College of Health and Medical Technologies
Department of Radiology Technologies
Computed Tomography

ABDOMEN (CT) SCAN
-ABDOMEN-PELVIS PROTOCOL (CT)
-CHEST ABDOMEN-PELVIS PROTOCOL (CT)
-LIVER
-PANCREASES

4 th stage

LECTUER 10

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MSc Radiographic Imaging

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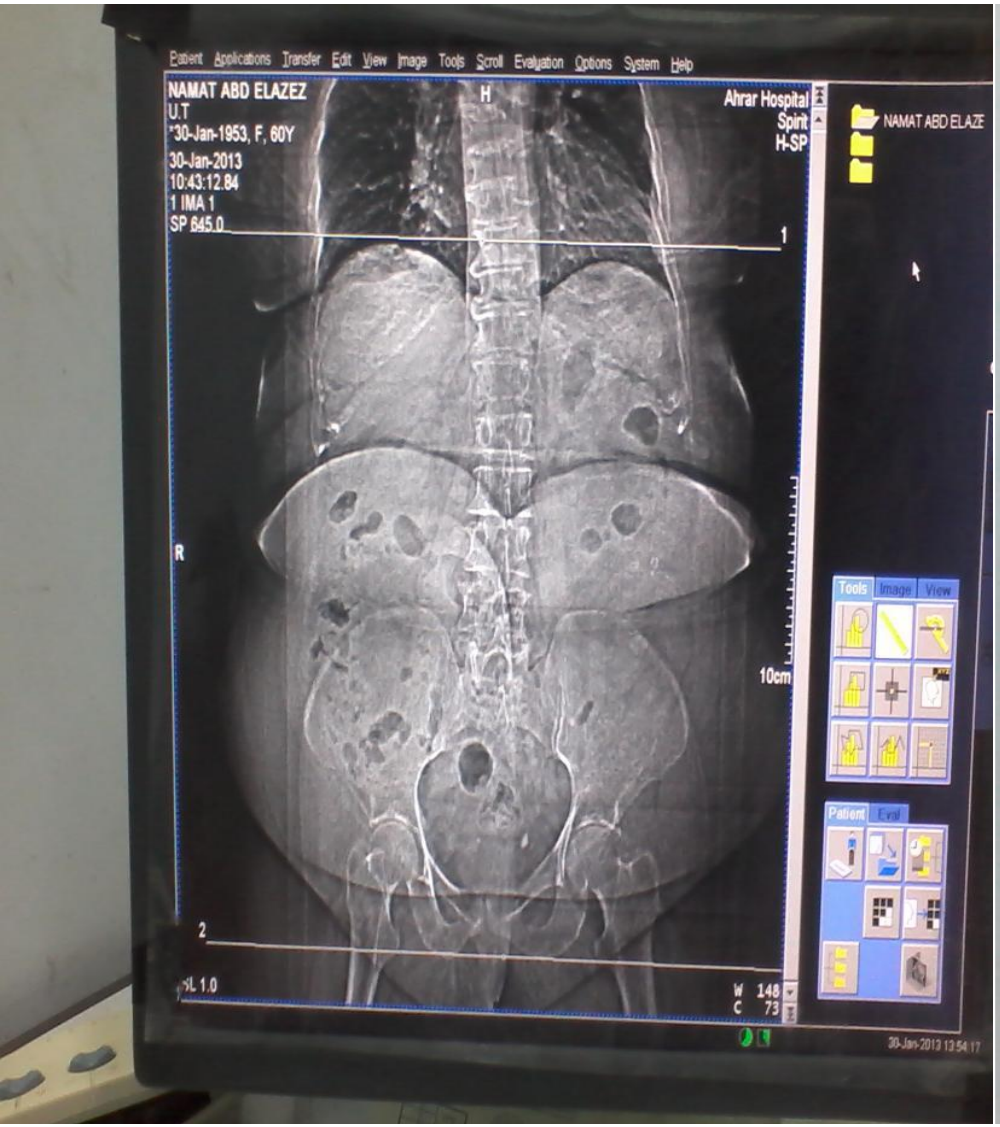
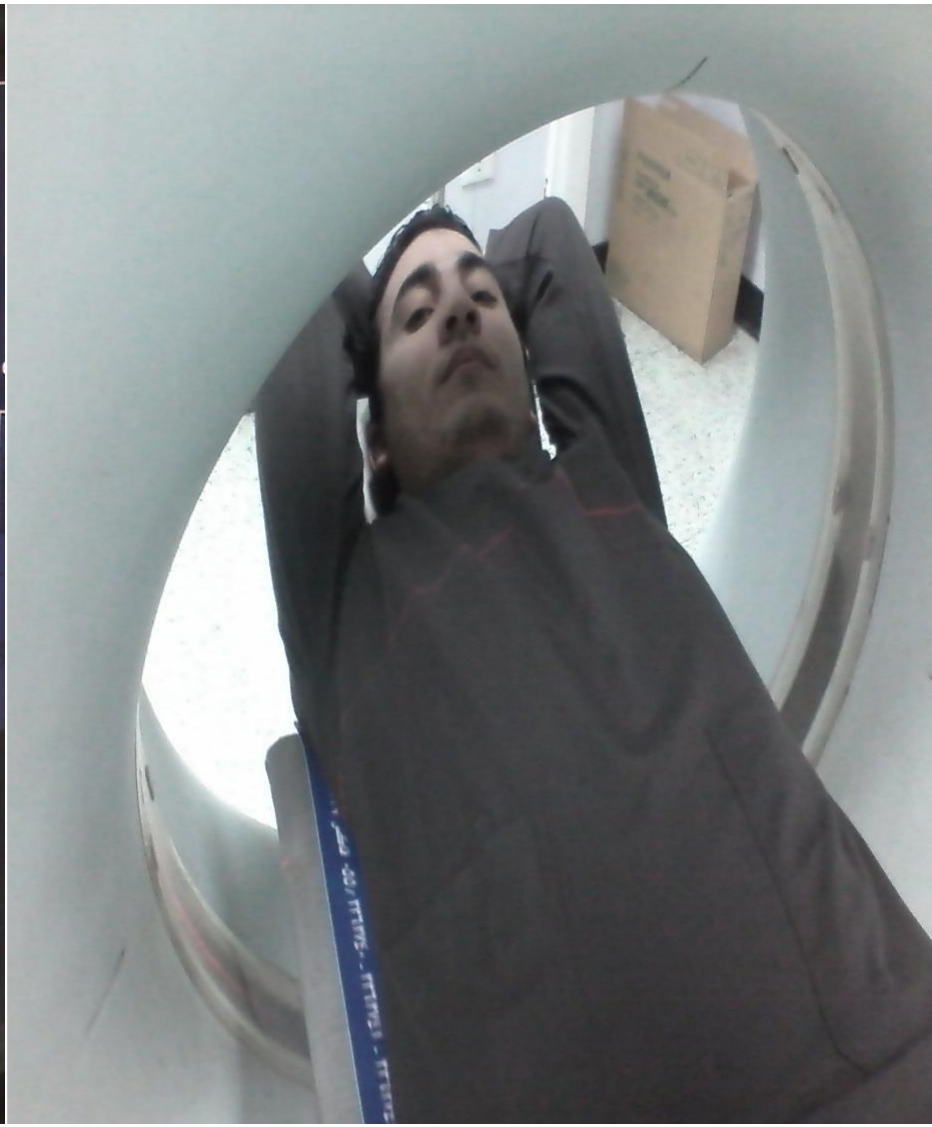
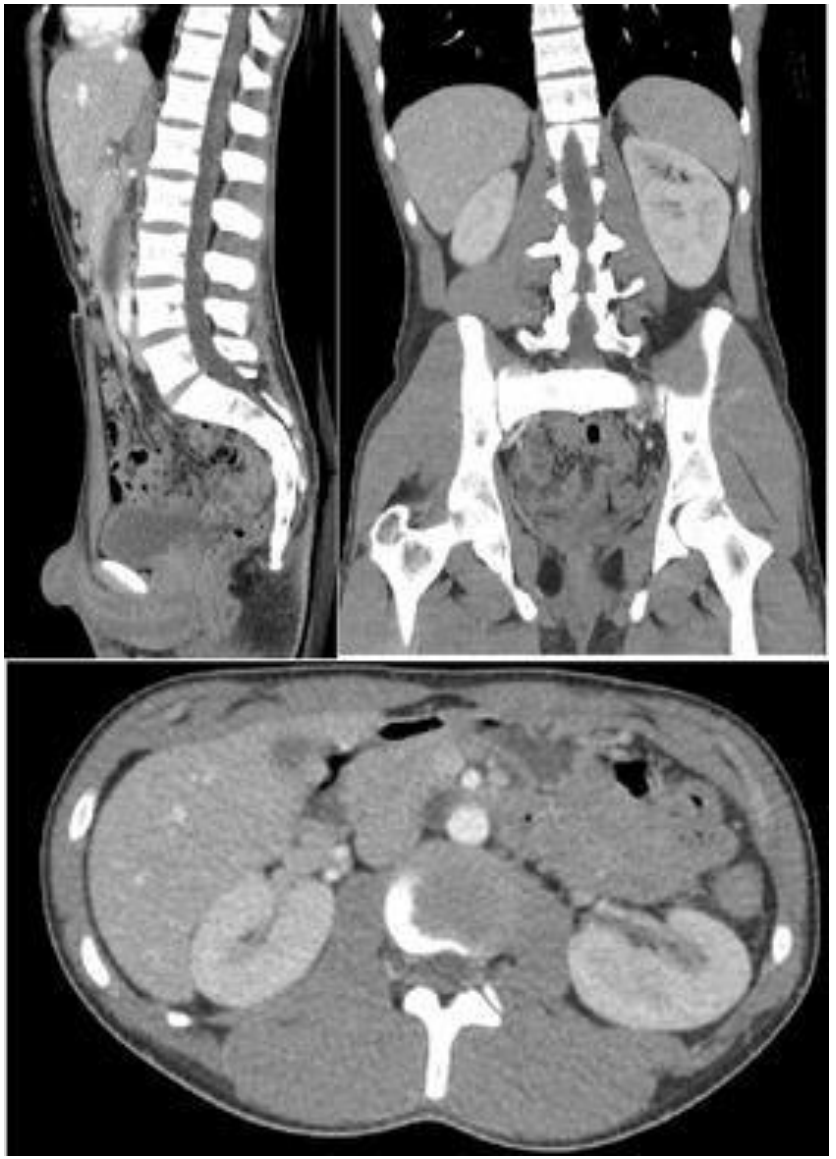
Position of Abdomen (CT) scan





ABDOMEN-PELVIS PROTOCOL (CT)

- The CT abdomen-pelvis protocol serves as an outline for an examination of the whole abdomen including the pelvis. It is one of the most common CT protocols for any clinical questions related to the abdomen and/or in routine and emergencies. It forms also an integral part of trauma and oncologic staging protocols and can be conducted as part of other scans such as CT chest-abdomen-pelvis or can be combined with a CT angiogram.



