Imaging in medical emergencies

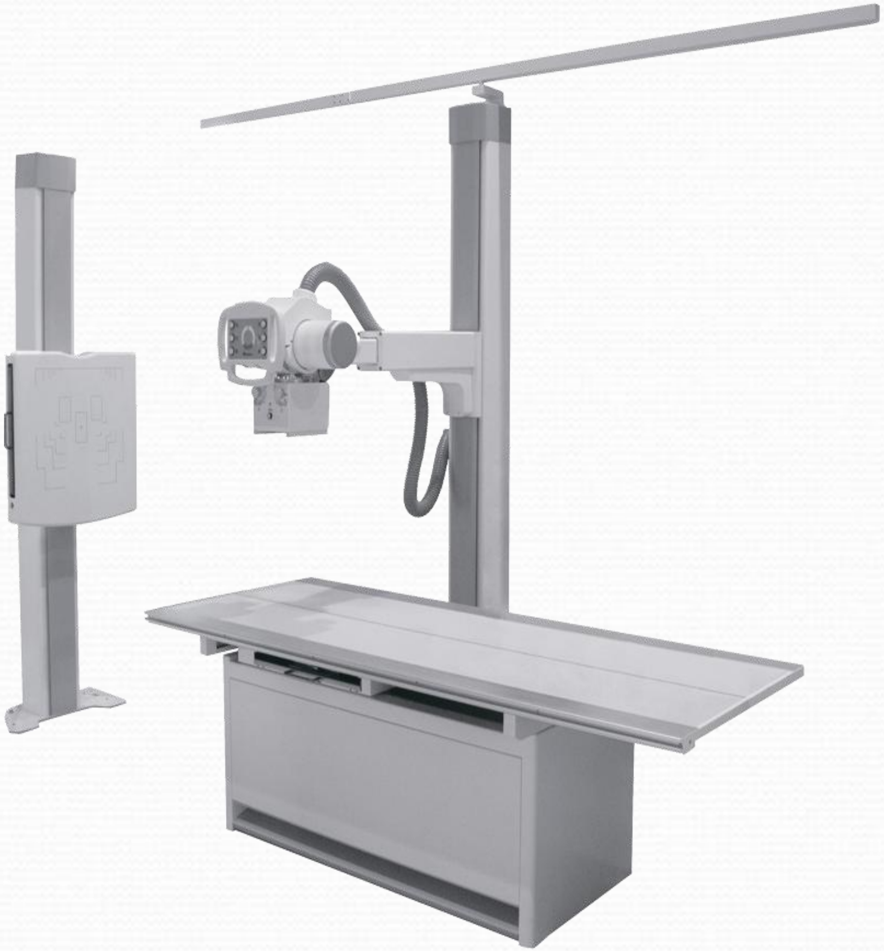
Imaging Methods

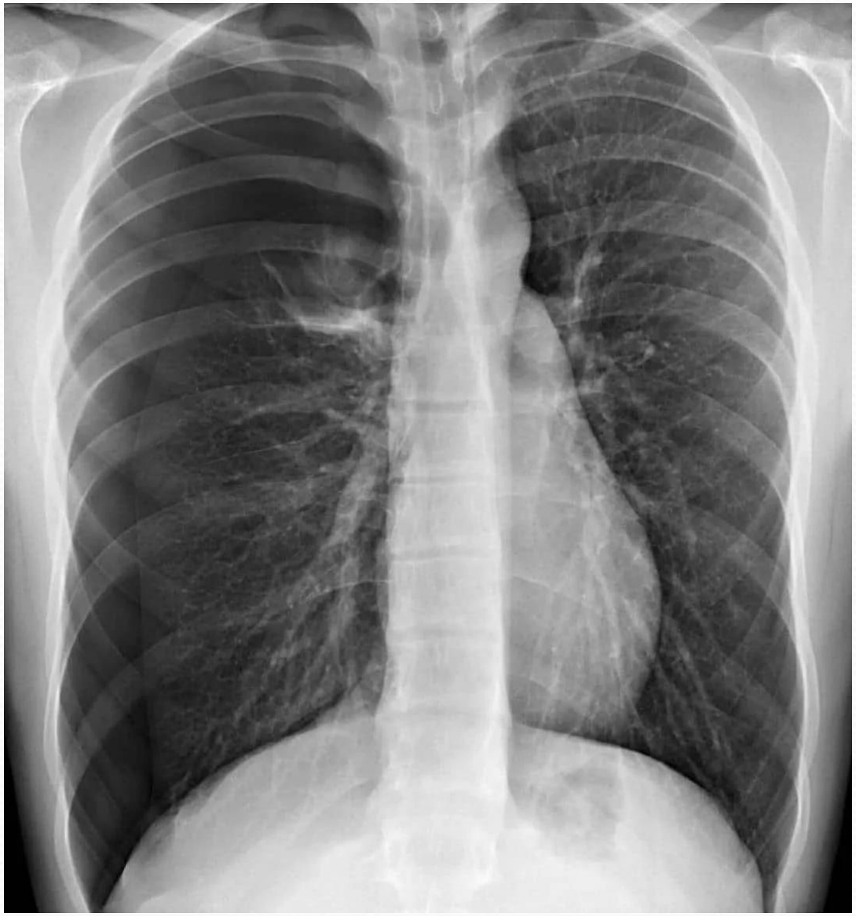
- **Radiological**
- **1.** Radiography
- **2.** Linear tomography
  3. CT
- **USG**
- **MRI**
- **Nuclear Medicine**
  1. Scintigrafy
  2. PET-CT

Imaging Methods

- Contrast substances
- Paramagnetic substances
- Radiopharmaceutical substances

Radiography





Radiography

- First-line method for assessing chest injuries in monitoring their progress and the effectiveness of treatment or therapeutic maneuvers
- It is affordable, fast, easy to make and low cost
- It can be performed on the patient's bed using portable radiological installations
- Provides sufficient information for the diagnosis of many post-traumatic injuries with immediate lethal risk and provides indirect signs for others
- Allows control of therapeutic maneuvers, such as positioning: orotracheal intubation probes, central venous catheters, pleural drainage tubes, nasogastric tubes

