Current staging of primary hepatic tumor: imaging implications

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Keywords: Staging, Primary hepatic tumors

1. Learning objectives

Providing an educational and pictorial review of radiologic staging of primary hepatic tumors. Discussing the potential extent of resection required in operable candidates.

2. Background

The resectability of primary hepatic tumors depends largely on the distribution of lesions in the liver and their relationships to vascular structures. Accurate delineation of the tumor extent poses a great challenge to modern imaging methods and MDCT as a single modality has the potential of comprehensively evaluate each patient for all the criteria of unresectability. It also has the potential of obviating the need for preoperative angiography in most cases. Magnetic resonance imaging (MRI) along with magnetic resonance cholangiopancreatography (MRCP) is ideally suited to evaluate the bile ducts and also identifies intrahepatic mass lesions.

3. Imaging findings OR Procedure details

INTRODUCTION:
We will review hepatocellular carcinoma and extrahepatic colangiocarcioma in separate. Current staging system will be presented and illustrated in a multimodality approach, focusing of the criteria of resectability with use of MDCT 3D reconstructions.

HEPATOCELLULAR CARCINOMA:

Hepatocellular carcinoma is one of the most common malignancies worldwide. Imaging plays a crucial role in the detection, diagnosis, staging, treatment, and surveillance of these patients. Reports to clinicians should include all pertinent diagnostic information for staging including **lesion size** and **number, location, presence of adenopathy, ascites, cirrhosis, vascular involvement, biliary tree involvement, and metastases**.

CT:

CT is highly accurate in the staging of HCC as the number of lesions [fig.1.jpg] (Fig.1) [fig.3.jpg] (Flg.3), segmental anatomy, regional adenopathy, vascular tumor invasion [fig.5.jpg] (Fig.5), and metastases. The evaluation of the liver in a patient with a clinical suspicion of HCC should be performed at three stages of contrast enhancement: the early arterial at 13-25 s, late arterial at 30-40 s, and portal venous phase at 45-60 s [fig.6.jpg] (Fig.6). HCC may appear as a single mass or as multifocal nodules [fig.1.jpg] (Fig.1) of variable sizes, and sometimes can be diffusely infiltrative. Most hypervascular HCCs are usually seen during the late hepatic arterial phase of contrast enhancement. Areas of internal necrosis or fat remain hypodense. As a consequence of rapid washout, the tumor will become hypodense compared with the liver parenchyma in the portal phase of contrast enhancement. Although most lesions are hyperdense in the early arterial phase of contrast enhancement, some may be isodense or hypodense compared with the liver. A heterogeneous pattern of enhancement has been termed the "mosaic" attenuation pattern and can often be caused by internal necrosis([fig.2.jpg] Fig.2).

MRI:

Similar to computed tomography, magnetic resonance imaging plays a role in staging, in the detection and number of lesions, their size, and vascular [fig.9jpg.jpg] (Fig.9) and biliary involvement [fig.8.jpg] (Fig.8). MR imaging also plays a critical role in postoperative treatment surveillance as recurrent tumor will demonstrate early enhancement and washout on the delayed phase. MRI can be

used as a modality to guide the treatment of HCCs not visualized by other modalities. Study (MRI) of HCC should include T1-weighted images, T2-weighted images with fat suppression, and dynamic contrast-enhanced 3D gradient-echo sequences of the liver. For T2-weighted sequences, a fast spin-echo sequence with fat suppression is performed. On T1-weighted sequences, hepatocellular carcinoma is usually hypointense-isointense to the liver. Areas of increased intensity may be due to fat, protein, or copper in the tumor. On T2-weighted sequences the tumor is usually hyperintense to the liver.

CRITERIA FOR HEPATIC RESECTION:

The usual criteria for hepatic resection in terms of the tumor status include:
- **absence of extrahepatic metastasis**
- absence of tumor thrombus in the inferior vena cava, main portal vein or contralateral hepatic artery invasion.
Although hepatic resection with removal of tumor thrombus in the inferior vena cava or main portal vein has been advocated by some authors, most liver surgeons consider the presence of tumor thrombus in the inferior vena cava ormain portal vein a contraindication for hepatic resection because the prognosis is usually poor even with such an aggressive approach. However, hepatic resection for patients with tumor invasion of the hepatic veins or major intrahepatic branches of the portal vein is justified because favorable survival results may be expected compared with nonsurgical treatment.

Occlusion of the portal vein:
Distinction between bland thrombus and tumor thrombus is not always feasible, but early enhancement within the thrombus is indicative of tumor [fig.7.jpg] (Fig.7). Occlusion of the portal vein can lead to cavernous transformation [fig.9jpg.jpg] (Fig.9). CT also plays a major role in post-treatment evaluation, surveillance, guidance for biopsy, and assessing regeneration of liver parenchyma The added speed and flexibility of multidetector CT allows high-quality, thin-section imaging and permits three-dimensional reconstruction for preoperative vascular mapping.

