

# Selecting the Correct Protocol for Body Imaging Studies

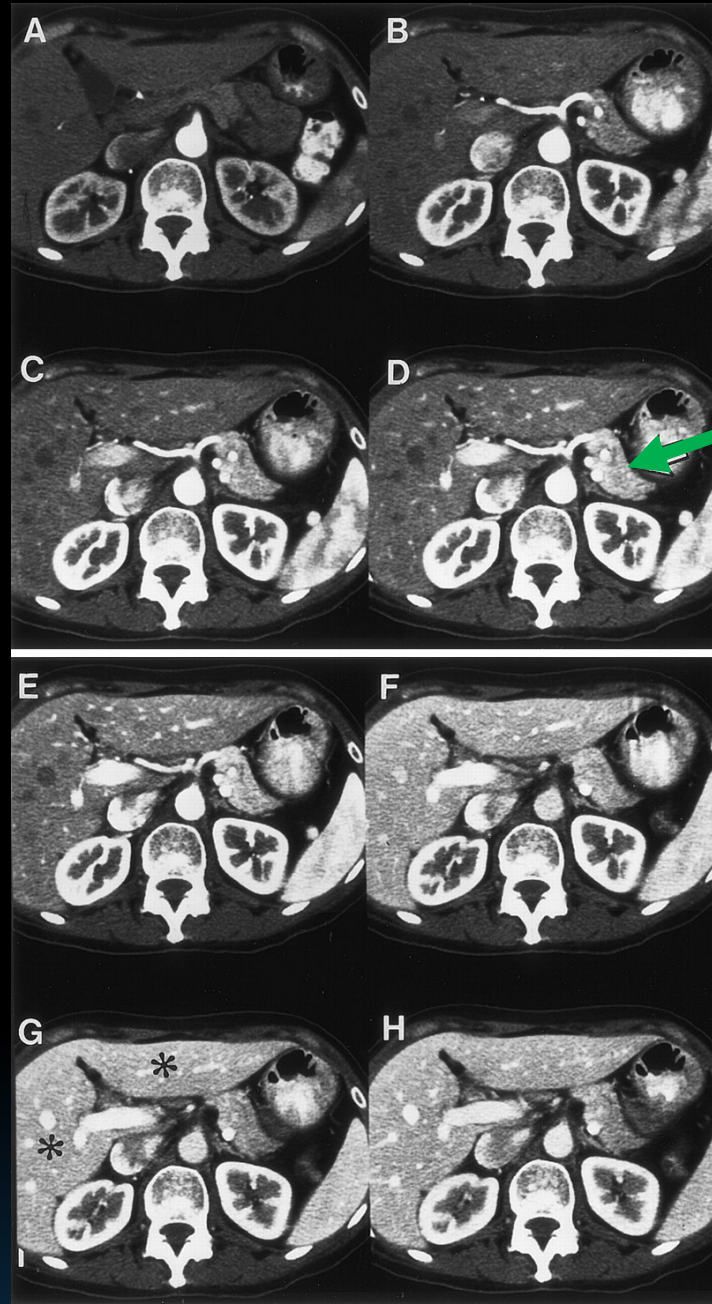
# What do you need to know to correctly protocol body imaging studies?

- 1. When does the organ of interest enhance maximally?
- 2. Does the tumor/abnormality you are searching for enhance *More* or *Less* avidly than the organ
- 3. When is the greatest attenuation difference *expected* between the organ and the lesion?

# Enhancement with iv contrast

- After iv contrast is injected, the arteries, veins, and abdominal organs will 'take up' the contrast (enhance) and will become brighter (higher attenuation).
- The rate of enhancement, and the peak enhancement varies from organ to organ, but has been studied and is predictable

Axial images at same level, taken sequentially after iv administration of 150ml of iodinated contrast at 5cc/sec



