

Exophytic Benign and Malignant Hepatic Tumors: CT Imaging Features

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Our objective is to describe the CT features of exophytic hepatic tumors those may pose a diagnostic challenge because of the uncertainty of tumor origin. The beak sign and the feeding artery of a tumor are useful diagnostic indicators of exophytic hepatic tumors. Two- or three-dimensional reformation images are also helpful for diagnosis. The CT features of exophytic hepatic tumors are similar to those of the usual intrahepatic tumors except for their location.

Index terms :

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If the center of a tumor lies beyond the confines of the liver and the tumor originates from the liver, it can be defined as an exophytic hepatic tumor (1). Benign tumors such as a hepatic cyst, hemangioma, hepatic adenoma, focal nodular hyperplasia, and angiomyolipoma and malignant tumors such as a hepatocellular carcinoma, cholangiocellular carcinoma, and metastases may show exophytic growth. Although the use of CT can demonstrate the presence of the tumor itself, making a correct diagnosis is often challenging for radiologists because of the uncertainty of the tumor origin.

In the diagnosis of exophytic hepatic tumors, the first step is to determine whether the tumor has originated from the liver. The 'beak sign' and the 'prominent feeding artery sign' are useful for identifying the origin of the tumor (2). Two- or three-dimensional reformation images are also helpful. The second step is to recognize the specific imaging features of a tumor such as the dynamic enhancement pattern, fatty component, homogeneity, etc. The aim of this pictorial essay is to show the CT features of various exophytic hepatic tumors.

Benign Exophytic Hepatic Tumors

Hepatic Cyst

Most of the hepatic cysts identified on CT can be diagnosed with confidence. The CT features of simple hepatic cysts are a well-defined intrahepatic lesion, water attenuation, round shape, thin wall, no septation, absence of internal structure, and no enhancement after administration of contrast material (3). If a hepatic cyst demonstrates exophytic growth, it may be misinterpreted as a pancreatic (Fig. 1) or omental cystic mass (Fig. 2). If a cyst is seen adjacent to the liver, the possibility of exophytic hepatic cyst should be considered and careful evaluation of the coronal and sagittal reformation images is mandatory.

Hemangioma

The majority of hepatic hemangiomas identified on CT can be diagnosed accurately

by CT examinations alone from the characteristic imaging features of these lesions. On hepatic artery phase dynamic CT, they show peripheral nodular or globular enhancement (4). With time, contrast enhancement progresses centripetally (4). The reported incidence of exophytic hemangiomas was about 12% in cirrhotic patients (5). However, pedunculated hemangiomas are very rare (6). Pedunculated hemangiomas can be asymptomatic or can be complicated by torsion and infarction. Pedunculated exophytic hemangiomas may show a thin pedicle that contains a feeding artery and draining vein, and this pedicle connects the hemangioma to the liver (Fig. 3). Other usual exophytic hemangiomas just show the beak sign (Fig. 4).

Hepatocellular Adenoma

A hepatocellular adenoma is a rare benign tumor that is usually encountered in young women that use oral contraceptives. Macroscopically, a hepatocellular adenoma is a spherical, sometimes pedunculated, well demarcated, often encapsulated solitary liver tumor (7). Exophytic growth or

distortion of the hepatic contour was present in 25% of cases (8). Angiographically, a hepatocellular adenoma presents as a hypervascular mass with centripetal flow (9). On non-enhanced and enhanced CT images, adenomas are usually heterogeneous because of fatty infiltration, hemorrhage, and necrosis (7). Therefore, identification of the feeding artery and the heterogeneous attenuation on CT may provide clues for the diagnosis of an exophytic hepatic adenoma (Fig. 5).

Focal Nodular Hyperplasia

Focal nodular hyperplasia is the second most common benign neoplasm of the liver. It is more common in women and it is seen predominantly during the third and fifth decades of life. Grossly, a focal nodular hyperplasia is a well-circumscribed, solitary mass that is often located on the surface of the liver or is pedunculated (10). In one study, a subcapsular location was seen in 81% of cases and exophytic growth or distortion of the hepatic contour was seen in 32% of the cases (10). On dynamic CT, the lesion enhances brightly and homogeneously on hepatic arterial

