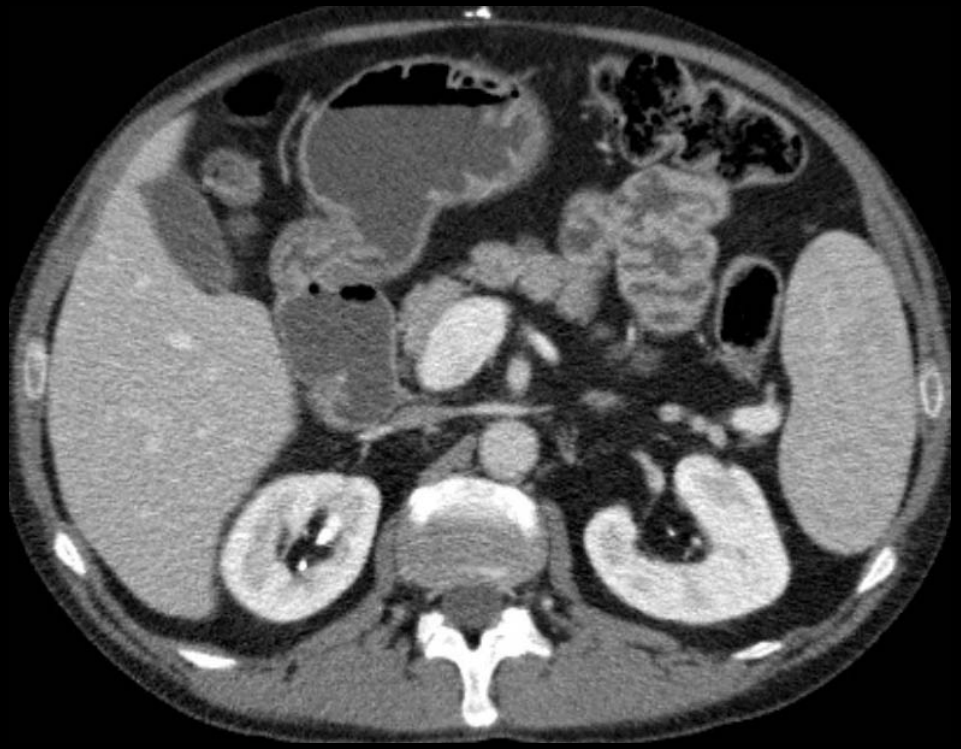


Advanced Abdominal Imaging Protocols

The protocol is a *prescription.* Make sure you understand the patient's history and the true indication for the study

This will ensure that the technique you prescribe is the most sensitive for that situation/condition

If you have uncertainty - ask for help

How?

-Done in eDH
-Select the optimal protocol from a list
-What must be specified:

- # and timing of imaging phases
- type of iv contrast
- type of oral contrast, route, and duration of oral prep

Things to consider……

- Age of patient & radiation risk
- # of prior CT scans. Should an alternative test be considered?
- Is the scan necessary; will it change clinical management?

