IMAGING CHARACTERISTICS OF HEPATOCELLULAR CARCINOMA

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Primary liver tumor, typically in setting of chronic liver disease
- Viral hepatitis (HBV, HCV) in 80% of cases

2nd leading cause of cancer death worldwide
- North America: 3 per 100,000 incidence, 3:1 male predominance

Often diagnosed late: no pathognomonic clinical symptoms, no sensitive lab tests, large functional reserve of liver
- Typically presents as exacerbation of chronic liver disease

Median survival 6-20 months
- Smaller size, absent metastases on detection associated with improved survival
Review: Liver anatomy

Source: “Segmental Anatomy of the Liver”
64 year-old man

- Diagnosed with Hepatitis C ten years ago
  - Unresponsive to interferon and ribavirin
- Last year: Staphylococcal infection complicated by encephalopathy

Considering his risk profile, what is the typical next step?
- Screening ultrasound at 6-month interval
In this case, our patient underwent a CT scan for an unrelated condition.

Continue to review this baseline CT.
Our patient: Viral cirrhosis on CT

- Findings: There is a nodular liver edge, consistent with cirrhosis from chronic viral hepatitis.
Findings: There is prominent splenomegaly as a result of cirrhotic portal hypertension
Our patient, 6 months later: Hepatocellular carcinoma on C-CT

Non-contrast

- Please continue to view all contrast-enhanced phases
Our patient, hepatocellular carcinoma on CT: Arterial phase

Non-contrast

Arterial phase

• Image findings in arterial phase: tumor enhancement due to increased arterial supply compared to rest of liver
Our patient, hepatocellular carcinoma on CT: Venous phase

- Non-contrast
- Arterial phase

- Image findings in portal venous phase: hypodense (or isodense) lesion
Our patient, hepatocellular carcinoma on CT: Delayed phase

Non-contrast

Arterial phase

Venous phase

Delayed phase
HCC: pathophysiologic basis of CT findings

- HCC classically receives its vascular supply from the hepatic artery, while normal liver parenchyma receives 80% of its perfusion from the portal vein.

- This results in arterial phase hypervascularity, and venous/delayed phase washout.


HCC: review of classic CT findings

- **Non-contrast CT**: hypodense masses relative to normal liver  
  - May be hyperdense relative to fatty liver
- **Arterial phase**: tumor enhancement, +/- hypodense capsule  
  - Malignant portal venous thrombus may be seen
- **Portal venous phase**: hypodense (or isodense)
- **Delayed phase**: allows more time for arterial washout, improves sensitivity

The patient underwent an MRI to further characterize this mass.

Continue to review the MRI findings.
Our patient, hepatocellular carcinoma on MRI: T1 pre-contrast

- Please continue to view all MRI phases and image findings
Our patient, hepatocellular carcinoma on MRI: T2 arterial phase

- Please continue to view all MRI phases and image findings
Our patient, hepatocellular carcinoma on MRI: T2 delayed phase

- Arterial hypervascularity, venous phase washout
HCC: classic MRI findings

• We have seen an example of arterial hypervascularity and venous phase washout on MRI
  • This is analogous to the findings on triple-phase CT

• HCC characteristics on MRI:
  • Mildly hyperintense on T2 weighted MRI
  • Hypointense on T1 weighted MRI

• MRI is better than CT/US for detecting HCC in very cirrhotic livers
Our patient, hepaticellular carcinoma on MRI: second suspicious focus

This separate 5 mm segment VIII focus of arterial enhancement with delayed washout is also concerning for hepaticellular carcinoma.
Our patient, hepatocellular carcinoma on MRI: tumor thrombus

The traversing right portal vein is thrombosed, with minimal internal enhancement raising concern for tumor thrombus.
The patient underwent ultrasound-guided biopsy of the mass.