Radiography + Fluoroscopy + Linear Tomography + Tomosynthesis

Computed Tomography

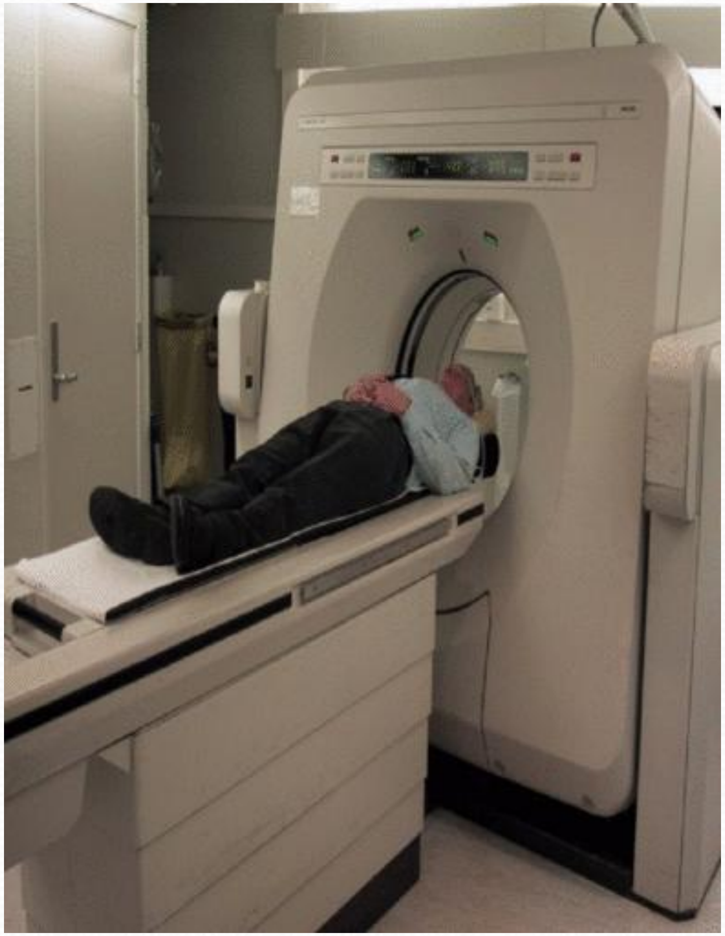
- The purpose of computed tomography is to produce an image of a cross section of a patient's body (from the Greek "tomos", which means to cut, cutting).

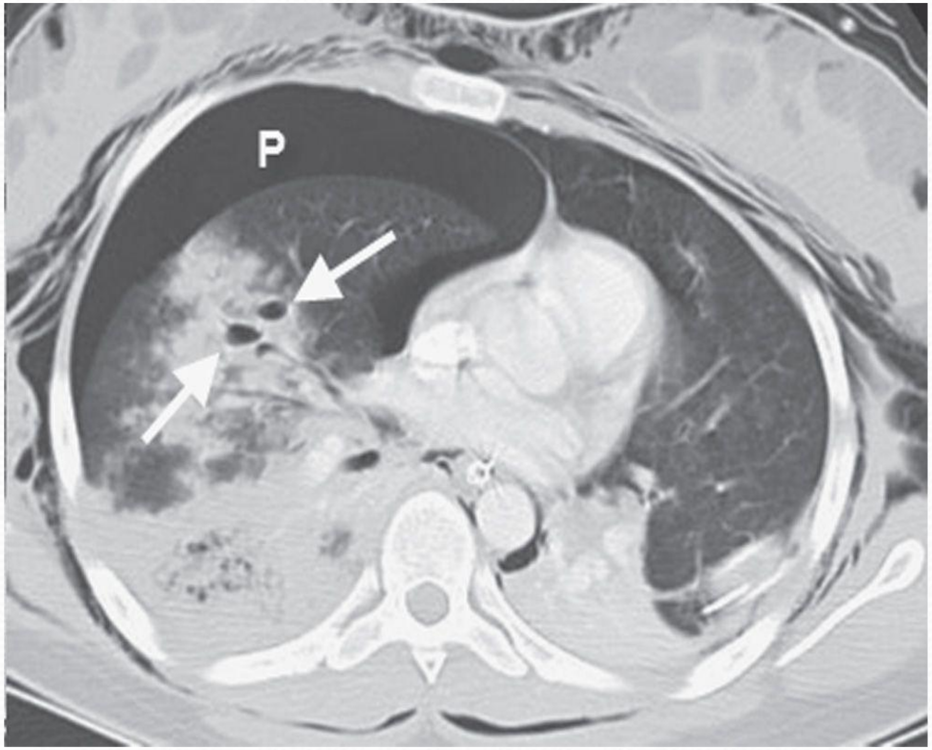
- This is done by rotating a thin, fan-shaped X-ray beam around the patient and further by measuring its density on the other side of the patient's body using a very large number of detectors.

Computed Tomography

- Assessment of acute lesions to quickly establish a complete lesion balance
- Monitoring of diagnosed lesions or diagnosis of intrathoracic complications
- Optimal in the diagnosis of acute stroke, hemothorax and pneumothorax, pulmonary parenchymal complications

Computed Tomography





Computed Tomography

Contraindications

- Pregnancy
- Allergic reactions to contrast agent injection

In vital indications, contraindications are practically missing!

Computed Tomography

On examination the native CT lesion may be:

- Hyperdense
- Hypodense
- Isodense
- - is highlighted indirectly by neighborhood changes
- - or after i / v injection of contrast medium

Computed Tomography

Hypodense lesion

- neuronal loss: ischemic stroke
- water load: edema
- tumor tissue / necrotic tissue
- cysts of various origins (generally have a fluid density of 0-12UH)

Computed Tomography

Hyperdense lesion

- fresh blood: hematomas (density: 60-80 UH), meningeal hemorrhage
- tumor tissue
- calcifications (density> 100UH)

