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# The Accuracy Of Ultrasonography And CT Scans In Diagnosing Liver Tumours

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***Abstract***.*Both benign and malignant liver tumours may occur. Multiple nodules or a single mass might be diffusely invasive. Our research diagnosed patients using CT scans and ultrasounds. We compared these strategies to determine which is better. A precise biopsy was performed on each tissue liver tumour to confirm the diagnosis of liver tumour. A 40 liver tumour patients were participated in this study included 24 men and 16 women. The average patient age was 52. The biopsy results were compared to CT and ultrasonography data for each subject. Ultrasonography resulted in 23 (57.5%) patients with malignant tumours and 9 (22.5) benign tumours, of which 8 (20%) were healthy. On the other hand, the CT scan results showed that 23 individuals (57.5%) had malignant tumours, and 17 (42.5%) had benign ones. These data suggest that CT scans are 100% more efficient than ultrasonography in identifying liver tumours.*

***Keywords:*** *Liver tumours, Ultrasonography, CT scans*

**Abstrak**.Tumor hati jinak dan ganas dapat terjadi. Nodul multipel atau satu massa mungkin bersifat invasif secara difus. Penelitian kami mendiagnosis pasien menggunakan CT scan dan USG. Kami membandingkan strategi ini untuk menentukan mana yang lebih baik. Biopsi yang tepat dilakukan pada setiap jaringan tumor hati untuk memastikan diagnosis tumor hati. Sebanyak 40 pasien tumor hati berpartisipasi dalam penelitian ini termasuk 24 pria dan 16 wanita. Usia rata-rata pasien adalah 52 tahun. Hasil biopsi dibandingkan dengan data CT dan ultrasonografi untuk setiap subjek. Ultrasonografi menghasilkan 23 (57,5%) pasien dengan tumor ganas dan 9 (22,5) pasien tumor jinak, dimana 8 (20%) diantaranya sehat. Sedangkan hasil CT scan menunjukkan 23 orang (57,5%) menderita tumor ganas, dan 17 orang (42,5%) menderita tumor jinak. Data ini menunjukkan bahwa CT scan 100% lebih efisien dibandingkan ultrasonografi dalam mengidentifikasi tumor hati.

**Kata Kunci:** Tumor hati, Ultrasonografi, CT scan

## 1. INTRODUCTION

The liver comprises a considerable portion of the abdomen's right-upper-quadrant (R. U. Q) behind the stomach diaphragm [1]. It is intraperitoneal from the 5th midclavicular intercostal gap to the right costal boundary. The diaphragm and inferior vena cava are in the superior posterior hepatic cavity. As the diaphragm reaches the visceral peritoneum at the coronary ligament's end, visceral fascia covers the liver [2]. Along the front, the falciform-ligament separates the liver into left and right. The falciform ligament's free-form borders hold the liver's round ligament, the embryonic umbilical vein's remnant. The liver has right, left, caudate, and quadrate lobes [3]. The ligamentum venosum, inferior vena cava, and porta hepatis define the caudate lobe's medial, posterior, and anterior borders. The embryonic ductus

