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Accuracy of Ultrasound-Guided versus CT-Guided Percutaneous Liver Biopsy

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Abstract: The procedure of percutaneous liver biopsy is still the standard of reference in the diagnosis of focal liver lesions, as well as diffuse parenchymal disease. Ultrasound (US) and computed tomography (CT) are proven guidance techniques. This study is to compare the diagnostic accuracy, procedural features, and adverse event profile of US-guided and CT-guided percutaneous liver biopsy. A cross-sectional study of 101 consecutive patients (75 with focal lesions, 26 with diffuse hepatic disease) was performed, with 51 patients undergoing hepatic biopsy under US guidance and 50 patients undergoing hepatic biopsy under CT guidance. Baseline data, procedural factors, and 30-day outcomes were documented. The diagnostic performance was evaluated in relation to surgical pathology as the reference standard at 12-month clinical-radiological follow-up. Additionally, the technical success rate was 94.1% for US-guided procedures and 90.0% for CT-guided procedures in the first attempt. There were no significant differences between modalities for sample adequacy (98.0% vs. 92.0%) or overall diagnostic accuracy (93.3% vs. 89.8%). US-guided biopsy was found to be significantly faster (14.2 ± 5.1 minutes vs. 22.6 ± 7.4 minutes). The overall complication rate was similar (33.3% vs. 38.0%), and there were no deaths in either group. US- and CT-guided percutaneous liver biopsy offers similar and high diagnostic accuracy and a similar safety profile. Where available, ultrasound guidance provides much shorter procedure times and should be preferred.

Keywords: Ultrasound-Guided, CT-Guided Percutaneous Liver Biopsy, and Complications.

Introduction

Although the measurement of fibrosis has become increasingly important, and the use of non-invasive measurement has become common practice, there is no replacement for tissue sampling for grading inflammation, staging fibrosis, diagnosis of specific metabolic disease, and characterization of focal liver lesions [1, 2]. The success and safety of this procedure relies greatly on the accuracy of the image

guidance employed to manoeuvre the needle to the target parenchyma or lesion. Computed tomography (CT) has been considered the better modality to guide biopsies, especially small and deep-lying lesions, because of its superior spatial resolution and detailed anatomy presented in cross-section [3].

With the advent of high-resolution real-time ultrasound (US), however, this paradigm is coming into question, as the technology provides an alternative to radiation, low cost, and an interactive and dynamic experience [4]. The accuracy of these two modalities is not a sole technical issue but is crucial for the diagnostic yield, complication rates, and patient management strategies in the clinic [5].

The basic difference between US-guided and CT-guided techniques is the type of imaging and how it is used. Ultrasound has the ability to visualize the needle trajectory in real time, provide observation with the needle, and adjust it according to respiratory motion; it can also avoid intervention of the vascular structures as a dynamic structure. This near-instantaneousness can help to shorten the procedures and improve patient comfort [6].

In contrast, in CT, the position of the needle is checked by taking back-and-forth static images. Although the techniques of cone-beam CT and fluoroscopy have advanced since their inception, they fail to provide real-time feedback, which can create difficulties when dealing with moving targets [7].

Also, CT involves radiation and is occasionally accompanied by the use of intravenous contrast, which can be harmful for patients with kidney disease or an allergy to the dye. Unlike radiology, ultrasound is free from radiation hazards and can be delivered bedside, making it more accessible in acute care. The consistency of tissue discrimination provided by CT, however, overcomes many of the operator dependency issues with US, including patient body habitus and bowel gas interference [8].

In other studies, the diagnostic sufficiency rate of US-guided biopsy was shown to be as high as 85% or greater in cases of diffuse liver diseases (chronic hepatitis or cirrhosis), with rates exceeding 95% in the hands of experienced hepatologists or radiologists. US-guided biopsy of visible lesions is as likely to be diagnostic as CT, is less likely to be complicated by post-procedural pain and bleeding, but has lower sensitivity for lesions less than 1 cm, which are not visible on ultrasound [9], [10].

Methodology

The sample consisted of a cross-sectional study of different hospitals in Iraq from February 2025 to February 2026. It included 101 consecutive patients who were referred for percutaneous liver biopsy. Indications were liver focal lesions, which were suspected of malignancy on cross-sectional imaging (n=75), and diffuse parenchymal liver disease (n=26) where non-invasive assessment was inconclusive. Exclusion criteria included uncorrectable coagulopathy (INR >1.5 or platelets $<50\times10^9$/L) as well as the lack of a safe percutaneous window and refusal by patients. All participants gave written informed consent, and the study was approved.

