ORIGINAL RESEARCH

Diagnostic accuracy of CT in pediatric hepatoblastoma taking histopathology as gold standard

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ABSTRACT

Introduction: Hepatoblastoma is the most common primary malignant liver tumor in children, accounting for approximately 80% of cases. **Objectives:** The main objective of the study id to find the diagnostic accuracy of CT in pediatric hepatoblastoma taking histopathology as gold standard. **Materials and Methods:** This is a cross-sectional study aimed at evaluating the diagnostic accuracy of CT imaging in pediatric patients with suspected or confirmed hepatoblastoma, using histopathological examination as the reference standard. **Results:** Data were collected from 76 patients with an age range of 0.5 to 12 years, with a median age of 3.8 years. The gender distribution showed 55% males and 45% females. The primary symptom among patients was abdominal swelling or pain, with most cases presenting with abdominal swelling. Additionally, elevated alpha-fetoprotein (AFP) levels were observed in 82% of the patients, aligning with common hepatoblastoma markers. The diagnostic performance of CT imaging for detecting pediatric hepatoblastoma showed strong sensitivity at 95% and a positive predictive value (PPV) of 92%, indicating high reliability in identifying true cases. Specificity was 67%, with a negative predictive value (NPV) of 77%, reflecting some limitations in accurately ruling out non-hepatoblastoma cases. **Conclusion:** It is concluded that CT imaging demonstrates high sensitivity and diagnostic value in detecting pediatric hepatoblastoma, particularly in assessing tumor size and vascular involvement.

INTRODUCTION

Hepatoblastoma is the most common primary malignant liver tumor in children, accounting for approximately 80% of cases. Correct diagnosis and staging help to select correct therapeutic interventions and improve results in pediatric population. Though the histopathological assessment of biopsy specimens has been the mainstay of diagnosing hepatoblastoma current imaging studies specifically CT show potential in providing diagnosis while being non invasive [1]. Being in relevant risk for development of HCC, and especially while having cirrhosis, surveillance of patients with chronic liver disease is recommended by leading hepatology societies [2].

Ultrasonography is now considered the imaging method of choice for surveillance of liver cancer with diagnostic sensitivity of up to 80% and specificity of more than 90 %. A greater benefit is given to the semiannual screening instead of screening of children at one-year interval [3].Further, the 3-month interval does not report higher survival rates, and in fact, there are no higher detection rates for small HCC lesions of 3 cm and lower; there are, in fact, higher cost.hological examination of biopsy specimens has traditionally been considered the gold standard for diagnosing hepatoblastoma, recent advancements in imaging techniques, particularly computed tomography (CT), have shown promise in providing non-invasive diagnostic information [4]. Surveillance of patients with chronic liver disease and at relevant risk for development of HCC, especially with cirrhosis, is recommended by leading hepatology societies [5].

The preferred imaging modality for liver cancer surveillance is ultrasonography with a diagnostic sensitivity up to 80% and a specificity of more than 90%. Semiannual screening is more beneficial than screening at a 12-month interval. Additionally, a 3-month interval does not show increased survival rates or higher detection rates for small HCC lesions

(≤3 cm) and there are higher cost [6]. The disadvantage of sonographic surveillance is that it is a very operator dependent technique. Moreover, the diagnostic tests like tumour marker alpha-fetoprotein have also been used for the assessment of HCC [7]. Both ultrasonic examination and determination of alpha-fetoprotein levels have higher detection rates for HCC. However, due to the high prevalence of HCC in patients with cirrhosis, new biomarkers for the early diagnosis of HCC must be recognized [8]. CT scan is unique in the diagnostic work up of hepatoblastoma since it offers anatomical details of the liver and neighboring organs. CT scans can reveal information about tumor intrinsic such as its size, position, blood supply and metastatic staging to help with outline a disease's scope and curative strategy [9]. Also, CT imaging will aid in differentiating hepatoblastoma from other hepatic lesion including focal nodular hyperplasia, hepatocellular carcinoma, and hepatic adenomas. With this study, we hope to fill these gaps and offer supporting information for the application of CT as a diagnostic tool for pediatric hepatoblastoma [10].

HYPOTHESIS

Null Hypothesis (H_0): There is no difference in diagnostic accuracy between computed tomography (CT) imaging and histopathological examination in pediatric hepatoblastoma.

Alternate Hypothesis (H_1): There is a difference in diagnostic accuracy between computed tomography (CT) imaging and histopathological examination in pediatric hepatoblastoma.

OBJECTIVES

The main objective of the study id to find the:

- Diagnostic accuracy of CT in pediatric hepatoblastoma taking histopathology as gold standard.

MATERIALS AND METHODS

This is a cross-sectional study aimed at evaluating the diagnostic accuracy of CT imaging in pediatric patients with suspected or confirmed hepatoblastoma, using histopathological examination as the reference standard.

Sample Size

The sample size was determined using the WHO sample size calculator, estimating the need for 76 patients based on the following parameters:

- Z-score for a 95% confidence interval (CI): 1.96
- Estimated sensitivity or specificity (p): 0.80
- Desired margin of error (d): 0.10

Sampling Technique

A non-probability consecutive sampling technique was employed to select patients meeting the eligibility criteria.

Sample Selection

Inclusion Criteria

- Pediatric patients aged 0–18 years with suspected or confirmed hepatoblastoma.
- Availability of both CT imaging and histopathological examination results for comparison.
- Patients who underwent both CT imaging and histopathological examination.

Exclusion Criteria

- Patients with incomplete or unavailable CT imaging or histopathological examination results.
- Patients with a history of previous liver surgery or other liver malignancies.
- Patients with contraindications to either CT imaging or histopathological examination.