Ultrasonography

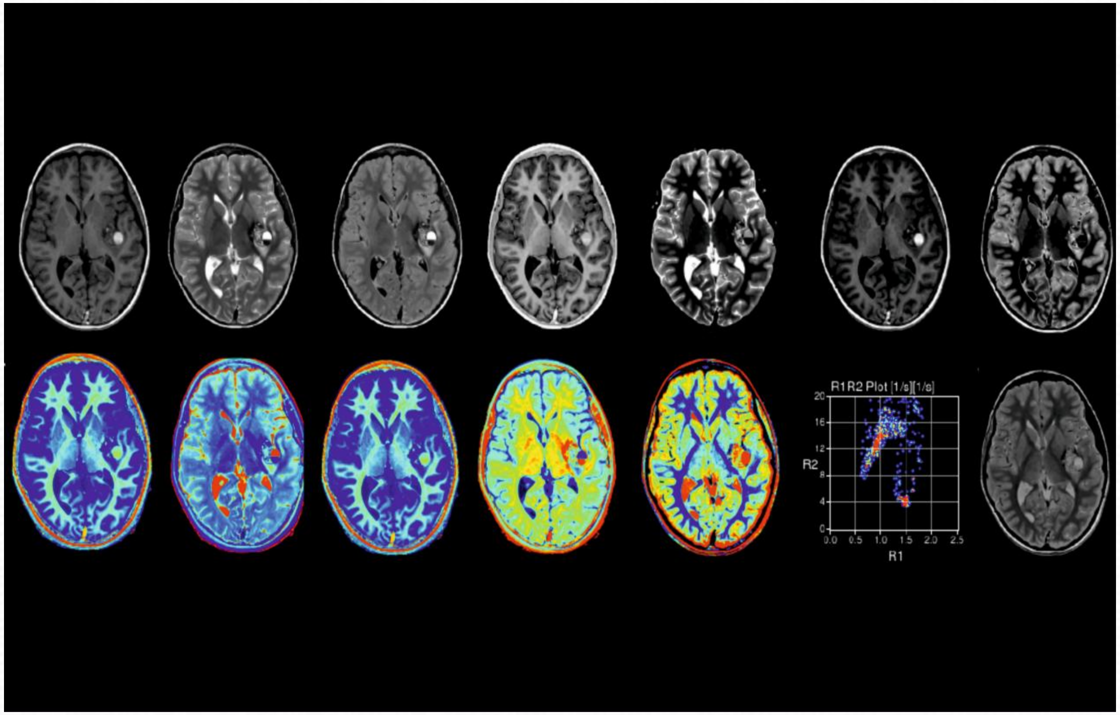
Ultrasonography advantages

- access
- cheap
- rapid
- It does not require special patient preparation
- Non-radiated
- It does not require a contrast media
- It can be performed simultaneously with resuscitation maneuvers, intraoperatively or at the patient's bedside, in intensive care units.
- No special arrangements are required for the use of the equipment

Magnetic Rezonance Imaging

- is a technique of medical imaging that uses the strong magnetic field, radio waves and a computer to produce images of body structures.
- there are no density scales.
- operates with the notion of signal. - iso - hypo / signal - hyper
- the reference contrast is given: - by the white matter in the cerebral stage - by the spinal cord in the spinal level

Magnetic Rezonance Imaging



Magnetic Rezonance Imaging

Advantages

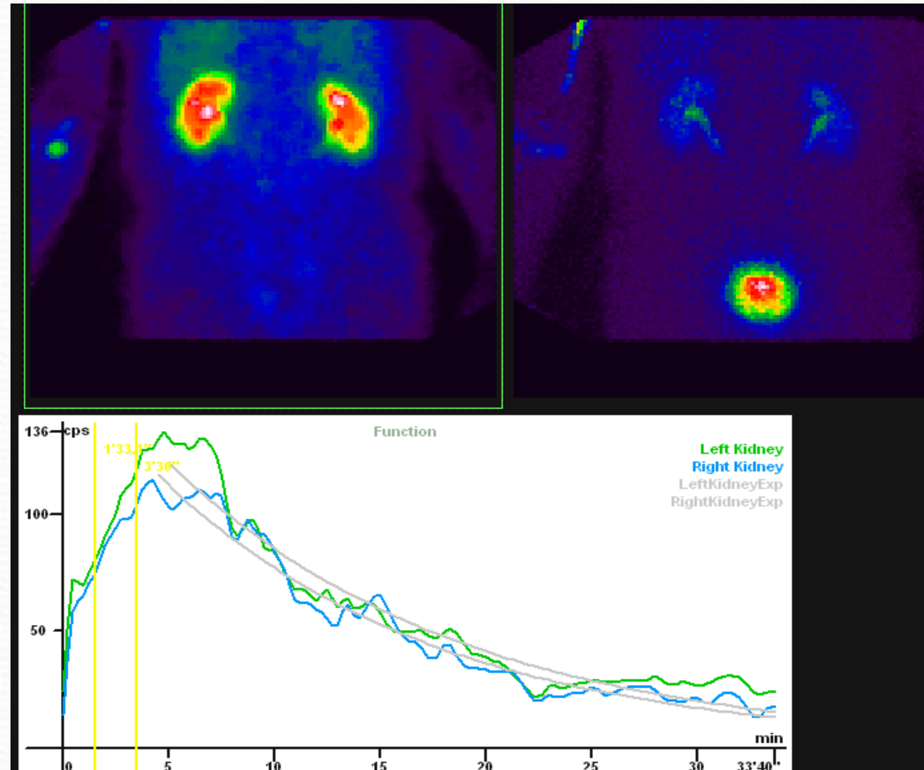
- Very good resolution in contrast
- Study in 3 planes
- There are no bone artifacts - the study of the posterior cerebral fossa
- There is no radiation
- Exceptional risk of major adverse reactions

Magnetic Rezonance Imaging

Disadvantages

- MRI spatial resolution <CT
- relatively long examination time
- does not highlight calcifications
- does not highlight small air accumulations

Nuclear Medicine

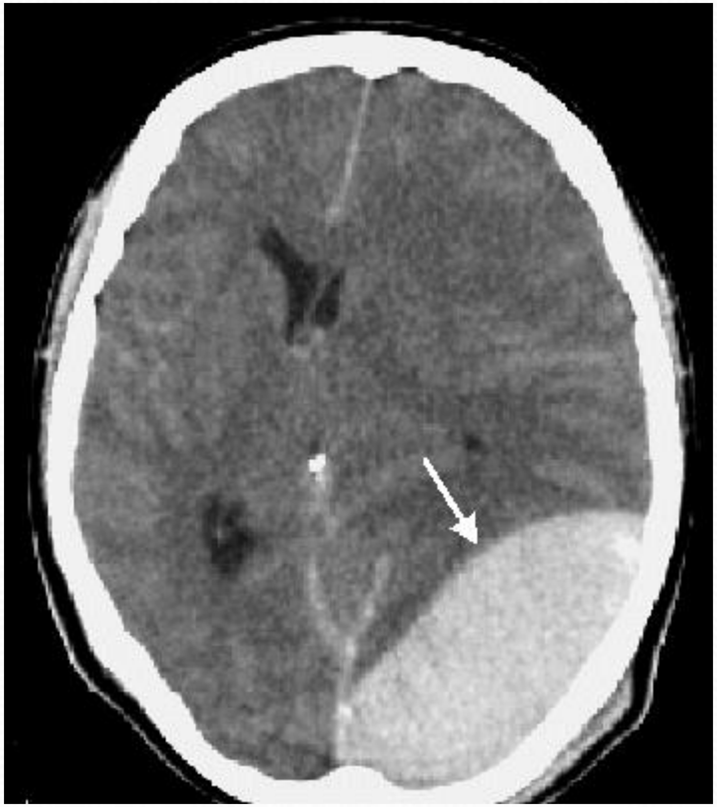


	Left	Right
T0 (sec):	0	0
Tmax:	4'45"	4'15"
Thalf:	9'34"	9'11"
Wash-out Thalf:	6'45"	8'15"
Residual Activity:	28.5 %	29.1 %
Norm.Res. Activity:	42.9 %	38.8 %
Relative Function:	52.1 %	47.9 %