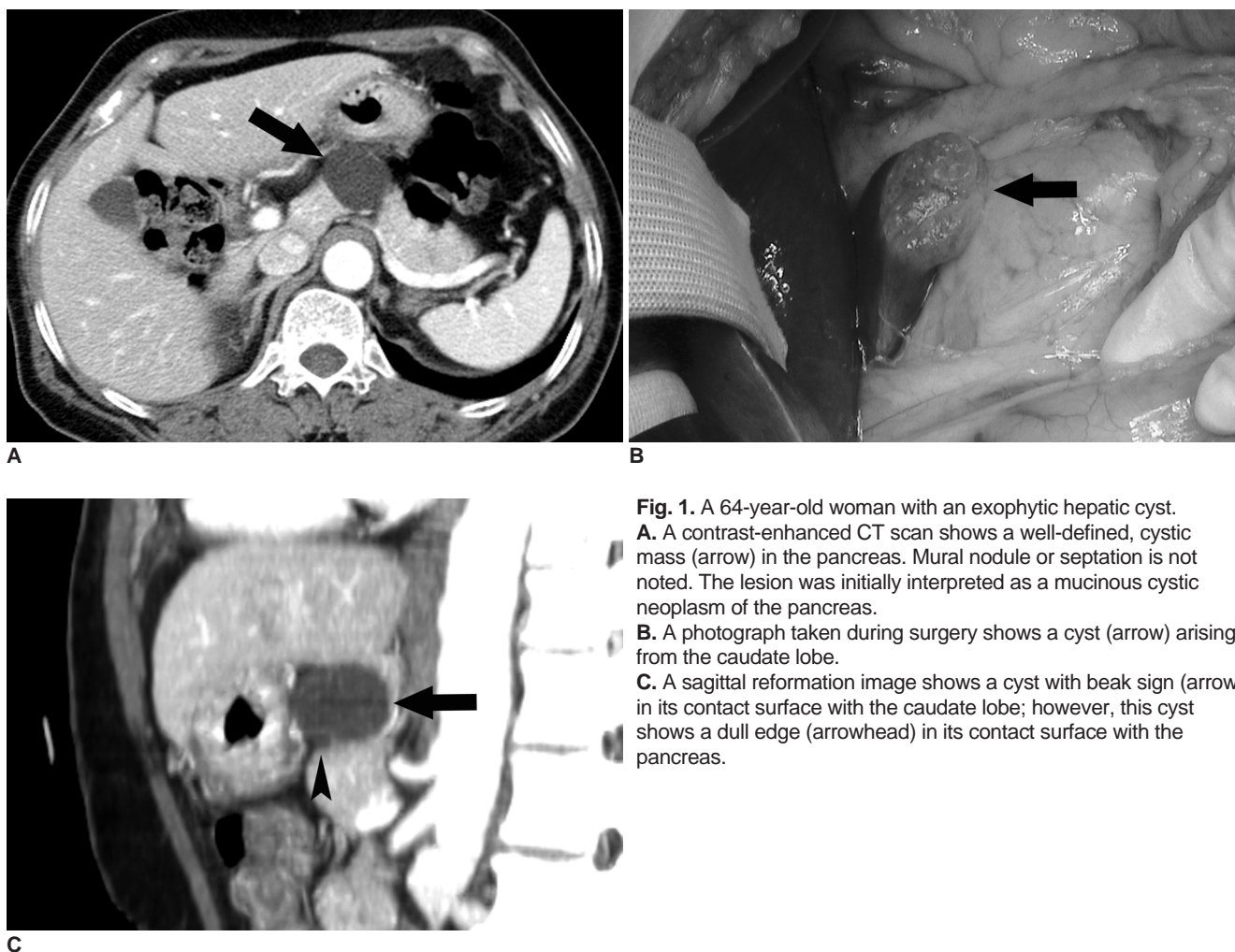
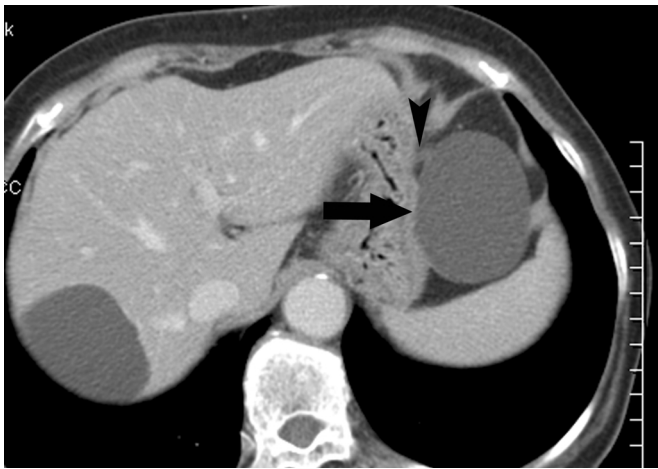
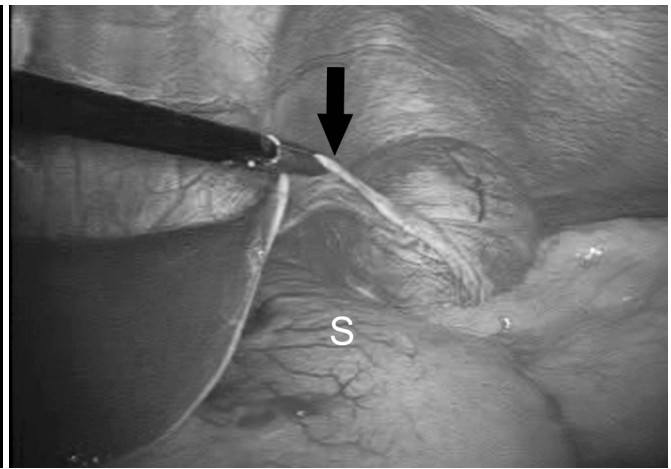


Fig. 1. A 64-year-old woman with an exophytic hepatic cyst. **A.** A contrast-enhanced CT scan shows a well-defined, cystic mass (arrow) in the pancreas. Mural nodule or septation is not noted. The lesion was initially interpreted as a mucinous cystic neoplasm of the pancreas. **B.** A photograph taken during surgery shows a cyst (arrow) arising from the caudate lobe. **C.** A sagittal reformation image shows a cyst with beak sign (arrow) in its contact surface with the caudate lobe; however, this cyst shows a dull edge (arrowhead) in its contact surface with the pancreas.