CHOLANGIOCELLULAR CARCINOMA

Cholangiocarcinoma is the most common malignant bile duct and the second most common primary malignant tumor in the liver. It can be classified as intrahepatic (peripheral) or extrahepatic. Extrahepatic cholangiocarcinomas originate most often from the main hepatic duct and confluence (referred to as Klatskin tumor). Prognosis of hilar cholangiocarcinoma is poor, because most tumors are unresectable at the time of diagnosis. ERCP demonstration of Klatskin tumors is often incomplete due to incomplete filling of bile ducts peripheral to the stenosis. MR imaging and helical CT are the methods of choice in the diagnosis and staging of hilar cholangiocarcinoma.

CT:

Multi-phasic contrast-enhanced thin-section helical CT may show Klatskin tumors with a sensitivity of up to 100% [fig.11.jpg] (Fig.11) [fig.12.jpg] (Flg.12). Tumors are better seen on arterial-dominant phase than on portal venous phase scans [fig.10.jpg] (Fig.10). With CT the extent of bile duct involvement may be better displayed due to multi-planar imaging capabilities. Curved planar reconstruction of multi-slice CT data sets along the portal vein and the bile ducts reveal tumor involvement [fig.13.jpg] (Fig.13).

MRI:

Magnetic resonance imaging (MRI) along with magnetic resonance cholangiopancreatography (MRCP) is ideally suited to evaluate the bile ducts above and below a stricture and also identifies intrahepatic mass lesions. Because of their intrinsic high tissue contrast and multiplanar capability, MRI and MRCP are able to detect and preoperatively assess patients with cholangiocarcinoma, investigating all involved structures, such as the bile ducts, vessels, and hepatic parenchyma. Extrahepatic cholangiocellular carcinoma frequently presents in advanced unresectable stages. MR cholangiography in conjunction with MRI and MRA provides information of tumor size, bile duct involvement, and vascular compromise, and thus, resectability of the tumor. MR cholangiography is useful in depicting the severity of intrahepatic duct dilatation as well as the site and extent of the stricture ([fig.14.jpg] Fig.14) ([fig.15.jpg] Fig.15). Furthermore, MR cholangiography can delineate dilated bile duct segments that are not opacified at conventional cholangiography. On T1-weighted MR images, hilar cholangiocarcinomas are typically hypo- or isointense relative to liver parenchyma. Their appearance on T2-weighted images is variable. Scirrhous tumors tend to demonstrate low signal intensity centrally and variable high signal intensity peripherally, whereas well-differentiated cholangiocarcinomas may exhibit higher signal intensity on T2-weighted images

CRITERIA FOR RESECTABILITY:

Criteria for resectability usually include:

- contralateral hepatic artery invasion ([fig.13.jpg] Fig.13)

- segmental main or contralateral portal vein invasion longer than 2 cm - biliary extension to the contralateral secondary confluence farther than 2 cm from the hepatic hilum

- enlarged lymph nodes at the right side of the celiac axis and portacaval area

- peritoneal seeding

4. Conclusion

The role of imaging, particularly volumetric MDCT is crucial in preoperative staging and determining resectability of primary hepatic cancer. Adequate preoperative staging affects the therapeutic management and outcome of patients.

5. References

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7. Mediafiles

fig.1.jpg

Fig.1: Multifocal hepatocarcinoma. Axial contrast-enhanced CT demonstrates various nodules with homogeneous arterial enhancement

fig.2.jpg

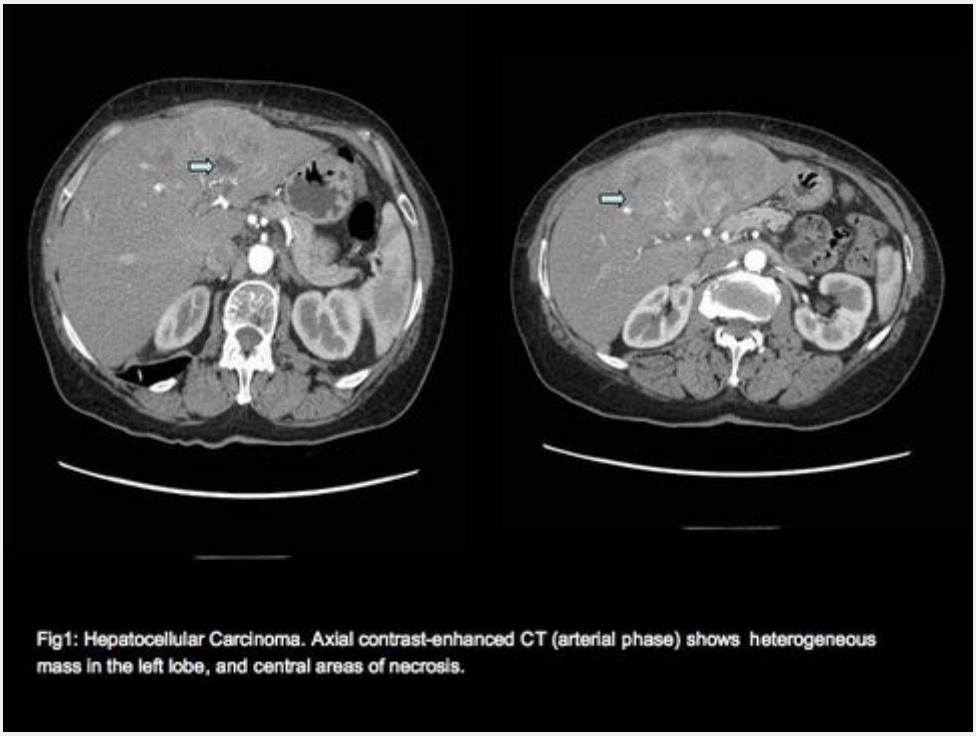

Fig1: Hepatocellular Carcinoma. Axial contrast-enhanced CT (arterial phase) shows heterogeneous mass in the left lobe, and central areas of necrosis.