Continue to review the ultrasound findings.
There is an ill-defined, heterogeneous, hypoechoic mass seen within segment V of the right lobe of the liver.
The vascular supply of the lesion may be seen on Doppler imaging.
Not all HCC is hypoechoic. This companion patients demonstrates a large hyperechoic mass due to HCC
Companion patient #2: HCC and portal venous invasion on Doppler exam

- This color Doppler flow image shows **left portal vein thrombus** due to portal venous invasion by HCC

HCC: classic ultrasound findings

- Poorly-defined margins, coarse/irregular internal echoes
  - Small (<3cm) tumors are classically hypoechoic due to homogeneous structure
    - Thin fibrous capsule
    - Acoustic enhancement
  - Large tumors may be hyperechoic/heterogeneous
    - This is due to necrosis, hemorrhage, fatty change, interstitial fibrosis, and sinusoidal dilatation
Our patient: ultrasound-guided needle biopsy of HCC

- The needle tract is visible on ultrasound during biopsy of this lesion.
Our patient: portacaval lymph node on staging CT
Our patient: porta hepatitis lymph node on staging CT
Our patient, hepatocellular carcinoma on staging CT: second suspicious focus
Our patient, hepatocellular carcinoma on staging CT: tumor thrombus
Abnormal enhancement and washout involving the right lobe of the liver centering on segment V and VI though tracking superiorly to involve segment VII, concerning for infiltrative hepatocellular carcinoma.

Transverse right portal venous branch thrombosis, possible minimal thrombosis in the right anterior portal veins.

Separate 5 mm segment VII focus of arterial enhancement with delayed washout is also concerning for a delayed disease focus.

Periportal lymphadenopathy, most prominent at porta hepatis and portacaval stations.

No evidence of distant metastatic disease within the chest or pelvis.
Multiple staging systems are used (TNM, Okuda, CLIP, Barcelona, French); none has been universally adopted.

Source:
Via UpToDate.
HCC: treatment options

- Surgical resection
- Liver transplantation
- Radiofrequency ablation
- Percutaneous ethanol/acetic acid ablation
- Transarterial chemoembolization
- Cryoablation
- Radiation therapy
- Systemic therapy (sorafenib, chemotherapy)
Our patient underwent transarterial chemoembolization: Injection of a mixture of 60 mg doxorubicin and 15 mL Lipiodol, 20 mL 1% lidocaine and Gelfoam in various steps.
HCC: why is surveillance imaging important?

- Ultrasound surveillance for HCC every 6 months improves survival in chronic viral hepatitis
HCC: who should be screened?

- Patients with stage 4 biliary cirrhosis, genetic hemachromatosis-related cirrhosis, and alpha-1 antitrypsin deficiency-related cirrhosis should also be screened for HCC.
Nonviral cirrhosis $\rightarrow$ **nodular** (well defined margin, expansive growth)  

HBV/HCV $\rightarrow$ **infiltrating** (poorly defined margin, infiltrating growth)

Companion patients 3 and 4: HCC etiology may influence radiographic appearance

Nonviral cirrhosis $\rightarrow$ nodular (well defined margin, expansive growth)  
HBV/HCV $\rightarrow$ infiltrating (poorly defined margin, infiltrating growth)

Ultrasound is usually preferred for screening

Multiple imaging modalities often are needed due to cirrhotic liver

- **Distortion of architecture** (fibrosis, necrosis, regenerating nodules)
- **Altered portal hemodynamics** for IV contrast

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<tr>
<th>Imaging Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Ultrasound</td>
<td>60%</td>
<td>97%</td>
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<tr>
<td>CT</td>
<td>68%</td>
<td>93%</td>
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<tr>
<td>MRI</td>
<td>81%</td>
<td>85%</td>
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Why is Ultrasound Used for Screening?

• Widely available, noninvasive, inexpensive

• Other advantages:
  • Assess for *intralesional blood flow*
  • Assess for *tumor thrombus*
    • Portal vein, hepatic veins, IVC
    • Worst prognostic factor for recurrence
  • Guidance for biopsy

• Disadvantages:
  • Cannot distinguish between HCC and other solid tumors
  • Some lesions are isoechoic
  • May be obscured by right diaphragm, bowel gas, adiposity
HCC: Alternative modalities

- **Angiography**
  - Invasive, reserved for interventions (chemoembolization, hemorrhage control)

- **PET-CT**
  - Greater sensitivity for distant metastases
  - Only 55-65% of HCC is FDG-avid on PET-CT
    - Normal liver also uptakes FDG
Diagnosis may be made on CT/MRI alone

Risks associated with biopsy: bleeding, tumor seeding along needle tract

A negative biopsy does not rule out HCC, and requires further imaging follow-up

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Everything that we see
is a shadow cast
by that which we do not see.

- Martin Luther King, Jr.

References


