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Carcinoma of the Gallbladder: CT Findings in 50 Cases

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Abstract. Fifty patients with histologically proven carcinoma of the gallbladder were examined by computed tomography (CT). The gallbladder masses were categorized into two broad groups: group 1 (74%) included patients in whom the gallbladder was identified along with a mass lesion; and group 2 (26%), where a large mass was present in the gallbladder fossa with no identifiable gallbladder. Group 1 was further divided into three types according to the nature of the tumor: Type 1, mass almost filling the entire gallbladder lumen; Type 2, a polypoidal mass projecting into the lumen; type 3, an infiltrating tumor seen as focal or diffuse wall thickening. Liver involvement, in the form of localized invasion in the vicinity of the primary gallbladder malignancy, was the most common associated finding (80%). Other ancillary features included presence of calculi, lymphadenopathy, and biliary obstruction. CT was found useful for characterizing and defining the extent of carcinoma of the gallbladder. However, it may not consistently demonstrate involvement of the gastrointestinal tract, omentum, and abdominal wall. CT can also be used for aspiration/biopsy guidance of the gallbladder mass in selected cases.

Key words: Gallbladder carcinoma, diagnosis—Gallbladder, CT.

Carcinoma of the gallbladder is the most common malignant tumor of the biliary tract [1]. In the West, it is the fifth most common malignancy of the gastrointestinal tract, accounting for 1–3% of all cancers [1], whereas in north India it is relatively more common, being the third most common gastrointestinal malignancy, accounting for 4.4% of all cancers [2, 3]. Even in the West, certain communities, such as the native Indian and Mexican population in the southwestern United States, reportedly have a higher prevalence of biliary tract disease, including carcinoma of the gallbladder [4, 5].

The symptomatology of gallbladder carcinoma is not dissimilar from that of benign gallbladder disease nor is the duration of symptoms a reliable parameter to distinguish between the two. Consequently, a correct clinical diagnosis is infrequent. Moreover, imaging modalities used in the past, such as percutaneous transhepatic cholangiography (PTC), endoscopic retrograde cholangiopancreatography (ERCP), and barium studies, reveal nonspecific features, contributing little towards the correct diagnosis [1, 6, 7].

Ultrasonography (US) and computed tomography (CT) have been established as useful imaging modalities for diagnosis of carcinoma of the gallbladder [6–9]. There are relatively few reports detailing the appearance of this malignancy on CT. In this paper, therefore, we describe the CT spectrum of gallbladder carcinoma in 50 cases.

Materials and Methods

We reviewed CT scans of 50 patients with pathologically proven carcinoma of the gallbladder seen at our institution over a 3-year period. The diagnosis was established either by surgery, laparoscopy, fine-needle aspiration under US guidance, or blind biopsy of the palpable mass.

The age of the patients ranged from 22–74 years (mean 48 years). The great majority of the patients (78%) were in their fourth and fifth decades of life. There were 16 men and 34 women, the male:female ratio being 1:2.1. The duration of symptomatology in 47 patients varied from 1 month to 4 years with the mean duration of symptoms being 8 months. One patient presented with acute intestinal obstruction of 1 week duration and two patients had symptoms for 7 and 8 years, respectively. The salient symptoms and signs included pain in the right upper quadrant (98%), weight loss (88%), hepatomegaly

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(66%), palpable right upper quadrant lump (60%), and jaundice (52%).

All patients were scanned on a Somatom DR-H whole body CT scanner (manufactured by Siemens, Germany). Three hundred milliliters of 3% Urografin (sodium meglumine diatrizoate) was given orally 15–20 min prior to scanning in order to opacify the gastrointestinal tract. Eight-millimeter thick slices (occasionally 4 mm) at intervals of 8 mm were obtained from top of the liver to the level of iliac crests inferiorly. Initial nonenhanced scans were obtained in all patients. Additionally, 48 patients also had scans after intravenous administration of an ionic contrast agent (Urografin 76%) using multiple small bolus dynamic scan technique. As many slices as possible (usually four to five) were obtained immediately after a 20-ml bolus of contrast material was injected by hand. The process was repeated until the entire region of interest was covered. All the CT scans were analyzed by two radiologists. The features which were assessed on CT scans included primary features of the gallbladder tumor (presence or absence of gallbladder lumen, nature of the gallbladder lesion, presence of gallstones, presence of gallbladder wall thickening, density, and enhancement pattern of the tumor) and associated features, such as surrounding liver invasion, biliary obstruction, presence of lymphadenopathy (porta, peripancreatic, and retroperitoneal), invasion of gastrointestinal tract and surrounding structures, and ascites.

