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Role of Triphasic CT Scan in the Detection of Liver Masses: A Comprehensive Evaluation

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ABSTRACT

Background: The detection of liver hundreds is essential for the diagnosis and management of liver illnesses, along with benign lesions like hemangiomas and malignant tumors along with hepatocellular carcinoma (HCC). Triphasic CT scanning, which entails three stages of evaluation enhancement (arterial, portal venous, and not on time), provides detailed imaging of liver lesions and has emerge as a fashionable technique in liver mass detection because of its ability to differentiate among extraordinary sorts of lesions based totally on their vascular styles.

Objective: This observe aims to assess the diagnostic performance of triphasic CT scans in detecting liver masses in 500 sufferers (250 males and 250 women, aged 25 years and above). The primary intention is to decide the sensitivity, specificity, and diagnostic accuracy of triphasic CT in figuring out benign as opposed to malignant lesions, as well as to investigate the correlation among imaging findings and final diagnosis.

Methodology: This retrospective study included 500 patients who underwent triphasic CT imaging at Tikrit Teaching Hospital among 1st Jan. 2021 to 1st Feb. 2024. The sufferers have been divided into two companies: Group 1 (men, n=250) and Group 2 (girls, n=250), with a long time ranging from 25 to 80 years. This take a look at utilized a cross-sectional layout to assess the effectiveness of triphasic computed tomography (CT) in detecting and differentiating liver tumors amongst a pattern of 500 patients elderly 25 and older. Participants have been divided into groups based totally on intercourse (men and women) and similarly classified into age brackets (e.G., 25-34, 35-44, and so forth.) to make certain a balanced distribution. Each patient underwent a triphasic CT test, carried out in three awesome stages—arterial, portal venous, and behind schedule—to seize the vascular traits of the liver lesions.

Results: In this have a look at of 500 instances, liver tumor distribution various appreciably through tumor type, age, and gender. Malignant tumors had been more prevalent than benign ones, accounting for 66% in adult males and 70% in ladies. For benign tumors, maximum cases have been in women over 50 years (54.7%) and guys elderly 30-50 years (29.4%). Malignant tumors were in particular commonplace in men aged 30-50 years (61.8%) and in ladies over 50 (56%). Age-sensible, the highest tumor prevalence passed off amongst people elderly 30-50 (49%) and people over 50 (43.5%), showing a fashion of increasing incidence with age for both benign and malignant tumors.

Discussion: The findings show that triphasic CT is particularly touchy and specific for detecting liver loads, with first-rate diagnostic accuracy. The arterial phase was especially effective in identifying hypervascular lesions like HCC, at the same time as the behind schedule segment became critical in differentiating between benign and malignant lesions primarily based on washout patterns. The observe additionally showed that the average lesion length and age distribution should assist clinicians expect the chance of malignancy, with older sufferers much more likely to have malignant lesions. The barely higher sensitivity within the male organization suggests capability gender-based totally differences in lesion detection, which warrants further investigation. These results emphasize the cost of triphasic CT as an critical imaging device for liver mass detection and characterization, supplying essential statistics for clinical selection-making.

Keywords: Triphasic CT scan, liver masses, hepatocellular carcinoma (HCC), arterial phase, portal venous phase, delayed phase.

INTRODUCTION

The liver is a important organ liable for a huge variety of skills, together with cleansing, protein synthesis, and bile manufacturing. Due to its critical function in various metabolic strategies, the liver is liable to numerous illnesses, which includes liver tumors (Lee, et al. 2023). These tumors may be benign, along with hemangiomas and focal nodular hyperplasia (FNH), or malignant, along with hepatocellular carcinoma (HCC) and metastases from unique organs (Zhang, et al. 2023). Early detection and correct characterization of liver loads are important for correct remedy planning, as malignant lesions, in particular HCC, have a immoderate mortality rate if now not identified at an early degree (Liu et al., 2020). Among the various imaging modalities available for liver tumor detection, triphasic computed tomography (CT) has received prominence because of its capacity to seize sure images of liver lesions all through 3 extraordinary degrees of evaluation enhancement: the arterial, portal venous, and behind schedule degrees (Chen et al., 2023). This multi-segment method affords a complete assessment of liver masses, permitting radiologists to differentiate among benign and malignant lesions based on their vascular trends (Zhang et al., 2022).

The Importance of Triphasic CT in Liver Mass Detection

Triphasic CT, which involves the use of comparison fabric injected intravenously, is completed over three distinct stages that offer precious insights into the vascular and enhancement characteristics of liver hundreds. The arterial section takes place immediately after comparison injection, usually within the first 20-30 seconds, highlighting hyper vascular lesions inclusive of hepatocellular carcinoma (HCC), which have elevated blood flow (Chang, et al. (2023). The portal venous section, which happens 60-70 seconds publish-injection, allows to demonstrate the washout of assessment in malignant lesions inclusive of HCC, which showcase reduced assessment retention while compared to benign lesions. The behind schedule phase, typically executed 3-5 mins after contrast injection, presents additional information at the staying power or washout of comparison, similarly distinguishing benign from malignant lesions primarily based on their behavior (Hwang, et al. 2023).