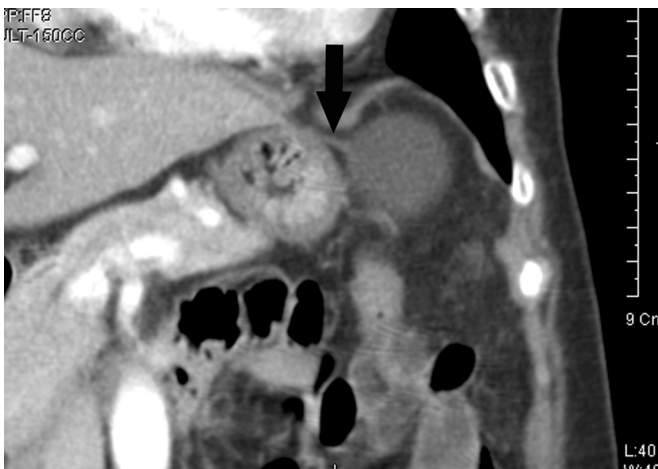
Exophytic Benign and Malignant Hepatic Tumors



A



B



C

Fig. 2. A 72-year-old woman with an exophytic hepatic cyst.
A. A contrast-enhanced CT scan shows a well-defined, cystic mass (arrow) adjacent to the greater curvature side of the stomach. Initially, the lesion was interpreted as an omental cyst, lymphangioma, or duplication cyst. Thin band-like opacity (arrowhead) is suspicious at the anteromedial aspect of the cystic mass.
B. A photograph taken during surgery shows a thin stalk (arrow) that connects the cyst with the lateral segment, crossing over the stomach (S).
C. A coronal reformation image shows a thin stalk (arrow) connecting the cyst with the lateral segment.



A



B

Fig. 3. A 53-year-old woman with a pedunculated hemangioma.

A. A contrast-enhanced CT scan during hepatic arterial phase shows a small nodular lesion (arrow) adjacent to the greater curvature side of the stomach. There is a vascular pedicle (arrowheads) connecting nodule with the lateral segment (prominent feeding artery sign). It shows dense peripheral enhancement.
B. A contrast-enhanced CT scan during portal venous phase shows centripetal enhancement of this small nodule (arrow).

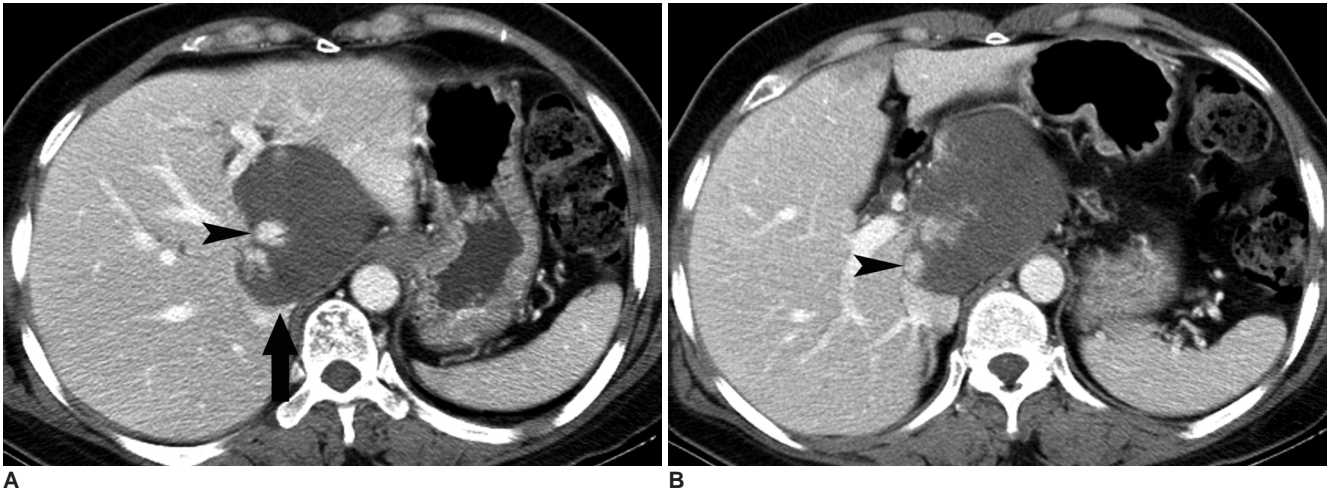


Fig. 4. A 51-year-old woman with an exophytic hemangioma. **A, B.** Contrast-enhanced CT scans show a large low density mass in the lesser sac. The beak sign is seen in its contact surface with the caudate lobe (arrow in **A**) and dense peripheral globular enhancement (arrowheads) is noted. A Tc-99m RBC scan (not shown) shows a blood pooling mass in the same location as on the CT image.