STROKES

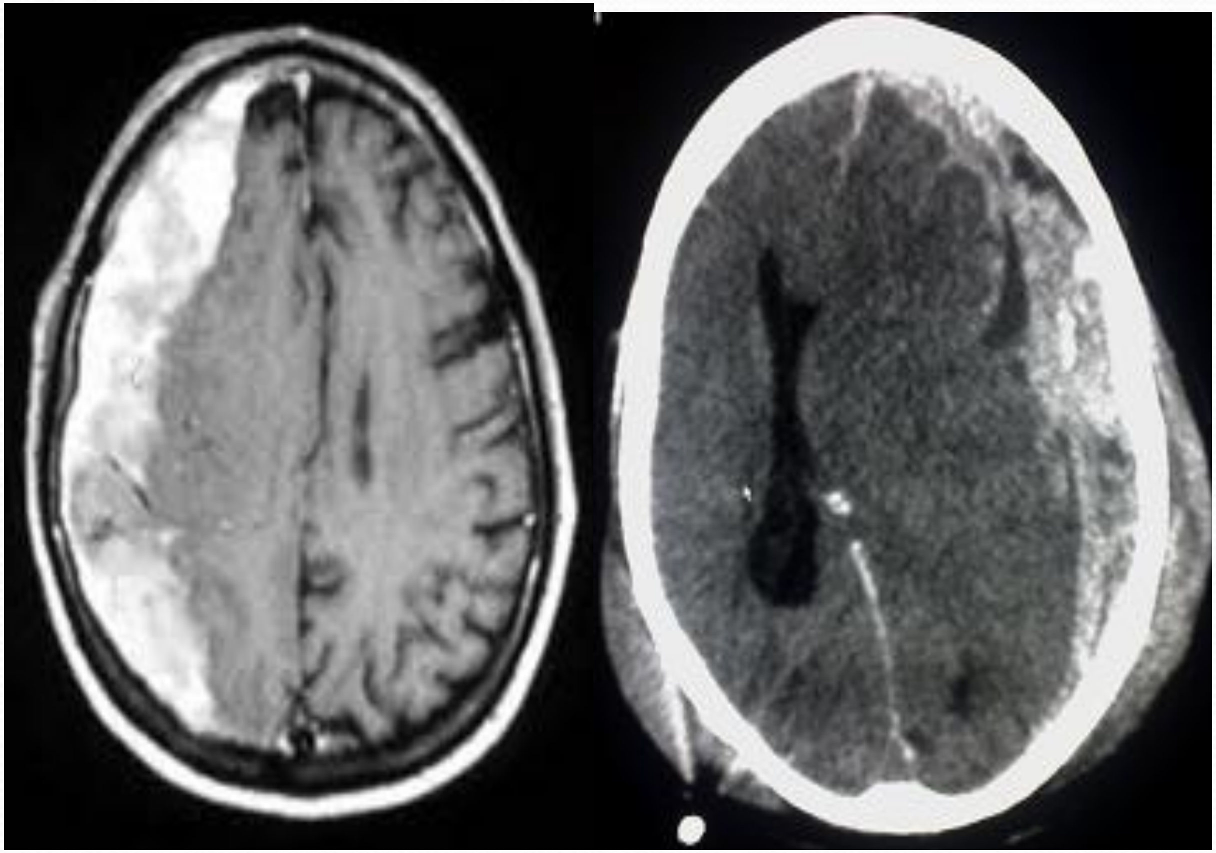
- All patients with a presumptive diagnosis of stroke are recomended computed tomography (CT) of the head, which in most cases makes it possible to distinguish hemorrhagic stroke from ischemic stroke and to exclude other diseases (tumors, inflammatory diseases, injuries of the central nervous system (CNS)). Magnetic resonance imaging (MRI) of the head is a more sensitive method for diagnosing cerebral infarction at an early stage. However, it is inferior to CT in detecting acute hemorrhages, and therefore is less suitable for emergency diagnosis. The study should be performed as early as possible, since its results largely determine the tactics of patient management and treatment.

