. Overall, better diagnostic accuracy (~82%) was shown by MRI compared to CT (~57%).

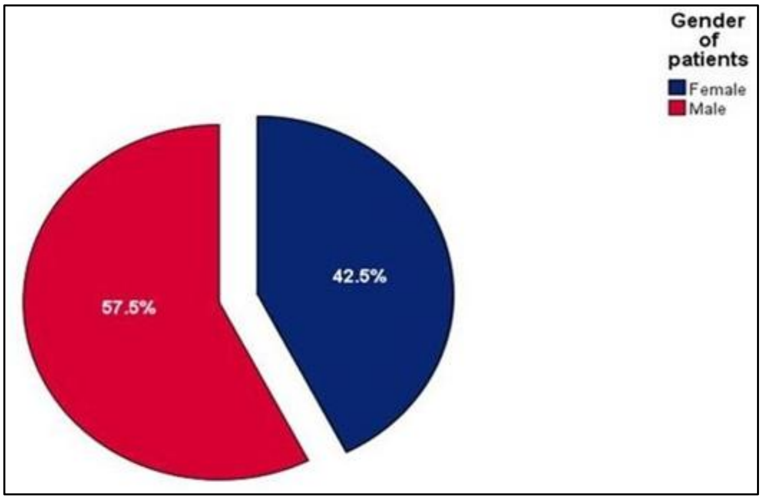

Figure 1: Distribution of patients Gender

The gender distribution of patients is demonstrated in the pie chart. Male patients represent the majority, with a percentage of 57.5; Female patients are 42.5%.

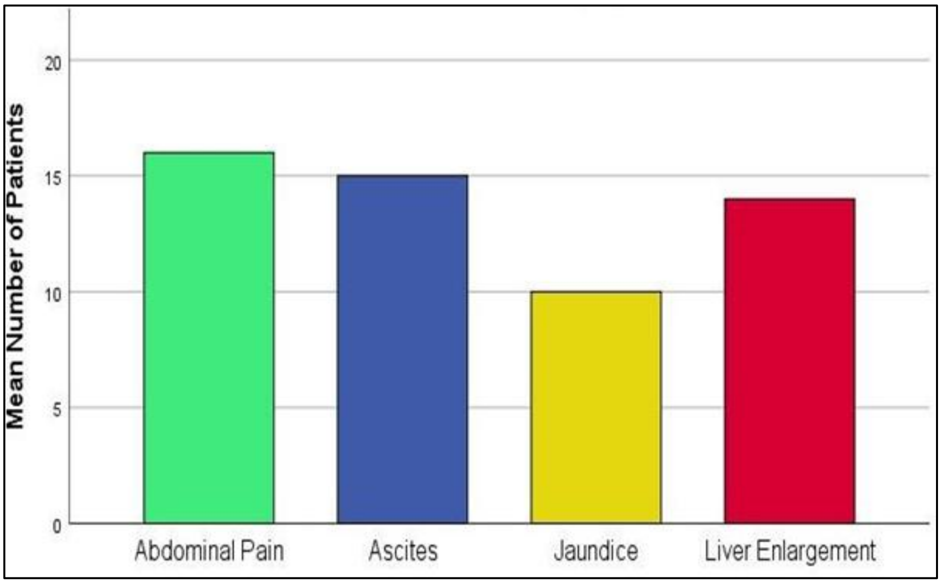

Figure 2: Number of patients underwent MRI experiencing different symptoms Abdominal Pain, Ascites, Jaundice, and Liver Enlargement.

The number of patients with certain symptoms is shown graphically in the bar graph. ―Abdominal Pain‖ has the highest average of patients among the presented symptoms, followed by ―Ascites.‖ ―Liver Enlargement‖ also suggests a large number of patients, and those who underwent MRI for ―Jaundice‖ are the least.