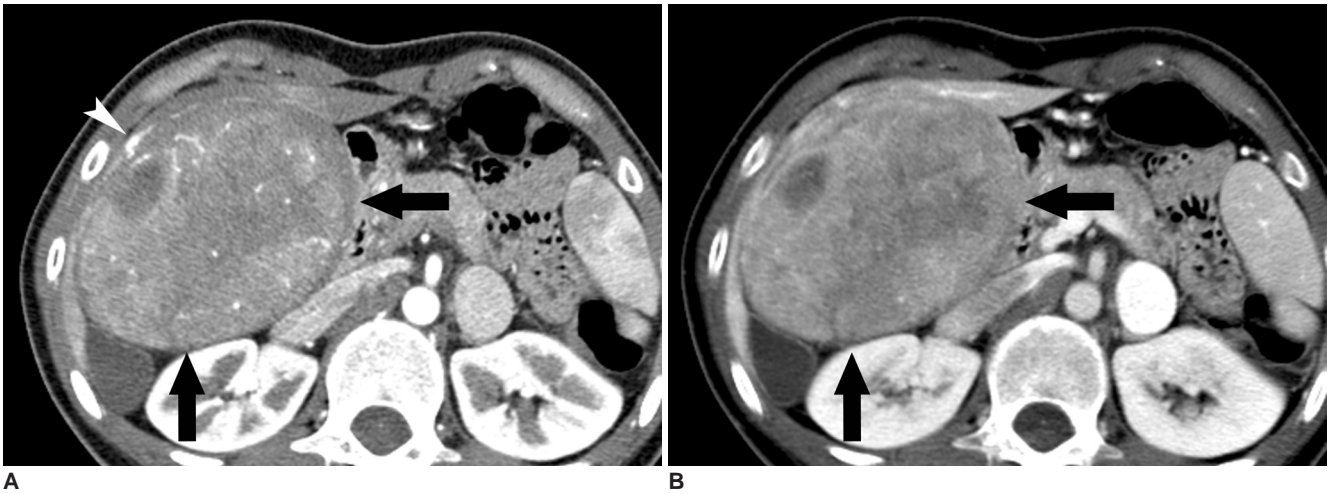
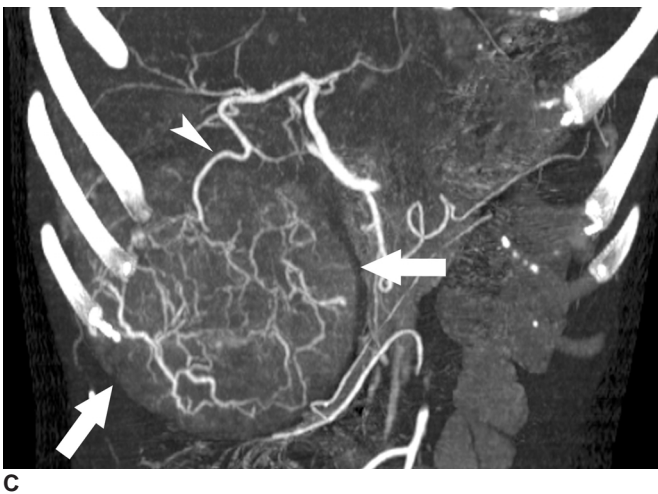


Fig. 5. A 23-year-old woman with an exophytic hepatocellular adenoma. **A.** A contrast-enhanced CT scan during hepatic arterial phase shows a heterogeneous and mild high-density mass (arrows), below the right lobe. Prominent subcapsular vessels are noted (arrowhead). The beak sign is not definite on serial axial images (not shown). **B.** On a contrast-enhanced CT scan during portal venous phase, the mass (arrows) shows persistent heterogeneity and a slightly decreased density. **C.** An oblique coronal maximum-intensity-projection image during hepatic arterial phase shows a large branch (arrowhead) from the right hepatic artery supplying this mass (arrows).



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phase, and it enhances similar to that of normal liver on portal venous phase and delayed phase images (10). Therefore, identification of the feeding artery, the homogeneity except for the central scar, and strong enhancement during hepatic arterial phase on CT images may provide clues for the diagnosis of an exophytic focal nodular hyperplasia (Fig. 6).

Angiomyolipoma

Hepatic angiomyolipomas are usually solitary and predominantly seen in women. Histologically, they are composed of smooth muscle, fat, and vessels in various

combinations. As far as we know, there is only one report describing a pedunculated or exophytic angiomyolipoma arising from the liver (11). Angiographically, angiomyolipomas are hypervascular and they may show aneurysms (12). Angiomyolipomas can have various CT appearances because of the variable fatty component that ranges between 5% and 90% (13). Identification of the feeding artery arising from the liver and the fatty component of the mass on CT may provide clues for the diagnosis of an exophytic angiomyolipoma (Fig. 7).