fig.3.jpg

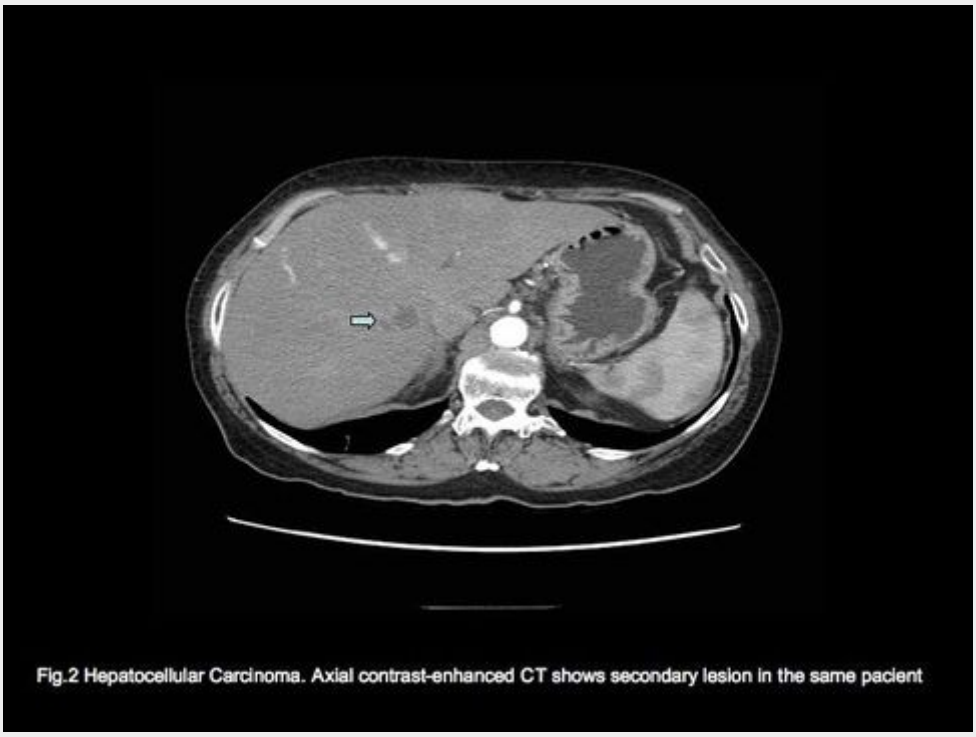

Fig.2 Hepatocellular Carcinoma. Axial contrast-enhanced CT shows secondary lesion in the same pacient

fig.4.jpg

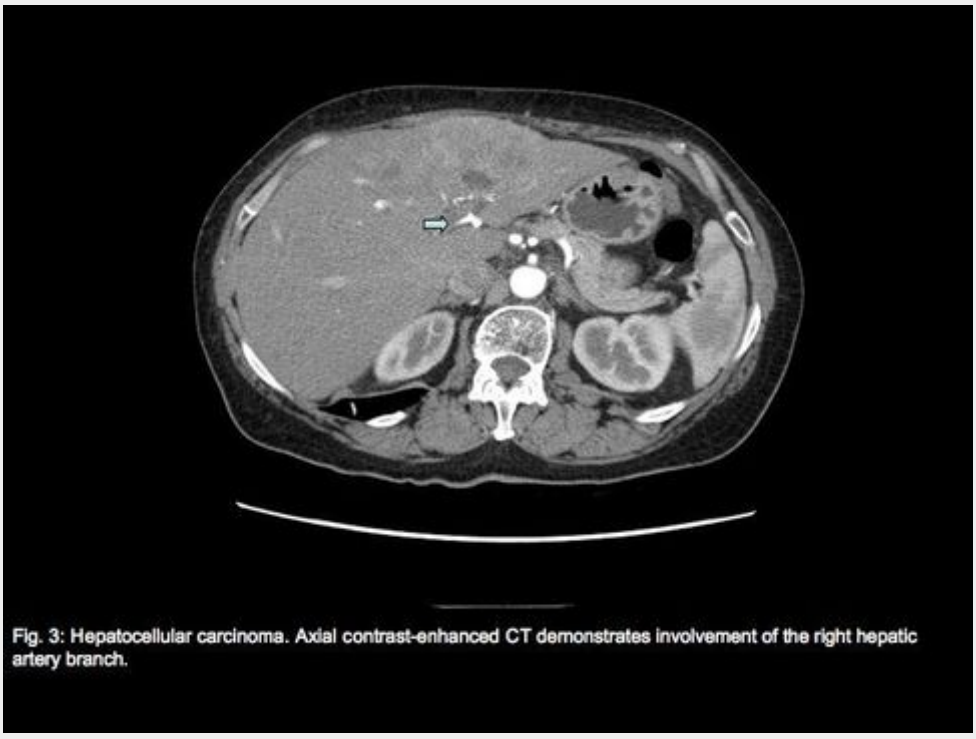

Fig. 3: Hepatocellular carcinoma. Axial contrast-enhanced CT demonstrates involvement of the right hepatic artery branch.