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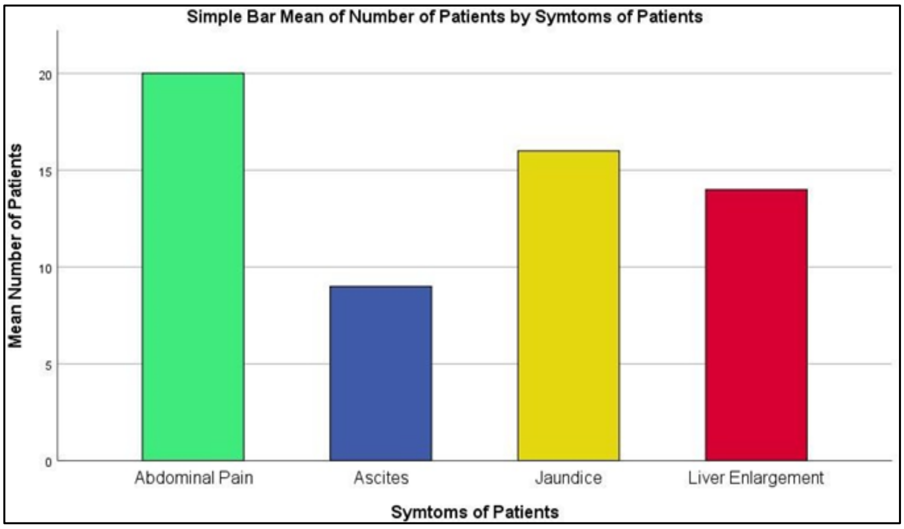

Figure 3: Number of patients underwent CT experiencing different symptoms: Abdominal Pain, Ascites, Jaundice, and Liver Enlargement

The average number of patients who underwent CT scan with certain symptoms is shown on the bar graph. The highest mean number of patients who underwent CT among the group which had symptoms is ―Abdominal Pain‖ which suggests that abdominal pain is the most frequent symptom. ―Jaundice‖ is the second most common symptom, then ―Liver Enlargement‖. Ascites is apparently the least symptom.

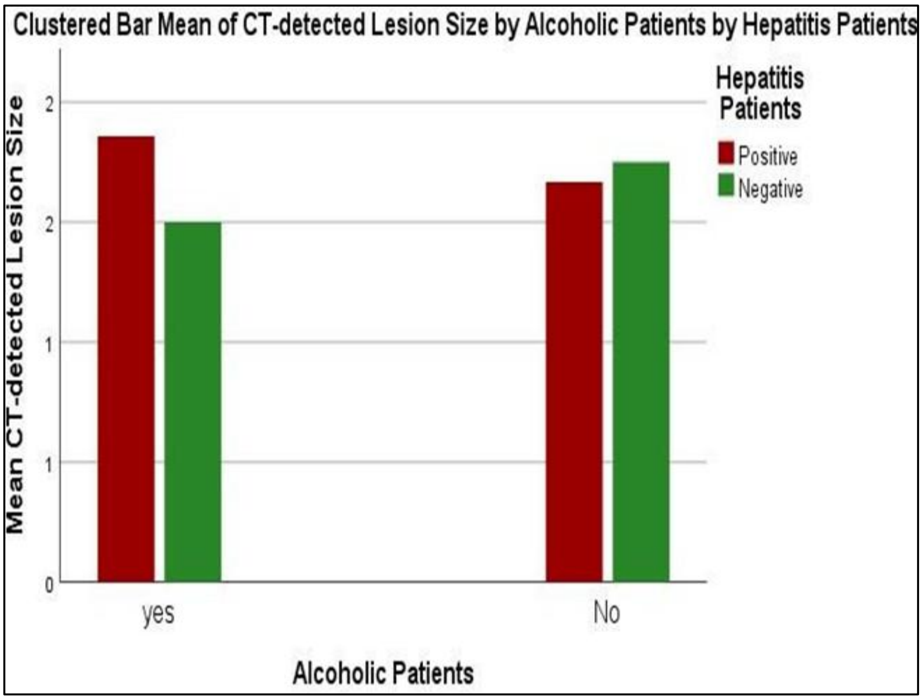

Figure 4: CT-Detected Lesion Size by Alcoholic Patients and Hepatitis Patients.

The graph illustrates the CT-detected lesion sizes among patients categorized by alcohol consumption and hepatitis status. Among alcoholic patients, those with hepatitis show a higher mean lesion size compared to those without hepatitis. In contrast, among non-alcoholic patients, those without hepatitis exhibit slightly larger lesion sizes than those with hepatitis. Unlike MRI findings, CT results show less pronounced variation based on hepatitis status among non-alcoholic patients. Overall, alcoholic patients with hepatitis tend to have larger lesions on CT compared to other groups, suggesting a potential combined impact of both risk factors on lesion development.