Notice that the pancreas enhances maximally before the liver

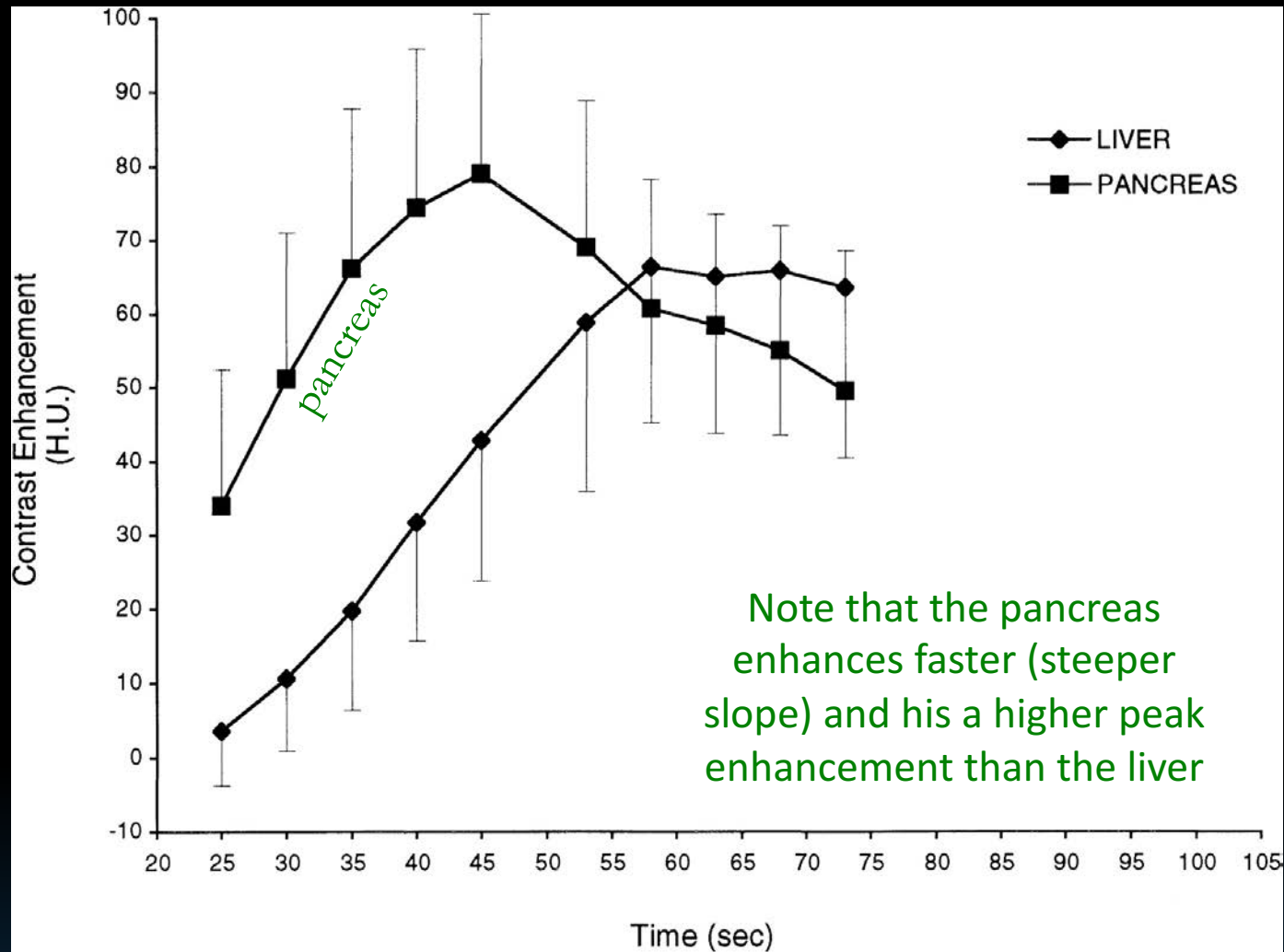
Liver enhances maximally later (\*)

C & D = 'Late arterial phase'  
This is the best time to detect hypervascular tumors in the liver. This is also the time of peak pancreatic enhancement.

G & H = 'PV phase.'  
This is the time of peak hepatic and peak venous enhancement.