Epidural hematoma
MRI



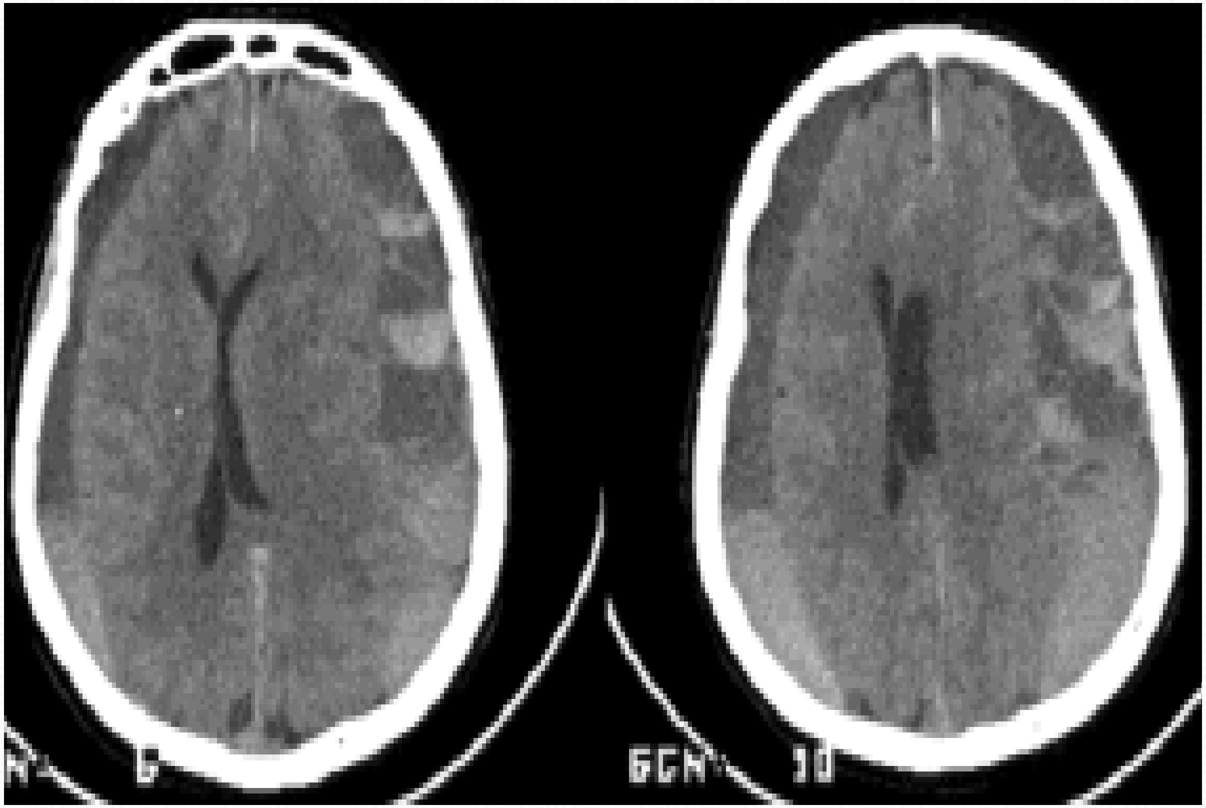
subdural hematoma MRI

- Spontaneously hyperdense, homogeneous collection
- Sickle-shaped, concave inwards, which does not creep into cisterns and ditches
- Arranged hemispherically, just below the cap
- Poorly defined contour
- At ct we evaluate the hematoma volume, location, mass effect and associated lesions

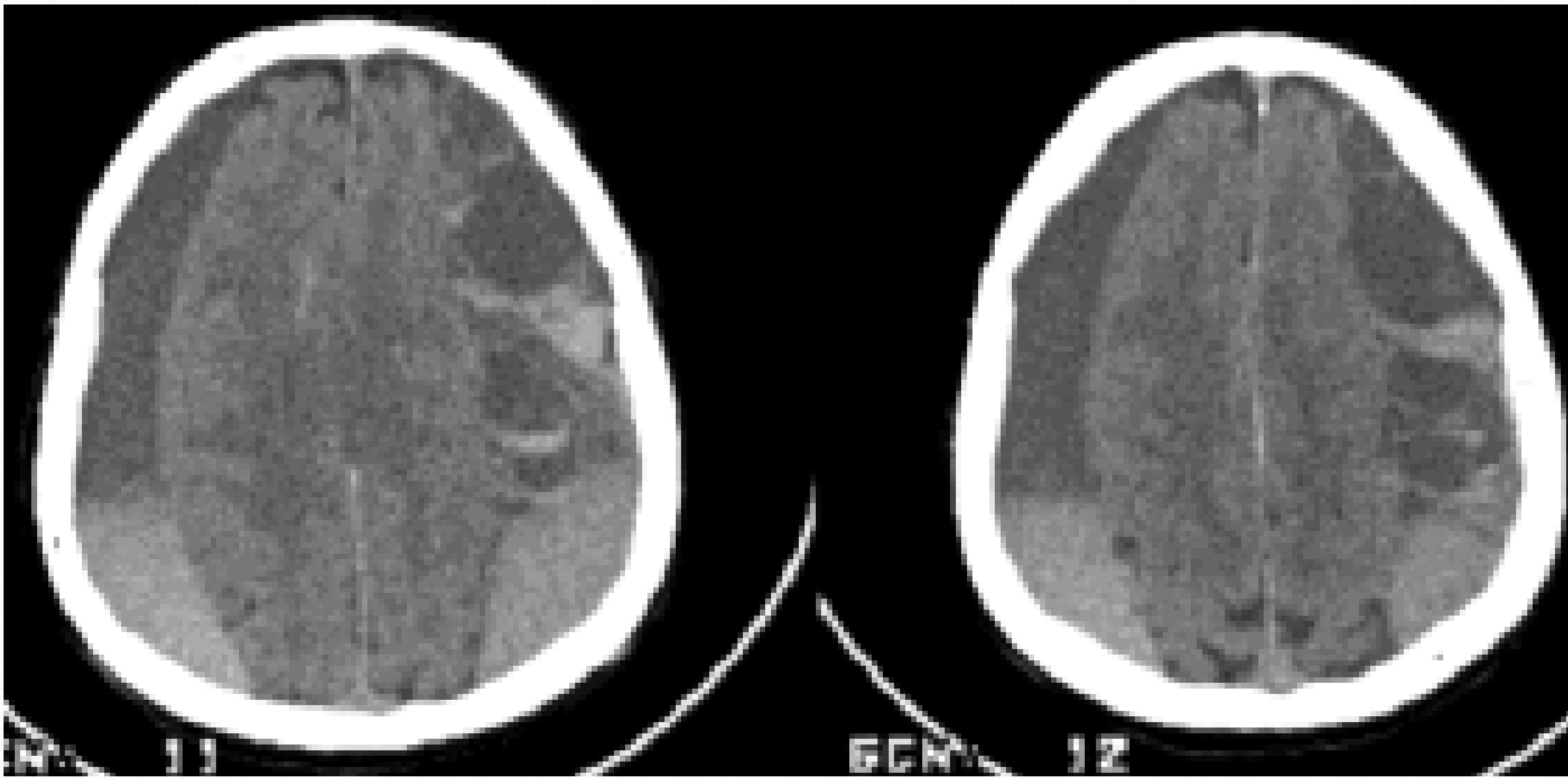


MRI
Chronic subdural hematoma

- Isodense collection at onset, which later becomes hypodense
- Heterogeneous hyperdensity indicates recent rebleeding in this case
- Panhemispheric
- Contrast injection loads the contours of the hematoma membrane