fig.5.jpg

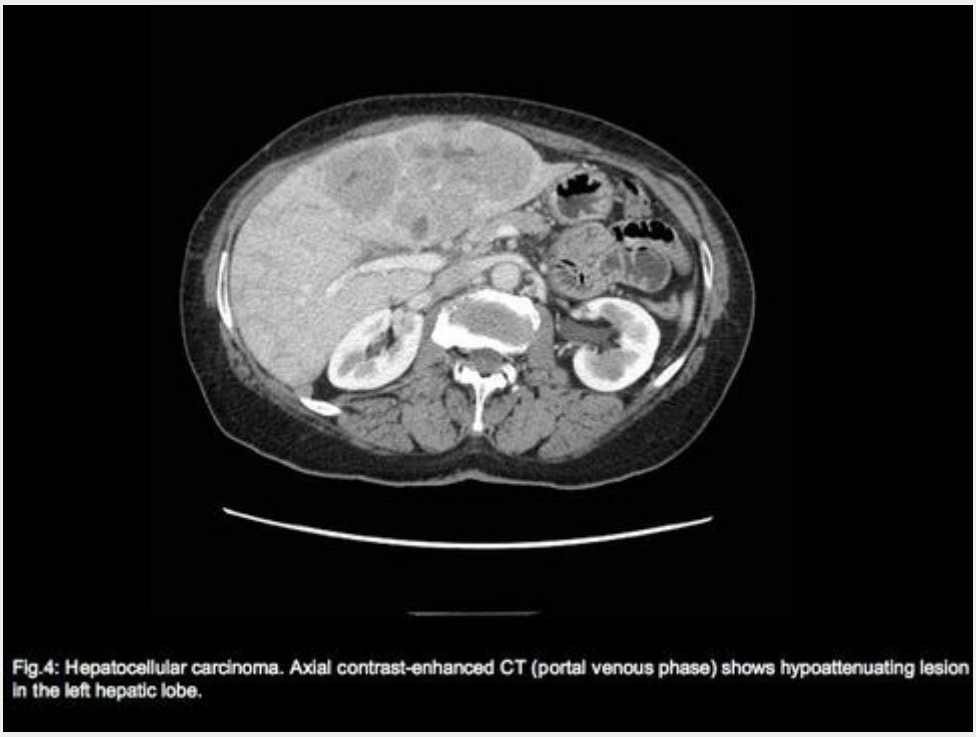

Fig.4: Hepatocellular carcinoma. Axial contrast-enhanced CT (portal venous phase) shows hypoattenuating lesion in the left hepatic lobe.

fig.6.jpg

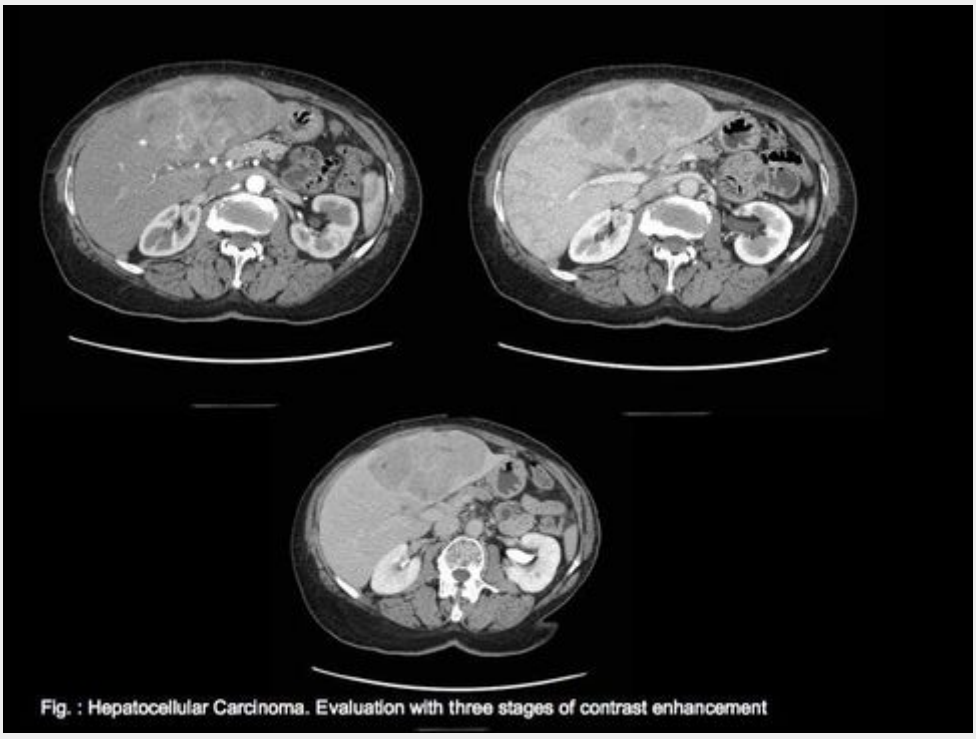

Fig. : Hepatocellular Carcinoma. Evaluation with three stages of contrast enhancement