# Target Organ enhancement

5 cc/sec injection rate



Tublin, M. E. et al. Radiology 1999;210:97-101

Radiology

# Organ enhancement Time attenuation curves

Dependent on

- Contrast type

Varies from omnipaque 300- isovue 370 mg/ml

100cc of each

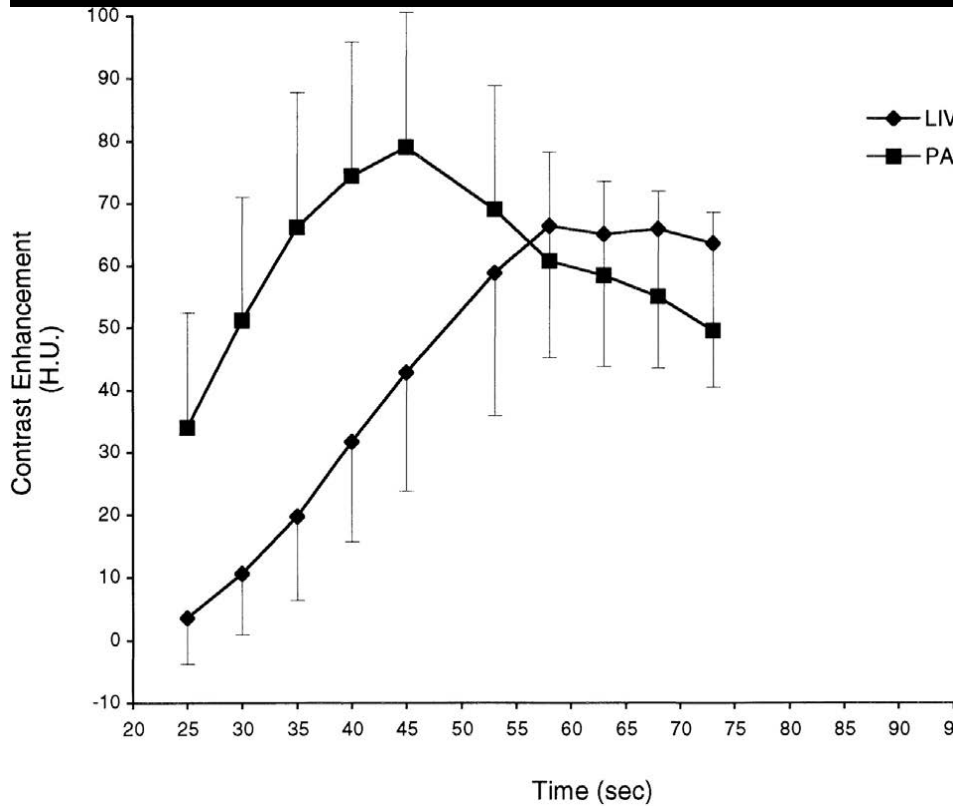
Omni = 30,000 mg iodine

Iso= 37,000 mg iodine

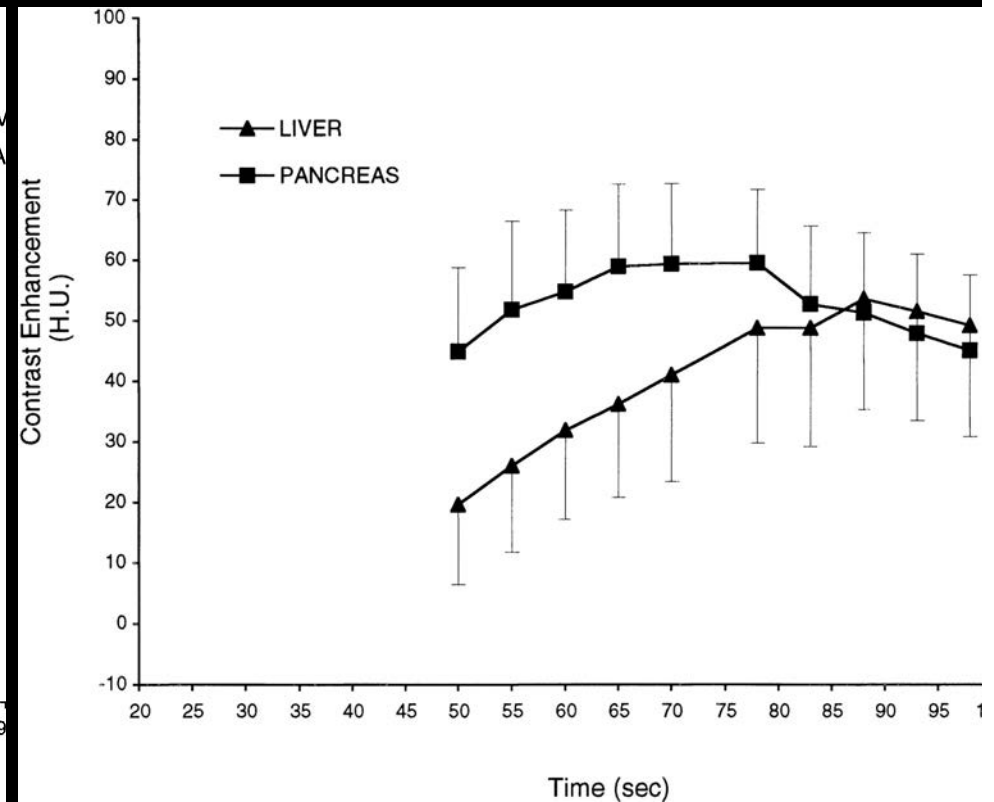
Total volume