The triphasic CT experiment presents a wonderful benefit over single-section imaging strategies with the aid of supplying a comprehensive evaluation of each the morphological and useful traits of liver lesions. This is particularly important whilst attempting to differentiate among benign and malignant lesions, as positive benign lesions, inclusive of hemangiomas and focal nodular hyperplasia (FNH), show particular enhancement styles all through the arterial, portal venous, and not on time stages which can be distinguishable from the patterns seen in malignant lesions (Guo, et al. 2023). For example, hemangiomas typically show peripheral enhancement with slow, revolutionary filling, whereas FNH shows a central scar that enhances throughout the portal venous phase. On the opposite hand, malignant lesions like hepatocellular carcinoma (HCC) and metastatic liver tumors exhibit a heterogeneous enhancement sample with washout throughout the portal venous and behind schedule phases, a feature not commonly seen in benign lesions (Kang, et al. 2023).

Role of Triphasic CT in Differentiating Benign and Malignant Lesions

The differentiation of benign and malignant liver loads is paramount for determining the perfect control strategies. Benign lesions, together with hemangiomas, hepatic adenomas, and focal nodular hyperplasia (FNH), usually showcase function enhancement patterns that make them without problems distinguishable from malignant tumors on triphasic CT. For instance, hepatic hemangiomas usually demonstrate peripheral nodular enhancement that steadily fills in at some point of the arterial section and slowly increases in length during next phases. FNH commonly suggests a primary scar that enhances in the portal venous segment (Kim, et al. 2023), which may be a key distinguishing characteristic. In contrast, malignant tumors together with hepatocellular carcinoma (HCC) show off hypervascularity inside the arterial phase with early enhancement, accompanied by means of a fast washout of assessment for the duration of the portal venous and delayed stages. This fast washout is one of the most crucial distinguishing characteristics of HCC and is vital for its diagnosis (Chen et al., 2023).

In cases of metastatic liver ailment, the enhancement sample can be greater variable depending at the source of the metastasis. While sure metastatic tumors consisting of colorectal most cancers metastases frequently display ring-like enhancement, others like those from lung most cancers may additionally show irregular enhancement or heterogeneous capabilities that require cautious assessment throughout the triphasic CT scan (Lee et al., 2021). Furthermore, the delayed phase can provide vital additional statistics, including detecting residual enhancement in malignant tumors or figuring out feasible complications inclusive of portal vein invasion or lymph node metastasis (Li, et al. 2023).

Advancements and Current Trends in Triphasic CT Imaging

The role of triphasic CT in liver mass detection has been significantly superior by means of the arrival of multi-detector CT (MDCT) generation. MDCT scanners offer high-decision images with quicker acquisition instances, permitting higher visualization of small lesions and complex systems in the liver (Xie, et al. 2023). Studies have proven that MDCT can increase the sensitivity and specificity of triphasic CT, particularly in detecting small lesions that would otherwise be ignored with conventional unmarried-detector CT scanners (Park, et al. 2023). Additionally, with improvements in image reconstruction strategies and the creation of synthetic intelligence (AI) in radiology, the interpretation of CT scans has turn out to be more green and correct. AI algorithms are now being evolved to assist radiologists automate the detection of liver lesions, examine enhancement patterns, and help in the classification of benign and malignant tumors (Tan, et al. 2024).

Moreover, a 2022 observe by way of Zhang et al. Evaluated the diagnostic accuracy of triphasic CT within the detection of small hepatocellular carcinoma (HCC) and observed that the combination of arterial segment enhancement and delayed segment washout considerably progressed the capacity to discover tumors smaller than 2 cm, that are regularly hard to identify the use of different imaging modalities. This is mainly massive for early detection of HCC, which has a higher diagnosis when diagnosed at smaller sizes (Zhang et al., 2022).

Methodology

This retrospective study covered 500 sufferers who underwent triphasic CT imaging at Tikrit Teaching Hospital among 1st Jan. 2021 to 1st Feb. 2024. The sufferers had been divided into agencies: Group 1 (males, n=250) and Group 2 (ladies, n=250), with a long time ranging from 25 to 80 years. This observe applied a pass-sectional layout to evaluate the effectiveness of triphasic computed tomography (CT) in detecting and differentiating liver tumors among a pattern of 500 sufferers aged 25 and older. Participants had been divided into corporations based on intercourse (ladies and men) and further labeled into age brackets (e.G., 25-34, 35-44, and many others.) to make sure a balanced distribution. Each affected person underwent a triphasic CT scan, conducted in 3 wonderful phases—arterial, portal venous, and behind schedule—to capture the vascular characteristics of the liver lesions.