We classified gallbladder masses into two broad groups depending on whether or not a portion of the gallbladder was visualized (Fig. 1). Group 1 tumors were further subdivided into three types depending upon their extent (Table 1). Type 1 consisted of those masses that almost, but not totally, filled the gallbladder leaving only a small uninvolved portion. Polypoidal tumors were classified as type 2. Infiltrating tumors that manifested as wall thickening without an obvious mass were classified as type 3.

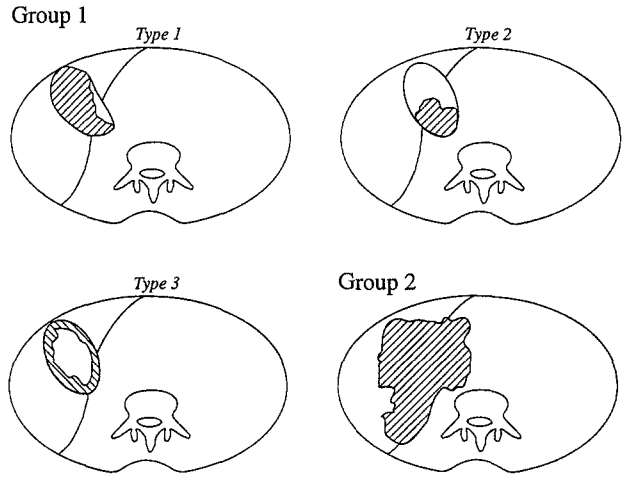

Fig. 1. Line diagram illustrating our classification of the gallbladder carcinoma into two broad groups and further division of group 1 masses into three different types.

Table 1. Primary features of gallbladder carcinoma on CT

CT appearance	Cases (%)
Group 1: gallbladder visualized with a mass	37 (74)
Type 1: mass almost filling the gallbladder lumen	21 (42)
Type 2: polypoidal mass protruding into the lumen	13 (26)
Type 3: infiltrating mass causing focal or diffuse wall thickening	3 (6)
Group 2: mass in the gallbladder fossa; gallbladder not recognized separately	13 (26)

Results

Primary Features

The great majority of the patients had advanced disease at the time of presentation. Consequently, the tumor observed on CT scans was relatively large in size. The primary features of gallbladder tumors are illustrated in Table 1 and Figs. 2–5. Most tumors were of low attenuation, but a few (five patients) had high attenuation on the initial unenhanced CT scan. Three patients had a mixed attenuating mass. The enhancement pattern of the tumors was nonspecific and quite variable, ranging from little or no enhancement to marked enhancement. However, enhanced CT scans better demonstrated wall thickness, liver involvement, and lymph node metastases.

Associated Features

A number of associated features were useful in establishing the diagnosis. These are summarized in Table 2. Liver involvement in the form of localized spread adjacent to the primary tumor, with or without multiple disseminated nodules, was the most common associated feature, seen in 40 patients (80%). This was followed by biliary ductal dilatation (52%). The site of obstruction was usually at or just below the porta, the cause being either the tumor mass itself or enlarged lymph nodes. However, in two patients the obstruction was at the lower end of the common bile duct, due to enlarged peripancreatic lymph nodes in one and choledocholithiasis in the other. Other associated features included cholelithiasis, ascites, and bowel involvement.

The great majority of the tumors were adenocarcinomas (46 patients, 92%). There was one case each of adenosquamous and squamous carcinoma. Two tumors were undifferentiated carcinomas.

Discussion

Since the clinical presentation greatly overlaps with the more commonly seen benign gallbladder diseases, it is not surprising that a diagnosis of gallbladder cancer is infrequently considered, until the disease is quite advanced. In the present study, a clinical diagnosis of the gallbladder carcinoma was made in less than half the patients. The clinical index of suspicion is even lower in the West. Thus, a diagnosis of carcinoma of the gallbladder was made in only 4% in one series [10]. Therefore, it is important for the radiologist to be aware of its manifestations in order to suggest the diagnosis.

