Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Radiology

Computed Tomography Evaluation of Gall Bladder Mass with Histopathological Correlation

Dr. SM Hedayetul Islam Sagar[1*], Dr. Nashid Amir[2], Dr. Md. Husnaion Zubery[3]

[1]Radiologist, Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh
[2]Junior Consultant, Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh
[3]Junior Consultant, Department of Radiology and Imaging, Naogaon Medical College Hospital, Naogaon, Bangladesh

DOI: 10.36347/sjams.2024.v12i06.001 | **Received:** 02.04.2024 | **Accepted:** 08.05.2024 | **Published:** 01.06.2024

***Corresponding author:** Dr. SM Hedayetul Islam Sagar
Radiologist, Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh
Email: sagarrmc@yahoo.com

Abstract **Original Research Article**

Background: In extrahepatic biliary carcinoma patients, unresectable disease is frequently discovered during exploration despite thorough preoperative assessment, leading to unnecessary laparotomy. Gallbladder carcinoma ranks fifth among gastrointestinal malignancies, following colorectal, pancreatic, gastric, and esophageal carcinomas. ***Aim of the study:*** The aim of the study was to establish the diagnostic usefulness of computed tomography (CT) in the diagnosis of gallbladder mass. ***Methods:*** This case-control study was conducted at the Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh from March 2018 to August 2018. The study included 65 patients diagnosed with a gallbladder mass, selected through purposive sampling. SPSS version 23.0 was utilized for data analysis. ***Results:*** CT scans accurately predicted various features of gallbladder mass, showing high sensitivity, specificity, and accuracy, with positive and negative predictive values of ≥95% for adenocarcinoma, squamous carcinoma, cholecystitis, metastases, GB polyp, and adenoma. Chronic cholecystitis sensitivity was over 83%. Overall, CT diagnosis performed at least 88.9% across all features. The histopathological assessment also detected nearly similar features of gallbladder mass. ***Conclusion:*** Computed tomography (CT) serves as a valuable diagnostic tool for distinguishing gallbladder neoplasms preoperatively. It is worth noting that CT scans aid in the rational management approach for patients with gallbladder neoplasms.

Keywords: Histopathological correlation, Computed tomography, CT scan, Gall bladder mass, Carcinoma.

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INTRODUCTION

Gallbladder tumors are increasingly detected thanks to advancements in imaging technology. Identifying high-risk gallbladder polyps is crucial due to their potential malignancy. Research suggests that polyp size is the primary predictor of malignant transformation [1]. In the Indian population, particularly in northern cities, the incidence of gallbladder malignancies is notably higher (National Cancer Registry Program, 2001) [2]. Risk factors for gallbladder neoplasms include gallstones (65–95%) and a history of chronic cholecystitis (40-50%), with an estimated 22% of patients with porcelain gallbladder developing a mass [3]. The prevalence of gallbladder cancer varies widely by geographical region. Despite the incidence of gallbladder masses in Bangladesh being comparable to that in the Western world, there is a lack of comprehensive studies on this topic. Early diagnosis of gallbladder masses is challenging as most patients present with nonspecific symptoms such as right upper quadrant pain, malaise, weight loss, jaundice, anorexia, and vomiting. At the time of diagnosis, most patients are deemed unresectable due to direct extension into adjacent organs, local lymph node metastasis, or distant metastatic disease [4]. Gallbladder masses may manifest as a mass completely replacing the gallbladder (40-65%), an intraluminal polypoid lesion (15-25%), or focal or diffuse asymmetric gallbladder wall thickening (20-30%) [5]. Abdominal ultrasound (USG) is the preferred diagnostic tool for detecting gallbladder and biliary duct lesions, though challenges in differentiation from polyps and acute inflammatory disease may arise. CT scans offer better visualization of gastrointestinal tract invasion and lymphadenopathy, aiding treatment planning. USG typically reveals large solid masses in the gallbladder bed, irregularities in the gallbladder wall, complex reflective masses obliterating the lumen, and irregular polypoid masses. CT scans play a crucial role in detecting, staging, and assessing the spread of gallbladder disease. Typical CT findings of a gallbladder mass include three patterns: a mass replacing the gallbladder fossa, an intraluminal mass, and gallbladder wall thickening. The mass replacing the gallbladder fossa is the most common appearance. CT scans also detect direct invasion into adjacent structures. Kalra *et al.*, (2006) [6] reported that CT had a sensitivity of 72.7%, specificity of 100%, and accuracy of 85% for determining the respectability of gallbladder carcinoma. However, Yoshimitsu *et al.*, (2002) [7] found poor sensitivity (33%) for accurate T1 staging, with only one of three patients with T1 gallbladder cancer correctly diagnosed on CT. In contrast, Kim *et al.*, (2008) [8] reported a relatively high sensitivity (79.3%), with 23 of 29 pT1 lesions correctly diagnosed. The recent advancements in CT technology, from axial to single-slice helical to modern scanners, have significantly improved imaging capabilities. This transition has led to reduced imaging time and enhanced spatial and temporal resolution in all imaging planes [9]. Gallbladder masses are frequently encountered in Bangladesh, where ultrasonography and CT scans serve as essential diagnostic tools for assessing hepatobiliary conditions. The objective of this study was to establish the diagnostic usefulness of computed tomography (CT) in the diagnosis of gallbladder mass.