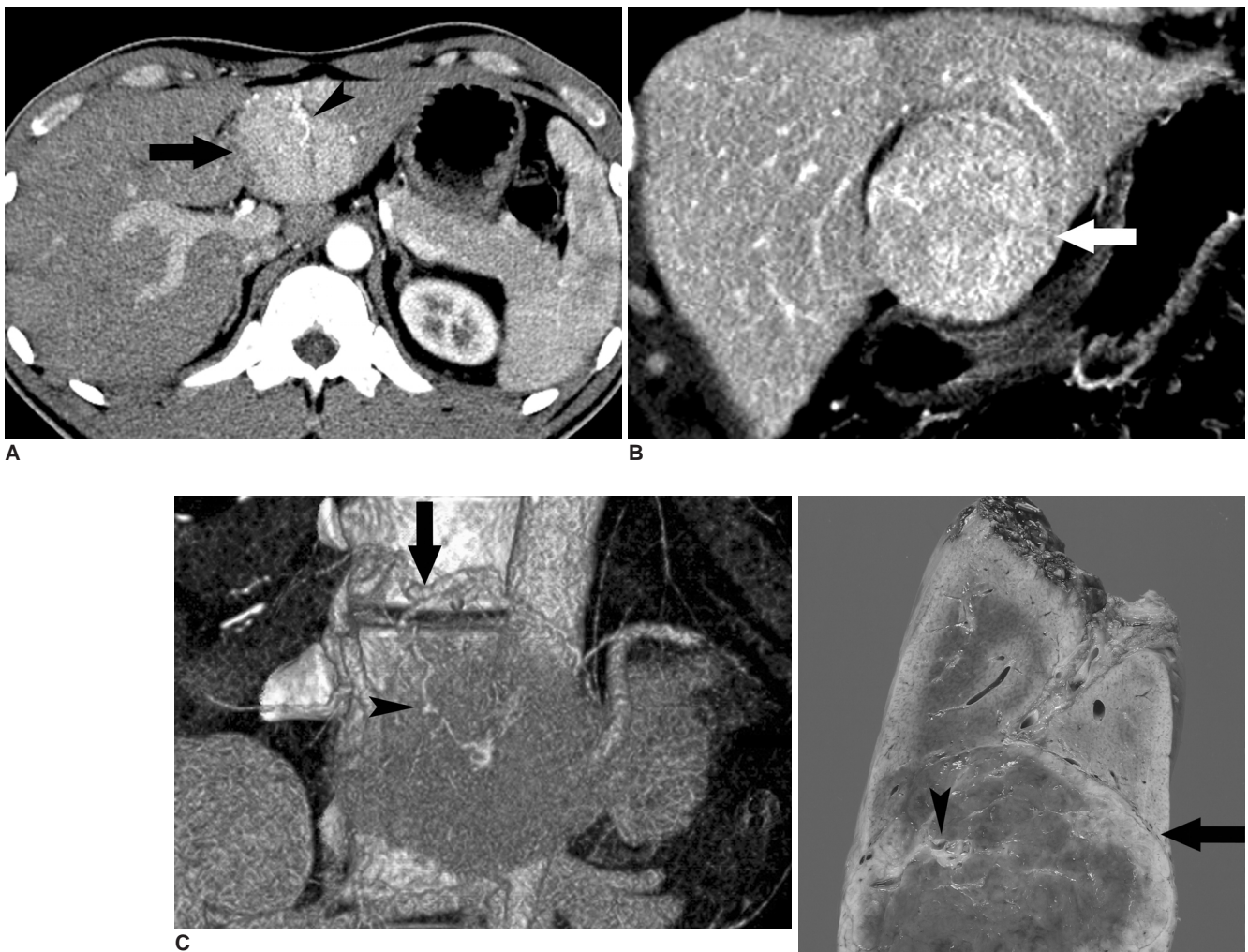
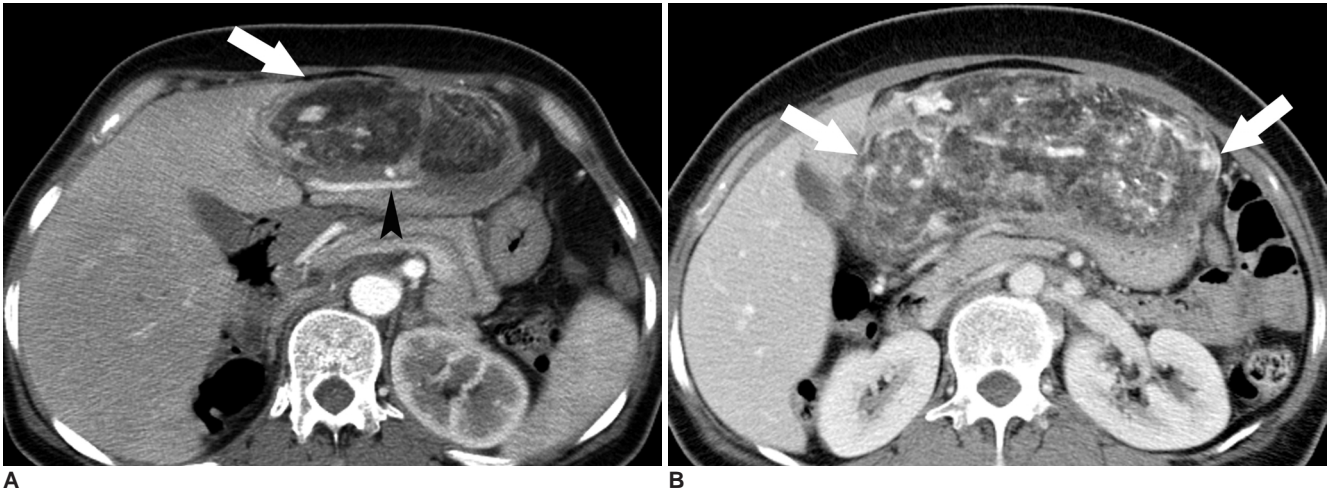
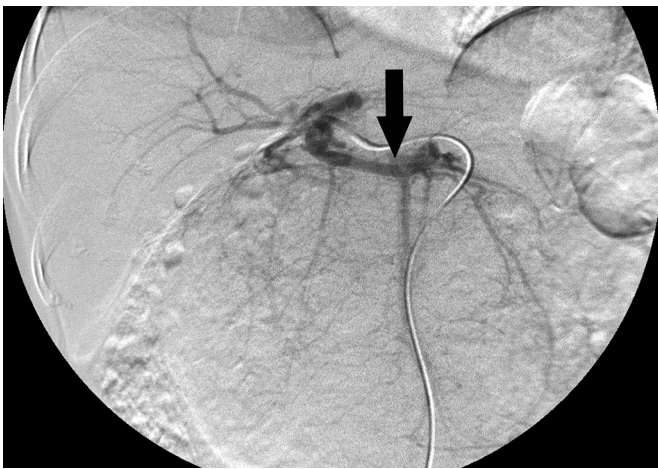