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venosus remains as the ligamentum venosum. The quadrate lobe is anterior to the porta hepatis, lateral to the liver's round-ligament, and near the gallbladder. The liver's eight blood-flow-divided functional sub-divisions do not match these anatomic lobes [4]. The liver has functional lobules. Liver lobules are hexagonal hepatocyte clusters with a central venous spine [5]. A sinusoid membrane and thin fenestrated endothelium line the vascular space. Hepatocyte cords inside lobules have vascular gaps. Sinusoids house hepatic lipocytes Stellate and liver macrophages Kupffer. Portal triads, biliary duct, portal vein and hepatic- artery branches are at the hexagon's vertices. The portal vein and hepatic artery branches provide blood to a central vein. Blood flows to the main vein via the lobule [6]. The extremities of a rhomboid connect two central triads with major veins. Changed hepatocyte organisation. Using the portal acinus, liver functional zones are defined. Zone 1 hepatocytes oxidise energy around portal tracts. Near the main veins, zone 3 hepatocytes biotransform drugs. Zone 2 hepatocytes function inconsistently between zones 1 and 3 [7]. The liver shields us against GI-absorbed poisons—processing and metabolism in the lobules. Phase I operations are catabolised by the cytochrome- P-450 enzyme system, whereas phase- II events conjugate molecules with glucuronide, glutathione, and sulphate [8]. The liver is the most significant gland, absorbs nutrients and detoxifies drugs and other toxins [9]. It conducts endocrine and exocrine functions. The liver's exocrine function produces and excretes bile salts and bilirubin into the common hepatic duct [10]. The liver controls blood sugar via insulin and glucagon. Liver cells generate fibrinogen, albumin, prothrombin, and amino acids. Proteins are converted into enzymes and peptide hormones by the liver. In addition to fatty acid metabolism, the liver creates lipoproteins, cholesterol, and phospholipids. It also stores and synthesises glucose. Contributes to lactic acid metabolism and ammonia-derived urea. The liver stores vitamins and iron. The liver, a vital gut-blood mediator, metabolises exocrine, endocrine, macronutrient, hormone, and plasma components. Also important is liver function [11].

### 1.1 Role of Ultrasound and CT-Scan in Diagnosis of Liver Tumors

#### a. Ultrasound (US)

Ultrasonography (US) is noninvasive, real time imaging. Thus, it is the most common liver disease imaging modality. Hepatocellular Cancer (HCC) monitoring and characterisation need US. In-appropriated liver function and high recurrence characterise most HCC patients with liver cirrhosis (LC). In LC patients, early HCC detection is essential for effective treatment to limit damage and preserve liver function [12].

US can detect most small HCCs without contrast, unlike CT and MRI. Elderly people use CT and MRI contrast agents less due to renal function. The US is radiation-free due to its

frequent tests that may be done and also appropriate for HCC monitoring [13]. Contrast drugs improve US sensitivity and specificity for HCC malignancy grade assessment, which is critical for selecting a treatment [14]. In abdominal US, detection and characterisation assist diagnosis localised liver lesions. B-mode ultrasonography distinguishes HCC by tumour morphology, border and contour, margin, intratumoral and posterior echo [15]. Japan Society of Ultrasonics in Medicine (JSUM) Terminology and Diagnostic Criteria Committee HCC B-mode findings are in Table 1. This helps identify isolated liver lesions [16].

**Table 1.1 Features of Liver Tumours in Ultrasound [16].**

| Sub-type | Appearance | Border-Contour | Tumor Edge | Intra-tumour characteristics | Posterior Echo | Further Results |
|---|---|---|---|---|---|---|
| Nodular-type (≤ 2 cm) | Round/Roundish | Moderately well defined & smooth | Hypoechoic-peripheral zone (infrequent) | Various_echo levels (mosaic pattern is sometimes observed) | Unchanged–sometimes enhanced | Bright loop |
| Nodular type (> 2 cm) | Round/Roundish | Moderately well defined&Smooth | Thin hypoechoic_ peripheral zone (halo) | Mosaic pattern, nodule in nodule. (varies depending on the size and degree of differentiation) | Enhanced | |
| Massive_ type | Unclear shape | Poorly defined | | Various echo levels | | Lateral echo |

US HCC characteristics must also be understood. HCC internal echoes are mosaic (17–38%), hyperechoic (12–38%), or hypoechoic (23–54%) depending on tumour size [2–5]. HCCs under 10 mm exhibit almost hypoechoic or isoechoic interior echoes that rise with cell density. Multistep hepatocarcinogenesis often causes fatty change (36.4%) at 10–15 mm tumour diameters with hyperechoic internal echoes [7]. When an HCC is 20 mm or greater, US patterns, including “mosaic pattern,” “peripheral sonolucency (halo),” “lateral shadow,” and “posterior echo enhancement”, may be noticed [17]. Findings of “mosaic pattern,” “posterior echo enhancement,” and “lateral shadow” diagnosis HCC more accurately (≥70%) and specifically (≥90%) than metastatic liver cancer. US findings increase with tumour size. These US findings are rare in smaller HCCs. HCCs' thin fibrous capsules form the "halo sign" in Figures 1 a, b [18]. The sonographic halo sign matches the histological capsule by 90.1%. A linear US feature at the tumour's periphery, the "lateral shadow," demonstrates ultrasonic refraction between spherical tissue and surrounding tissue at varying speeds (Figures 1 c, d). Although ultrasonic beam intensity is preserved distal to the lesion, posterior