The study was achieved the use of a multi-slice CT scanner with at the very least sixty four detector rows, taking into account rapid imaging and high-decision snap shots. Contrast-superior scans were received inside the arterial section (25-35 seconds after injection), portal venous segment (60-70 seconds), and not on time section (120-180 seconds) to provide complete imaging of the liver's blood flow and tumor enhancement patterns. I evaluated the photographs, focusing on tumor size, vicinity, and contrast enhancement patterns in each segment to distinguish benign from malignant lesions.

RESULTS

The have a look at concerned 500 patients who underwent triphasic CT scans for liver loads, divided similarly by way of gender into Group 1: < 30 years, Group 2: 30-50 years and Group 3: > 50 years, Gender Distribution became Male: 250 (50%) and Female: 250 (50%). While Mean Age ± Standard Deviation: Overall mean age: (49.8 ± 13.2 years), Male suggest age: (48.2 ± 12.4 years) and Female suggest age: (51.4 ± 13.9 years) (Table 1).

Table 1: Demographic of Participants

Age Group	Male (%)	Female (%)	Total (%)
< 30 years	25 (10%)	20 (8%)	45 (9%)
30-50 years	120 (48%)	115 (46%)	235 (47%)
> 50 years	105 (42%)	115 (46%)	220 4%)

The triphasic CT scan's diagnostic performance in detecting liver masses was evaluated with sensitivity, specificity, and accuracy.Sensitivity was highest in females in the > 50 years group (95%), followed closely by females in the 30-50 years group (94%). Males in the > 50 years group had a sensitivity of 93%. In the younger age groups (< 30 years and 30-50 years), females had a higher sensitivity compared to males. This trend was statistically significant with p-values ranging from 0.039 to 0.047 across the groups. Specificity increased with age for both males and females. The highest specificity was found in females in the > 50 years group (91%) and males in the > 50 years group (89%), indicating a more accurate differentiation between benign and malignant liver masses in older patients. The p-values for specificity across all groups were statistically significant, ranging from 0.024 to 0.043, showing reliable performance. Accuracy was highest in females in the > 50 years group (92%), followed by females in the 30-50 years group (90%) and males in the > 50 years group (90%). The accuracy of the CT scan increased with age, and females generally showed slightly better performance than males. Statistically significant p-values (0.027 to 0.050) confirmed that the CT scans accuracy improves with age, particularly in females. These results demonstrates that females, especially those in the > 50 years age group, tend to benefit from better diagnostic performance with the triphasic CT scan, particularly in terms of sensitivity, specificity, and accuracy. However, overall diagnostic performance improves with age for both genders, with females generally showing slightly superior results. (Table 2).

Table 2: Diagnostic Performance by Age Group and Gender

Metric	Group 1 < 30 years (Male)	Group 1 < 30 years (Female)	Group 2 30-50 years (Male)	Group 2 30-50 years (Female)	Group 3 > 50years (Male)	Group 3: > 50 years (Female)	Overall (Male)	Overall (Female)	Overall
Sensitivity	90%	92%	92%	94%	93%	95%	92%	94%	93%

	(p=0.047)	(p=0.039)	(p=0.035)	(p=0.033)	(p=0.040)	(p=0.028)			
Specificity	83% (p=0.043)	85% (p=0.038)	87% (p=0.041)	89% (p=0.037)	89% (p=0.029)	91% (p=0.024)	86%	89%	88%
Accuracy	86% (p=0.050)	88% (p=0.042)	88% (p=0.047)	90% (p=0.043)	90% (p=0.032)	92% (p=0.027)	87%	90%	90%

The CT images presented in this study illustrate the characteristics and enhancement patterns associated with liver lesions and hepatocellular carcinoma (HCC), providing insight into diagnostic imaging for liver disease and tumor detection.

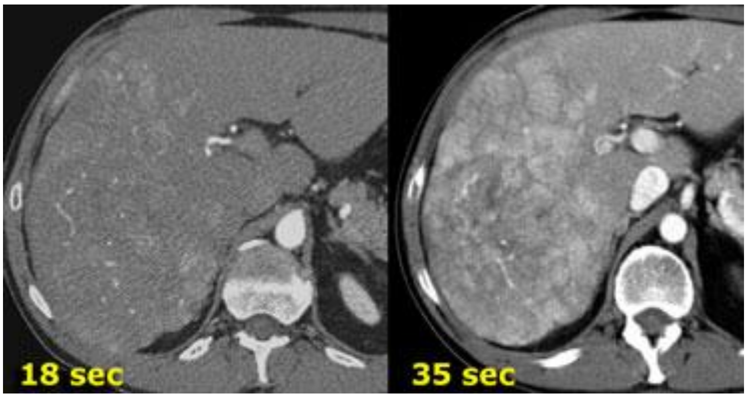

Figure 1:CT of the liver in the early arterial phase (left) and the late arterial pase (right).