METHODOLOGY

This was a case-control study that was conducted at the Department of Radiology and Imaging, Rajshahi Medical College Hospital, Rajshahi, Bangladesh from March 2018 to August 2018. The research involved 65 patients diagnosed with a gallbladder mass, chosen through purposive sampling. The inclusion criteria were defined as follows: patients presenting with signs and symptoms suggestive of a gallbladder mass, which included upper abdominal pain, jaundice, itching, weight loss, and the presence of an upper abdominal mass. Additionally, the criteria encompassed elderly patients within the age range of 40 to 80 years. The exclusion criteria comprised patients with clinical suspicion of a gallbladder mass, yet whose imaging reports did not support this diagnosis. Furthermore, cases deemed inoperable were also excluded from the study. Ethical approval for the study was obtained from the mentioned hospital's ethics committee. Written consent was obtained from all participants before data collection. The entire intervention adhered to the principles outlined in the Helsinki Declaration for human research [10] and complied with relevant regulations, including the General Data Protection Regulation (GDPR) [11]. In this study, the variables assessed via CT scan included the type of gallbladder, its size, wall thickness, margin characteristics, content within the gallbladder lumen (such as clear fluid, stones, masses, or sludge), involvement of hepatic parenchyma, biliary tree dilation, and enlargement of lymph nodes. On the other hand, histopathological variables were several types and status of gall bladder mass. The CT scan report included details such as the type, size, wall thickness, margin, and content of the gallbladder lumen (including clear, stone, mass, and/or sludge), as well as hepatic parenchymal involvement, biliary tree dilatation, and lymph node enlargement of the lesion. Biopsy for histopathology was obtained during surgery according to the management plan of the respective department. The CT scan was performed with the patient in the supine position using a PHILLIPS MULTISLICE HELICAL (64 slice) CT machine. Helical scanning allowed for the entire abdomen to be scanned in a single breath hold, with overlapping 10 mm slice thickness providing contiguous image sections. SPSS version 23.0 was used for data analysis.