echo amplification occurs in any lesion that attenuates sound less than surrounding tissue [19]. Besides HCC, hemangiomas and cystic lesions have posterior echo amplification [20].

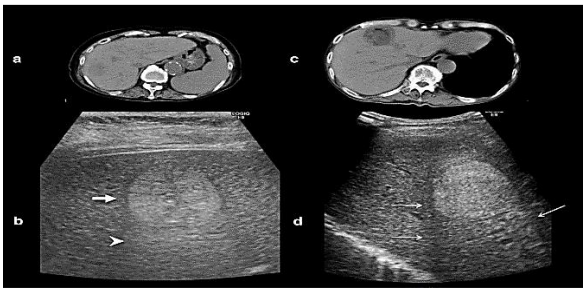


**Fig. 1.1 A patient has recently acquired hepatocellular carcinoma (HCC) in Segment 7, with a maximal diameter of 26 mm.**

A low attenuation region in Segment 7, a- is visualised on computed tomography (CT). The conventional ultrasound reveals a nodule with a mosaic pattern, posterior wall enhancement (shown by an arrowhead), and a halo image (indicated by a thick arrow) b. A patient with cirrhosis caused by the hepatitis C virus has acquired hepatocellular carcinoma (HCC) in Segment 4, c. The conventional ultrasonography reveals a nodule with a strong echo and a characteristic lateral shadow (shown by thin arrows) d [20].

Colour Doppler shows blood flow around a tumour and its direction. Colour Doppler identifies nutrient vessels and blood flow [21]. Power Doppler detects blood flow orthogonal to the ultrasonic beam or low flow velocity. Power Doppler increases detection sensitivity but not blood flow direction or velocity. Modern technology allows power Doppler to detect blood flow [22].

JSUM's TDCC [23] summaries Doppler HCC characteristics (Table 2). Most HCCs under 2 cm have lines or patches from limited blood flow. Colour Doppler shows afferent continuous waveform signals from small HCCs, suggesting feeding portal flow. Blood flow increases with 2 cm or bigger tumours. Moderately differentiated HCCs with capsules and expansive growth have basket-pattern blood flow. A delicate circulatory network surrounds the tumour nodule. Afferent pulsatile, intratumoral, and efferent continuous waveform signals are characteristic colour Doppler findings in advanced HCC (large type) [24].

**Table 1.2 Colored Doppler Characteristics [21-24].**

| Sub_type | Blood-flow | Vascularity | Blood flow characteristics | Further Results |
|---|---|---|---|---|
| Nodular_type (≤ 2 cm) | Low | Linear or dot like vascularity is seen inside and around the tumour in some cases | Steady, sometimes pulsating | In several cases, blood flow indications are not visible. |

| | | | | |
|---|---|---|---|---|
| Nodular_ type (> 2 cm) | High | Basket-pattern (vascular network from the periphery to the centre) | Pulsating, sometimes steady | A–P shunts and tumour emboli are seen in some cases |
| Massive-type | High | Irregular vascularity, basket_ pattern | Pulsating | When pulsating flow is observed in the portal vein, tumour emboli or A–P shunts are suspected |