Indications

-abdominal pain, flank pain, pelvic or inguinal pain

- suspected abdominal or pelvic masses or fluid collections

- primary abdominal tumors or metastatic spread

- infections and inflammatory conditions of the abdomen and pelvis & abscesses

- bowel obstruction and/or mesenteric ischemia

- unclear findings on other imaging studies

- abdominal and pelvic organ manifestation in systemic disease

- abdominal and pelvic trauma

- postoperative follow-up

- pre and post transplant evaluation

- congenital abnormalities

- abdominal interventions (e.g. CT-guided biopsy, drainage)

Technique

patient position

supine position, abdomen centered within the gantry, both arms elevated **tube voltage** ≤120 kVp,

tube current: as suggested by the automatic exposure control **scout :**above the diaphragm to the lesser trochanter

scan extent

arterial phase: diaphragm to the iliac crest (might be extended in some indications)

venous phase: above the diaphragm to the symphysis **scan direction**: craniocaudal

field of view (FOV): 350 mm (should be adjusted to increase in-plane resolution)

slice thickness: ≤0.75 mm, interval: ≤0.5 mm

reconstruction algorithm: soft tissue, bone window

oral contrast

positive contrast agent (abscesses, infectious conditions): as per preparation guide

neutral contrast agent (non acute conditions): 1000 ml water 20-30 min before the scan

contrast injection considerations

1 non-contrast (optional)

2 biphasic arterial ± venous acquisition

contrast volume: 70-100ml (1 mL/kg) with 30-40 mL saline chaser at 3-5 mL/s bolus tracking: abdominal aorta

arterial phase: minimal scan delay

portal venous phase: 30-50 seconds after the arterial phase or 60-80 seconds after contrast injection

3 single acquisition with a monophasic injection (venous phase):

contrast volume: 70-100ml (1 mL/kg) with 30-40 mL saline chaser at 3 mL/s

portal venous acquisition: 60-80 sec after contrast injection

respiration phase

single breath-hold: inspiration

multiplanar reconstructions

axial images: strictly axial to the body axis

coronal images: strictly coronal to the body axis

sagittal images: strictly sagittal to the body axis

slice thickness: soft tissue ≤3 mm, bone ≤2 mm overlap 20-40%

CHEST ABDOMEN-PELVIS PROTOCOL (CT)

- The CT chest-abdomen-pelvis protocol serves as an outline for an examination of the trunk covering the chest, abdomen and pelvis.
- It is one of the most common CT examinations conducted in routine and emergencies.
- It can be combined with a CT angiogram.

Indications

- suspected tumors or fluid collections of the chest, abdomen and pelvis
- diagnosis and staging of malignancies
- traumatic injuries
- infections and inflammatory conditions
- patients with sepsis or fever of unknown origin
- evaluation of vascular abnormalities
- postoperative follow-up
- pre and posttransplant evaluation
- congenital abnormalities

Technique

patient position: supine position, body centered within the gantry

both arms elevated

tube voltage: ≤120 kVp

tube current: as suggested by the automatic exposure control

Scout: above the lung apices to the symphysis

scan extent : includes lung apices and pubic symphysis

scan direction: craniocaudal

scan geometry: field of view (FOV): 350 mm

slice thickness: ≤0.75 mm, interval: ≤0.5 mm

reconstruction algorithm: soft tissue, bone

oral contrast

positive contrast agent

neutral contrast agent : 1000 ml water 20-30 min before the scan

contrast injection considerations

1 non-contrast (if contrast medium is contraindicated or not needed)

2 biphasic arterial ± venous acquisition

contrast volume: 70-100ml (1 mL/kg) with 30-40 mL saline chaser at 3-5 mL/s

bolus tracking: abdominal aorta

arterial phase: minimal scan delay

portal venous phase: 30-50 seconds after the arterial phase or 60-80 seconds after contrast injection

3 single acquisition with a monophasic injection (venous phase):

contrast volume: 70-100ml (1 mL/kg) with 30-40 mL saline chaser at 3 mL/s

portal venous acquisition: 60-80 sec after contrast injection

respiration phase

single breath-hold: inspiration

if a single breath is not possible consider dual-phase over chest and abdomen-pelvis