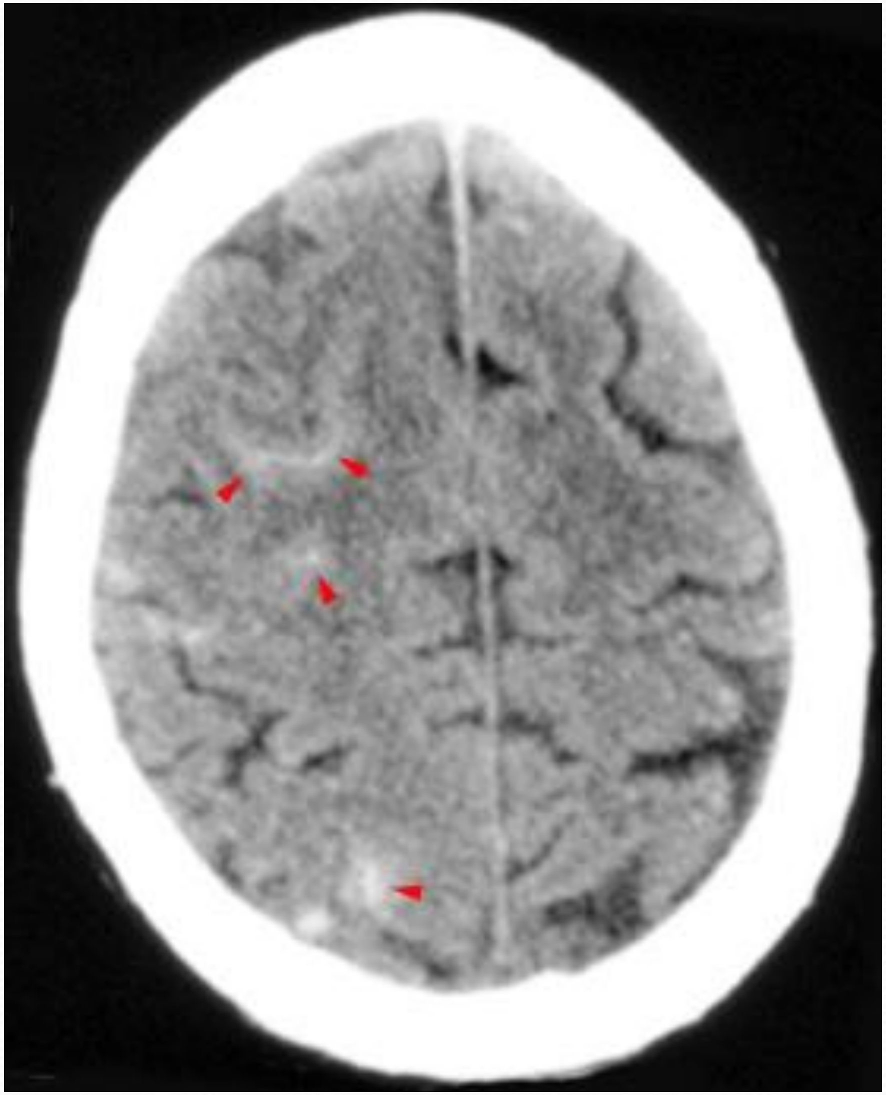


MRI
Chronic subdural hematoma



CT
Subarachnoid hemorrhage

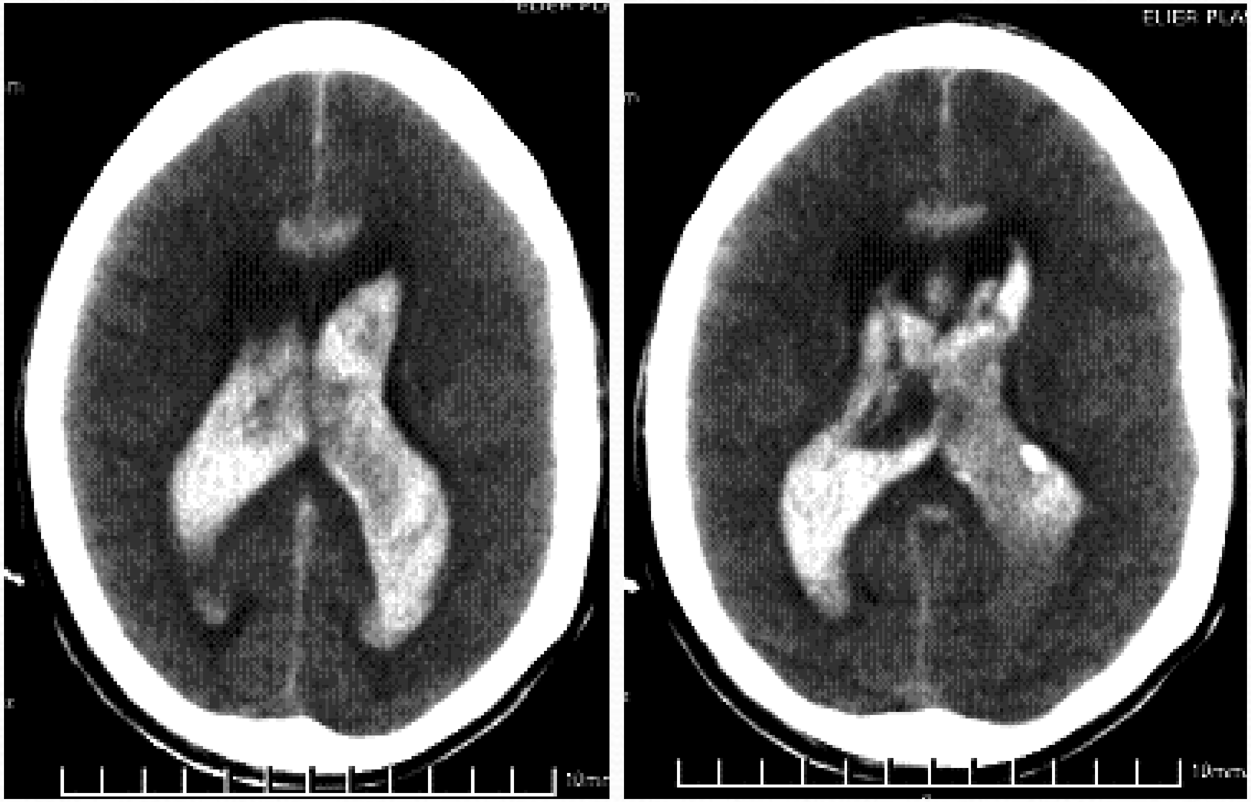
- As the only non-invasive method of diagnosis recommended in emergency situations
- It is highlighted in the form of hyperdense images located at the level of the hemispherical grooves and grooves, the cerebral cisterns, the brainstem, the free edges of the tentorial incision.
- It occurs by breaking an aneurysm or a mav
- Location between arachnoid and pia mater