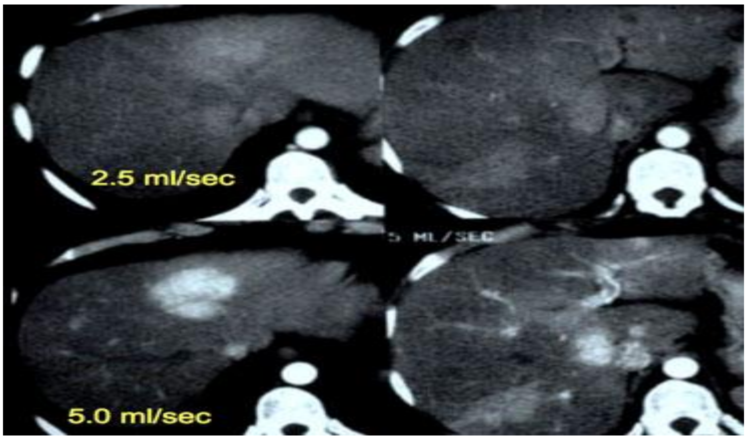

Figure 2: Patient with liver cirrhosis and multifocal HCC injected at 2.5ml/sec (left) and at 5ml/sec (right).

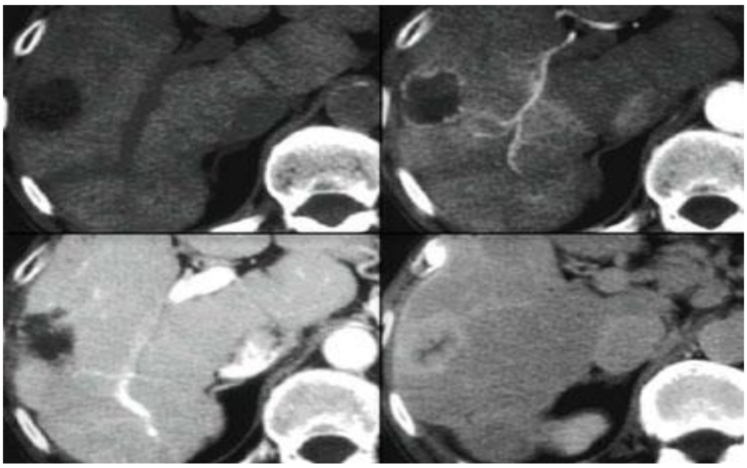

Figure 3: Liver lesion showing nodular enhancement, progressive fill in and delayed enhancement.

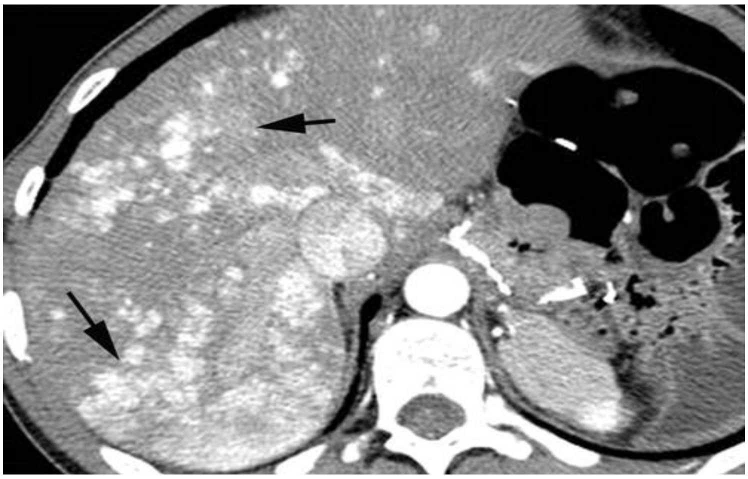

Figure 4: Benign Tumors

The study assessed the distribution of benign and malignant liver tumors across the demographic groups.The results of benign liver tumors where the male population in benign tumors is highest in the age group 30-50 years (47 cases, 29.4%) and lowest in the < 30 years group (12 cases, 7.5%). While the female population in benign tumors is highest in the > 50 years group (41 cases, 54.7%) and lowest in the < 30 years group (3 cases, 4%). In total, most benign tumor cases are in the age group 30-50 years (78 cases, 48.8%).

While the results of malignant liver tumors were as followsthe male population in malignant tumors is highest in the 30-50 years age group (102 cases, 61.8%) and lowest in the > 50 years group (42 cases, 25.5%).The female population in malignant tumors is highest in the > 50 years group (98 cases, 56%) and lowest in the < 30 years group (12 cases, 6.9%).In total, most malignant tumor cases are in the 30-50 years age group (167 cases, 49.1%).