**b. CT-Scan**

Modern CT scanners are fast and provide high-quality images. In the early 1980s, pharmacokinetic, hemodynamic, and technical ideas were well established [25]. Most centers don't follow them, yet they're legitimate. Controlling these principles is the only method to optimise contrast-enhanced CT. In the recent decade, several bolus or biphasic contrast injection strategies were devised to optimise contrast enhancement in the limited scanning window [26]. Take images before intravascular and extravascular contrast media concentrations balance following a single bolus. The use of dynamic CT scanners and a growing understanding of the shortcomings of our current scanning methods have rekindled the debate surrounding dynamic contrast enhancement in liver scanning. Ultrafast CT and spiral scanners might simplify contrast supply. One contrast bolus and rapid scanning may show the liver [27]. A single 120-ml contrast infusion at 3ml/ sec. with a 35 or 45-second delay and a 2-second probe cycle, scanning mode has allowed vascular and liver parenchyma visualisation at the University of Chicago (Figure 2). The best liver tumour identification and extent results are using CT arterial portography. CTAP misses 20% of small liver metastases, whereas typical CT misses 62% [28]. Because intra-arterial infusion provides twice as much contrast medium in liver parenchyma as intravenous, although this invasive method detects less than 100% of liver lesions and produces false-positive outcomes, it is the benchmark CT technique for liver tumour resectability. Hepatic temporal iodine should be added to less invasive liver CT to enhance it, and CTAP should not be utilised for screening. Instead of cc/sec, intravenous administration might utilise 5 or more. Temporary contrast medium concentrations rise without increasing contrast volume with fast scanning and timing. It should detect microscopic lesions better with subcentimeter slice thickness CT scanning [29].

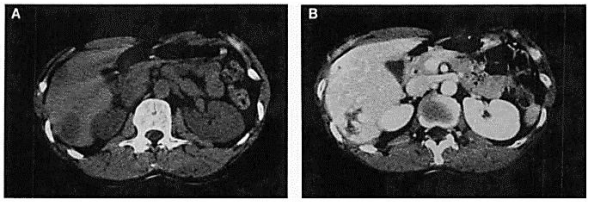


**Fig. 1.2 A: CT scan of the liver without the use of contrast agents. Low-density lesions indicate the presence of colon cancer metastases.**

B: Significant improvement in the visibility of blood arteries and the boundaries of the metastases was seen after administering an intravenous infusion of 120 ml of contrast media at a rate of 3 cc/sec, followed by a 35-second pause before doing a rapid CT scan [27-29].

Cavernous hemangiomas afflict 7% of healthy adults. Cavernous hemangiomas were found in 20% of 95 men's medicolegal autopsy, typically <1 cm [30]. It seems that CT and other imaging modalities overlook many benign tumours. Better technology will diagnose more of them, making them more unpleasant because they are common and may contain metastatic deposits. CT is difficult since each lesion must be defined separately. Nonenhanced scans may not show low density with a well-defined lesion and delayed contrast filling from the lesion's border to the core. Despite contrast dynamics, hemangiomas are only 86% probable. The most characteristic CT findings of cavernous hemangioma are globular foci of enhancement within the lesion and the lack of a hypodense ring surrounding the lesion in contrast enhanced images, unlike malignant tumours [31] (Figure 3 A, B).

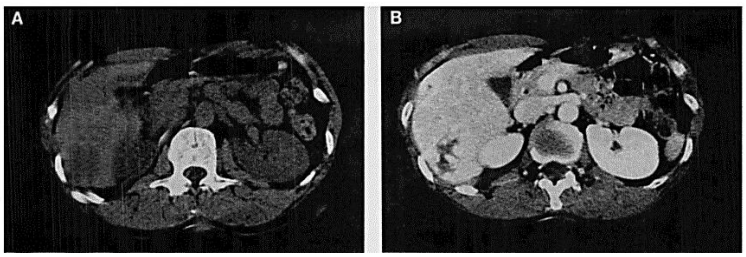


**Fig. 1.3 Images A and B show a hemangioma with the typical CT look before and shortly after the administration of contrast agent [31].**

Recently, the latter pattern has 94% specificity. Fascial nodular hyperplasia (F. N. H) (Figure 4) and hepatic cell adenoma (Figure 5) are benign, less frequent hepatic neoplasms that often display early hyperdense contrast enhancement resembling HCC or vascular metastasis. Because of this, CT features alone cannot distinguish them from vascular hepatic metastases or fibrolamellar HCC. Nuclear medicine scans are complimentary, and colour Doppler flow imaging showed encouraging outcomes [32]. Both biopsy and surgery are still needed to diagnose these rare benign hepatic lesions.