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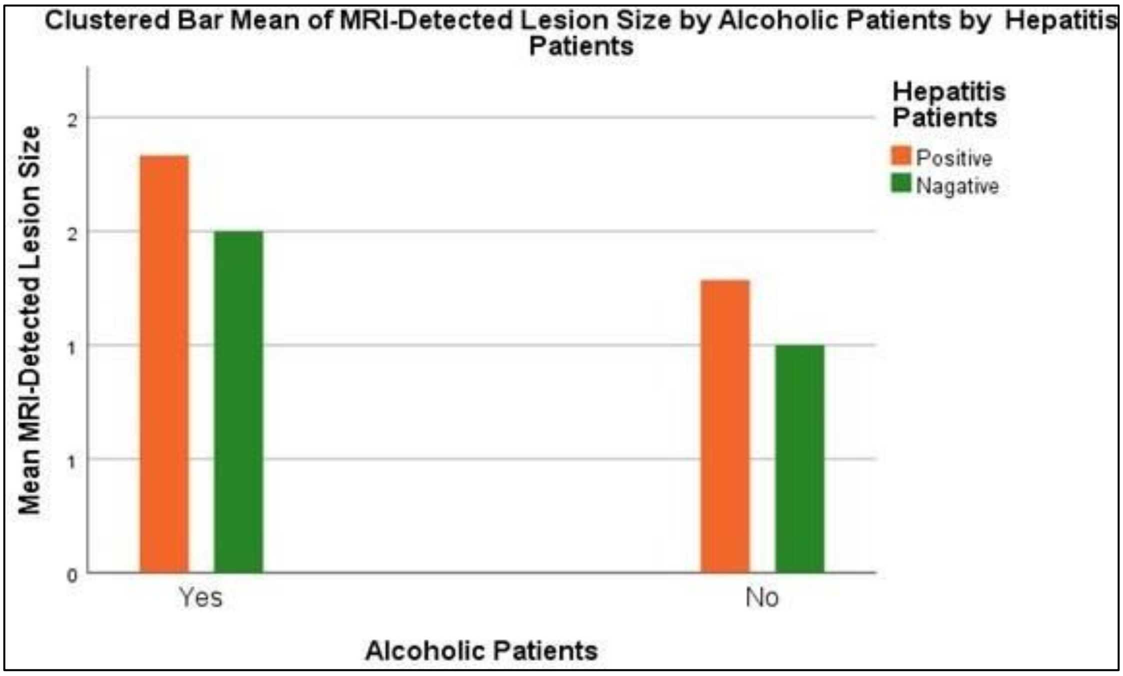

Figure 5: Clustered Bar Mean of MRI-Detected Lesion Size by Alcoholic Patients and Hepatitis Patients.

The MRI-detected lesion size is plotted against alcohol consumption and hepatitis status. For ―Alcoholic Patients‖ (Yes), the average lesion size, in patients is significantly higher in ―Hepatitis Positive‖ patients as compared to ―Hepatitis Negative‖ patients. In addition, within 'Non-Alcoholic Patients' (No), _Hepatitis Positive' cases have a higher mean lesion size than _Hepatitis Negative' cases, but non-alcoholic cases have smaller lesion sizes than alcoholic ones, regardless of hepatitis status. Both in alcoholic and in non-alcoholic subjects, MRI-measured lesion sizes are significantly larger in hepatitis positive subjects.