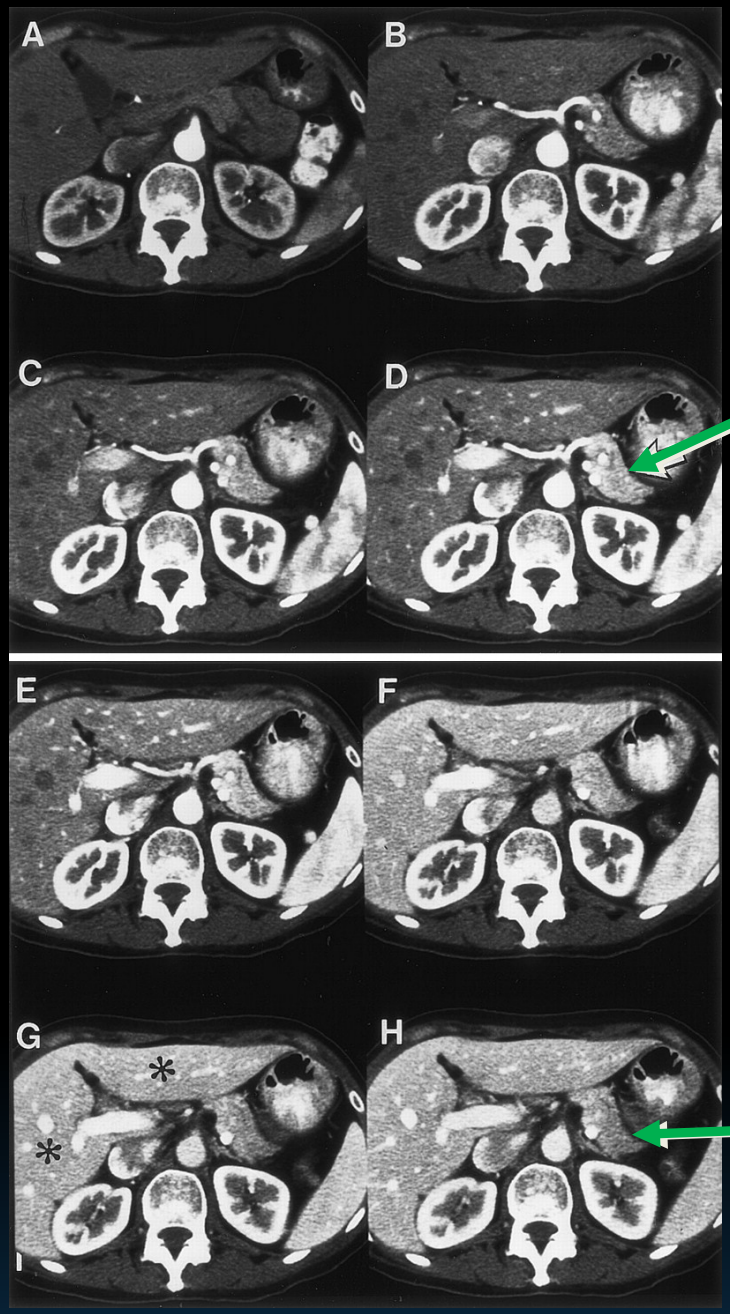
Essential info to know

1. When the target organ enhances 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
4. What are the phases of imaging

Organs enhance at different rates, and to different peak levels

Compare the density of the liver & pancreas

150ml at 5cc/sec



Panc enhances maximally before the liver

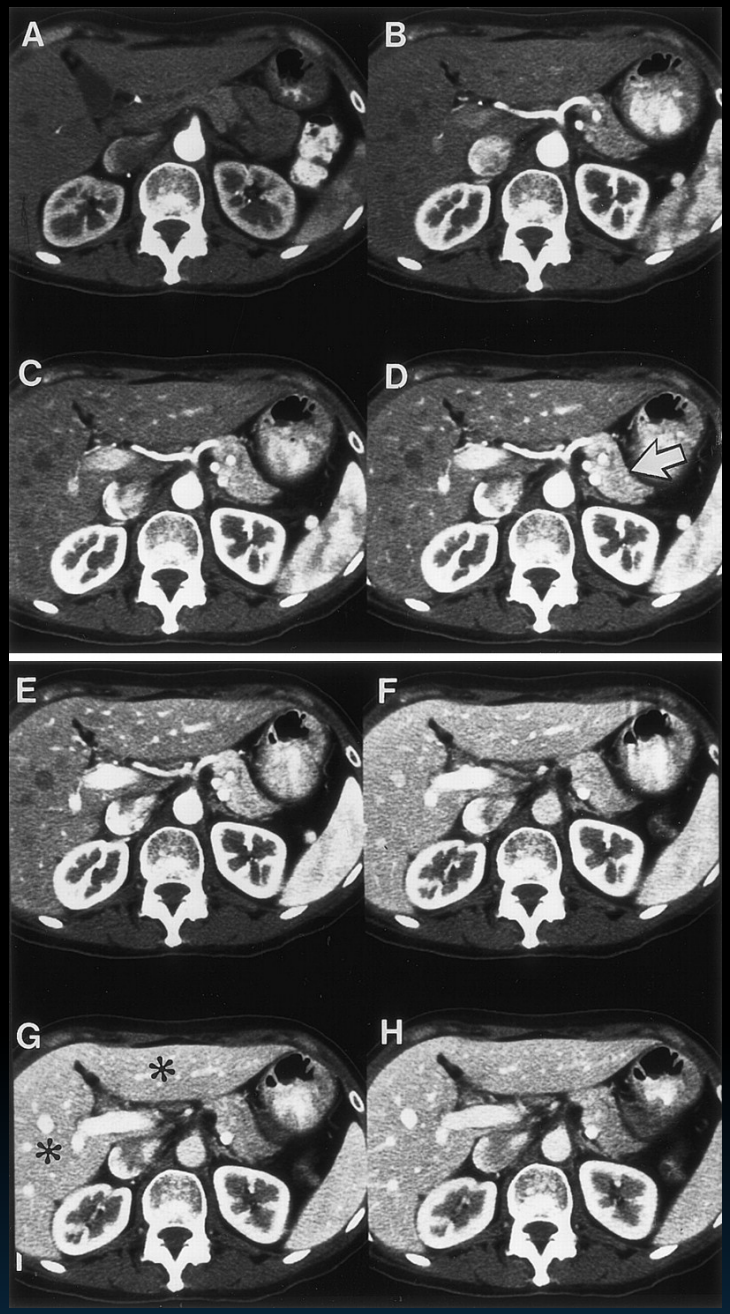
Liver brightest here, but note the pancreas has washed out