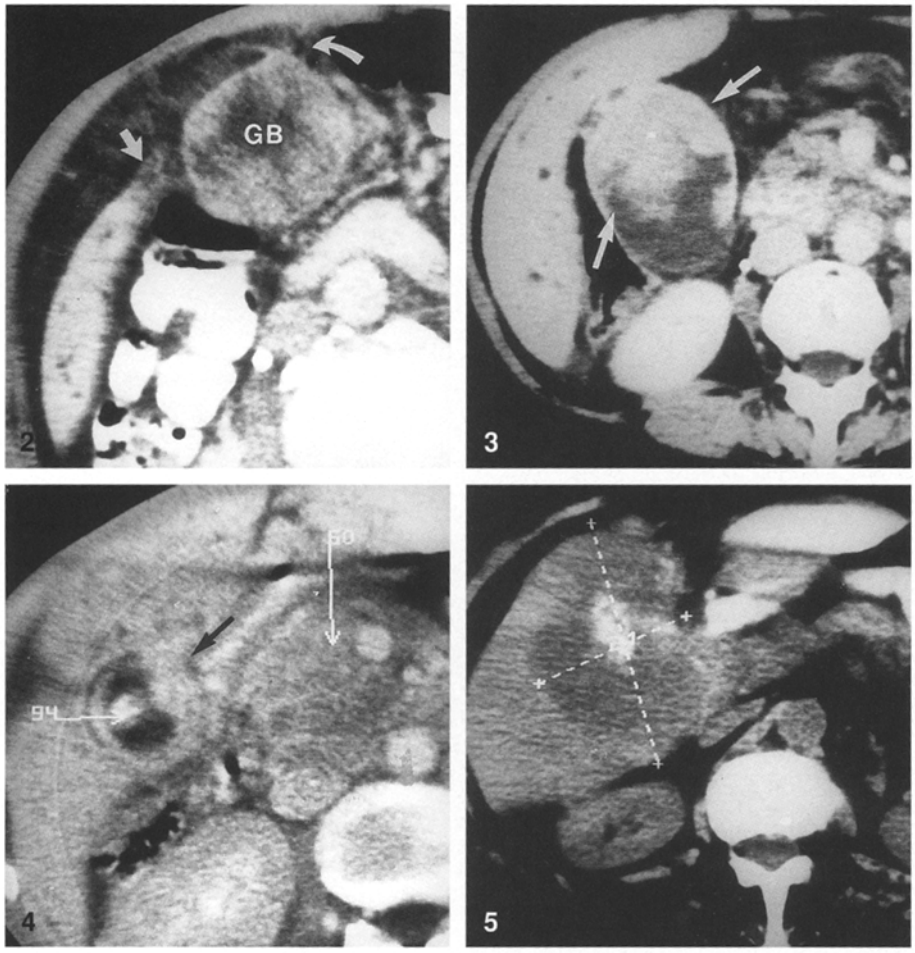

Fig. 2. *Gallbladder carcinoma, type 1.* CT scan demonstrates a soft tissue mass enlarging and almost completely filling the gallbladder lumen (*GB*). Liver involvement is seen adjacent to the mass (*straight white arrow*). Streaky densities extending to the abdominal wall suggest contiguous spread (*curved white arrow*).

Fig. 3. *Gallbladder carcinoma, type 2.* Enhanced CT scan shows a large polypoid tumor projecting into the gallbladder lumen from the anterior wall (*arrows*). No extension is seen outside the gallbladder.

Fig. 4. *Gallbladder carcinoma, type 3.* The gallbladder wall is diffusely infiltrated and there is an area of marked focal thickening medially (*black arrow*). A stone is present in the lumen of the gallbladder (*white arrow* with number 94 representing the CT Hounsfield number). Large peripancreatic lymph nodal mass is also present (*Long white arrow* with number 60 at the end represents the CT number of the lymph nodal mass).

Fig. 5. *Gallbladder carcinoma, group 2 findings.* A large low-attenuating mass (between cursors) with calculi embedded within is seen in the gallbladder fossa. No recognizable gallbladder is identified separately.

In the majority of patients, it was possible to identify at least part of the gallbladder that was uninvolved by tumor (group 1). The most common type of lesion in this category was a large mass filling most of the gallbladder (type 1) which was invariably enlarged and deformed. The tumor was usually low attenuating with a variable enhancement pattern. Involvement of adjacent liver parenchyma, which was better appreciated on the contrast-enhanced CT, was common and indicated the aggressive nature of this type of lesion. Itai et al. [8] reported a similar experience. Calculi, where seen, were embedded within the mass. Empyema of the gallbladder may have similar appearance on CT. However, empyema does not usually invade the liver and only rarely produces biliary dilatation.

In our series, type 2 (polypoidal) masses were the second most common lesions in group 1. However, Itai et al. [8] found these to be the least frequent in their series of 27 patients. The size of polypoidal tumors is reported to be closely correlated with tumor spread and consequently with the prognosis [11]. Koga et al. [12] suggested that a polypoid tumor more than 1 cm in diameter is more likely to be malignant, whereas tumors less than 1 cm are more often benign, commonly cholesterol polyps. In their series, polypoidal tumors larger than 4 cm were associated with hepatic invasion and lymph nodal involvement. In our series, although we did not categorize polypoid lesions by size, most of the them were much larger than 1 cm, and were associated with liver invasion (though less often than type 1 masses). Majority of the tumors in this group in our study were not early carcinomas and were essentially surgically nonresectable. In general, polypoidal tumors