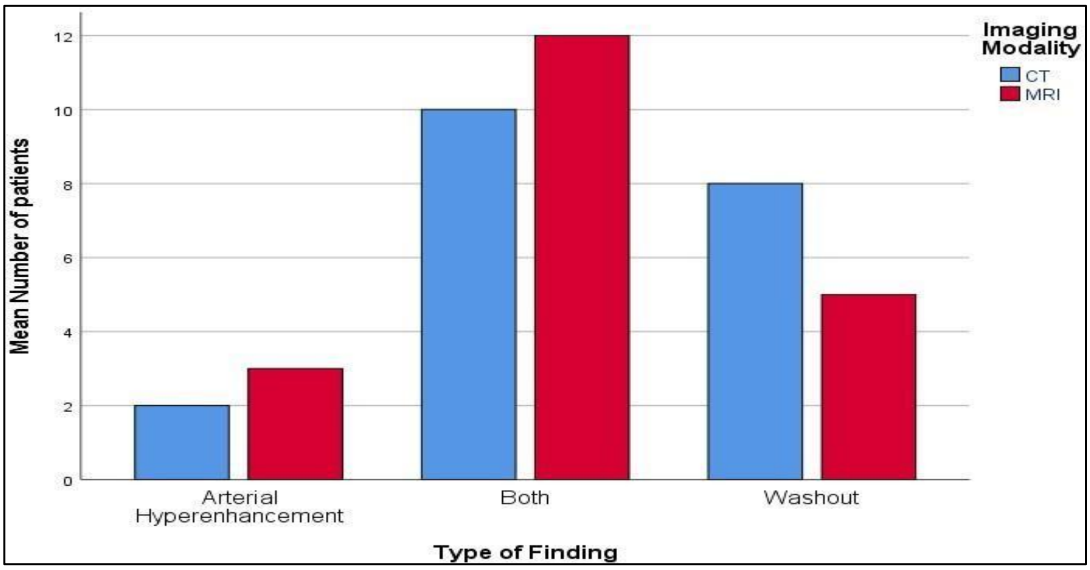

Figure 6: Comparative analysis of imaging modalities (CT vs. MRI) across different types of findings

The clustered bar graph depicts the number of patients per 3 findings categories such as _Arterial Hyperenhancement', _Both' and _Washout', by CT, and MRI examination. For ―Arterial Hyperenhancement‖, MRI has a higher number of patients than CT. For the ―Both‖ category, that is, findings seen by both modalities, MRI also has a higher number of patients than CT, showing that and there were more patients with findings detected by both modalities when in MRI. In contrast to ―Washout‖ findings, the number of patients identified by CT was higher than that by MRI. This indicates that CT and MRI perform differently according to specific imaging finding.

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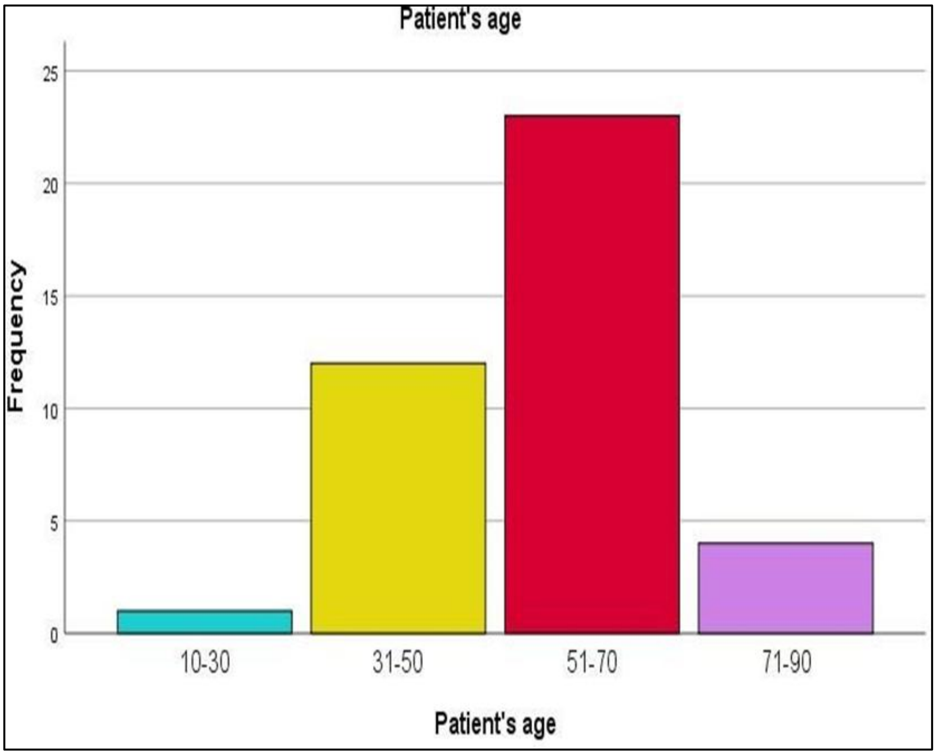

Figure 7: Distribution of patient ages**.**

The bar chart shows the distribution of patients in different age. Most common age group is ―51-70‖ years (n = 23). The 31-50 year group is in the subsequent position, with 12 patients. The under frequency appears in ―71-90‖ (about 4 patients) and to a lesser extent in ―10-30‖ (about 1 patient). This means that most of the patients are aged on the higher scale, from 51 to 70 years.