Injection rate

## 5 cc/sec injection rate



## 2.5 cc/sec injection rate



Injecting the iv contrast more slowly results in lower peak enhancement and slower time to peak enhancement

Radiology

# Defining the phases of enhancement

Arterial

True/early

Late

Portal venous

Nephrographic

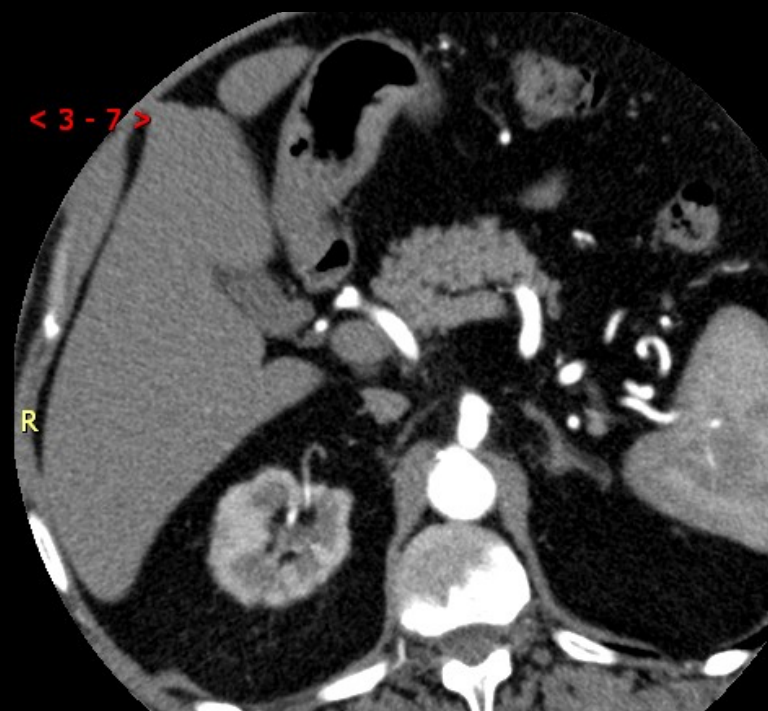
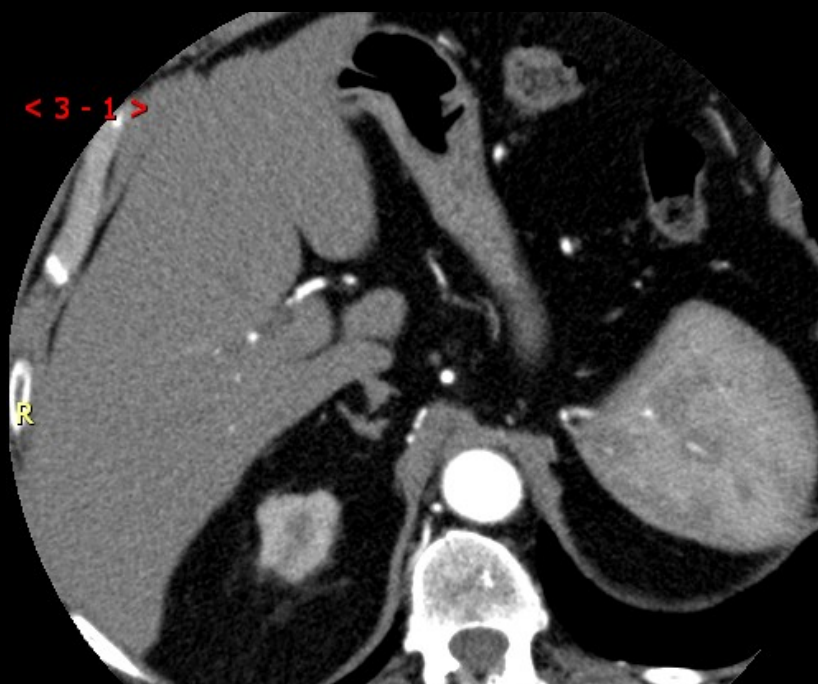
Delayed