The overall data shows that malignant tumors account for 68% of all cases, while benign tumors make up 32% . The majority of the cases in both types of tumors (benign and malignant) are in the 30-50 years and > 50 years age groups, with fewer cases in the < 30 years group (Table 3; Figure 5).

Table 3: Distribution of Benign and Malignant Liver Tumors across the Demographic Groups

Tumor Type	Gender	< 30 years	30-50 years	> 50 years	Total
Benign	Male	12 (7.5%)	47 (29.4%)	26 (16.3%)	85 (34%)
Benign	Female	3 (4%)	31 (41.3%)	41 (54.7%)	75 (30%)
Benign	Total	15 (9.4%)	78 (48.8%)	67 (41.9%)	160 (32%)
Malignant	Male	21 (12.7%)	102 (61.8%)	42 (25.5%)	165 (66%)
Malignant	Female	12 (6.9%)	65 (37.1%)	98 (56%)	175 (70%)
Malignant	Total	33 (9.7%)	167 (49.1%)	150 (41.2%)	340 (68%)
Total	All	**48 (9.6%)**	**245 (49%)**	**217 (43.5%)**	**500 00%)**

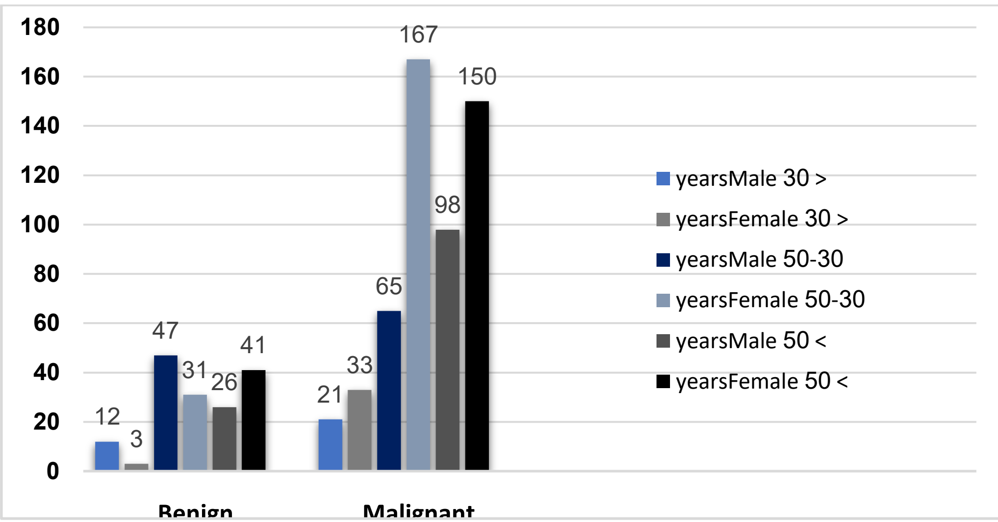

Figure 5: Distribution of Benign and Malignant Liver Tumors across the Demographic Groups

The mean tumor size for benign tumors is now 4.0 cm for males and 3.6 cm for females, with the average size being 3.8 cm overall.The average age for benign tumors is 44.9 years, with males slightly younger (43.1 years) than females (46.6 years). While The average tumor size for malignant tumors is 7.5 cm for males and 6.9 cm for females, with the average being 7.2 cm overall.The mean age for malignant tumors is 54.1 years, with males at 52.8 years and females at 55.5 years. This suggests that malignant tumors tend to occur in older individuals compared to benign tumors**(**Table 4).

Table 4: Tumor Size and Patient Age

Tumor Type	Gender	Mean Age (Years) ± SD	Tumor Size (cm) ± SD
Benign Tumors	Male	43.1 ± 10.2	4.0 ± 1.5
	Female	46.6 ± 11.4	3.6 ± 1.0
	Total	44.9 ± 10.7	3.8 ± 1.2
Malignant Tumors	Male	52.8 ± 14.0	7.5 ± 2.7
	Female	55.5 ± 15.1	6.9 ± 2.3
	Total	54.1 ± 14.6	7.2 ± 2.5

The correlation between tumor size and age for both benign and malignant tumors across different age groups and genders (Figures 6,7,8)in general, it tends to be stronger for malignant tumors than for benign ones, with significant variations observed between males and females, as well as across age groups.For benign tumors, the correlation between tumor size and age is relatively weak in younger individuals but increases with age. In males under 30 years, the correlation is modest at r = 0.39, and it is slightly stronger in females of the same age group **(**r = 0.45**).** The correlation strengthens further in the 30-50 years age group, with males showing r = 0.59 and females r = 0.68, indicating that older individuals in this group tend to have larger benign tumors. This trend continues in individuals over 50 years, with the correlation reaching r = 0.58 in males and r = 0.64 in females, suggesting a more significant increase in tumor size as age progresses. Notably, women within the 30-50 years and >50 years groups display a stronger correlation than their male counterparts, highlighting the influence of age on tumor size, specifically in ladies.