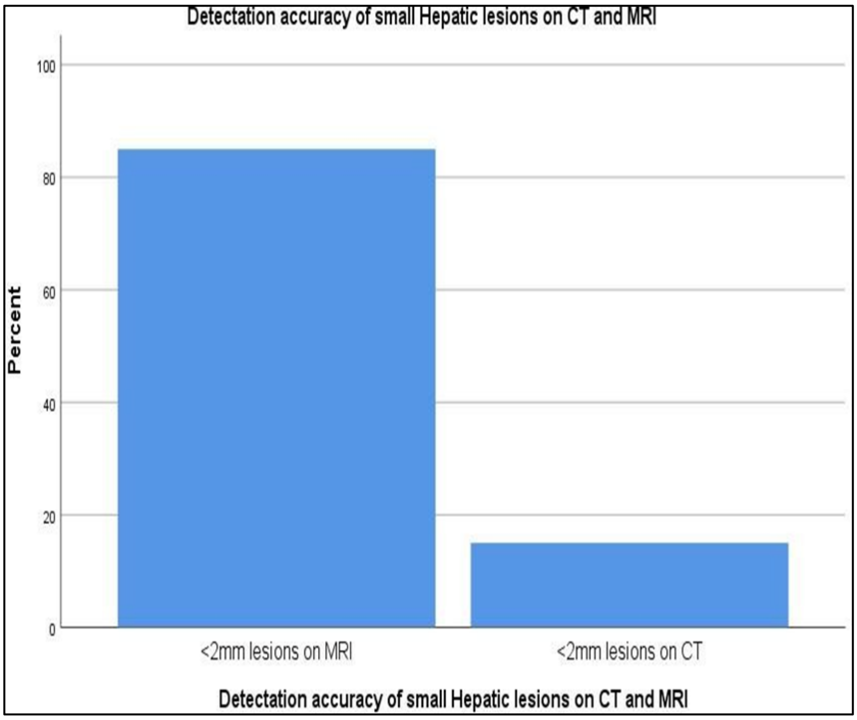

Figure 8: Detection accuracy of small Hepatic lesions on CT and MRI.

The bar graph indicates the gap in detection accuracy on small hepatic lesions (<2mm) between MRI and CT scans. From the bar graph it can be seen that MRI has much better detection performance for small (diameter <2mm) liver lesions than CT, with the detection accuracy of MRI far higher than CT.

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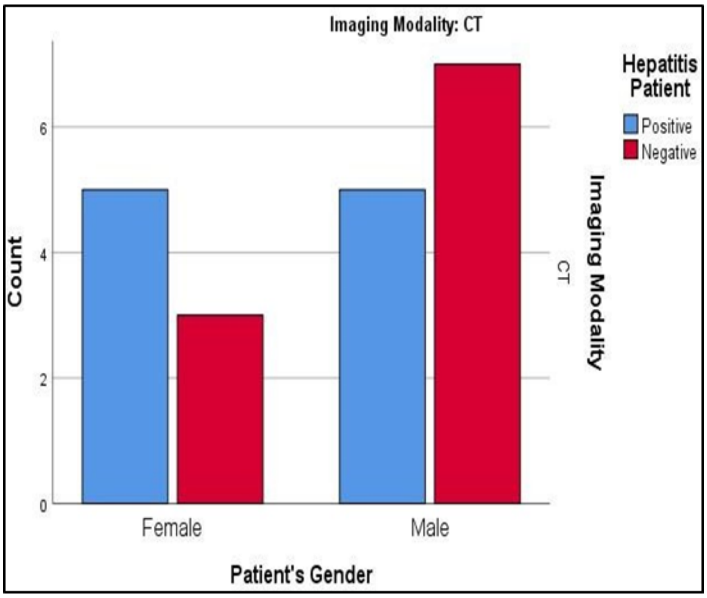