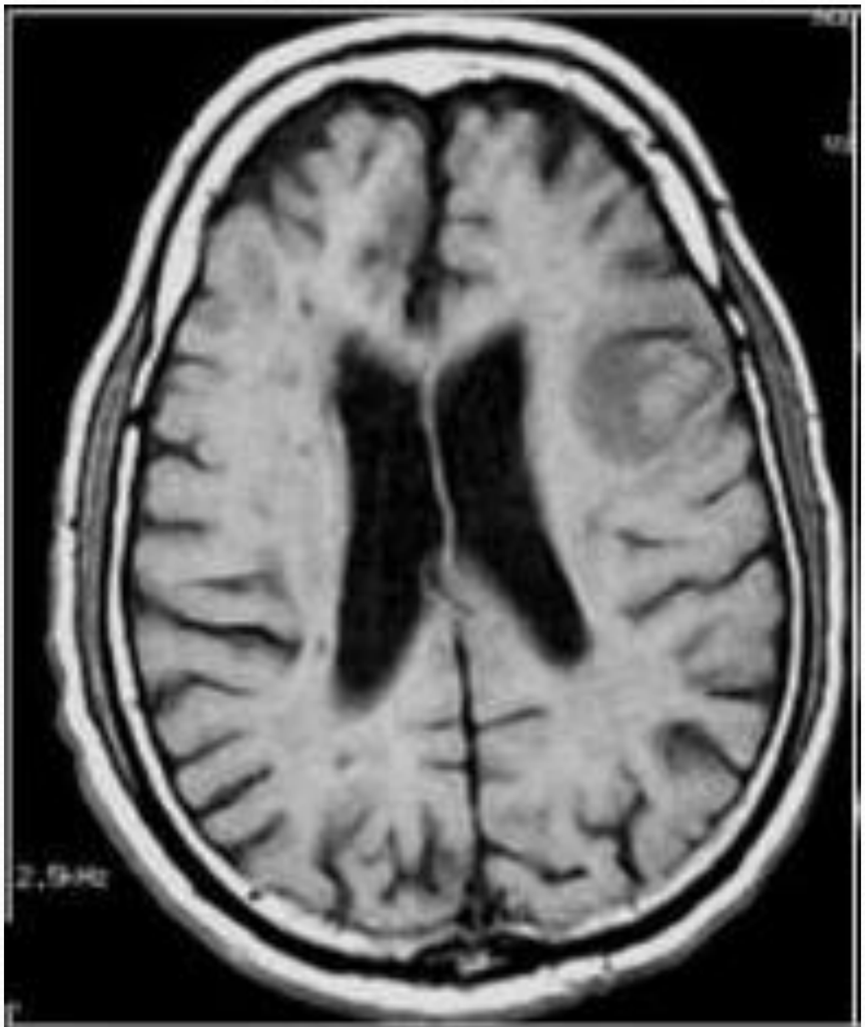
CT
Subarachnoid hemorrhage

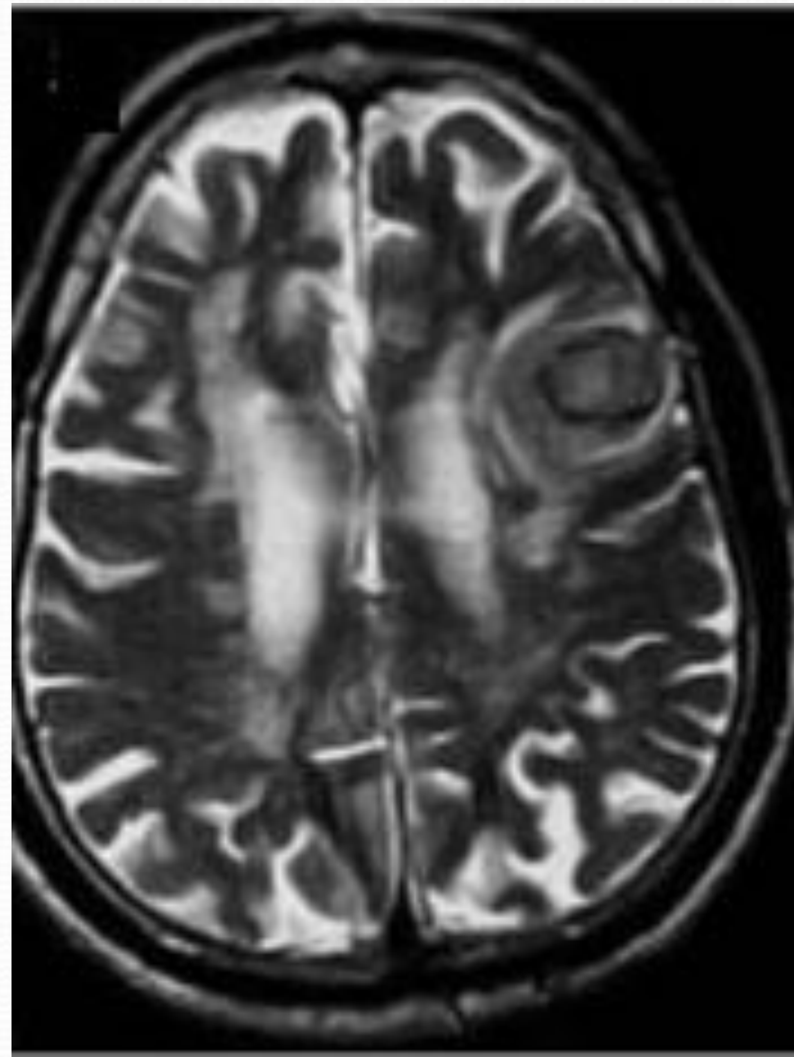
CT
Intraventricular hemorrhage

- It is an intraaxial hyperdensity located in all ventricles or only in certain areas of the ventricular system.