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

Radiology

The Phases of Imaging

These images were taken every 10 seconds following iv contrast injection



True or early arterial phase

Late arterial phase

Portal venous phase

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

Radiology

Normal Organ enhancement patterns

- Dependent upon
  1. Contrast type

     Different types have different quantities of iodine:

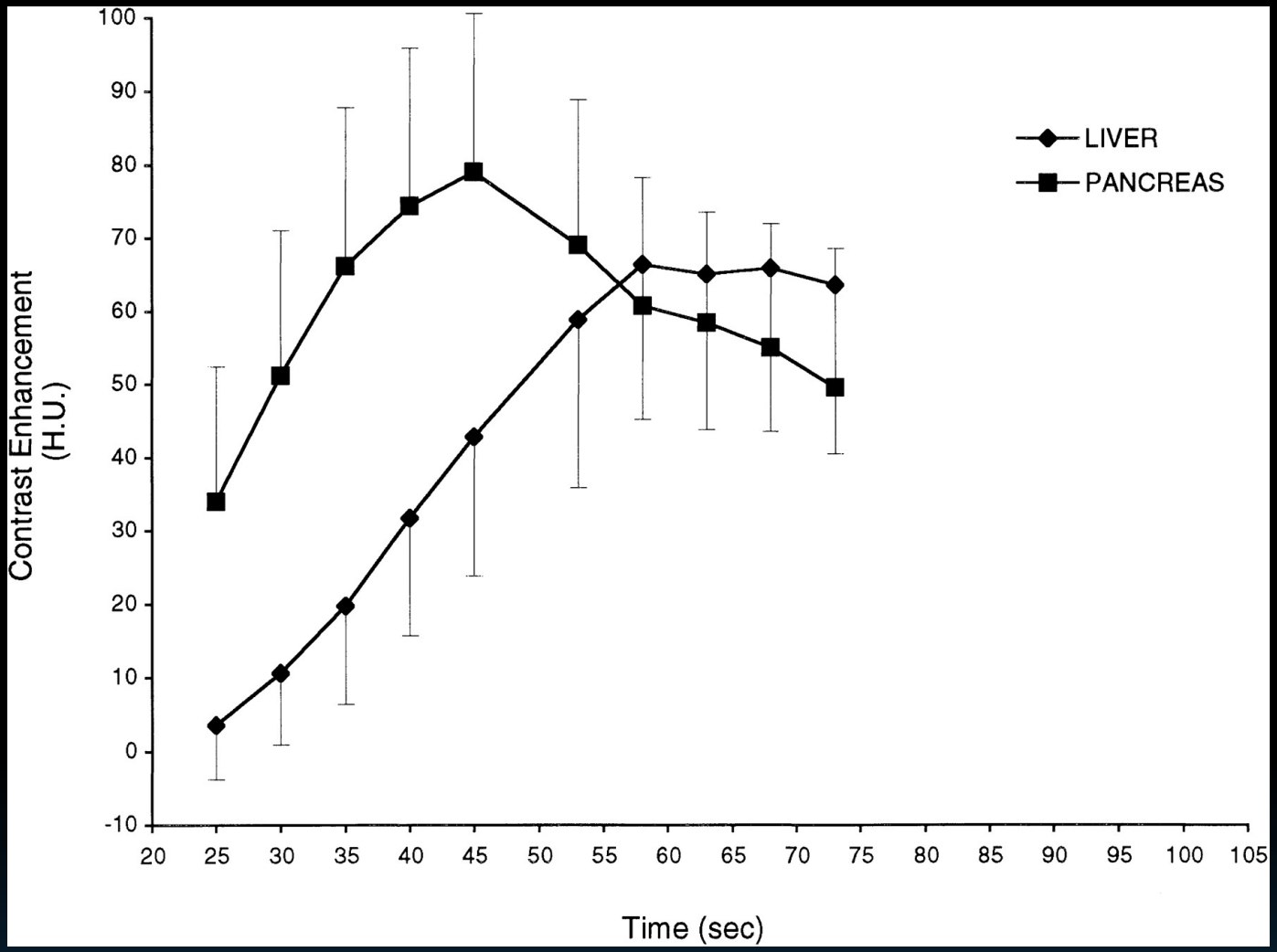
     Example: 100ml of each:

     Omnipaque 300= 30,000 mg iodine

     Isovue 370 = 37,000 mg iodine
  2. Total volume injected
  3. Injection rate

Target Organ enhancement

At 5 cc/sec injection rate

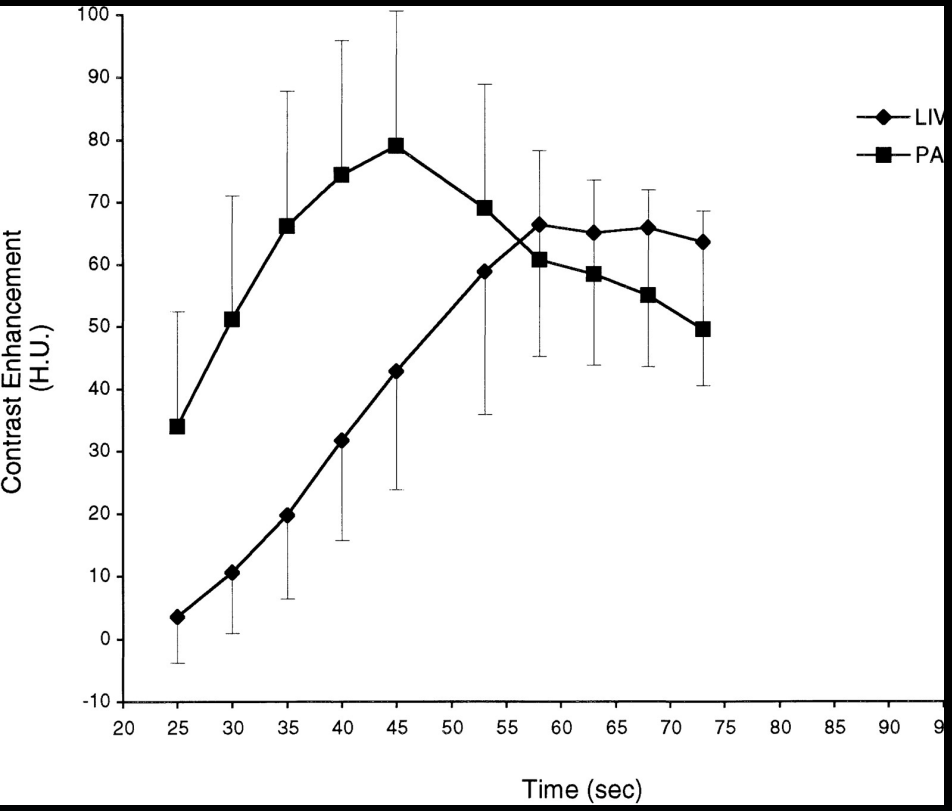


Tublin, M. E. et al. Radiology 1999;210:97-101

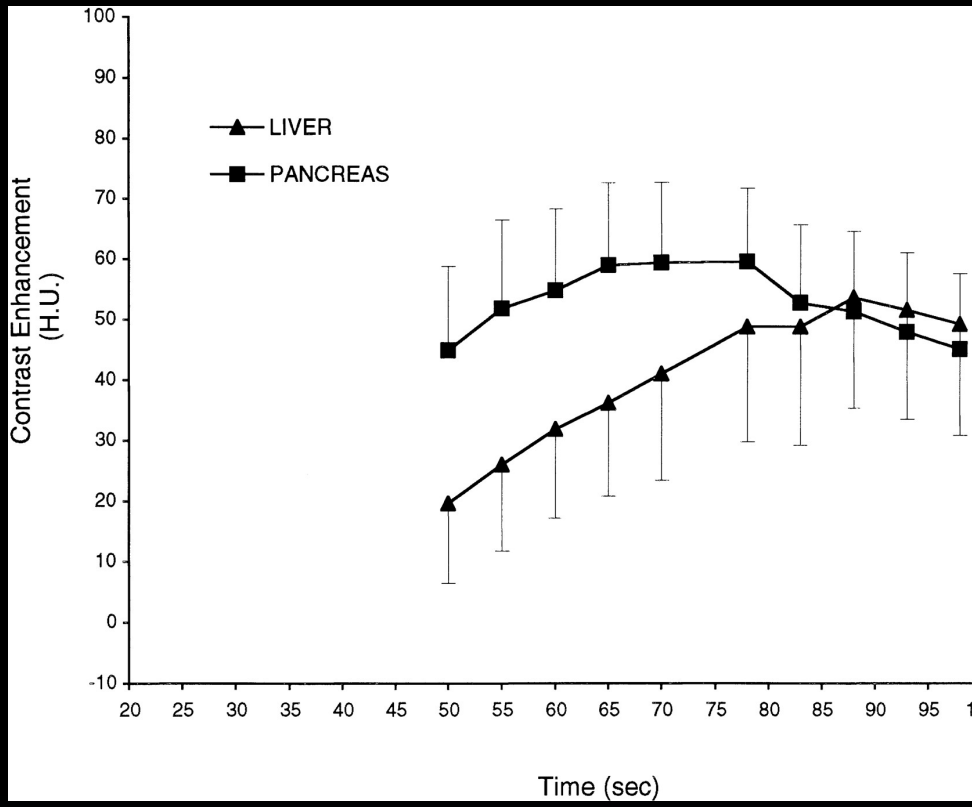