fig.7.jpg

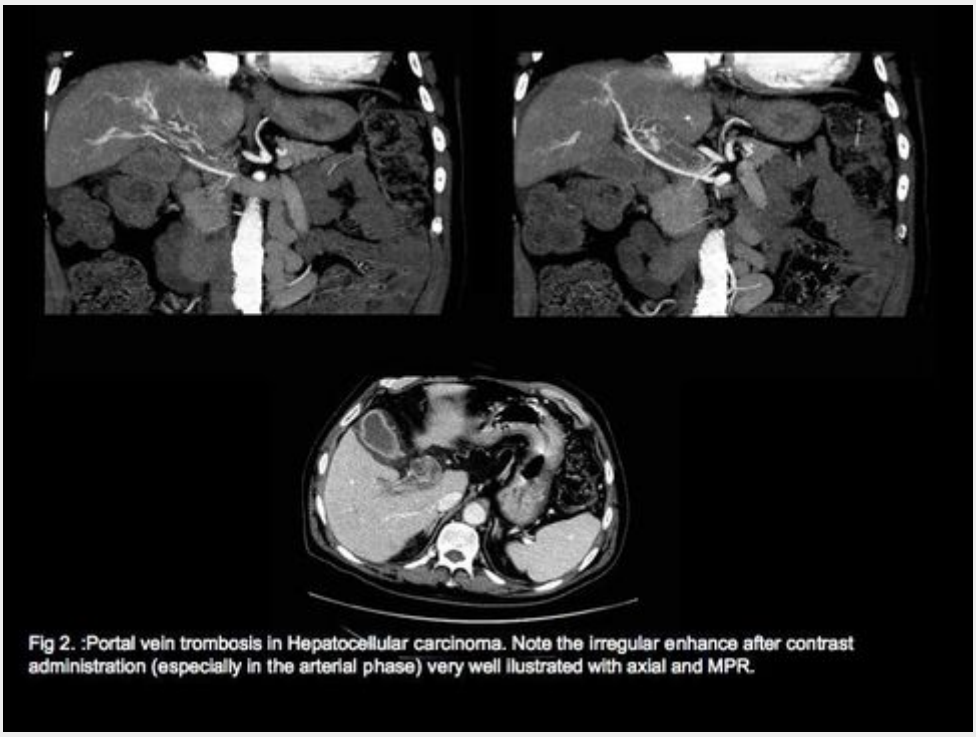

Fig 2. :Portal vein trombosis in Hepatocellular carcinoma. Note the irregular enhance after contrast administration (especially in the arterial phase) very well ilustrated with axial and MPR.

fig.8.jpg

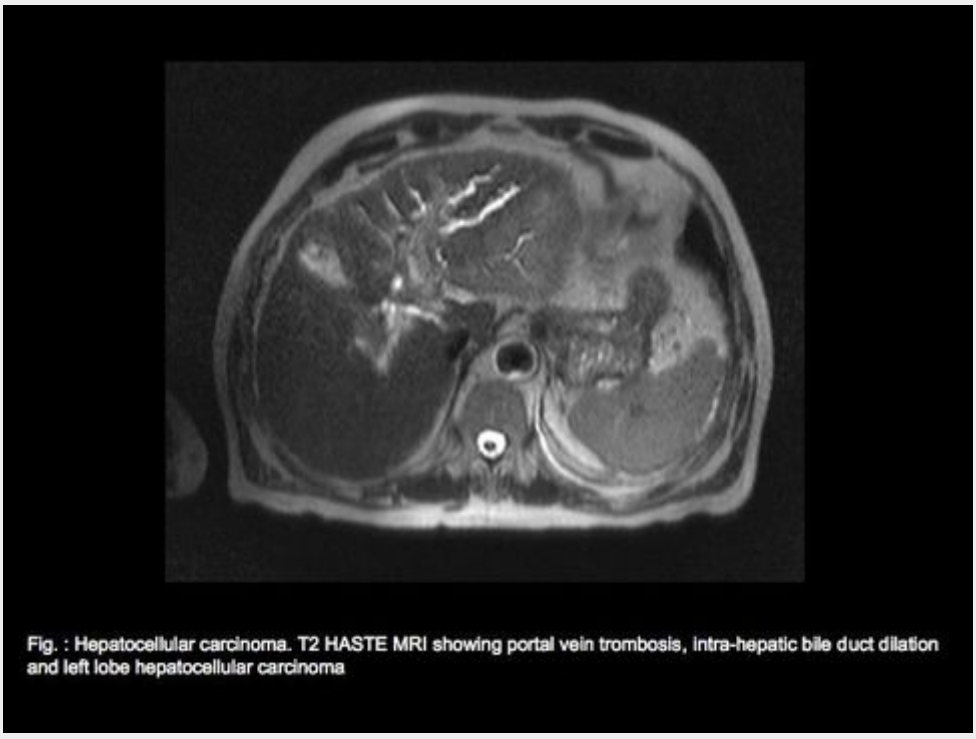

Fig. : Hepatocellular carcinoma. T2 HASTE MRI showing portal vein trombosis, intra-hepatic bile duct dilation and left lobe hepatocellular carcinoma