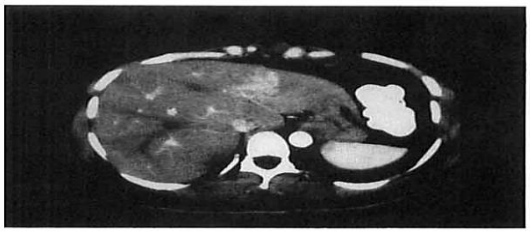

**Fig.1.4 Focal nodular hyperplasia is seen as a liver tumour that exhibits early enhancement [31, 32].**

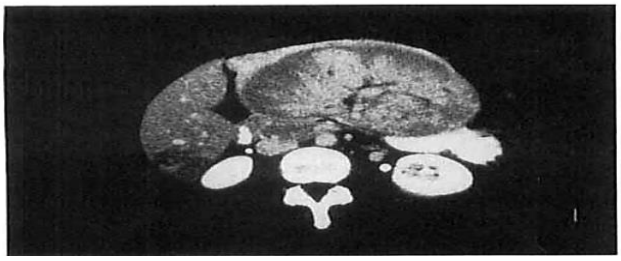

**Fig. 1.5 A massive hepatic adenoma with rapid contrast enhancement [31, 32].**

**c. Patients and Method**

This study was designed as a prospective randomised controlled trial (RCT) and conducted at Oncology Hospital in Medical City/Baghdad. A local ethics committee approval was obtained from the Al-Hadi University college. The patients were collected from Medical City/ Oncology Hospital- Baghdad during the period From June 2023 to January 2024; they had liver tumours. When examining patients with abdominal pain, healthcare professionals typically use a combination of CT scans, ultrasound examinations, and biopsy investigations. This method is highly sensitive and widely utilized for accurately detecting tumors. The study involved a total of 40 patients, comprising 24 males and 16 females, with ages ranging from 12 to 80 years. The mean age of the patients was 52 years.

## 2. RESULTS

The age distribution of a total number of 40 patients is represented in table 3.

**Table 2.3 Age distribution of patients with liver tumours in comparison to the sex of patients**

| | **Total number of patients** | | **Males** | | **Females** | |
|---|---|---|---|---|---|---|
| **Age** | Pt. | % | Pt. | % | Pt. | % |
| **10-19** | 3 | 7.5 | 2 | 5 | 1 | 2.5 |
| **20-29** | 5 | 12.5 | 4 | 10 | 1 | 2.5 |
| **30-39** | 5 | 12.5 | 3 | 7.5 | 2 | 5 |
| **40-49** | 4 | 10 | 3 | 7.5 | 1 | 2.5 |
| **50-59** | 12 | 30 | 8 | 20 | 4 | 10 |
| **60-69** | 5 | 12.5 | 2 | 5 | 3 | 7.5 |
| **70-80** | 6 | 15 | 2 | 5 | 4 | 10 |
| **Total** | 40 | 100 | 24 | 60 | 16 | 40 |

**Table 2.4 Age distribution of patients with types of examination**

| | Number of Pt. | | CT- Scan | | U/S | | Biopsy | |
|---|---|---|---|---|---|---|---|---|
| **Age** | Pt. | % | Pt. | % | Pt. | % | Pt. | % |
| **10-19** | 3 | 7.5 | 3 | 7.5 | 2 | 5 | 3 | 7.5 |
| **20-29** | 5 | 12.5 | 5 | 12.5 | 5 | 12.5 | 5 | 12.5 |
| **30-39** | 5 | 12.5 | 5 | 12.5 | 5 | 12.5 | 5 | 12.5 |
| **40-49** | 4 | 10 | 4 | 10 | 1 | 2.5 | 4 | 10 |
| **50-59** | 12 | 30 | 12 | 30 | 12 | 30 | 12 | 30 |
| **60-69** | 5 | 12.5 | 5 | 12.5 | 3 | 7.5 | 5 | 12.5 |
| **70-80** | 6 | 15 | 6 | 15 | 4 | 10 | 6 | 15 |
| **Total** | 40 | 100 | 40 | 100 | 32 | 80 | 40 | 100 |