Radiology

Radiology

5 cc/sec injection rate



2.5 cc/sec injection rate



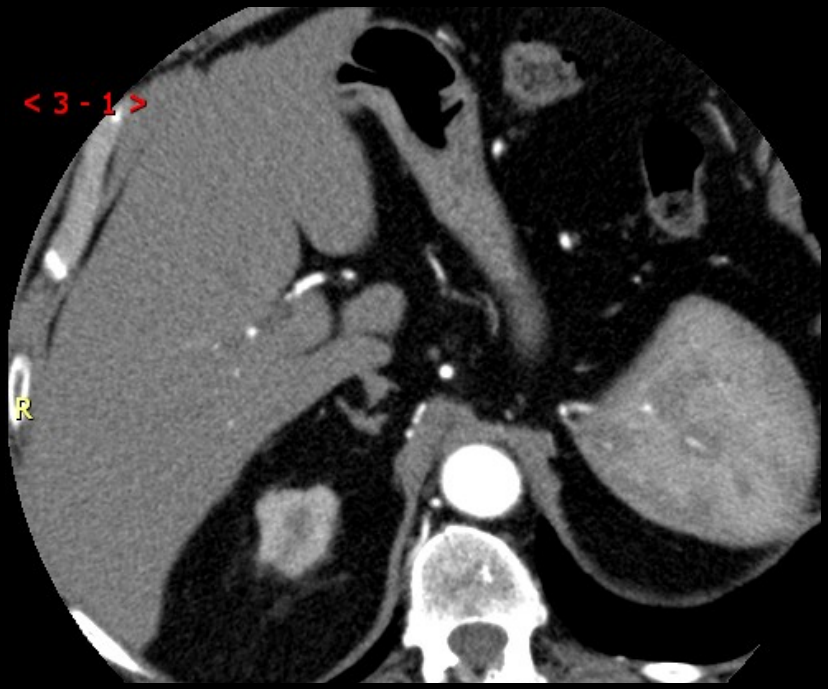
Tublin, M. E. et al. Radiology 1999;210:97-101

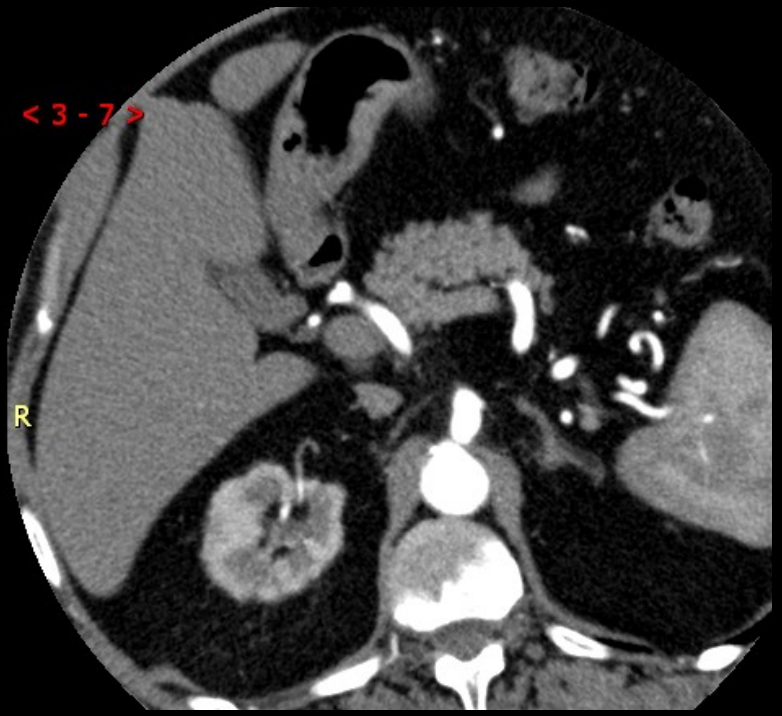
Note that slower injection rate results in lower peak enhancement and delayed time to peak enhancement.