fig.9jpg.jpg

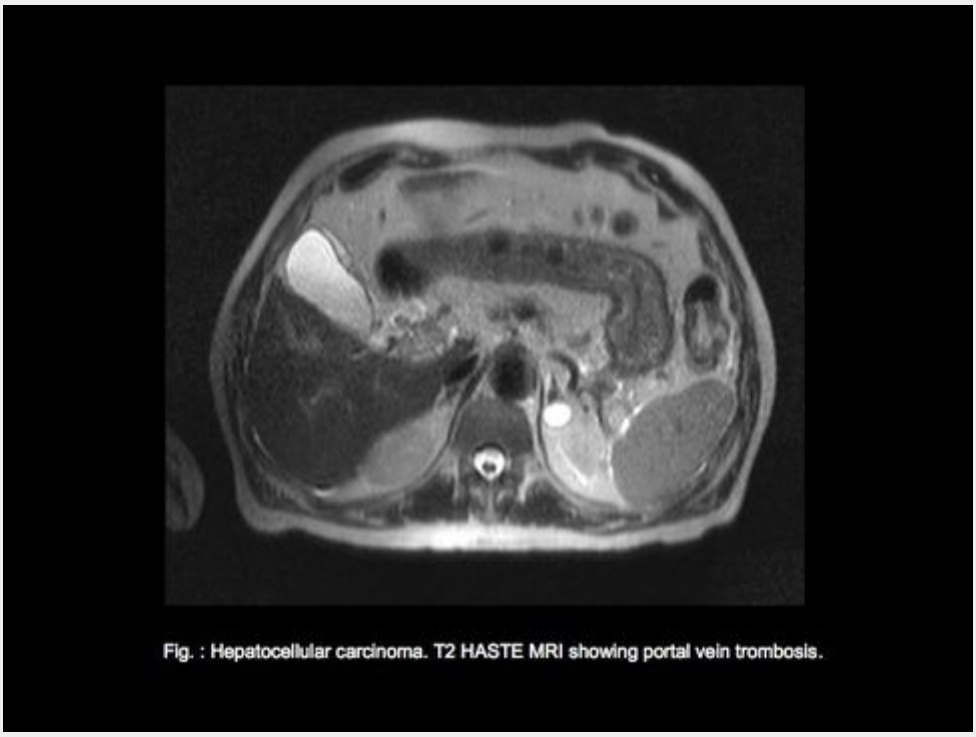

Fig. : Hepatocellular carcinoma. T2 HASTE MRI showing portal vein trombosis.

fig.10.jpg

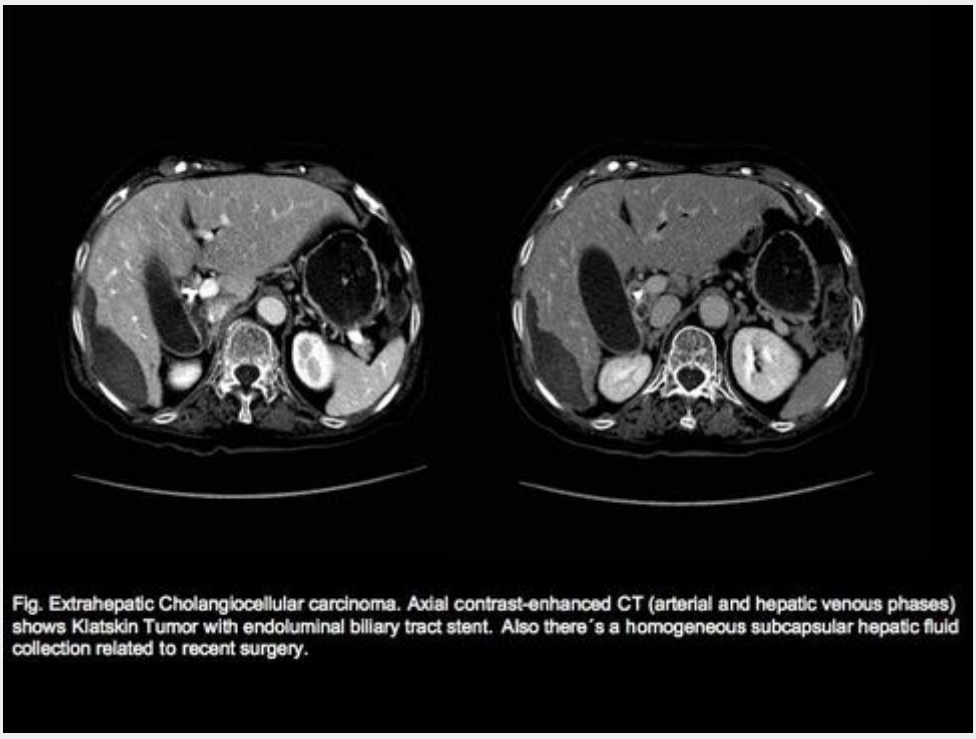

Fig. Extrahepatic Cholangiocellular carcinoma. Axial contrast-enhanced CT (arterial and hepatic venous phases) shows Klatskin Tumor with endoluminal biliary tract stent. Also there´s a homogeneous subcapsular hepatic fluid collection related to recent surgery.