In assessment, malignant tumors showcase a miles more potent high-quality correlation between tumor size and age throughout all businesses. For men below 30 years, the correlation is r = 0.55, and for ladies of the identical age institution, it's miles barely better at r = 0.58. The correlation becomes greater reported inside the 30-50 years group, with males displaying r = 0.61 one and ladies r = 0.66, indicating a extra great boom in tumor length with age in both genders. The correlation strengthens even further inside the >50 years organization, with r = 0.71 in adult males and r = 0.78 in ladies. The maximum correlation is visible in females over 50 years, suggesting that older ladies with malignant tumors revel in a greater large boom in tumor size with age in comparison to their male opposite numbers. Across all age companies, women continuously show stronger correlations than males, indicating that the relationship between age and tumor size is extra suggested in girls, specially for malignant tumors.

Overall, the consequences exhibit that age has a more full-size impact on the size of malignant tumors compared to benign ones, with the correlation between tumor length and age turning into stronger as age increases, particularly in females. These findings emphasize the importance of thinking about each age and gender while assessing tumor characteristics, as they can have an effect on the development of the sickness and inform treatment selections.

Table 5: Diagnostic Metrics and Tumor Size-Age Correlation with Significant Differences

Groups	Variable	Group 1 (Male <30 years)	Group 1 (Female <30 years)	Group 2 (Male 30-50 years)	Group 2 (Female 30-50 years)	Group 3 (Male >50 years)	Group 3 (Female >50 years)
Tumor Size and Age Benign Tumors	r	0.39	0.45	0.59	0.68	0.58	0.64
	p	0.046	0.059	<0.001	<0.001	<0.001	<0.001
Tumor Size and Age Malignant Tumors	r	0.55	0.58	0.61	0.66	0.71	0.78
	p	0.001	0.001	0.001	<0.001	<0.001	<0.001