multiplanar reconstructions

axial images: strictly axial

to the body axis

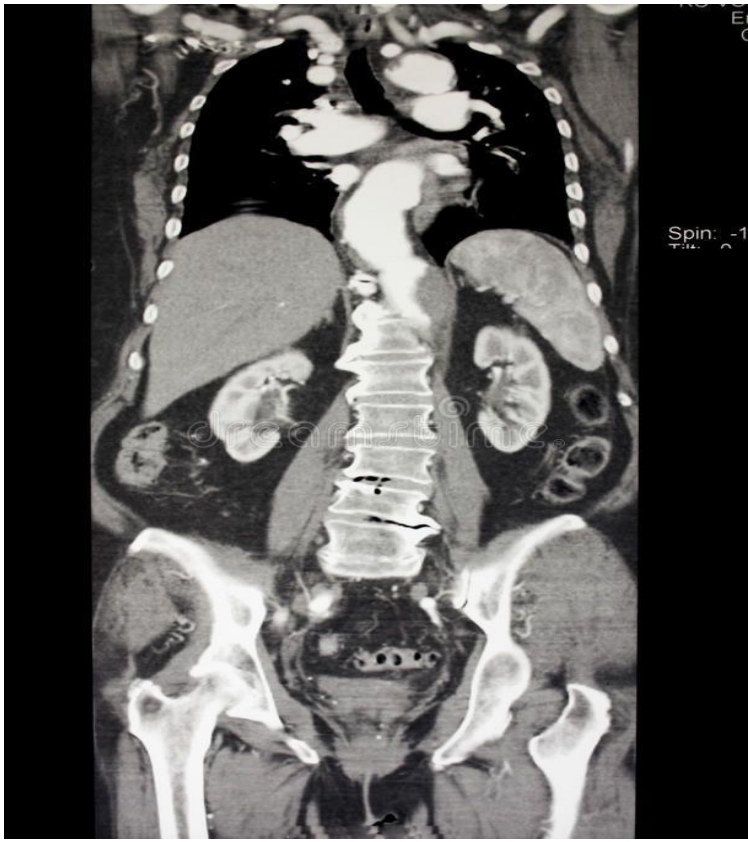
coronal images: strictly

coronal to the body axis

sagittal images: strictly

sagittal to the body axis

slice thickness: soft tissue ≤3 mm, bone ≤2 mm overlap 20- 40%



Liver

Indications

- 1. Suspected focal or diffuse liver lesion.
- 2. Staging known primary or secondary malignancy.
- 3. Abnormal liver-function tests.
- 4. Right upper-quadrant pain or mass.
- 5. Hepatomegaly.
- 6. Suspected portal hypertension.

Contraindications

- 1. Pregnancy
- 2. Allergy to iodinated contrast agents

TECHNIQUE

Single-phase (portal phase) contrast-enhanced computed tomography:

- This is the technique for the majority of routine liver CT imaging.
- The liver is imaged during the peak of parenchymal enhancement

- i.e. when contrast-medium-laden portal venous blood has fully perfused the liver (around 60–70 s after the start of a bolus injection).

- Oral contrast may be given but is not necessary if only the liver is being investigated.

- Slice thickness will depend upon the CT scanner specification but should be 5 mm or less

Multiphasic contrast-enhanced computed tomography:

- The triple-phase liver CT protocol is a useful examination in the assessment of focal liver lesions, hyper vascular liver metastases and endocrine tumors. It involves multiphasic scanning: arterial phase, portal venous phase and delayed phase acquisition.

Multiphasic contrast-enhanced computed tomography:

Arterial phase: This scan is made about 20-30 seconds after the administration of IV contrast agent. The contrast agent is still in the arteries and some organs are starting to absorb the agent.

Used for evaluating arteries and detecting hyper vascular lesions.

Portal venous: This scan is made about 60-80 seconds after the administration of IV contrast agent. This is the most commonly used scan phase. In this phase, the contrast agent is for the most part in the veins. The abdominal organs have absorbed the contrast agent and are 'enhanced'. -This scan phase is generally used to screen to detect hypovascular liver lesions.

Equilibrium /delayed: this scan is made about 6-10 minutes after the administration of iv contrast agent. this phase is also termed the washout or delayed phase. the contrast agent has passed through all the organs and is being excreted by the kidneys. -this phase is used frequently to evaluate the urinary tract, in addition, this phase can help characterize liver lesions or detect bile duct tumors.

Multiphasic contrast-enhanced computed tomography:

Phase	Time	Indications
No contrast	_	Kidney/ureteral stones, arterial calcifications.
Arterial	20 - 30 sec	Abdominal bleeding, aortic aneurysm, arterial stenosis/occlusions, hypervascular liver metastases, pancreas tumors.
Portal venous	60 - 80 sec	Screening, hypovascular liver metastases, abscess formation, venous thrombosis.
Equilibrium /delayed	6- 10 min	ureteral obstruction or leaks, characterization of liver tumors.

- The majority of liver tumors lesions have a predominantly arterial blood supply whereas the liver parenchyma receives 75–80 per cent of its blood supply via the portal vein.[1] Since the increased vascularity of tumors, relative to normal tissue, develops from the arterial blood supply, these lesions are best imaged during the brief arterial phase after the administration of contrast medium. The best visualization of hyper vascular tumors is obtained during the arterial phase with the use of highly concentrated contrast media (small volume) and high injection rate.
- Optimizing the protocols and timing of these phases to maximize lesion-to- liver contrast now varies with system acquisition speed.
- The typical MDCT protocol (Table 1) starts with a bolus injection of iodinated contrast medium at a flow rate of 4 ml/s. The slice thickness is commonly 5 mm

- For hyper-vascular lesions (both benign tumors and hyper vascular metastases), a dual-phase acquisition is performed: First, the liver is imaged during the late arterial phase 35 s after injection; then, imaging is performed during the portal phase, 60 s after injection, with the same scanning parameters sometimes, imaging is also performed in the late phase, after 3 min (Triple phase acquisition). Both the dual phase & triple phase acquisitions are called dynamic contrast enhanced studies.
- Alternatively, for hypo-vascular metastases, a single acquisition 60 s after the administration of contrast medium is often sufficient. (The normal liver tissue will have been enhanced by the contrast agent delivered by the portal vein, while the hypo vascular lesions will appear hypodense relative to the normal liver parenchyma & thus become highlighted)

Table 1. Typical parameters for MDCT of the liver

X-ray generation	
Kilovolt	120 kV
Effective current	160 mA
Scan parameters	
Rotation time	0.5 s
Collimation	2.5 mm
Table feed per rotation	12.5 mm
Slice thickness	5 mm
Increment	3 mm
Contrast medium administration	
Iodine concentration	400 mg/ml
Volume	1.7–2.0 ml/kg body weight
Flow rate	4 ml/s

Many patients require multiple-phase scans, e.g. in abdominal trauma or in liver, pancreas and kidney tumors. (e.g. Triphasic liver CT). You asked to take inspiration during the scanning. Any motion, or body movements, can lead to artifacts on the images.