fig.11.jpg

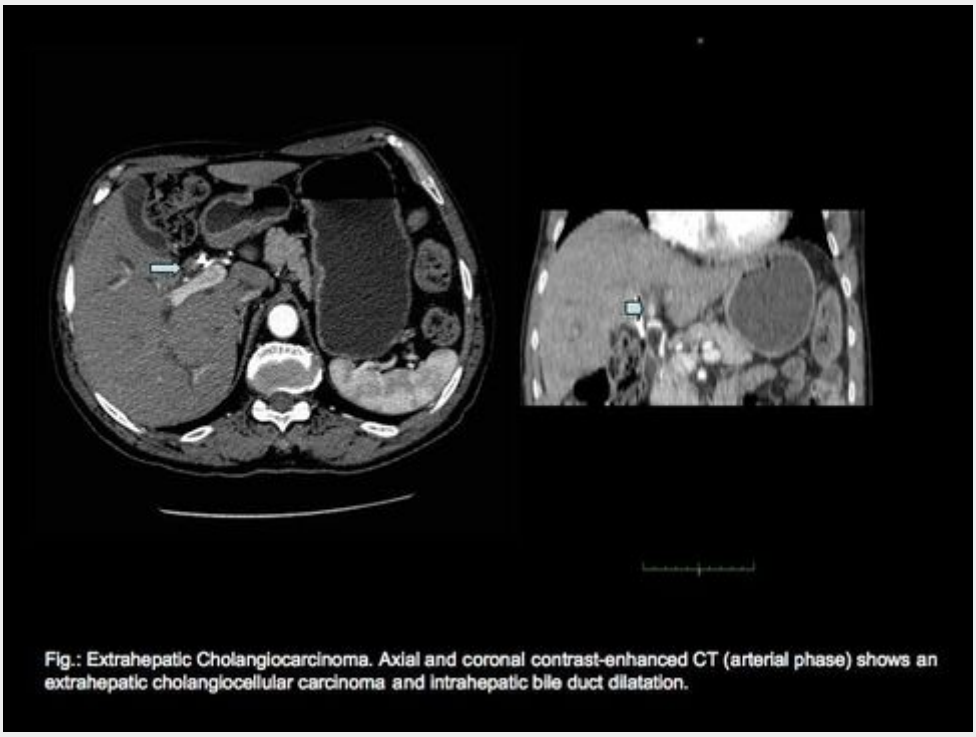

Fig.: Extrahepatic Cholangiocarcinoma. Axial and coronal contrast-enhanced CT (arterial phase) shows an extrahepatic cholangiocellular carcinoma and intrahepatic bile duct dilatation.

fig.12.jpg

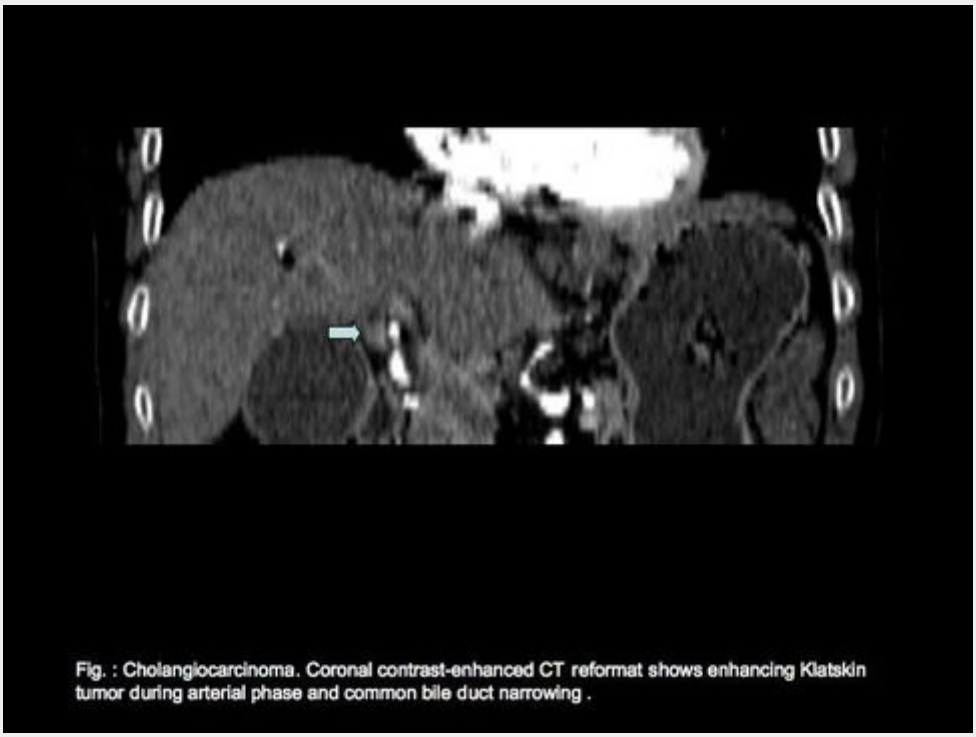

Fig. : Cholangiocarcinoma. Coronal contrast-enhanced CT reformat shows enhancing Klatskin tumor during arterial phase and common bile duct narrowing .

