CT Procedures Overview

Head, Neck, Body CT Procedures

- Overview of indications and comparing studies
  - Head and face
  - Cerebral blood vessels
  - Spine and neck
  - Chest and mediastinum
  - Cardiac
  - Liver
  - Spleen
  - Bowel
  - Retroperitoneum
  - Pelvis
  - Trauma
  - Vascular system
  - Interventional applications
  - Musculoskeletal system

Head and Face

- CT is valuable for assessing intracranial pathological conditions, especially in acute stage
  - Cerebral infarction
  - Hemorrhage
  - Aneurysm
  - Hematoma
  - Infection
  - Tumors
  - Congenital defects

Algorithm (kernel) – brain and bone
Scanning Protocols - Head

- Orbitomeatal line perpendicular
- Transverse plane
  - Reformats - thin slices
  - Vertex through C2
- MPR – coronals and sagittals
- Contrast enhancement?
  - For any CTA of head or neck
  - When infection or tumor is suspected
    - Contrast enhanced head CT is significantly inferior to MRI for these indications

Infarction

Figure 17-1 A, Early subtle infarction. B, Late well-defined cerebral infarction. Subtle loss of the distinction between the gray and the white matter is present on the early CT, in the right middle cerebral artery territory, with good delineation of the affected area on the later CT.

Hematoma

Figure 17-2 A, Large left parenchymal hematoma causing a marked midline shift to the right. B, Severe subarachnoid hemorrhage outlining all the cisterns of the skull base.
Metastasis

Figure 17.4 A, Multiple ring enhancing metastases in both frontal lobes. B, Enhancing bifrontal (butterfly) GBM. It is surrounded by edema, causing mass effect on frontal horns.

Scanning Protocols – Head

- Sinuses = direct coronals
  - Sinuses (air-fluid levels)
  - Temporal petrous bones/IACs/Sella turcica
- Orbits
- Pituitary
- IACs

Scanning Protocols – Head

- Facial Bones
  - Bone and soft tissue
  - Include mandible?
- Mandible
  - Horizontal axials set up or may angle with mandibular body to avoid dental metal
- Trauma
  - Need quick acquisition!
There is a crescent-shaped hyperdense fluid collection overlying portions of the left frontal and parietal lobes (white arrows), compatible with an acute subdural hematoma. Subdural hematomas cross sutures - epidural hematomas don’t. Also present is a small acute right posterior interhemispheric subdural hematoma.
**Pituitary Adenoma**

Very large pituitary adenoma, filling the sphenoid sinus but not abutting on the optic chiasm, imaged in transverse plane and reformatted in coronal plane.

---

**Sinusitis**

Sinusitis of bilateral ethmoid sinuses, and left maxillary sinuses in adult patient. There is smaller air fluid level in right maxillary sinuses.

---

**IACs**

Direct (i.e., with neck extension) coronal images of the internal auditory canals (IAC), on soft tissue (C) and bone (D) algorithms. E, Left petrous bone, acquired in direct coronal plane, showing the ossicles in the middle ear, surrounded by air.
PET/CT of Brain

- 18FDG used
- Establish IV site ~15 - 30 mins prior to FDG injection
- Uptake phase should last 45 - 60 mins
- CT scout acquired just before PET emission acquisition
- Brain should be imaged in 1 bed position = 5-10 mins

Diseases:
- Application in Epilepsy
- Picks and Alzheimer’s
- Assessment with trauma
- Low vs high metabolic glioblastoma

PET/CT of Brain

PET/CT Brain scan

PET/CT of Brain

Cerebral Blood Vessels

- CT Angiography
  - 15-20 sec delay = arterial
  - 30 sec delay = venous
  - Stenosis
  - Thrombosis
  - Aneurysm
  - Cerebral infarction
    - CVA
    - CT perfusion

Info from Mark Crosthwaite

Image from Northern CA PET Imaging
Cerebral Blood Vessels

- Cerebral blood vessels
- Perfusion imaging
- IV contrast
- Workstations
  - MIP or 3D surface-shaded
  - Calculated values