A standard abdominal CT, a slice thickness of 5 mm is recommended. The 1mm slices are recommended for more detailed analysis or small structures.

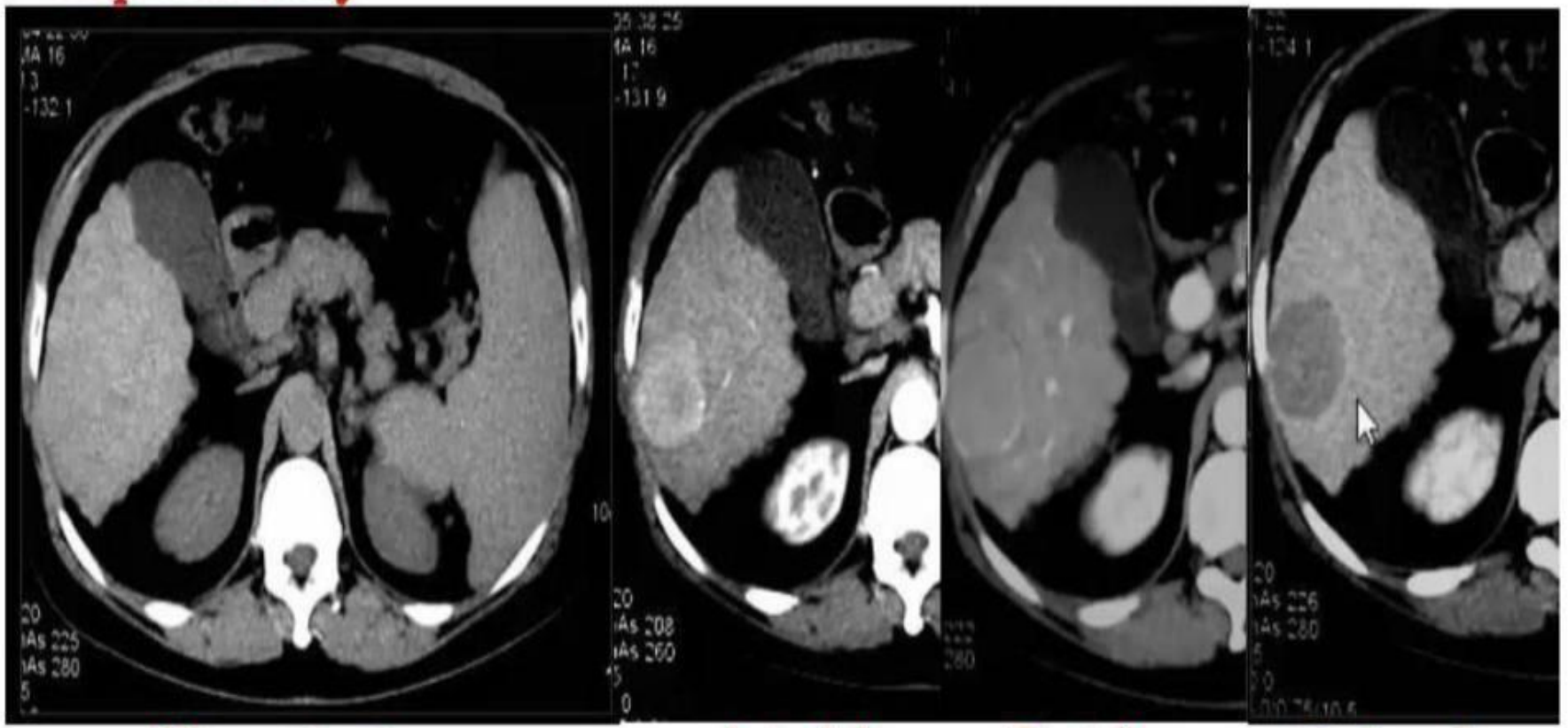
-Pre and post contras medium.

Liver study extend from above the xiphoid, and extend quite far caudally to the reference point at umbilical region.