**Table 2.5 The relationship between the sex of patients with types of liver tumours examined by CT scan.**

| | Number of patients | | Male | | Female | |
|---|---|---|---|---|---|---|
| **Types of liver tumours** | Pt. | % | Pt. | % | Pt. | % |
| **Malignant** | 23 | 57.5 | 11 | 27.5 | 12 | 30 |
| **Benign** | 17 | 42.5 | 13 | 32.5 | 4 | 10 |
| **Total** | 40 | 100 | 24 | 60 | 16 | 40 |

**Table 2.6** The relationship between sexes of patients with types of live tumours examined by Ultrasonography.

| | Number of Pt. | | Male | | Female | |
|---|---|---|---|---|---|---|
| **Types of liver tumours** | Pt. | % | Pt. | % | Pt. | % |
| **Malignant** | 23 | 57.5 | 11 | 27.5 | 12 | 30 |
| **Benign** | 9 | 22.5 | 6 | 15 | 3 | 7.5 |
| **Total** | 31 | 80 | 16 | 42.5 | 15 | 37.5 |

**Table 2.7** The relationship between biopsy and ultrasound examinations.

| | | Liver Tumours | | | | | |
|---|---|---|---|---|---|---|---|
| **Biopsy** / **U/S** | | **-Ve Findings** | | **+Ve Benign Tumour** | | **+Ve Malignant Tumour** | |
| | | Pt. | % | Pt. | % | Pt. | % |
| **Liver tumors** | Benign | 8 | 20 | 9 | 22.5 | - | - |
| | Malignant | - | - | - | - | 23 | 57.5 |
| **Total** | | 8 | 20 | 9 | 22.5 | 23 | 57.5 |

## 3. DISCUSSION

This study reveals that there were 24 males, constituting 60% of the total, and 16 females, constituting 40% of the total. Research demonstrated a higher susceptibility of guys to liver tumours compared to those of other genders. The results of this study align with the findings of Mahfouz and Vogl [33], indicating that men had a higher propensity to display affection. Regarding age distribution, twelve individuals, constituting thirty percent of our patient population, had liver tumours within the age range of fifty to sixty-nine years. Out of the total number of patients, eight were male and four were female. This suggests that

individuals within this age bracket are more susceptible to the effects of liver tumours. The results of this experiment are comparable to the findings of study [33]. The ultrasound findings were useful in diagnosing malignant tumours in 23 patients (57.5%), benign tumours in 9 patients (22.5%), and identifying 8 patients (20%) as healthy individuals with no signs of benign tumours. This was in contrast to CT scans [34]. The biopsy studies yielded a favourable outcome. This aligns with the results of a study done by Fowlkes and Holland [33], which discovered that the ultrasound technique had constraints that hinder the identification of some liver tumours. One disadvantage of ultrasonography is that it is unable to identify any lesion that is not adjacent to the surrounding tissues. A CT scan is quite valuable for identifying liver tumours. The results of the CT scan were compared with the biopsy findings, and they were found to be consistent. CT is more effective in identifying liver cancers by employing thin slices during tumour evaluation, as shown by Cullough's research [35]. Forty individuals exhibited affirmative results of liver tumours while undergoing CT-scan examination. Out of the total number of patients, 23 (57.5%) were found to have malignant tumours, whereas 17 (42.5%) were identified with benign tumours.

## 4. CONCLUSION

CT scans are very successful and accurate in diagnosing liver tumours, with a success rate of nearly 100%. In comparison, ultrasonography has an efficiency of roughly 80% for the same diagnostic purpose.

## 5. RECOMMENDATIONS

It is recommended that patients be evaluated with a CT scan if there are no contraindications for the procedure. This is because the CT scan picture gives valuable information about the anatomy, and it is more accurate than an ultrasound examination. It is not recommended that a CT scan be performed on a pregnant woman who is suffering from liver tumours because of the potential for damage to the developing foetus.

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