CTA shows left middle cerebral artery occlusion

47-year-old woman with a left internal carotid aneurysm

Neck, Spine, and Blood Vessels

- Trauma
- Masses/tumors
- Infections
- Arthritis
- Scoliosis

- Avoiding artifacts from dental objects
  - Gantry angling

Neck, Spine, and Blood Vessels

- Neck
  - IV contrast
  - Alignment with cervical disks
  - Phonation techniques
  - Bone algorithm vs soft tissue
Neck, Spine, and Blood Vessels

- Spine
  - Gantry positioning (perpendicular or angled)
  - Sequential vs helical scanning
  - Bone algorithm vs soft tissue algorithm
  - IV contrast
  - Reformatted images

Fractures

Figure 17-10  A, Reformatted image of the cervical spine showing fractures of C2 and C5. Multiple spinal fractures are not uncommon. B, Metal causes streak artifacts but still demonstrates the C1 fracture. C, Alignment is a critical component of spinal assessment. A facet lock is present.

Vascular Mass

Figure 17-11  A, Large vascular mass (carotid body tumor) shown on CTA. B, Metastatic ring enhancing necrotic lymph nodes, abutting on the right submandibular gland. C, Large thyroid goiter encircling trachea
Rotary Subluxation

Figure 19-4 Rotary subluxation of C1 vertebral body. Axial image (A) demonstrates 30 degrees of clockwise rotation of C1 with respect to C2. The rotation is better demonstrated on the 3D surface-shaded display (B).

Metastasis to Spine

- Metabolic imaging using 18FDG
- Useful in tumor staging
- Useful in predicting prognosis and treatment response
  - Ex: Lymphoma → higher FDG uptake is indication of higher malignancy

- Indications:
  - Differentiation of benign from malignant lesions.
  - Staging of malignant disease
  - Evaluating chemotherapy response

Image/info from St. Joseph's at Carlstadt
**PET/CT of Neck**

- Image:PET/CT scan showing uptake in the neck region with annotations indicating lymph node involvement.
- Description: Head and Neck Cancer was identified in this patient with squamous cell involvement. A (black arrow) shows tonsil uptake whereas B (red arrow) defines lymph involvement. Additional lymphatic involvement is seen on the whole-body procedure along the cervical lymph nodes.

**Chest and Mediastinum**

- Mediastinum
  - Lymphadenopathy
  - Vascular enhancement
- Lung
  - Pulmonary metastases
  - Sensitivity vs specificity
    - High resolution CT (HRCT)
  - Multislice and blunt trauma
  - Screening CT

**Bronchogenic Carcinoma**

- Image: CT scan showing a bronchogenic carcinoma (black arrow) with pretracheal mediastinal lymphadenopathy (white arrow).

- Figure 18-1: Bronchogenic carcinoma (black arrow) with pretracheal mediastinal lymphadenopathy (white arrow).
Pulmonary Emboli

Multiple filling defects caused by pulmonary emboli in the pulmonary arteries of both lungs (arrows).

Interstitial Changes

Figure 18-6 Additional interstitial changes (arrows) on plain films (A) are shown to have occurred as a result of paraseptal emphysema on high-resolution thin sections (B).

Cardiac

- Evaluation of coronary arteries and calcifications
  - Very rapid scanning
  - Thin collimation
  - Extended range
  - ECG gating
  - Negative predictive values
**PET/CT - Cardiology**

- Allows the study and quantification of various aspects of heart tissue function
- **Myocardial Perfusion**
  - \(^{13}\)NH\(_3\), \(^{15}\)O, or \(^{82}\)Rb
  - Shows whether pt has coronary artery disease
  - Images of myocardial blood flow taken before and after pharmacologic stress to see if blood flow restricted by coronary artery stenosis
- **Myocardial Viability**
  - \(^{18}\)FDG
  - Determine viability of heart muscle if has been damaged due to decreased/absent blood flow