RESULT

The mean age of our participants was 53.7±8.4 years and the male-female ratio was 1:2.6. The presenting complaints included upper abdominal pain in 86.2% of patients, nausea and vomiting in 81.5%, itching in 75.4%, unintentional weight loss in 72.3%, deep jaundice in 72.3%, and ascites in 47.7%. The CT features of the study patients revealed that 50.8% had contracted gallbladder size, 35.4% had a mass within the lumen of the gallbladder, 23.1% showed a mass replacing the gallbladder fossa, 44.6% had a mass at the fundus intraluminal site, 52.3% had irregularly thickened mass, 63.1% showed local invasion, 16.9% had distant metastases, and 43.1% had biliary tree dilatation. The CT diagnosis of the study patients revealed that among malignant cases, adenocarcinoma was present in 45 (69.3%) patients, squamous carcinoma in 3 (4.6%), and metastasis in 8 (12.3%). Among benign cases, GB polyp was found in 1 (1.5%), chronic cholecystitis in 7 (10.8%), and adenoma in 1 (1.5%). On the other hand, as per histopathological assessment among the study patients, adenocarcinoma was observed in 45 (69.3%) patients, squamous carcinoma in 3 (4.6%), and metastasis in 8 (12.3%) among malignant cases. Among benign cases, GB polyp was found in 1 (1.5%), chronic cholecystitis in 7 (10.8%), and adenoma in 1 (1.5%). In the comparison of histopathology and computed tomography (CT) diagnosis for evaluating adenocarcinoma in 65 cases, 44 cases were true positive when CT scans were diagnosed as positive, while 1 case was false positive. Additionally, among the 20 cases where CT scans were diagnosed as negative, 19 cases were true negative, and 1 case was false negative. In the evaluation of squamous carcinoma, CT scans correctly identified 3 cases as positive and 62 cases as negative when compared to histopathological findings. For the evaluation of metastases, CT scans accurately identified 8 cases as positive and 57 cases as negative when compared to histopathological findings. CT scans diagnosis for evaluation of GB polyp, true positive 1 case and 64 cases true negative in identification by histopathology. For the evaluation of chronic cholecystitis, CT scans correctly identified 5 cases as positive (true positive), while incorrectly identifying 1 case as positive when it was negative (false positive). Additionally, there was 1 case that was negative on CT scans but positive on histopathology (false negative). However, CT scans accurately identified 58 cases as negative (true negative) when compared to histopathological findings. For the evaluation of adenoma beg, CT scans correctly identified 1 case as positive (true positive), while accurately identifying 64 cases as negative (true negative) when compared to histopathological findings. The computed tomography (CT) diagnosis evaluation for predicting various features of gallbladder mass demonstrated high sensitivity, specificity, accuracy, and positive and negative predictive values for most features. Sensitivity, specificity, accuracy, and positive and negative predictive values for adenocarcinoma, squamous carcinoma, cholecystitis, metastases, GB polyp, and adenoma were all reported as ≥95%. chronic cholecystitis sensitivity was indicated as >83%. Overall, the CT diagnosis evaluation exhibited a minimum performance of ≥88.9% across all features evaluated.