In addition, lesions were biopsied under real-time ultrasound guidance (n=51), and lesions which were not well defined on real-time ultrasound were referred for biopsy under computed tomography guidance (n=50) (typically deep-seated, subcapsular, and isoechoic lesions). All procedures were carried out by one of two interventional radiologists who have over five years of experience in hepatic intervention by the freehand technique with semi-automated 16G or 18G cutting needles with a coaxial system. The number of passes was based on the judgement of the operator, based on the macroscopic assessment of the sample. The same conscious sedation and local anesthesia procedures were used in both arms.

Additionally, diagnostic accuracy (concordance of biopsy and reference standard, surgical pathology during 12 months' follow-up clinical, and imaging) was the primary outcome. Secondary outcomes were sample adequacy, first-attempt technical success, procedure time (from needle insertion to withdrawal), and complications (according to the Society of Interventional Radiology classification) within 30 days. The sensitivity, specificity, positive predictive value, and negative predictive value was computed for each modality with 95% CIs.

For data with expected cell counts <5, categorical variables were compared with the chi-squared test. Continuous variables were evaluated for normality with the Shapiro-Wilk test and compared with

independent-samples t-test or Mann-Whitney U tests, depending on the normality of the variables. A two-tailed p-value <0.05 was considered significant. SPSS version 26.0 was used for analyses.

Results

Table 1. Outline the basics parameters of 101 patients enrolled in thiscross–sectional study

Variable	US-guided (n=51)	CT-guided (n=50)	p
Age, years, mean ± SD	54.6 ± 11.8	56.2 ± 12.3	0.51
Age, median (IQR)	55 (46–63)	57 (48–65)	0.55
Male sex, n (%)	29 (56.9)	27 (54.0)	0.80
BMI, kg/m², mean ± SD	27.4 ± 4.3	27.9 ± 4.6	0.57
Cirrhosis, n (%)	16 (31.4)	14 (28.0)	0.71
Platelets, ×10⁹/L, mean ± SD	168 ± 62	161 ± 58	0.56
Platelets, median (IQR)	170 (128–210)	162 (115–198)	0.59
INR, mean ± SD	1.05 ± 0.12	1.07 ± 0.11	0.38
Indication: focal lesion, n (%)	38 (74.5)	37 (74.0)	0.95
Indication: diffuse disease, n (%)	13 (25.5)	13 (26.0)	0.95
Lesion size, mm, mean ± SD	31.5 ± 14.2	33.8 ± 15.6	0.45
Lesion size, median (IQR)	29 (22–40)	31 (24–43)	0.47

Table 2. Clinical outcomes of surgical procedures into both guiding

Variable	US-guided (n=51)	CT-guided (n=50)	p
16G core needle, n (%)	34 (66.7)	32 (64.0)	0.84
18G core needle, n (%)	17 (33.3)	18 (36.0)	0.84
Number of passes, median (IQR)	3 (2–3)	3 (2–4)	0.34
Number of passes, mean ± SD	2.8 ± 0.9	3.1 ± 1.0	0.12
Procedure time, min, mean ± SD	14.2 ± 5.1	22.6 ± 7.4	<0.001
Procedure time, median (IQR)	13 (10–18)	21 (17–27)	<0.001
Conscious sedation, n (%)	21 (41.2)	24 (48.0)	0.48
First-attempt technical success, n (%)	48 (94.1)	45 (90.0)	0.49

Table 3. Hospitalization outcomes of diagnostic accuracy based on both guiding

Outcome	US-guided (n=51)	CT-guided (n=50)	p
Sample adequacy, n (%)	50 (98.0)	46 (92.0)	0.20
Diagnostic success, n (%)	48 (94.1)	44 (88.0)	0.32
Sensitivity, % (95% CI)	93.9 (79.8–99.3)	88.9 (73.9–96.9)	0.66
Specificity, % (95% CI)	92.3 (64.0–99.8)	90.9 (58.7–99.8)	1.00
PPV, %	93.9	88.9	—
NPV, %	92.3	90.9	—
Overall accuracy, %	93.3	89.8	0.60