Defining the phases of imaging

- Arterial – there are 2 arterial phases
  - True (25 sec) - used for CT arteriograms
  - Late (35 sec) - used for hypervascular tumors
- Portal venous (60-70 sec)
- Nephrographic (90 sec)
- 'Delayed' (anything after 90 seconds)

Early Arterial phase





Aka “True” arterial phase

~25 sec

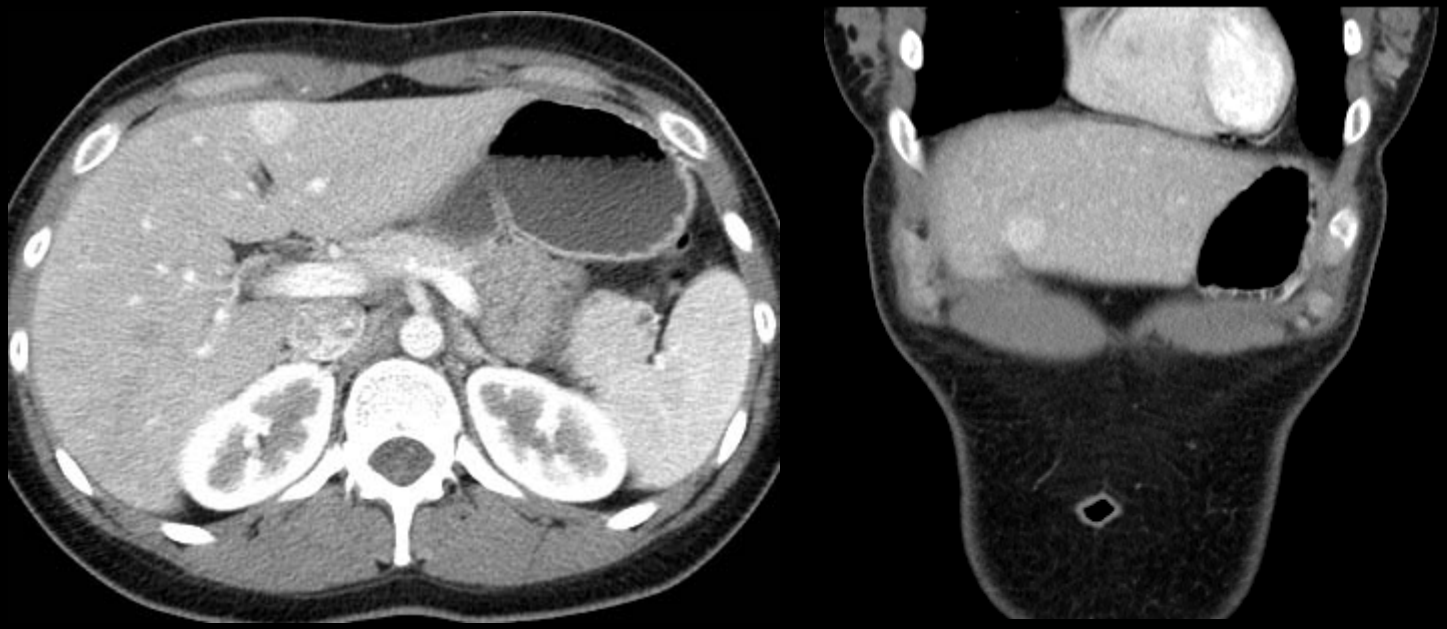
Only the arteries are opacified

PV is not yet enhanced

Renal cortex enhances

*CTA, reformatting

Late arterial phase



Late arterial or ‘arterial dominant’ phase

~35 sec

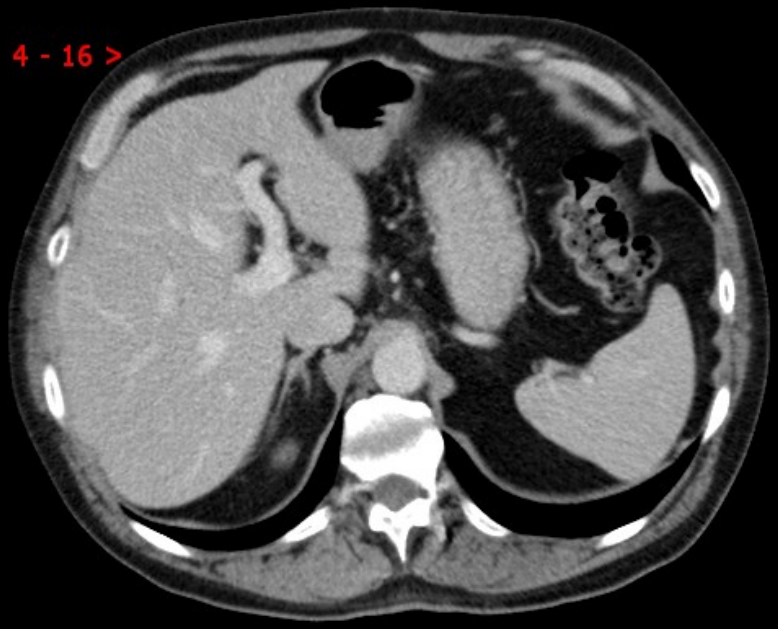
Still arterial phase, but *some* filling of PV