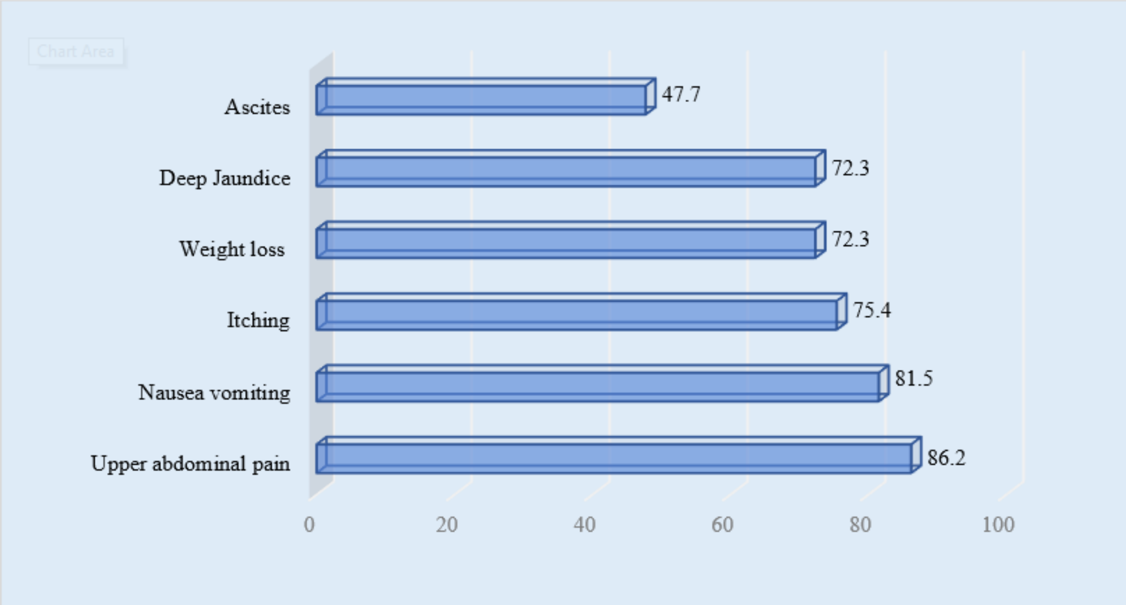

Figure 1: Bar chart showed Presenting complaints of the patients

Table 1: Distribution of CT features (N=65)

CT features	n	%
Size of GB		
Normal	7	10.8%
Contracted	33	50.8%
Distended	25	38.4%
Lumen of GB		
Empty	12	18.5%
Stone	16	24.6%
Mass	23	35.4%
Stone with mass	14	21.5%
Mass replacing GB fossa		
Positive	15	23.1%
Negative	50	76.9%
Intraluminal mass site		
Fundas	29	44.6%
Neck	6	9.2%
Body	15	23.1%
Not present	15	23.1%
The wall thickness of GB		
Normal	1	1.5%
Diffusely thickened	30	46.2%
Irregularly thickened	34	52.3%
Local invasion		

CT features	**n**	**%**
Present	41	63.1%
Absent	24	36.9%
Distant metastases		
Present	11	16.9%
Absent	54	83.1%
Biliary tree dilatation		
Present	28	43.1%
Absent	37	56.9%

Table 2: Malignancy as per CT diagnosis (N=65)

CT diagnosis	**n**	**%**
Malignant (n=56)		
Adeno carcinoma	45	69.3%
Squamous	3	4.6%
Metastasis	8	12.3%
Benign (n=9)		
GB polyp	1	1.5%
Chronic cholecystitis	7	10.8%
Adenoma	1	1.5%

Table 3: Histopathological findings (N=65)

Histopathological type	**n**	**%**
Malignant (n=56)		
Adeno carcinoma	45	69.3%
Squamous	3	4.6%
Metastasis	8	12.3%
Benign (n=9)		
GB polyp	1	1.5%
Chronic cholecystitis	7	10.8%
Adenoma beg	1	1.5%

Table 4: Comparison between histopathology and CT diagnosis for evaluation of adenocarcinoma (N=65)

CT diagnosis	**Histopathology**	
	Positive (n= 45)	**Negative (n=20)**
Positive (n=45)	44 (True Positive)	1 (False Positive)
Negative (n=20)	1 (False negative)	19 (True negative)

Table 5: Comparison between histopathology and CT diagnosis for evaluation of squamous carcinoma (N=65)

CT diagnosis	**Histopathology**	
	Positive (n=3)	**Negative (n=62)**
Positive (n=3)	3 (True Positive)	0 (False Positive)
Negative (n=62)	0 (False negative)	62 (True negative)

Table 6: Comparison between histopathology and CT diagnosis for evaluation of metastases (N=65)

CT diagnosis	**Histopathology**	
	Positive (n=8)	**Negative (n=57)**
Positive (n=8)	8 (True Positive)	0 (False Positive)
Negative (n=57)	0 (False negative)	57 (True negative)

Table 7: Comparison between histopathology and CT diagnosis for evaluation of GB polyp (N=65)