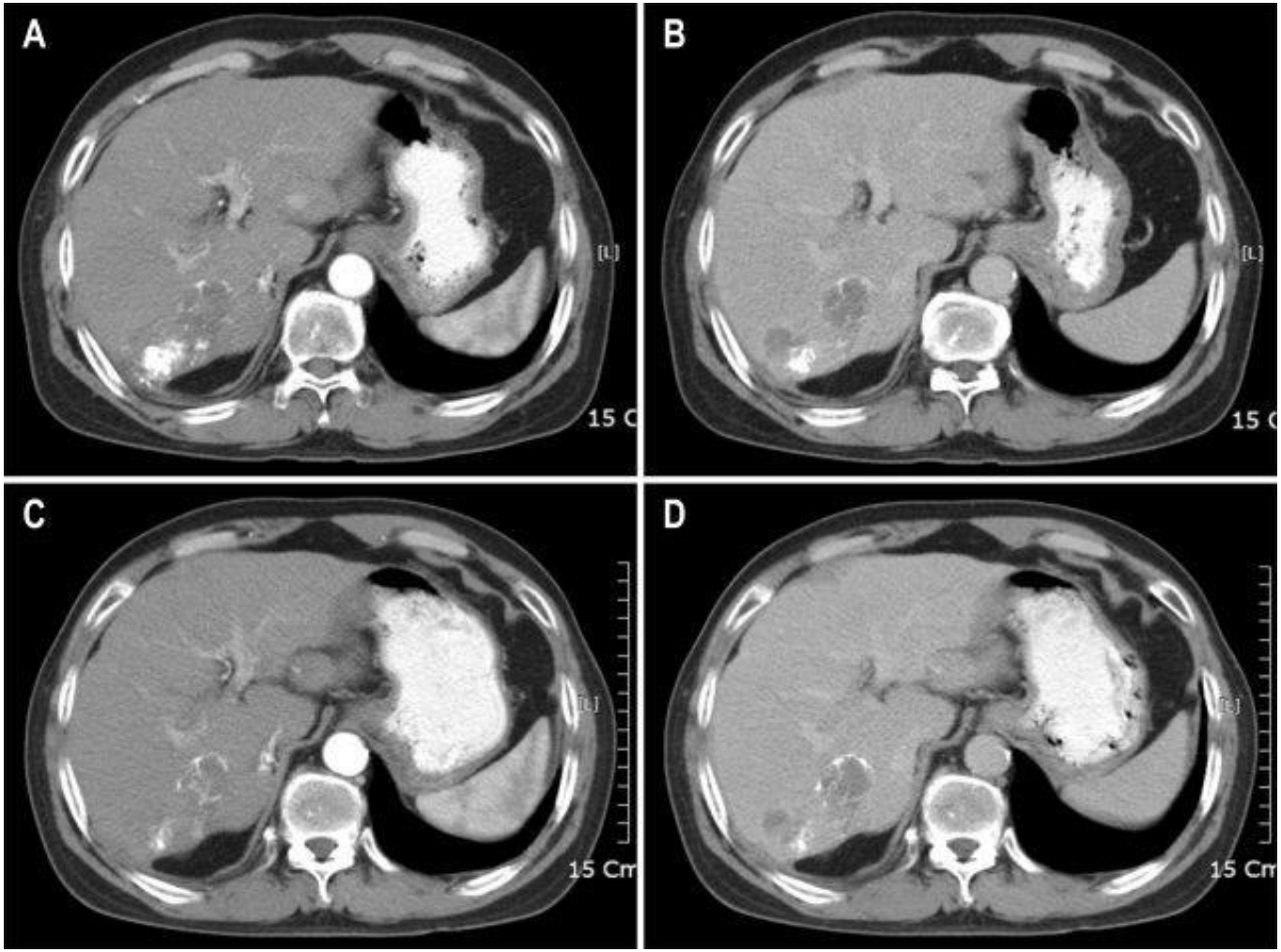
Normal Appearance:

- The liver parenchyma is homogeneous with attenuation values of 54–60 HU, usually 8–10 HU greater than the spleen. The vascular structures can be identified by their location on the unenhanced images and confirmed by enhancement with IV contrast medium.
- The peripheral intrahepatic biliary tree is not normally visualized, although the main right and left hepatic ducts and the common hepatic and bile ducts are normally seen.

Triphasic study



No contrast Arterial Portal Delayed


A
B
C
D

Pancreas

CT scans of the pancreas may be used to distinguish between disorders of the pancreas and disorders of the retroperitoneum (the back portion of the abdomen behind the peritoneal membrane).

Indications:

1.Epigastric pain.

2.Obstructive jaundice.

3.Suspected pancreatic malignancy.

4.Acute pancreatitis and its complications.

5.Chronic pancreatitis and its complications.

6.Evaluation of pancreatic tumors and/or cystic lesions

7.Complications of pancreatic diseases.

8.Unclear findings on ultrasound or CT abdomen

9.Pancreatic interventions (e.g. CT-guided biopsy, drainage).

Purpose

The purposes of a pancreatic CT includes the following:

1-detection and characterization of pancreatic tumors.

*arterial phase: hyper vascular lesions e.g. neuroendocrine tumors, vascular lesions

*pancreatic phase: depiction of hypo attenuating tumors such as pancreatic ductal adenocarcinoma.

*portal venous phase: depiction of hepatic metastases, venous thrombosis etc.

2-detection and characterization of cystic pancreatic lesions acute pancreatitis:

-staging and severity assessment (best-done ≥2-3days after symptom onset).
-search for etiology (choledocholithiasis, autoimmune pancreatitis, groove pancreatitis etc.).
-detection of complications in early and late phases including extra pancreatic complications.

-confirmation of the diagnosis of pancreatitis (only if clinically unclear - rare).

chronic pancreatitis:

-identification and characterization of pancreatic calcifications.