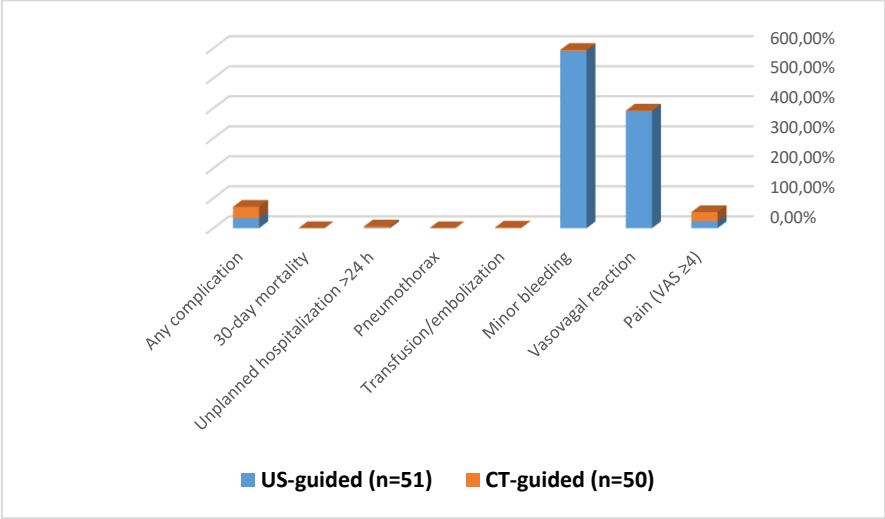

Figure 1. Determining the detected complications during 30 days.

Table 4. A multivariable logistic regression in the diagnostic accuracy prediction within all cases.

Predictor	**OR**	**95% CI**	**p**
CT-guided (vs US-guided)	0.72	0.21–2.44	0.59
Age ≥60 years	0.81	0.29–2.28	0.69
Lesion size <20 mm	0.28	0.09–0.88	0.03
Cirrhosis	0.55	0.17–1.74	0.31
≥4 biopsy passes	1.63	0.52–5.11	0.40
Platelets <100 ×10⁹/L	0.66	0.14–3.07	0.59

Discussion

In the present study, the US-guided and CT-guided percutaneous liver biopsy yielded similar and clinically excellent diagnostic accuracy with an overall accuracy of 93.3% and 89.8%, respectively, with no significant difference between the two modalities. In agreement with some studies, these results suggest that the modality of guidance must be personalized depending on the type of lesion and the operator's experience and not based on the fear of the loss of diagnostic performance [11], [12], [13].

The biggest difference between the two methods was the efficiency of the procedure. The mean time for US-guided biopsies was 14.2 minutes, versus 22.6 minutes for CT-guided biopsies. This discrepancy is due to the multi-step method used in CT guidance (scanning, moving the needle, confirming imaging between steps) and the continuous imaging of the needle-target relationship during US guidance. The non-ionizing nature of ultrasound, which is even more important in younger patients and in patients with cirrhosis who need repeated examinations, is another advantage [14]. However, the role of CT is clearly not obsolete for lesions that are inadequately visualized sonographically, and the CT arm is deliberately enhanced in this group with such technically demanding lesions.

The only independent predictor of diagnostic failure determined by our multivariable analysis was lesion size, with lesions < 20 mm having an odds ratio of 0.28 for diagnostic accuracy. This result is in agreement with previous studies in the USA (18 – 20) that have shown small lesion size to be the predominant technical barrier regardless of the type of biopsy [15].

The safety profiles of both techniques were comparable: the complication rates were 33.3% and 38.0%, respectively, without mortality at 30 days, and major bleeding events were restricted to a single CT-guided procedure managed with transfusion. This is in keeping with a Swiss study in which the rates of major complications were both reported below 2% with both treatment options [16]. The single major

hemorrhage was seen in a patient with a subcapsular lesion, which is a known risk factor and highlights the importance of pre-procedural planning in trajectory design for both modalities [17], [18].

Conclusion

The two methods of percutaneous liver biopsy, US-guided and CT-guided, showed similar, high diagnostic accuracy (93.3% vs 89.8%) and similar technical success and complication rates within 30 days, and no mortality. Use of ultrasound guidance was correlated with a significantly shorter procedure time (14.2 vs 22.6 minutes) and also eliminates the use of ionizing radiation, making it the first-line modality whenever the target lesion is sonographically visible. Biopsy by CT is still an effective and safe alternative method for targets that are not readily detectable by sonography.

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