We talk about the phases of enhancement often in body imaging

The phases describe the timing of scanning after giving iv contrast, and indicate what will be enhanced on images taken at that time



# Arterial phase



Called 'True' or 'Early' arterial phase

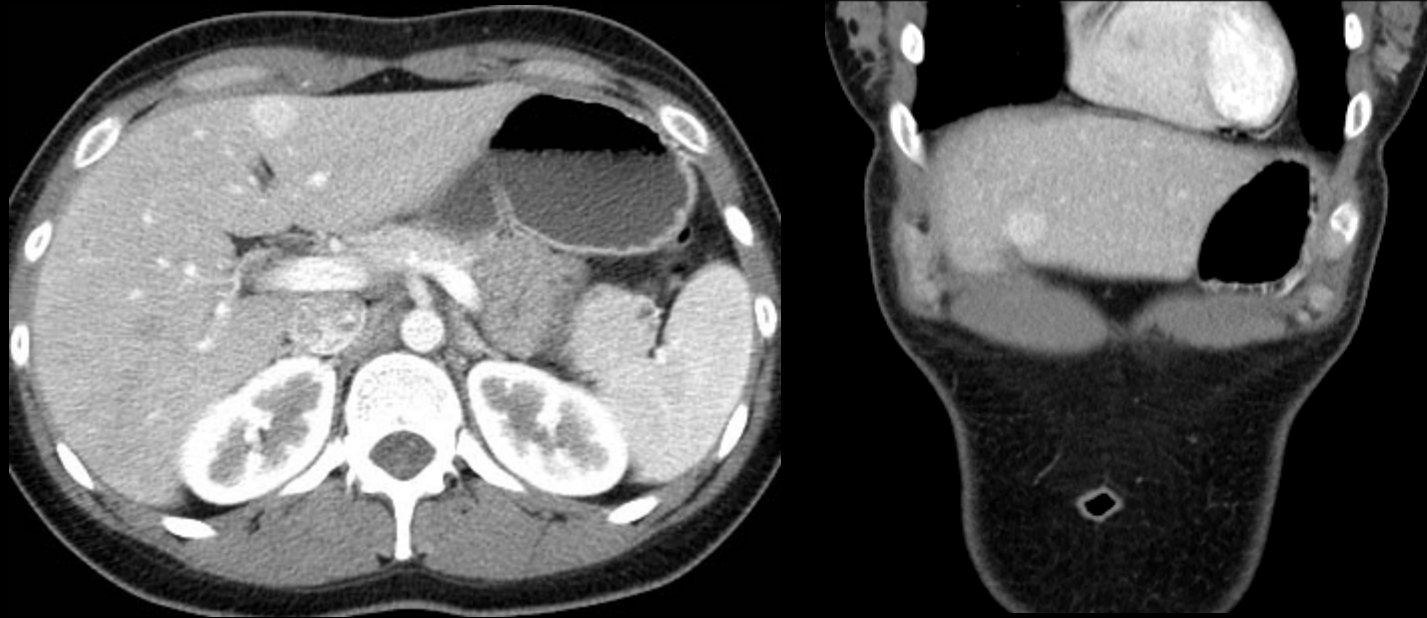
~25 seconds after Iv contrast injection begins