Fig. 6. A 26-year-old man with an exophytic focal nodular hyperplasia.
A. A contrast-enhanced CT scan during hepatic arterial phase shows a homogeneous high-density mass (arrow) in the left lobe. The feeding artery (arrowhead) is noted in the central portion of the mass.
B. On a coronal reformation image during the portal venous phase, the beak sign is noted in its contact surface with the lateral segment (arrow).
C. An oblique coronal volume rendering image during hepatic arterial phase shows a prominent left hepatic artery (arrow) and a small central artery (arrowhead) supplying this mass.
D. A pathological specimen shows the beak sign (arrow) in its contact surface with the lateral segment and a small central artery (arrowhead) within the fibrous scar.

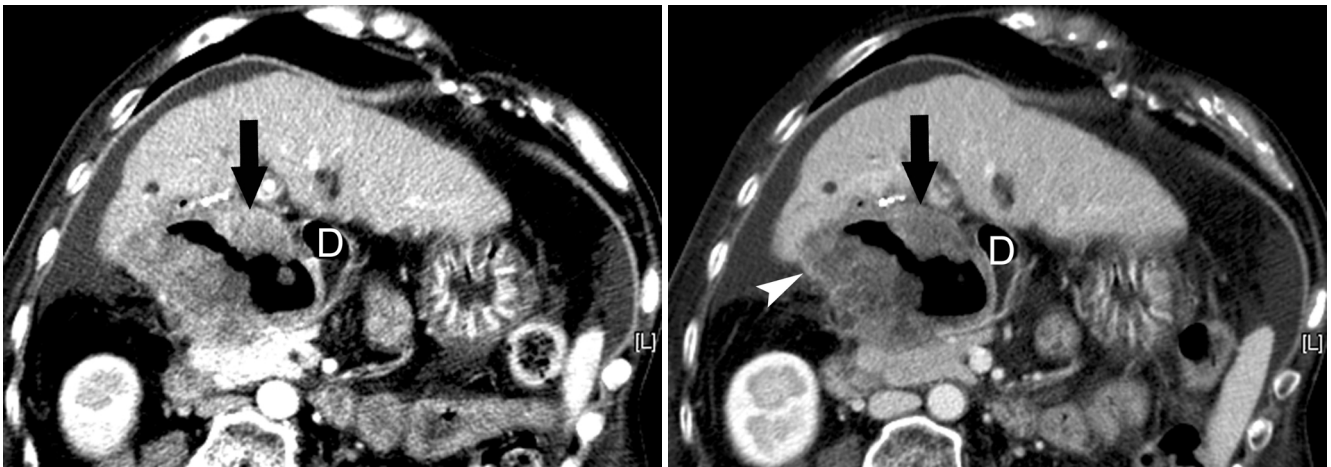


A **B**



C

Fig. 7. A 52-year-old woman with an exophytic angiomyolipoma. **A.** A contrast-enhanced CT scan during hepatic arterial phase shows a fatty mass in the lateral segment of the liver. This fatty mass shows the beak sign (arrow) in its contact surface with the lateral segment. The left hepatic artery (arrowhead) is enlarged and it is a prominent feeding artery supplying this fatty mass. **B.** On a contrast-enhanced CT scan during portal venous phase, 4 cm below (A), most of the huge fatty mass (arrows) is located in the peritoneal cavity. **C.** Hepatic arteriography shows a dilated left hepatic artery (arrow) and prominent tumor vessels.



A **B**

Fig. 8. A 57-year-old woman with an exophytic hepatocellular carcinoma with duodenal invasion. **A.** A contrast-enhanced CT scan during hepatic arterial phase shows a large necrotic mass, compressing the lateral wall of the duodenum (D). The solid portion of this mass (arrow) shows iso-density in comparison with the liver parenchyma. **B.** On a contrast-enhanced CT scan during portal venous phase, the solid portion of this mass (arrow) shows low density in comparison with the liver parenchyma. The beak sign (arrowhead) is noted in its contact surface with the right lobe. The fine nodular hepatic surface suggests liver cirrhosis. The lateral wall of the duodenum (D) is not definite.