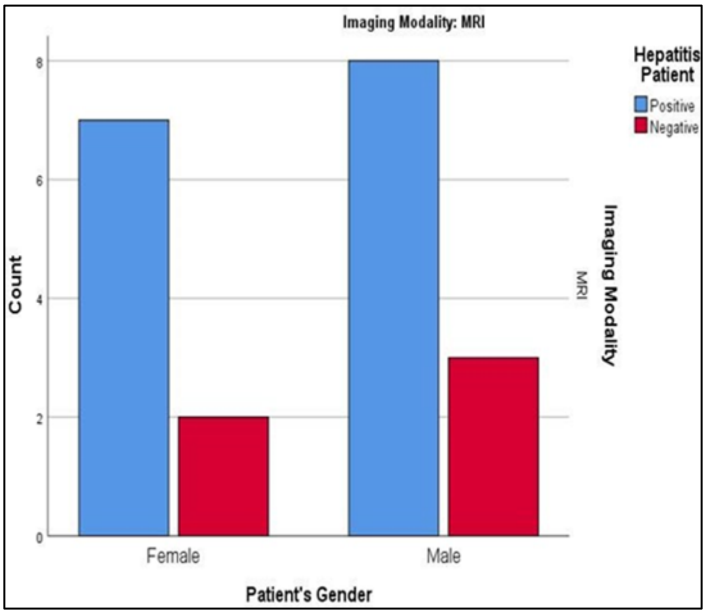

Figure 9: Distribution of Hepatitis Patients (Positive/Negative) by Gender, Stratified by Imaging Modality (CT vs. MRI).

A‖ Graph displays the sex distribution of hepatitis patients diagnosed with CT. More females are positive for hepatitis than negative. In males, the prevalence of hepatitis among the patients with hepatitis is much higher than the value obtained by CT, while opposite is true, among female patients. —B‖ Graph shows the gender distribution of hepatitis patients in MRI. Like for CT, in women there are more hepatitis-positives than -negatives. In males, the number of hepatitis-positive to negative patients is also larger from MRI, but the values might not be the same as in the CT curve.

Table 1: Comparison of Diagnostic Accuracy between CT and MRI in Detecting HCC

arameter	**CT**	**MRI**	**Conclusion**
Sensitivity (%)	~68–77%	~85–95%	MRI is more sensitive in detecting HCC
Lesion < 2mm Detection (early HCC)	Only 3/16 cases detected (18.8%)	10/18 cases (55.6%) were <2mm	MRI is more effective in detecting early-stage lesions.
Arterial Phase Hyperenhancement	Found in **70–75%** of CT cases	Found in **90–95%** of	MRI detects APHE more clearly.

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		MRI cases	
Washout Appearance	Seen in majority (60–70%)	Seen in ~85–90% of MRI cases	MRI provides clearer washout contrast.
Motion Artifacts / Image Quality	Less affected	Affected if patient cannot hold breath	CT is faster; MRI is superior if motion minimized
Radiation Exposure	Yes (ionizing radiation)	None	MRI is safer for long- term surveillance.
Contrast Agent Risk	Iodinated (renal risk)	Gadolinium (safer but not risk-free)	MRI has lower nephrotoxicity
Detection in Cirrhotic Liver	Good, but limited for small lesions	Excellent with hepatobiliary phase	MRI better in cirrhotic background
Scan Time	5-10 minutes	20-25 minutes	CT is faster; preferred in emergency settings.
Availability & Cost	Widely available, lower cost	Limited, more expensive	CT is more accessible; MRI offers higher diagnostic value.
Overall Diagnostic Accuracy (%)	~57%	~82%	MRI has higher overall diagnostic performance

DISCUSSION

A cross-sectional study of 40 patients, who suffered from hepatocellular carcinoma, underwent CT (a GE Optima scanner 128 × 128 slices) and MRI (a 1.5 Tesla GE Signa machine) in the radiology department of Allied Hospital Faisalabad. Both male and females was included with an age range between 14 years to 86 years. The goal of this study was to evaluate and compare the diagnostic accuracy of Computed Tomography and Magnetic Resonance Imaging in the detection of HCC. Our results show that MRI performs better at diagnosing early stage HCC, and gives detailed characterization of HCC lesions.

One of the most critical and unexpected findings in this study was the considerable difference in the detection of small HCC lesions between MRI and CT. MRI detected 55.6% of such lesions, while CT identified only 18.8%. This difference is clinically significant. Early detection is essential for improving survival outcomes in HCC patients. Small lesions often go unnoticed. As they are asymptomatic and have subtle imaging features. Our study shows the high performance of MRI in detecting early-stage HCC and aligns with several recent studies, including (19), which reported MRI sensitivity rates above 80% for small lesions. But our findings don't quite match what (Lertpipopmetha *et al.*, 2016), found, they reported higher sensitivity for multiphasic CT in small HCCs. This discrepancy might be due to different scan tech, methods, or types of patients in the studies.