fig.13.jpg

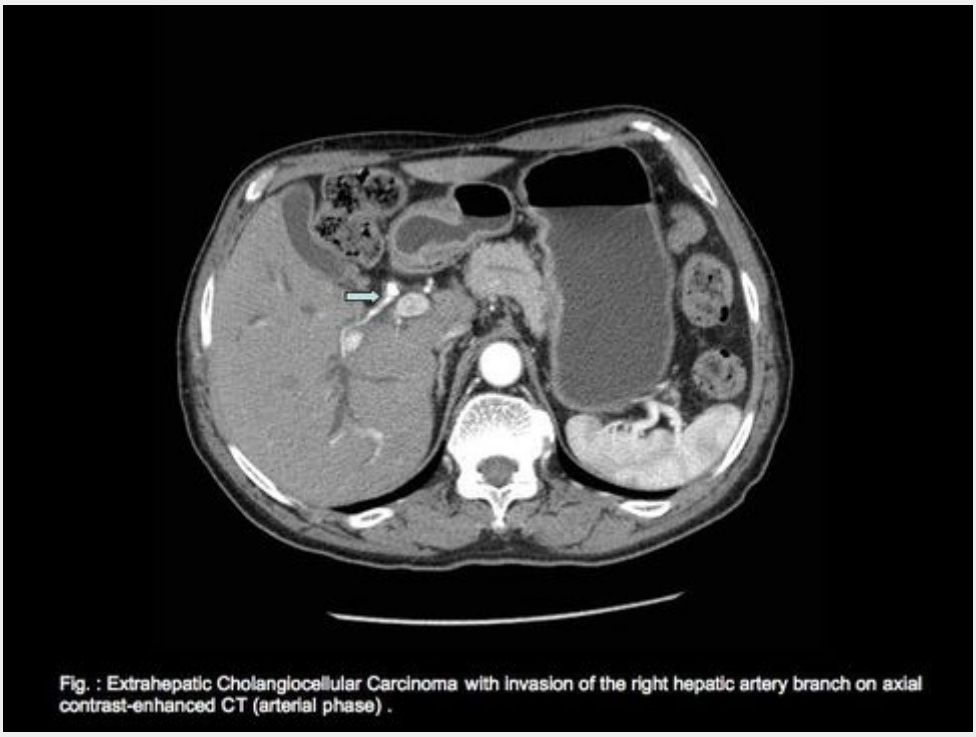

Fig. : Extrahepatic Cholangiocellular Carcinoma with invasion of the right hepatic artery branch on axial contrast-enhanced CT (arterial phase) .

fig.14.jpg

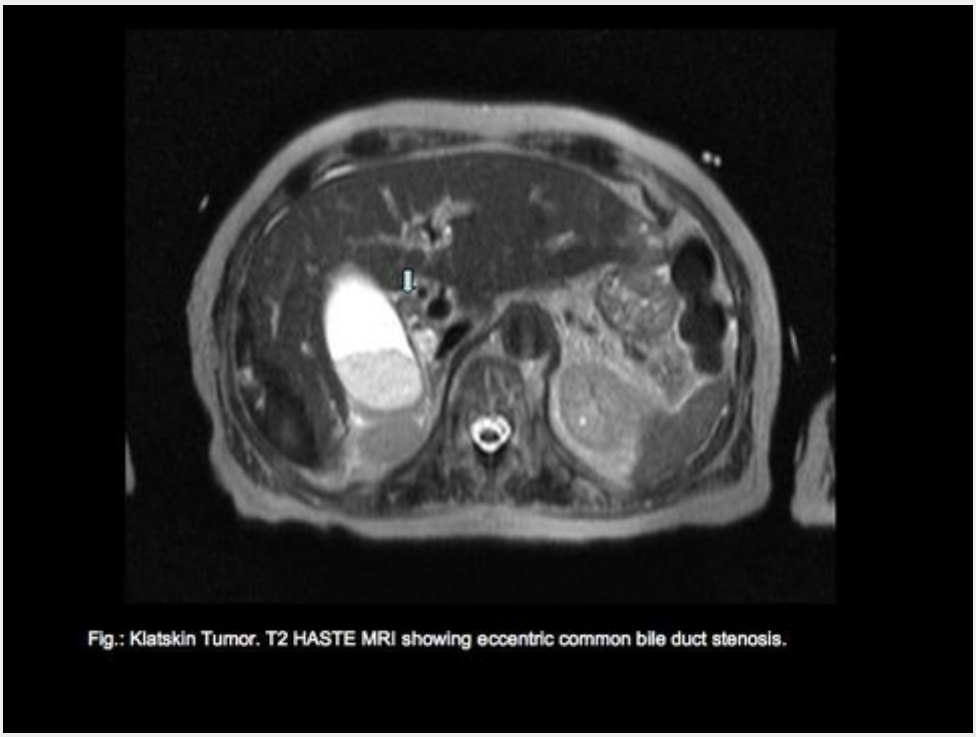

Fig.: Klatskin Tumor. T2 HASTE MRI showing eccentric common bile duct stenosis.

fig.15.jpg

Fig.: Klatskin Tumor. VRT and MIP reformation shows common bile duct stenosis.