Info/images from Siemens

**Liver**

- **Ultrasound vs CT**
- **IV contrast**
  - Arterial phase
  - Venous phase
  - Delayed scan

Liver

Hepatoma

Small cholangiocarcinoma not visible in portal venous phase (left), but seen as relative hyperdense lesion in the delayed phase (right).
**Spleen**

- Most commonly injured solid organ in abdomen
- Splenomegaly
- IV contrast
  - Hematoma
  - Laceration
  - Vascular injury

**Splenic Rupture**

Spleenic rupture. Notice free fluid in peritoneal cavity.

**Accessory Spleen**

Note: This is an example of an accessory spleen.
Bowel

- Visualization of lumen, bowel wall, and adjacent structures
  - Virtual colonoscopy
  - GI malignancies
  - Appendicitis
  - Trauma

Small Bowel Obstruction

Figure 18-11  A, Small bowel obstruction as evidenced by the multiple dilated loops of proximal small bowel (arrows).
B, Herniated loop in the left groin (arrowheads).

Bezoar

CT shows a ball of swallowed foreign material that has collected in the stomach and failed to pass through the intestines. It appears on the coronal and axial images as a mass that has displaced the liver anteriorly into the diaphragm.
Appendicitis

Thickened, inflamed appendix in the RLQ

Pancreas

- Acute pancreatitis
- Biphasic or triphasic examinations
  - Arterial phase
  - Parenchymal phase

Acute Pancreatitis

Figure 18-14 Acute pancreatitis. Necrotic pancreas surrounded by fluid
Kidneys
- Renal calculi
  - Non-contrast CT
- Tumors
- Cysts
- Renal donations

Renal Pelvis

Renal Mass

Figure 18-17  A, Dilated right renal pelvis (arrow).
B, Calculus (arrow) in the right ureter.

Figure 18-18  Solid mass in the renal pelvis (arrow) before (A) and after (B) contrast opacification of the renal pelvis.
Adrenal Glands
- Pheochromocytomas
- Cushing’s disease
- Conn’s syndrome
- Hyperplasia
- Metastasis
- Adrenal mass
  - Nonfunctioning adenomas

Adrenal Mass

Pelvis
- Ultrasonography remains the primary means of reproductive organ assessment
- Assessment of bowel
- Trauma
- Staging of tumor development

Figure 18-19 Region of interest within an adrenal mass (arrow) indicating a negative Hounsfield number, confirming the diagnosis of adenoma.
Imaging of the Pelvis

Figure 18-22  Thickening of the bladder wall without evidence of extension into the perivesical fat (proven amyloidosis).

Vascular and MSK

- **Vascular**
  - AAA vs dissection
  - Embolism
  - Graft placement
- **Musculoskeletal system**
  - Bony tumor or fractures

Interventional Applications

- **Interventional applications**
  - Abscess drainage
  - Biopsy
CT Runoff Angiogram

Figure 18.23: CT runoff angiogram demonstrating the entire vascular tree from the aorta to the lower calves. 3D reconstruction of the aorta and iliac arteries (A). Maximum intensity projection image of the thighs (B) demonstrating a femoral graft on the right (arrow) replacing the occluded superficial femoral artery. Maximum intensity projection image of the calves (C) demonstrating that the graft (arrow) has been anastomosed to one of the runoff branches. Most of the bony structures have been segmented and removed.

PET/CT

- **Overall Tumor Assessment**
  - Scan “Eyes to Thighs”
  - Except T-cell Lymphoma and Melanoma
    - “Head to Toe”
      - FDG → sugar uptake → metabolic

- **Bone Study**
  - 99mTc MDP → blastic lesions
  - NaF → lytics and blastic lesions
Role of CT Compared to Other Modalities

- Plain films
- Transcranial doppler
- MRA
- Gadolinium-DTPA enhanced MRI
- MRI

The End!