Malignant Exophytic Hepatic Tumors

Hepatocellular Carcinoma

Hepatocellular carcinoma (HCC) is the most common primary malignant hepatic tumor. Exophytic growth or pedunculation is not a novel finding of HCCs. It has been reported that exophytic HCCs constitute 0.2–4.2% of all HCCs (14, 15). It is well known that HCC may show retroperitoneal extension and thus mimic a right adrenal tumor (16). However, exophytic growth of HCCs may be seen in any lobe or segment of the liver. This tumor may invade the duodenum and mimic a duodenal gastrointestinal stromal tumor (Fig. 8). Bile duct and portal vein invasion are late presentations in usual intrahepatic HCCs and they may be seen in exophytic HCCs. Most intraductal masses are contiguous with the parenchymal HCCs (17). Therefore, an exophytic hepatic mass contiguous with a

bile duct mass is a similar finding to a usual intrahepatic HCC with bile duct invasion, except for location (Fig. 9). On dynamic CT, an intraductal HCC shows high density during hepatic arterial phase and washout during portal venous phase. Therefore, typical enhancement pattern of HCC, surrounding cirrhotic liver, and bile duct dilatation by the mass may be clues for the diagnosis of an exophytic HCC.

Mass-forming Intrahepatic Cholangiocarcinoma

A mass-forming intrahepatic cholangiocarcinoma (peripheral cholangiocarcinoma) arises from the intrahepatic bile duct epithelium and grows into a focal mass. Grossly, this neoplasm consists of a peripheral zone of neoplastic cells without fibrosis and a fibrosed central zone due to a desmoplastic reaction provoked by the neoplastic cells (18). On dynamic CT, minimal to moderate peripheral enhancement is followed by progressive and concentric