Technique

patient position

osupine position, abdomen centered within the gantry and both arms elevated
tube voltage: ≤120 kVp
tube current: as suggested by the automatic exposure control
scout

odiaphragm to the iliac crest (or symphysis).

scan extent

arterial/pancreatic phase: mid diaphragm to the iliac crest.
venous phase: above the diaphragm to the iliac crest, might be extended to include the whole pelvis.
scan direction

craniocaudal.
scan geometry
field of view (FOV): 350 mm (should be adjusted to increase in-plane resolution).

slice thickness: ≤0.625 mm, interval: ≤0.5 mm

reconstruction algorithm: soft tissue, bone.

oral contrast

neutral contrast agent: 800 ml water 20-30min before the scan

contrast injection considerations

non-contrast (rarely indicated).

biphasic pancreatic ± venous acquisition (to detect pancreatic mass).

contrast volume: 70-120ml (1 mL/kg) with 30-40 mL saline chaser at 3-5 mL/s.

optional bolus tracking: abdominal aorta.

pancreatic phase: scan delay 15-20 sec after trigger or 35-40 sec after contrast injection.

portal venous phase: 30 sec after the pancreatic phase or 65-70 sec after contrast injection.

biphasic arterial ± venous acquisition (to detect neuroendocrine tumors).

contrast volume: 70-120ml (1 mL/kg) with 30-40 mL saline 4-5 mL/s

bolus tracking: abdominal aorta.

arterial phase: minimal scan delay (or 20 seconds after contrast injection).

portal venous phase: 40 seconds after the arterial phase or 60-70 seconds after contrast injection.

single acquisition with a monophasic injection (venous phase).

contrast volume: 70-120ml (1 mL/kg) with 30-40 mL saline 3-5 mL/s.

portal venous phase: 65-70 sec after contrast injection.

respiration phase

single breath-hold: inspiration.

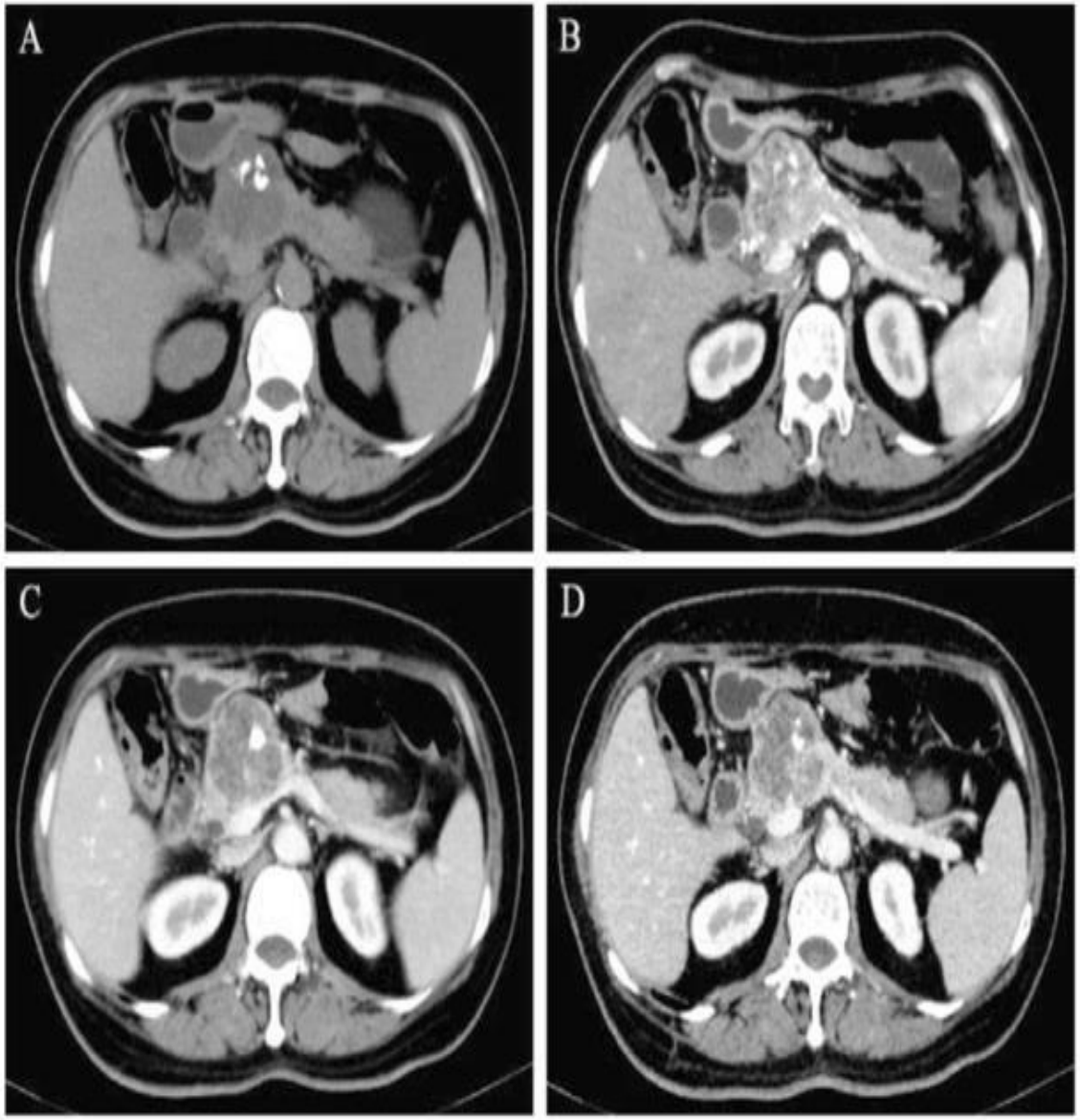
multiplanar reconstructions

axial images: accurately axial to the body axis.

coronal images: accurately coronal to the body axis.