Table 2. Associated features of carcinoma of the gallbladder

Associated features	Cases (%)
1. Liver involvement	40 (80)
2. Calculi	17 (34)
3. Dilatation of the biliary tree	26 (52)
4. Lymphadenopathy	17 (34)
a. Pericholedochal	
b. Other retroperitoneal	12 (24)
5. Ascites	8 (16)
6. Bowel infiltration	10 (20)

Fig. 6. *Gallbladder carcinoma mimicking pancreatic carcinoma.* CT demonstrates a mass (*M*) in the region of the head of the pancreas (*long white arrow* with number 38 at its end represents the CT number of the "pancreatic mass"). Irregular thickening of the gallbladder wall (*white arrows*) and a calculus in the lumen (*black arrow*) are seen. Surgery revealed "pancreatic mass" to be metastatic peripancreatic lymph nodes secondary to an infiltrating carcinoma in the wall of the gallbladder. This type of malignancy can mimic pancreatic carcinoma, as the gallbladder wall thickening may be attributed to chronic cholecystitis.

are reported to be better differentiated histologically and associated with better prognosis especially when small. Although benign diseases, such as polyps (cholesterol or inflammatory), adenomas, papillomas, and blood clot, may have a similar CT appearance, the presence of associated features is a helpful pointer towards the malignant nature of the disease.

Type 3 tumors (wall thickening type) were the least frequent in our series, as well as in the series of Weiner et al. [7]. This is the kind of tumor which is radiologically most difficult to distinguish from chronic cholecystitis. However, the wall thickening in the carcinomatous gallbladder tends to be focal, asymmetrical, and more pronounced. At times, although, it may not be possible to confidently distinguish these two entities, especially in the absence of any associated features. Moreover, a neoplastic growth may arise in a chronically scarred gallbladder, making the distinction even more difficult. Smathers et al. [9] found the presence of a curvilinear low attenuation "halo" around the gallbladder wall (observed in 85% of the patients in their series) to be specific for complicated cholecystitis.

Group 2 tumors were comprised of large, heterogeneous masses that completely replaced the gallbladder. Their distinction from group 1, type 1 masses (where a portion of the uninvolved gallbladder can be identified) is subtle but important as lack of visualization of the gallbladder may be attributed to chronic cholecystitis and the tumor thought to be arising from another organ. Nonvisualization of the gallbladder, presence of a mass in the gallbladder fossa, and stones trapped within the mass are pointers towards the gallbladder origin of the tumor. Biliary obstruction also favors a gallbladder neoplasm as this is not common with other masses at the porta [8].

Carcinoma of the gallbladder can spread by the following routes: direct extension, lymphatic, vascular, neural, intraductal, and intraperitoneal. Direct extension and lymphatic route are the most common means of spread. The vascular route plays a relatively minor role in dissemination of this cancer [13]. Venous drainage from the gallbladder ends into adjacent liver substance and thence to the hepatic veins [13]. Therefore, bloodborne metastases first present as localized invasion of liver in the vicinity of the primary tumor as different from other primary gastrointestinal tract malignancies which spread via the portal vein resulting in multiple disseminated liver metastases [13].

Liver involvement is by far the most frequent associated finding, as has been reported previously in the literature [7, 8, 14]. It can take these three forms: (1) localized spread in the vicinity of the primary tumor; (2) local spread as in (1) with satellite nodules in the right lobe of liver; and (3) multiple disseminated nodules. Localized liver invasion occurs due to three possible routes: direct extension, retrograde lymphatic spread, and infrequently from the vascular route [13].

Biliary obstruction is a common feature, seen in over half of the patients in this study. This has also been the experience of others [7, 8, 14]. The primary lymphatic drainage from the gallbladder is not to the porta nodes but to the cystic node and thence to pericholedochal nodes. Hence, nodal disease manifests as enlarged pericholedochal (including peripancreatic) nodes, which can result in biliary obstruction [13]. Depending upon which group of pericholedochal nodes is involved, the obstruction can be proximal (near porta) or distal (lower end of the common bile duct), the former being more common. The combination of a lymph nodal mass in the region of the head of the pancreas with "distal" biliary obstruction can simulate carcinoma of the pancreas (Fig. 6). In such cases, it is important to pay particular attention to the gallbladder to exclude a primary malignancy.

Local spread to adjacent organs like the stomach, duodenum, and hepatic flexure is not rare, as this is a locally aggressive cancer. CT did not always demonstrate contiguous spread, as the extent of disease was frequently found to be more at surgery than seen on CT, especially involvement of omentum and peritoneum.

Because of the nonspecific clinical presentation and low index of suspicion for gallbladder malignancy, it is important for the radiologist to be aware of its manifestations in order to suggest the diagnosis. CT can also be useful for providing guidance for aspiration/biopsy of

gallbladder in atypical cases and to confirm the diagnosis in advanced inoperable cases.

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