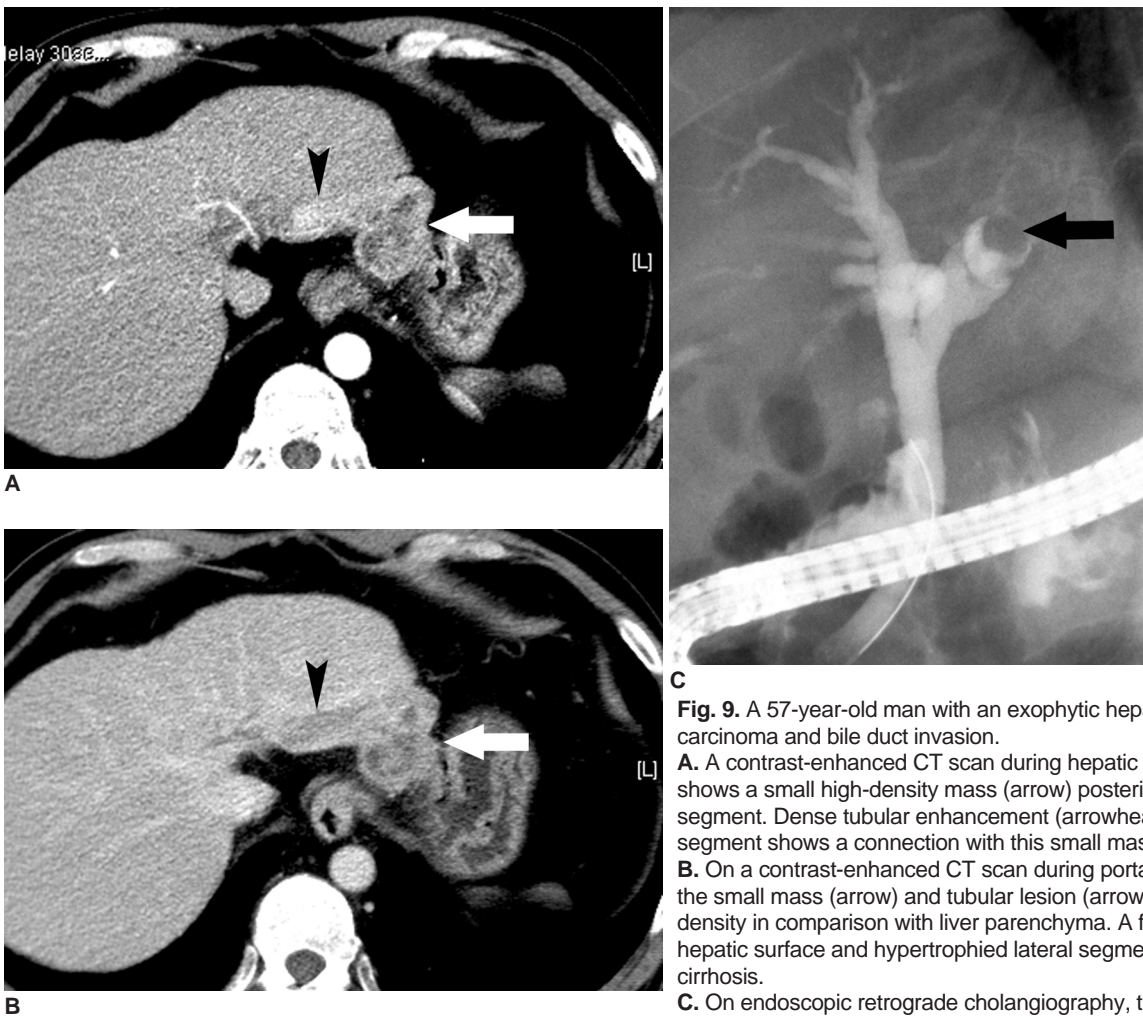


Fig. 9. A 57-year-old man with an exophytic hepatocellular carcinoma and bile duct invasion.
A. A contrast-enhanced CT scan during hepatic arterial phase shows a small high-density mass (arrow) posterior to the lateral segment. Dense tubular enhancement (arrowhead) in the lateral segment shows a connection with this small mass.
B. On a contrast-enhanced CT scan during portal venous phase, the small mass (arrow) and tubular lesion (arrowhead) shows low density in comparison with liver parenchyma. A fine nodular hepatic surface and hypertrophied lateral segment suggest liver cirrhosis.
C. On endoscopic retrograde cholangiography, there is a filling defect (arrow) in the B2 duct, which was seen as a tubular high density on hepatic arterial phase image (A). On surgery, it was confirmed as an exophytic hepatocellular carcinoma and bile duct invasion.

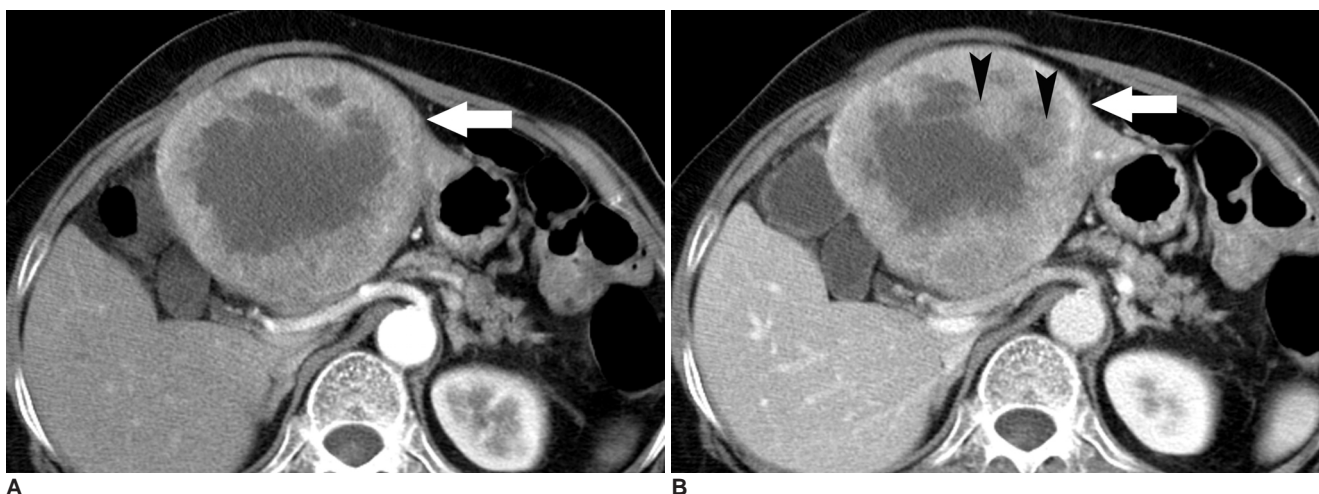


Fig. 10. A 66-year-old woman with an exophytic cholangiocellular carcinoma.

A. A contrast-enhanced CT scan during hepatic arterial phase shows a large mass with heterogeneous peripheral enhancement in the left lateral segment. It shows the beak sign (arrow) in its contact surface with the lateral segment.

B. A contrast-enhanced CT scan during portal venous phase shows centripetal progression of contrast enhancement (arrowheads) of this exophytic mass (arrow). On surgery, the lesion was confirmed as an exophytic cholangiocellular carcinoma.



Fig. 11. A 44-year-old man with exophytic hepatic metastasis from rectal cancer. A contrast-enhanced CT scan shows multiple low density masses in the liver of a patient with rectal cancer (not shown). A low density mass is seen adjacent to the lateral segment. The beak sign (arrow) is noted in its contact surface with the lateral segment.

filling of the tumor with contrast material (19). Any prominent feeding artery or draining vein is not noted in an exophytic cholangiocellular carcinoma, as this tumor is not highly vascularized. Therefore, its typical enhancement pattern, the surrounding non-cirrhotic liver, and the beak sign may be clues to reaching a correct diagnosis (Fig. 10).

Metastasis

Metastases are by far the most common malignant tumors of the liver. The CT appearance depends on the tumor size, the vascularity, and the degree of hemorrhage and necrosis. Although a single metastasis or oligonodular

involvement may be seen, multiple metastatic lesions are the general rule. If one considers that various benign and malignant hepatic tumors may show exophytic growth, it is not surprising that a metastasis may show exophytic growth. Multiplicity and a known or suspicious primary site are the keys to reach a correct diagnosis (Fig. 11).

CONCLUSION

Various benign and malignant hepatic tumors may show exophytic growth. The CT features of exophytic hepatic tumors are similar to those of their intrahepatic counterparts. If the tumors adjacent to the liver show CT features that are typical for hepatic neoplasms, then the exophytic hepatic tumors should be considered in a differential diagnosis and attention should be given to the clues implying a hepatic origin before making a final diagnosis.

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