Only arteries are brightly enhanced

Renal cortex and spleen begin to enhance

Other organs and all veins remain their baseline shade of gray

# Late arterial phase



## ‘Late arterial’ or ‘arterial dominant’ phase

~35 sec after Iv contrast injection begins

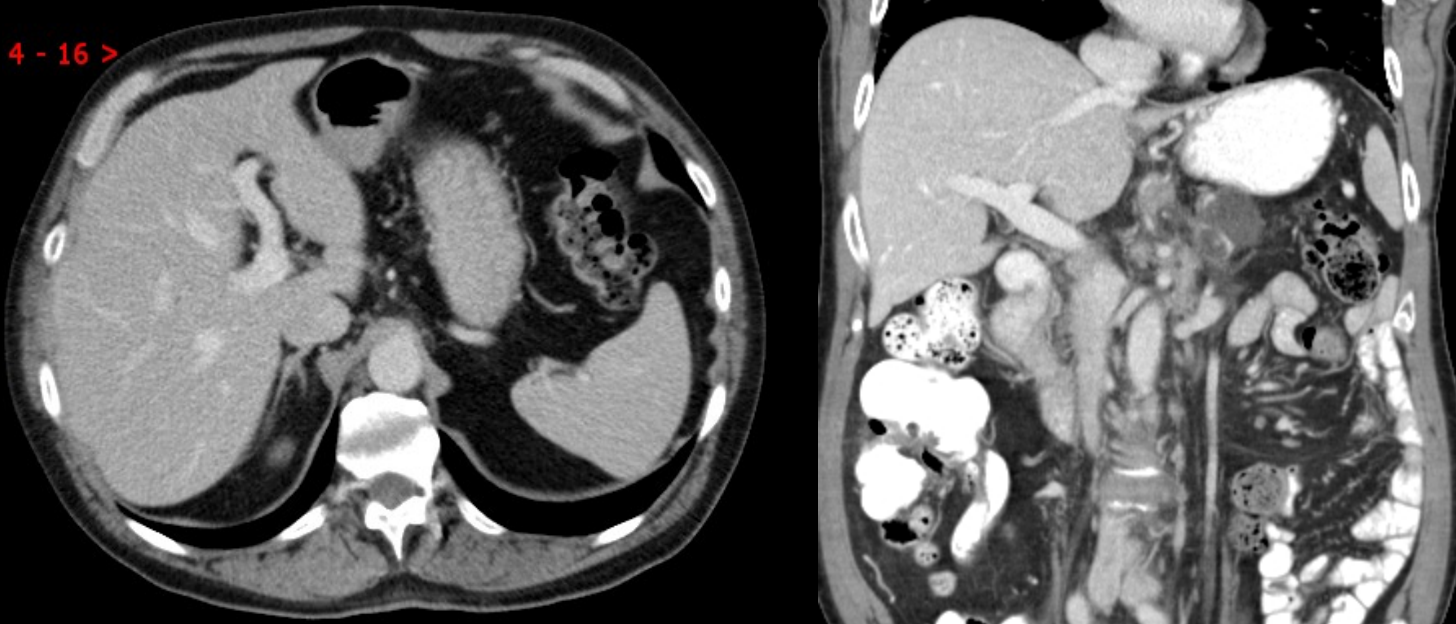
Arteries are still brightly enhanced, but the portal vein begins to enhance

Hepatic veins will not yet be opacified

Renal cortex avidly enhances, spleen is heterogeneously enhanced

Pancreas enhances maximally

# Portal venous phase



~60-70 sec after iv contrast injection begins

Arteries are less brightly enhanced

Portal vein fully opacified

HVs now opacified

Maximal liver parenchymal enhancement occurs during this phase

# Nephrographic phase



90-110 sec after iv contrast injection begins

The renal cortex and medulla are both enhanced and kidney looks uniform in density

No excretion into the renal collecting systems has occurred yet

Liver, spleen, pancreas all begin to 'wash out' and become lower density

# Liver Metastasis/Tumors

## Hypovascular tumors

Colon adenocarcinoma

Gastric adenocarcinoma

Pancreas adenocarcinoma

Small bowel adenocarcinoma

Lung

Breast

Enhance less brightly than the liver. Liver metastasis will be most conspicuous during the portal venous phase when the liver is bright

# Liver Metastasis/Tumors

## Hypervascular tumors

Hepatocellular carcinoma (HCC)

Adenoma

FNH

Neuroendocrine tumors (carcinoid, islet cell tumors)

Pheochromocytoma

Ocular melanoma

Medullary thyroid

Enhance earlier and more brightly than the liver.  
Liver metastasis will be most conspicuous during  
the late arterial phase when the tumor is bright,  
but the liver is not yet at peak enhancement

# How do we time scanning?

There are 3 methods:

1. Fixed time delay
2. Give test bolus, scan and view and trigger scan to start when bolus has arrived
3. Automated bolus tracking “smartprep”
  - Place ROI, start injecting, repetitively scan at level of ROI, set threshold, scan begins when threshold crossed

# Things to consider.....

- Age of the patient & ways to reduce radiation dose for the study
- # of prior CT scans. Is there an alternative test? If so, discuss it with clinician.
- Is this scan necessary, will it change clinical management?