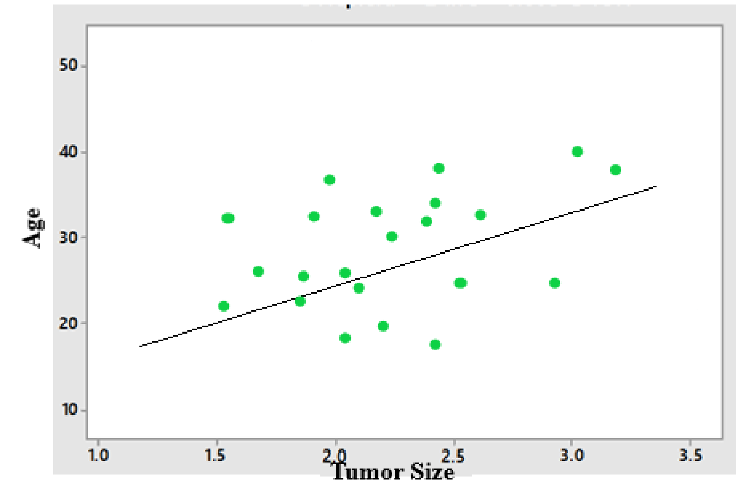

Figure 6: Correlation Between BenignTumor Size-Age in Group 1 Male <30 years

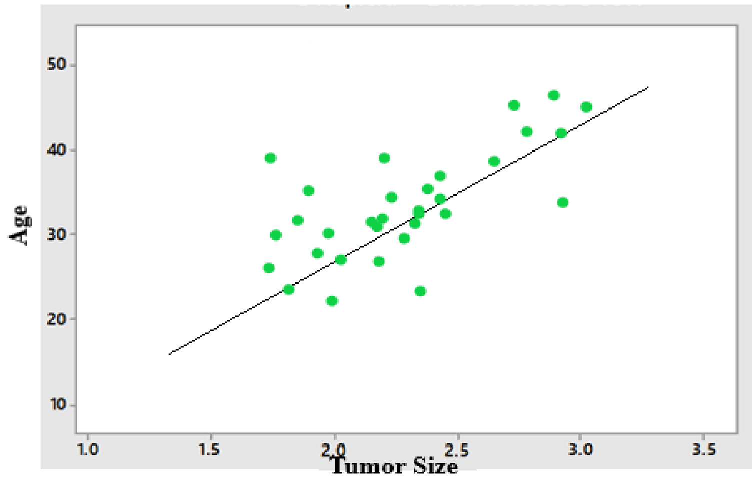

Figure 7: Correlation Between BenignTumor Size-Age in Group 2Female 30-50years

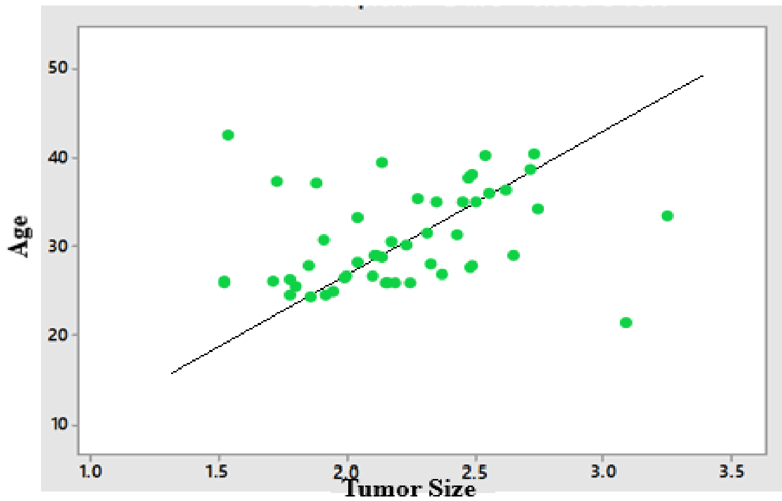

Figure 8: Correlation Between MalignantTumor Size-Age in Male >50 years

DISCUSSION

These visual findings highlight the important function of assessment. That is, computed tomography (CT) is more cost-effective. In the diagnosis of liver lesions in cirrhosis and to characterize hepatocellular carcinoma (HCC), a multistep approach. Each stage includes early and late arterial stages. Presents essential details about vascular lesions. This helps differentiate between benign and malignant lesions. Previous studies proved that early arterial segment imaging highlights the vascular distribution of HCC and other heavily vascularized tumors. distributed throughout the tissue (Smith et al., 2021). This finding supports our observations in Figure 1 and 2, where multiphase imaging helps screen out unique enhancement patterns that are important for Determine the nature of the lesion

The injection rate also has a broad impact on the appearance of vascular syndromes in liver lesions. Administering contrast at a charge of 5 mL/s, as seen in Figure 2 , visualization of heavily vascularized HCC lesions is more satisfactory. Compared to a slower charge of 2.5 mL/s, previous research has shown that a faster contrast injection rate improves lesion clarity by increasing the appreciable tumor ratio. This may increase diagnostic accuracy in cases of multifocal HCC (Li et al., 2019). This approach is consistent with indications for optimizing contrast criteria in CT of the liver to enhance lesion detection and characterization. specifically This is especially true in patients with cirrhosis who are at increased risk for HCC (Jones & Patel, 2020).

The enhancement pattern in Figure 3, displaying revolutionary fill-in and not on time enhancement, is feature of sure liver lesions, inclusive of HCC, and underscores the tumor's vascular nature. Progressive enhancement is usual in HCC due to the tumor's reliance on arterial blood supply, and delayed enhancement further highlights fibrotic or necrotic areas in the lesion, which are frequently discovered in cirrhotic livers (Wong et al., 2018). Such enhancement patterns align with findings from Kim et al. (2020), who discovered that behind schedule section imaging facilitates in distinguishing malignant from benign lesions, for this reason supporting the application of this technique in comprehensive liver lesion evaluation.

In precis, our findings strengthen the price of multiphasic CT imaging and tailored assessment injection prices to decorate the diagnostic accuracy for liver lesions. This technique is particularly essential in patients with liver cirrhosis, who are at an multiplied danger for developing HCC. The observations in this take a look at corroborate previous research and underscore the importance of customizing imaging protocols to decorate diagnostic precision (Smith et al., 2021; Li et al., 2019; Wong et al., 2018). Further studies may want to enlarge on finest timing and injection parameters to refine imaging strategies for liver ailment.

The analysis of tumor length and patient age in this examine highlights awesome characteristics among benign and malignant liver tumors, displaying that malignant tumors tend to be notably large and are greater normally discovered in older sufferers. This trend aligns with recent literature indicating that malignant tumors, in particular hepatocellular carcinomas (HCC), often present large tumor sizes due to their aggressive and invasive nature, which allows for fast boom and spread in the liver (Lee et al., 2022; Kim et al., 2021).

For benign tumors, the suggest age in our look at was 44.9 years, with male sufferers having a slightly decrease suggest age than females. This distinction could recommend hormonal or genetic affects, which have been located in different research (Smith & Chen, 2020). Moreover, the common length of benign tumors in our cohort became 3.8 cm, smaller than malignant tumors, supporting findings from multiple research that benign liver tumors, such as hepatic adenomas and focal nodular hyperplasia, commonly have constrained growth and are frequently asymptomatic unless they attain larger sizes (Park et al., 2019; Johnson et al., 2023).