sagittal images: accurately sagittal to the body axis, aligned through the center of the vertebral bodies and the sternum.

slice thickness: soft tissue 2,5 mm, bone 2 mm.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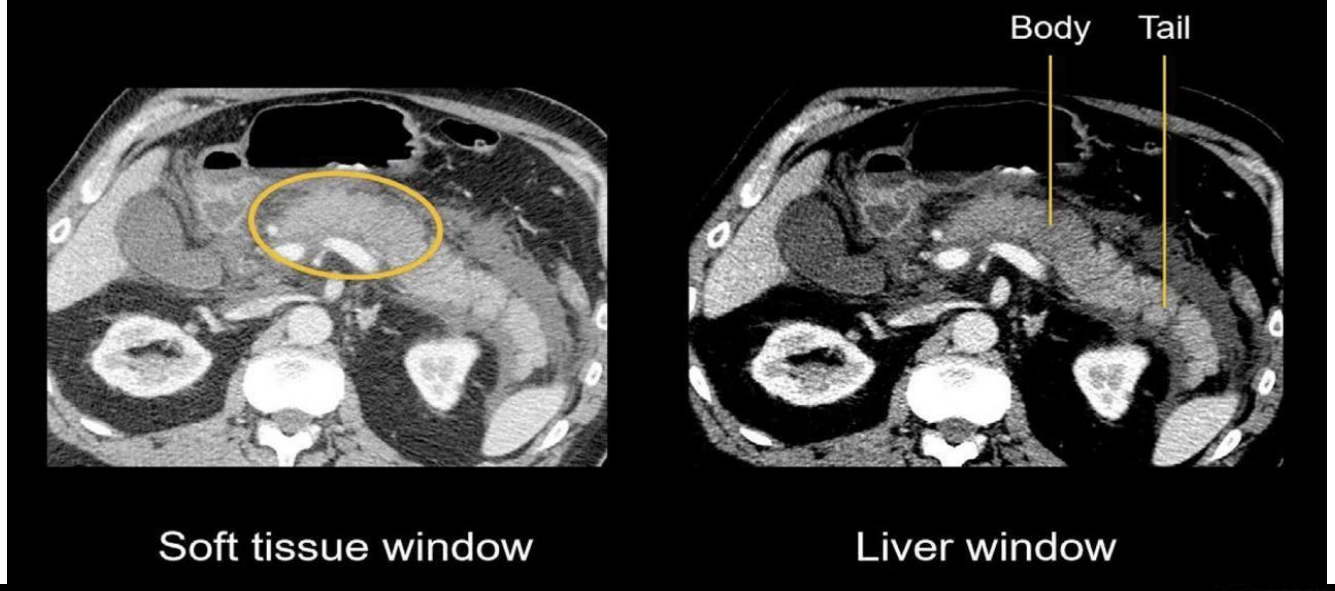
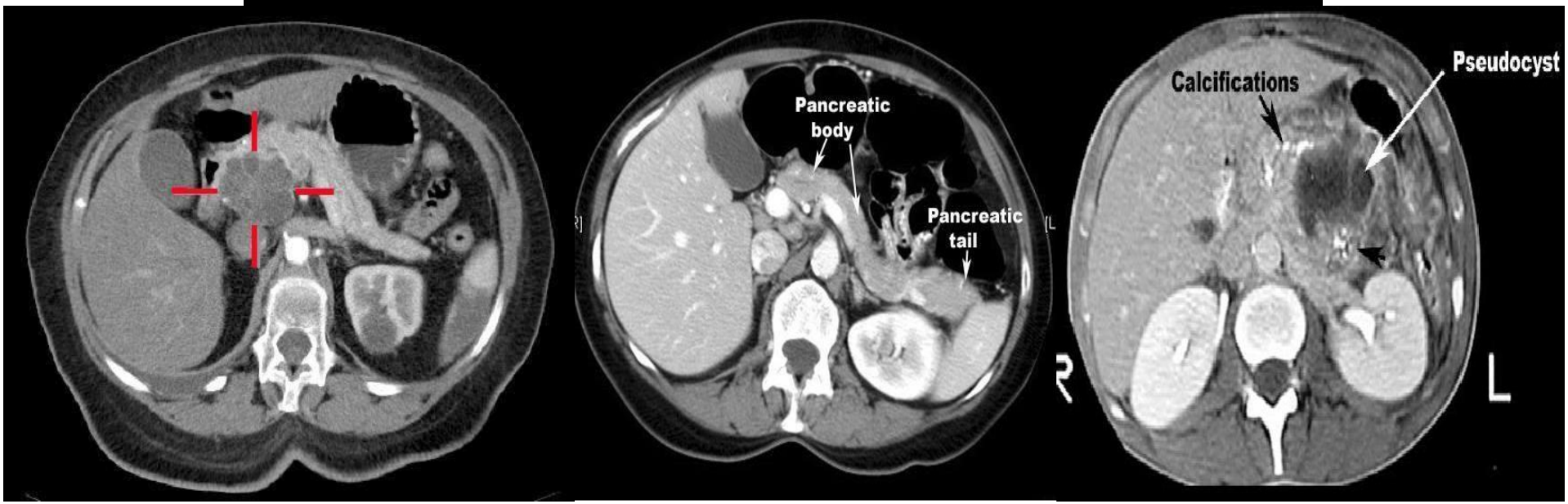

Body
Tail
Soft tissue window
Liver window


Pancreatic body
Pancreatic tail
Calcifications
Pseudocyst
R
L