Data Collection

Clinical data was obtained from electronic medical records, including patient demographics, clinical presentation, laboratory findings, imaging reports, and histopathological results. The CT imaging data included tumor characteristics such as size, location, vascularity, and presence of metastases, while the histopathological diagnosis of hepatoblastoma served as the reference standard for assessing diagnostic accuracy.

Statistical Analysis

Data analysis were performed using SPSS v12. Descriptive statistics were used to summarize patient demographics, clinical characteristics, CT imaging findings, and histopathological diagnoses. Diagnostic performance metricssensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of CT imaging were calculated using histopathological results as the reference standard.

RESULTS

Data were collected from 76 patients with an age range of 0.5 to 12 years, with a median age of 3.8 years. The gender distribution showed 55% males and 45% females. The primary symptom among patients was abdominal swelling or pain, with most cases presenting with abdominal swelling. Additionally, elevated alpha-fetoprotein (AFP) levels were observed in 82% of the patients, aligning with common hepatoblastoma markers.

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	Value
Age Range (years)	0.5–12
Median Age (years)	3.8
Gender - Male	55%
Gender - Female	45%
Primary Symptoms - Abdominal Swelling/Pain	Majority (Abdominal Swelling)
Elevated AFP (Yes)	82%

The mean tumor size among patients was 7.5 cm, ranging from 3 to 15 cm. The tumor was located in the right lobe in 64% of cases (49 patients) and in the left lobe in 36% (27 patients). Vascular involvement was detected in nearly half of the cases (48%), while metastases were observed in 15% (11 patients), highlighting the extent and spread of the disease.

Table 2: CT Imaging Findings

Characteristic	Value
Mean Tumor Size	7.5 cm (range: 3–15 cm)
Location in Right Lobe	49 (64%)
Location in Left Lobe	27 (36%)
Vascular Involvement	Detected in 48% (n=36)
Metastases	Observed in 15% (n=11)

Table 3: Diagnostic Performance of CT

Metric	Value
True Positives (TP)	58
True Negatives (TN)	10
False Positives (FP)	5
False Negatives (FN)	3
Sensitivity	95%
Specificity	67%
Positive Predictive Value (PPV)	92%
Negative Predictive Value (NPV)	77%
Overall Diagnostic Accuracy	89%

The diagnostic performance of CT imaging for detecting pediatric hepatoblastoma showed strong sensitivity at 95% and a positive predictive value (PPV) of 92%, indicating high reliability in identifying true cases. Specificity was 67%, with a negative predictive value (NPV) of 77%, reflecting some limitations in accurately ruling out non-hepatoblastoma cases.

Table 4: Chi-square Test Results for Categorical Variables Comparison

Comparison	p-value
Vascular Involvement (CT vs Histopathology)	< 0.05 (statistically significant)

The CT imaging accuracy for detecting specific hepatoblastoma characteristics was high, with a 93% accuracy in identifying tumor size and 89% for tumor location, closely aligning with histopathology confirmations at 95% and 90%, respectively. Vascular involvement showed excellent CT accuracy at 95%, nearly matching the 96% confirmation rate by histopathology. CT was slightly less accurate in identifying metastasis (85%), while histopathology confirmed metastasis in 88% of cases.

Table 5: Comparison of CT Findings with Histopathology Results

Finding	CT Accuracy (%)	Histopathology Confirmation (%)
Tumor Size	93	95
Tumor Location	89	90
Vascular Involvement	95	96
Presence of Metastasis	85	88

DISCUSSION

This study assessed the diagnostic accuracy of CT imaging in pediatric hepatoblastoma by comparing its performance to histopathological results.An analysis of the results presented in the work shows that sensitivity of CT reaches 95% and positive predictive

value totals 92% in diagnosing hepatoblastoma, thus, the methodology serves as an effective tool for initial and subsequent staging of the disease [11]. Nonetheless, moderate specificity (appx. 67%) is identified to contain some weaknesses: a few cases with CT positive results turned out to be false positive after the examination, which might cause some unnecessary treatments [12]. The accordance of high sensitivity observed in the current study with previous studies is probably due to the enormous reliability of CT in diagnosing hepatoblastoma with respect to size, vascular involvement, and metastatic potential [13]. However, the SPE was moderate, and there were false positives suggesting that histopathological confirmation is necessary to prevent over diagnosis [14]. This it explains the importance of CT scans in backing up clinical diagnosis particularly in cases of diagnostic uncertainty. However, the findings of this study highlighted a strong correlation between CT criteria in vascular involvement and histopathological changes as evidenced by reduced p-value < 0.05 across the chi-square test. From this observation it may be deduced that CT can be a highly reliable modality in the evaluation of the characteristics of tumor vasculature, an area which is central to surgical management and risk prognostication [15]. CT imaging enables early and noninvasive diagnosis of hepatoblastoma, thus introducing specific treatment in children. Nonetheless, clinicians must not be too eager for cases that may show positive CT but exhibit no clinical or laboratory manifestations of hepatoblastoma [16]. However, in such specimens, further evaluation, preferably with histopathology remains essential for diagnostic purposes [17]. The present study had several limitations: Inclusion of a relatively small cohort of patients could contribute to selection bias, and patients with contraindications to CT or patients with missing imaging and/or histopathological analysis were excluded from the study. Further, there is some weakness of cross-sectional study design that confines their analysis to a single-time point and does not explore the applicability of CT to serial follow up or treatment outcomes.

CONCLUSION

It is concluded that CT imaging demonstrates high sensitivity and diagnostic value in detecting pediatric hepatoblastoma, particularly in assessing tumor size and vascular involvement. However, due to moderate specificity, histopathological confirmation remains essential to avoid misdiagnosis. Integrating CT with other diagnostic tools may further enhance accuracy in clinical practice.

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