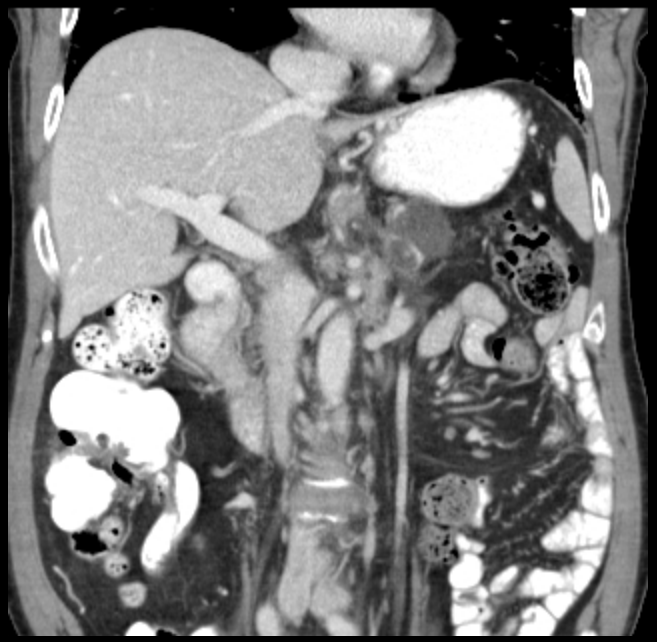
HVs will not yet be opacified, liver not yet maximally enhanced

Renal cortex avidly enhances

*Pancreas enhances maximally in this phase

Portal venous phase





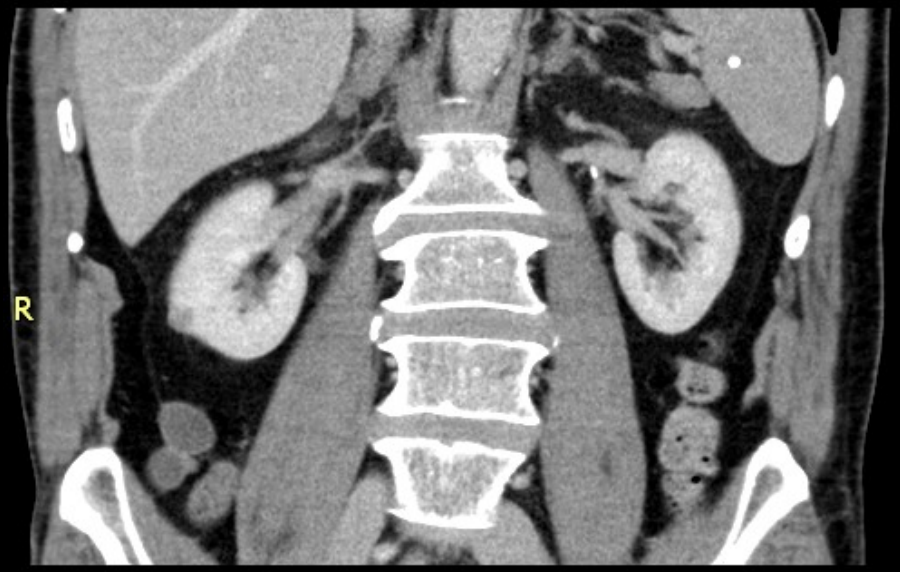
~60-70 sec

Portal vein fully opacified

HVs now opacified

*maximal liver parenchymal enhancement occurs during this phase

Nephrographic phase



~90-110 sec

Uniform enhancement of renal cortex and medulla; NO cortico-medullary differentiation