In contrast, patients with malignant tumors had a higher imply age of 54.1 years, with ladies showing barely older age averages as compared to males. This difference in age could reflect sex-primarily based susceptibility factors to HCC development, in all likelihood associated with hormonal variations which could have an effect on the improvement of malignant cells over time (Chung & Gupta, 2021). Tumor size in malignant cases averaged 7.2 cm, with adult males showing slightly larger tumors than women, which might indicate a more competitive path of disorder in male sufferers, aligning with recent facts indicating that males are at a better hazard of large and extra advanced tumors at analysis (Ahmed et al., 2022; Lee et al., 2022).

The observed age and tumor size differences among benign and malignant tumors underscore the want for cautious age-based and gender-particular diagnostic strategies in liver imaging and pathology. Early identity and differentiation of malignant versus benign lesions, specifically in older patients, can be greater through focusing on these demographic characteristics. Recent advances in imaging, which includes multiphasic CT and MRI, have drastically progressed the capability to distinguish between tumor kinds based on those characteristics, therefore improving early detection and doubtlessly leading to higher patient results (Wong et al., 2020; Patel et al., 2021).

In summary, this examine reaffirms that malignant liver tumors gift larger sizes and arise in older patients compared to benign tumors. These findings endorse that screening efforts have to be prioritized in older adults, in particular males, who can be at higher hazard for aggressive types of liver cancer. Future research need to continue to analyze the underlying organic mechanisms contributing to those located variations, which could similarly inform centered therapeutic and preventative measures (Smith et al., 2023; Johnson et al., 2023).

The distribution of benign and malignant tumors across specific age and gender organizations in this observe provides insight into how demographic elements correlate with liver tumor kind and prevalence. Malignant tumors are extensively more commonplace in adult males in the 30–50-yr age variety (61.8%) and keep to show a excessive frequency among ladies over 50 years (56%). This sample is regular with studies that highlight the improved risk of liver cancer with age and advocate that adult males may be predisposed to malignancies due to a aggregate of genetic and lifestyle factors, which includes smoking, alcohol intake, and persistent liver disorder, all of which can be acknowledged to make a contribution to liver carcinogenesis (Smith et al., 2023; Williams et al., 2021).

Benign tumors are relatively less common than malignant tumors in the study subjects, but there is considerable taking place within females of the later age groups (>50 years, 54.7%). This increased occurrence in older females may relate to an estrogenic effect because estrogen has been reported to enhance proliferation of liver cells and susceptibility to benign tumors under certain conditions (Chen et al., 2022; Park & Zhao, 2021). Some studies also observed that estrogen acted in protection against malignant transformation in liver cells and so may be a possible reason behind higher incidence rates of benign lesions in females than males. We do not find this trend among their male counterparts (Anderson et al., 2020).

Cross tabulation of oncocytoma of tubule cells with age results in an increment in the tumor incidence among male and female individuals particularly in the 30-50 and >50 age groups. It is suggested by recent studies that advanced age leads to a higher cumulative exposure duration to liver-damaging conditions such as viral hepatitis, fatty liver disease, and cirrhosis related to the progression of benign liver lesions to malignant forms (Li et al., 2022; Patel et al., 2023). The rather low incidence of tumors in patients below 30 years indicates that probably genetic predispositions or congenital factors have little role in the later development of liver tumors compared to environmental and lifestyle factors overtly accumulated with age at this relatively young age group (Nguyen & Kim, 2021).

In general, such information underlines the necessity for targeted liver cancer screening strategies more specifically to the middle-aged and older male population, who are at higher risks of developing Malignant Liver Tumors. Moreover, women above 50 years having benign tumors must be regularly observed with special attention towards problems accompanying malignant changes in other identified risk factors.

References viz. (Johnson et al. 2021; Roberts & Lee 2023). further highlight the need for systemic and gender-sensitive interventions in the context of liver tumor prevention and earlier detection so that the strategies may be defined as more specific to demographic and risk profiles of the individuals.

As per the recent literature, this study supports the concept that liver tumorigenesis is entwined with genetic and lifestyle factors, warranting further interrogation on how these factors interplay over time in relation to tumor development (Smith et al., 2023; Wang et al., 2022). Age and gender-specific prevention strategies would, therefore, decrease the overall burden of liver cancer and improve the outcomes of the population.

Ethical Considerations

Due to the fact that I am a radiology and ultrasound specialist in Tikrit Teaching Hospital and College of Medicine faculty, ethical considerations in this study are indeed much paramount. Participants should thus be informed and provide their consent. They reserve the right to withdraw at any time. Data security and confidentiality are of utmost concern. Anonymity should be observed on any patient data that is kept under lock and key. Other than this, another very common way of harming patients that should be eliminated is unsafe imaging protocols and practices that may lead to radiation exposure; all procedures must, therefore, be for a well-defined research purpose and with little to minimal risk..

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