CT diagnosis	Histopathology	
	Positive (n=8)	Negative (n=57)
Positive (n=1)	1 (True Positive)	0 (False Positive)
Negative (n=64)	0 (False negative)	64 (True negative)

Table 8: Comparison between histopathology and CT diagnosis for evaluation of chronic cholecystitis (N=65)

CT diagnosis	Histopathology	
	Positive (n=6)	Negative (n=59)
Positive (n=6)	5 (True Positive)	1 (False Positive)
Negative (n=59)	1 (False negative)	58 (True negative)

Table 9: Comparison between histopathology and CT diagnosis for evaluation of adenoma beg (N=65)

CT diagnosis	Histopathology	
	Positive (n=1)	Negative (n=64)
Positive (n=1)	1 (True Positive)	0 (False Positive)
Negative (n=64)	0 (False negative)	64 (True negative)

Table 10: Comparison between histopathology and CT diagnosis for evaluation of overall(N=65)

CT diagnosis	Histopathology	
	Positive (n=56)	Negative (n=9)
Positive (n=56)	55 (True Positive)	1 (False Positive)
Negative (n=9)	1 (False negative)	8 (True negative)

Table 11: Sensitivity, specificity, accuracy, positive and negative predictive values of the computed tomography (CT) diagnosis evaluation for prediction of several features of gallbladder mass (N=65)

Features	Test of validity	%
Adenocarcinoma	Sensitivity, specificity, accuracy, and positive & negative predictive value	≥95%
SC		100%
Metastases		100%
GB polyp		100%
CC		>83%
Adenoma		100%
Overall		≥88.9%