No excretion into collecting systems yet

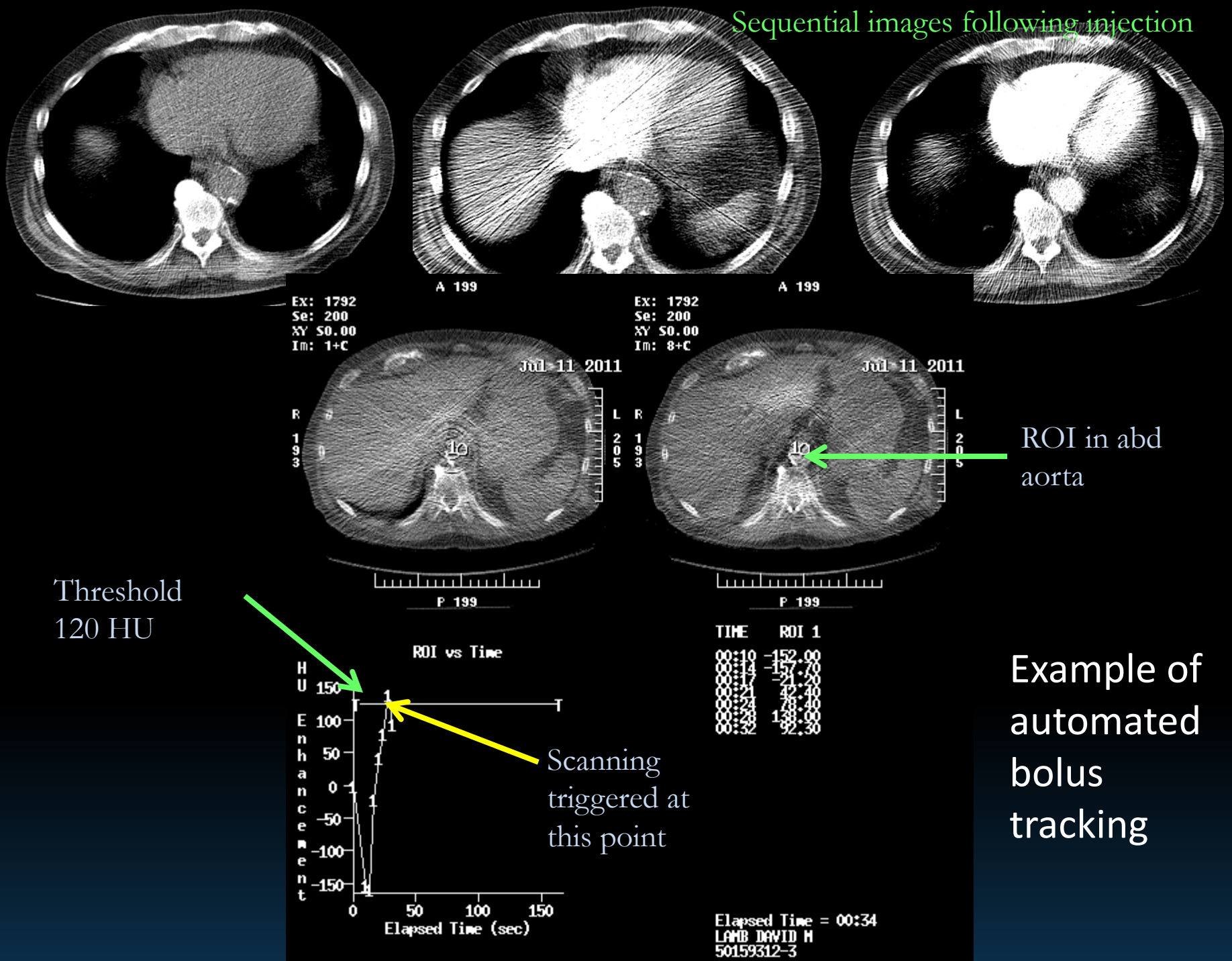
*Liver, pancreas now starting to wash out & not as bright

How do we time scanning

1. Fixed time delay
2. Test bolus

   -15-20cc given, then scan the area of interest- look for contrast bolus to arrive, then calculate the time delay needed
3. Automated bolus tracking

   -Place ROI on specific structure (will differ depending on scan type), set HU threshold, start injecting, repetitively scan at level of ROI, scan will be triggered to begin when threshold reached


Sequential images following injection
A 199
A 199
Ex: 1792
Se: 200
XY S0.00
Im: 1+C
Ex: 1792
Se: 200
XY S0.00
Im: 8+C
Jul 11 2011
Jul 11 2011
ROI in abd aorta
P 199
P 199
Threshold 120 HU
ROI vs Time
HU Enhancement
Elapsed Time (sec)
TIME ROI 1
Scanning triggered at this point
Example of automated bolus tracking
Elapsed Time = 00:34
LAMB DAVID M
50159312-3

Hypovascular Tumors

These tumors enhance less avidly than normal liver

Scan during PV phase, when liver is highest attenuation so contrast between the hypoenhancing tumor and the liver will be the greatest

All GI luminal adenocarcinomas:

- Gastric
- Small bowel
- Colon
- Rectal

- Breast
- Lung NSCLC
- Pancreatic adenocarcinoma

Hypervascular Tumors

These tumors enhance earlier and MORE avidly than normal liver

Scan during the late arterial phase, when the tumor enhancement is maximal and will contrast with the hypoenhancing liver.

Examples:

HCC
Adenoma
Focal Nodular hyperplasia
Ocular melanoma
Pancreatic neuroendocrine

Carcinoid tumor
Pheochromocytoma
Medullary thyroid
+/- Renal cell

Protocoling CT scans

1st rotation:

Have an attending or senior resident review ALL protocols

2nd rotation:

Have an attending/resident review ALL protocols you have any uncertainty about.

**If you plan to deviate from what was *ordered*, you MUST run it by an attending (may also require a phone call to the ordering doc)