MRI performed better overall but our findings did not establish a statistically strong relationship between lesion size and common risk factors such as hepatitis and alcohol use. Although literature such as (Wang, G. et al., 2019) suggests a clear association between HCC progression and these risk factors. Our analysis did not find strong correlations possibly due to relatively small sample size or the cross-sectional nature of the data. Even so, we noticed a pattern: patients with a history of alcohol use or hepatitis often had larger lesions size. This is clinically consistent with earlier epidemiological studies and highlights the importance of routine screening in these populations.

Furthermore, gender-based trends in HCC prevalence were consistent with existing research. More men were found to have hepatitis-related HCC than women. This reflects broader epidemiological patterns noted by (Zech, C. J. *et al.*, 2009).

They pointed out that men face a higher rate of HCC because they have greater exposure to risk factors like alcohol, chronic liver disease and occupational hazards. These patterns, although not statistically significant in our study, carry critical implications for designing gender-specific surveillance strategies.

In terms of diagnostic efficiency, CT was notably quicker and easier to use in emergency settings, with a shorter scan time of 5–10 minutes compared to MRI's 20–25 minutes. CT is widely available and lower cost continues to make it the first-line

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imaging modality in many clinical settings. Though, its lower soft tissue contrast resolution and the use of ionizing radiation remain limitations, especially in patients requiring long-term surveillance. MRI costs more and is less accessible, but it produces clearer images and better soft tissue differentiation while avoiding radiation. Fewer nephrotoxicity issues were also resulted from the use of gadolinium contrast agents in MRI compared to iodinated contrast agents used in CT. These findings are in line with the conclusions drawn by (Zucman-Rossi, J. 2010), who collectively emphasized MRI‘s advantages in functional imaging and lesion characterization.

One strong point of this study lies in how it compares CT and MRI side by side in an actual hospital setting while following standard imaging guidelines. Many earlier studies used retrospective data. However, this research collected prospective data, thereby strengthening its internal validity. Including factors like hepatitis status, alcohol consumption and gender allowed for a more holistic view of diagnostic accuracy in different subgroups. These clinical details provided added context to the imaging results and highlighted the real-life difficulties of making diagnoses.

The study does face some important drawbacks. A small group of 40 patients included, which makes limits the generalizability of the results and reduces the statistical power of subgroup analyses. Another limitation is the lack of histopathological confirmation. Tissue sampling such as biopsy or surgical tests is still the gold standard to confirm HCC when imaging features are inconclusive. Even though the imaging results were reviewed, not including tissue analysis leaves a gap. Third, the study was conducted in a single tertiary care center, which may not represent broader patient populations or imaging practices in different settings.

This study lays groundwork to explore new areas in research and clinical use. Larger multicenter studies with diverse populations are necessary to validate these findings and boost the reliability of data. Adding histopathological proof to imaging results could help make diagnoses more accurate . Moreover, advances in imaging technology, such as dual-energy CT, artificial intelligence-assisted MRI interpretation and the integration of radiomics, hold promise for enhancing early HCC detection even further. Policymakers should work to expand MRI access in public hospitals particularly in areas with high rates of HCC. To detect cases earlier and improve care. Testing ways to combine the speed of CT scans with the precise sensitivity of MRI might create a better and more efficient way to diagnose hepatocellular carcinoma.

CONCLUSION

This study concluded that MRI is the gold standard imaging modality for the early and accurate diagnosis of hepatocellular carcinoma, particularly in patients with cirrhosis or risks factors like hepatitis and alcohol use. Its superiority in detecting arterial phase hyperenhancement, washout appearance, and small lesion size makes it invaluable for surveillance and staging. CT scan still plays a key role due to its speed, cost-effectiveness and easier availability. But they have less sensitivity and specificity than MRI for liver assessment. To manage HCC in high-risk individuals, MRI should be considered the imaging modality of choice whenever feasible.

The limitations of this was Sample and time constraints (short duration, small sample, single center), Diagnostic limitations (no histopathological confirmation) and Practical and economic limitations (MRI cost and lack of cost-effectiveness analysis).

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