DISCUSSION

Gallbladder tumors are recognized with increasing frequency due to improvements in imaging techniques and increased utilization of these studies [1]. The size of a gallbladder polyp is generally the strongest predictor of malignant transformation. Ultrasonography and CT scan are two important diagnostic tools available in our country to evaluate the hepatobiliary system. In this study, malignant CT diagnoses consisted of adenocarcinoma in 69.3% of patients, squamous cell carcinoma in 4.6%, and metastasis in 12.3%. For benign CT diagnoses, gallbladder polyps were found in 1.5% of cases, chronic cholecystitis in 10.8%, and adenoma in 1.5%. Mehra *et al.*, (2018) [12] confirmed adenocarcinoma in all cases studied. While the exact cause of gallbladder carcinoma remains unknown, several associated risk factors have been identified. Zhang *et al.*, (2018) [13] noted in their study that 3 malignant lesions were misdiagnosed as probably benign and 5 were diagnosed as probably malignant. In this current series, malignant histopathological types included adenocarcinoma in 69.3% of patients, squamous cell carcinoma in 4.6%, and metastasis in 12.3%. Among benign histopathological types, gallbladder polyps accounted for 1.5%, chronic cholecystitis for 10.8%, and adenoma for 1.5%. Jindal *et al.*, (2018) [14] observed 17 malignant cases, with 15 being adenocarcinoma and two adenosquamous carcinomas of the gallbladder. Benign neoplasms like gallbladder polyps, including cholesterol polyps and adenomatous polyps, constitute approximately 50% of all polypoid lesions of the gallbladder. Other rare benign lesions include fibromas, leiomyomas, lipomas, and hemangiomas [15]. In the histopathological evaluation of this series, adenocarcinoma was found in 33 (68.8%) patients, squamous cell carcinoma in 2 (4.2%), metastasis in 6 (12.5%), gallbladder polyp in 1 (2.1%), chronic cholecystitis in 5 (10.4%), and adenoma in 1 (2.1%). According to VanderMeer *et al.,* (2013) [15], adenocarcinoma is histologically present in 90.0% of gallbladder cancer cases, while squamous cell carcinoma is found in 2.0% of cases. Several histologic subtypes of adenocarcinoma have been described, with papillary adenocarcinoma representing about 5.0% of gallbladder cancers; it tends to be well differentiated and carries a more favorable prognosis. According to Nurullah *et al.*, (2009) [16], adenocarcinoma and squamous cell carcinoma were found in 83.9% and 3.2% of cases, respectively. In the present study, CT scan diagnoses for the evaluation of adenocarcinoma resulted in 44 true positive cases, 1 false positive case, 1 false negative case, and 19 true negative cases compared to histopathology. Various studies have reported on the diagnostic accuracy of CT scans in staging the disease and determining resectability. Yoshimitsu *et al.,* (2002) [7] reported an accuracy range of 83-86% in diagnosing the local extent of gallbladder carcinoma. In the current study, the validity of CT evaluation for adenocarcinoma correlated with a sensitivity of 97.8%, specificity of 95.0%, accuracy of 96.9%, positive predictive value of 97.8%, and negative predictive value of 95.0%. In another study by Ohtani *et al.,* [17], the sensitivity of CT was reported as 100%, with a positive predictive value of 100.0%. In the study by Hamdani *et al.,* (2012) [18], CT was noted to have a positive predictive value of more than 90%. Ohtani *et al.,* [17] reported sensitivities in CT detection of liver metastases at 75.0%, with positive predictive values of 100% and 86%, respectively, consistent with findings in the current study. Zhang *et al.,* (2018) [13] noted that contrast-enhanced ultrasound (CEUS) demonstrated higher sensitivity, specificity, positive predictive value, negative predictive value, and accuracy compared to conventional ultrasound. Specifically, CEUS showed a sensitivity of 94.1%, specificity of 95.5%, positive predictive value of 80.0%, negative predictive value of 98.8%, and accuracy of 95.2%. In contrast, conventional ultrasound had lower values across these parameters, with a sensitivity of 82.4%, specificity of 89.8%, positive predictive value of 60.9%, negative predictive value of 96.3%, and accuracy of 88.6%. CT is generally more effective than ultrasound (US) at detecting lesions, although it has a low sensitivity for detecting lymph node metastasis. However, its positive predictive value is often over 90%. Both US and CT may miss showing local gastrointestinal and omental infiltration as well as peritoneal deposits [19]. In the current study, preoperative imaging of the abdomen, including both US and CT, revealed gallstones in 159 cases (80.3%) and a gallbladder mass in 184 patients (92.9%). In this present study, the computed tomography (CT) diagnosis evaluation for predicting various features of gallbladder mass exhibited high sensitivity, specificity, accuracy, and positive and negative predictive values for most features. Specifically, sensitivity, specificity, accuracy, and positive and negative predictive values for adenocarcinoma, squamous carcinoma, cholecystitis, metastases, GB polyp, and adenoma were all reported as ≥95%. For chronic cholecystitis, sensitivity was indicated as >83%. Overall, the CT diagnosis evaluation demonstrated a minimum performance of ≥88.9% across all features evaluated. All the findings from this study could prove beneficial for future research endeavors of a similar nature.

LIMITATION OF THE STUDY

The scope of the study was confined to a single hospital in Rajshahi city, raising concerns about the representativeness of its findings for the entire country. Additionally, the study was conducted over a short timeframe, and its small sample size further limits its applicability. Future research efforts should consider enlarging the sample size for a more comprehensive understanding. Furthermore, ultrasound evaluation was omitted from the study protocol, indicating a potential gap in diagnostic assessment.

CONCLUSION

Computed tomography (CT) plays a crucial role as a diagnostic tool in distinguishing gallbladder neoplasms preoperatively. By providing detailed imaging of the gallbladder and surrounding structures, CT scans can help differentiate between benign and malignant lesions, assess tumor size and extent, and identify any associated complications such as invasion into adjacent structures or metastasis. This information is essential for guiding the development of a rational management approach for patients with gallbladder neoplasms. CT findings can inform treatment decisions, including the need for surgical resection, chemotherapy, or other interventions, and help clinicians optimize patient care and outcomes. Therefore, CT imaging is invaluable in the comprehensive evaluation and management of gallbladder neoplasms.

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