IRM
Stroke





IRM
STROKE

STROKE

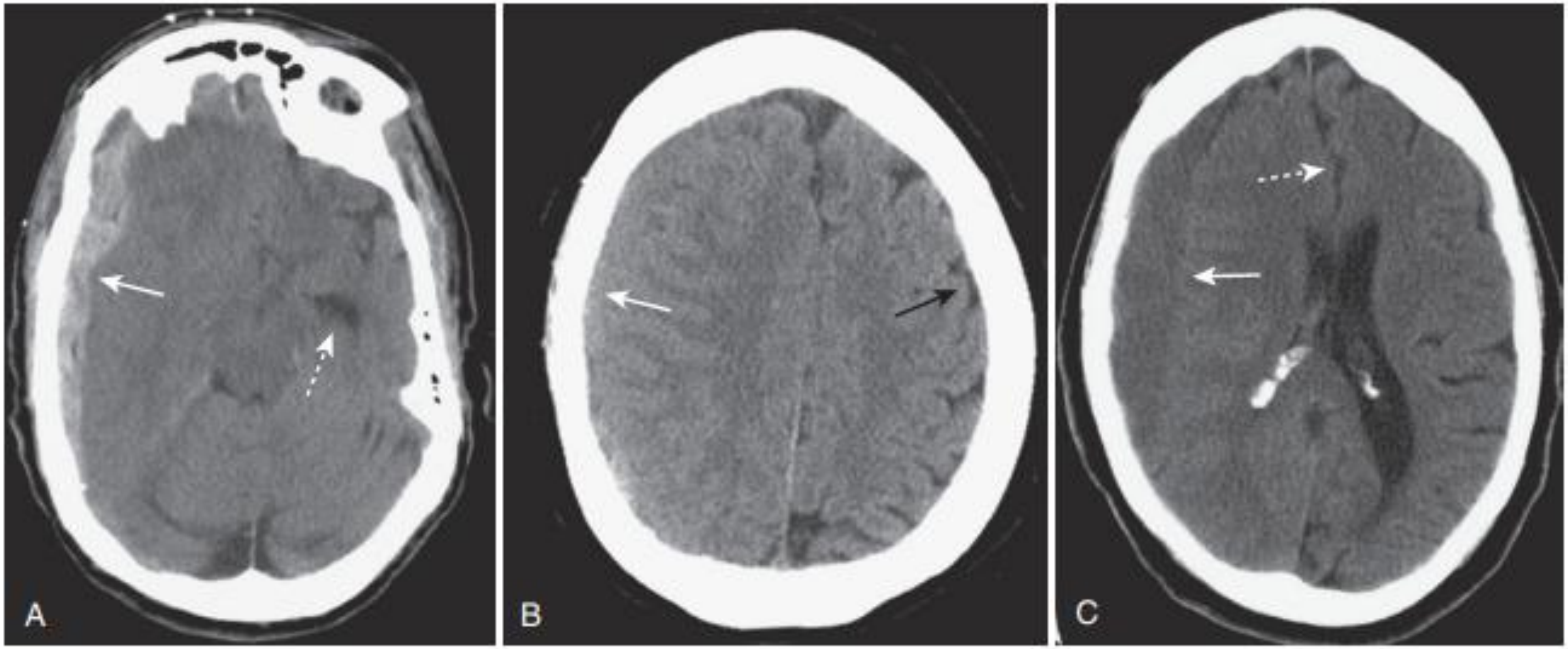


FIGURE 27-9 Acute, isodense, and chronic subdural hematoma. A, There is a crescent-shaped band of high-density blood concave inward toward the brain *(solid white arrow)*. There is mass effect with herniation of the brain as indicated by the dilated contralateral temporal horn *(dotted white arrow)*. **B,** As they become subacute, subdural hematomas become less dense and may be the same density (isodense) as the normal brain tissue *(white arrow)*. You can recognize an isodense subdural by the unilateral absence or displacement of the sulci away from the inner table of the skull compared with the normal opposite side *(black arrow)*. **C,** Chronic subdural hematomas (more than 3 weeks old) are usually of low density *(solid white arrow)* compared with the remainder of the brain. There is still mass effect demonstrated by displacement of the interhemispheric fissure *(dotted arrow)* and compression of the lateral ventricle.

STROKE

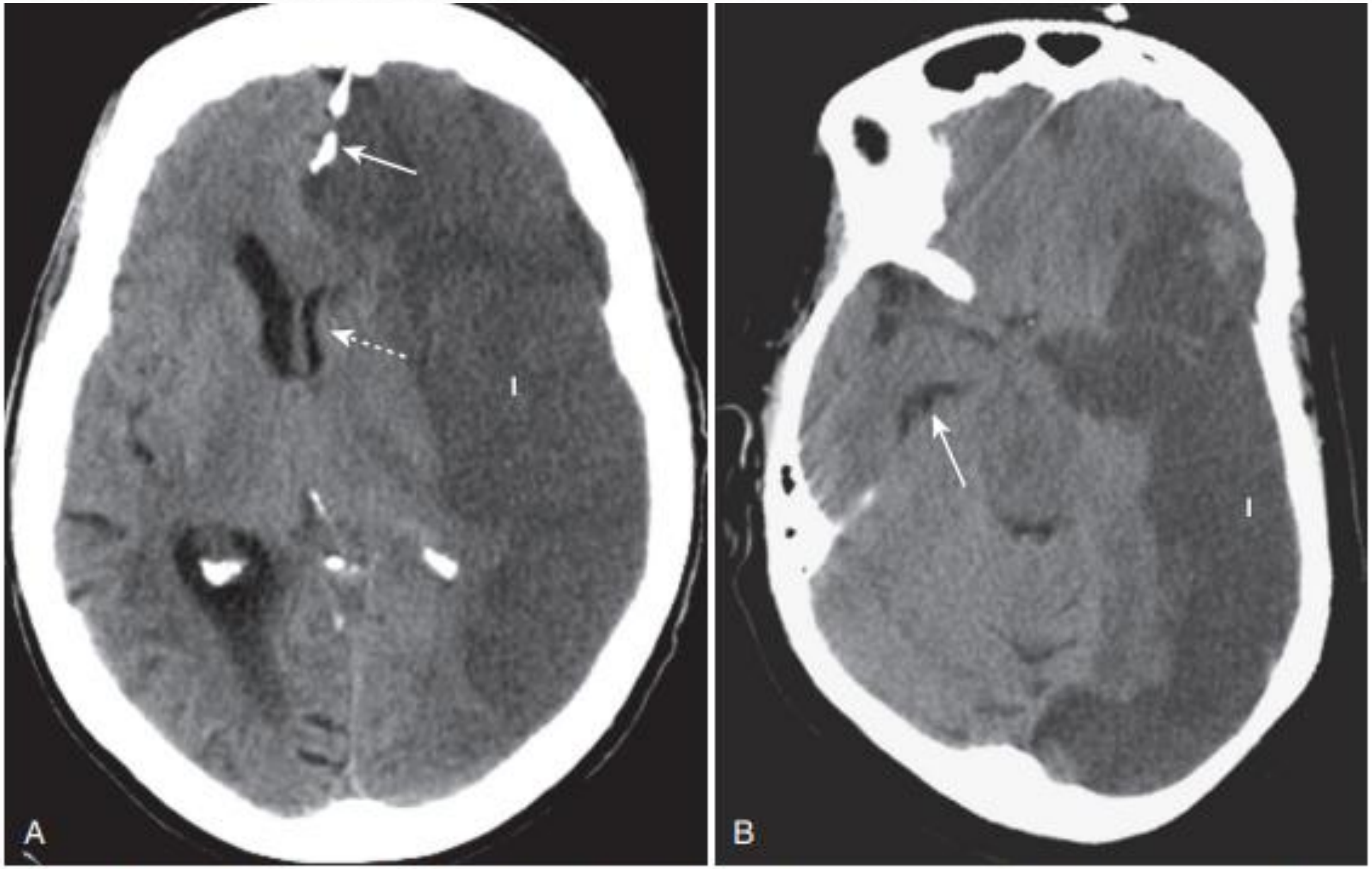


FIGURE 27-12 **Brain herniations. A, Subfalcine herniation** occurs when the supratentorial brain, along with the lateral ventricle and septum pellucidum, herniates beneath the falx *(solid white arrow)* and shifts across the midline toward the opposite side *(dotted white arrow)*. **B, Transtentorial herniation** usually occurs when the cerebral hemispheres are displaced downward through the incisura beneath the tentorium, compressing the ipsilateral temporal horn and causing dilatation of the contralateral temporal horn *(white arrow)*. Both patients had large cerebral infarcts (I) with cytotoxic edema.

STROKE

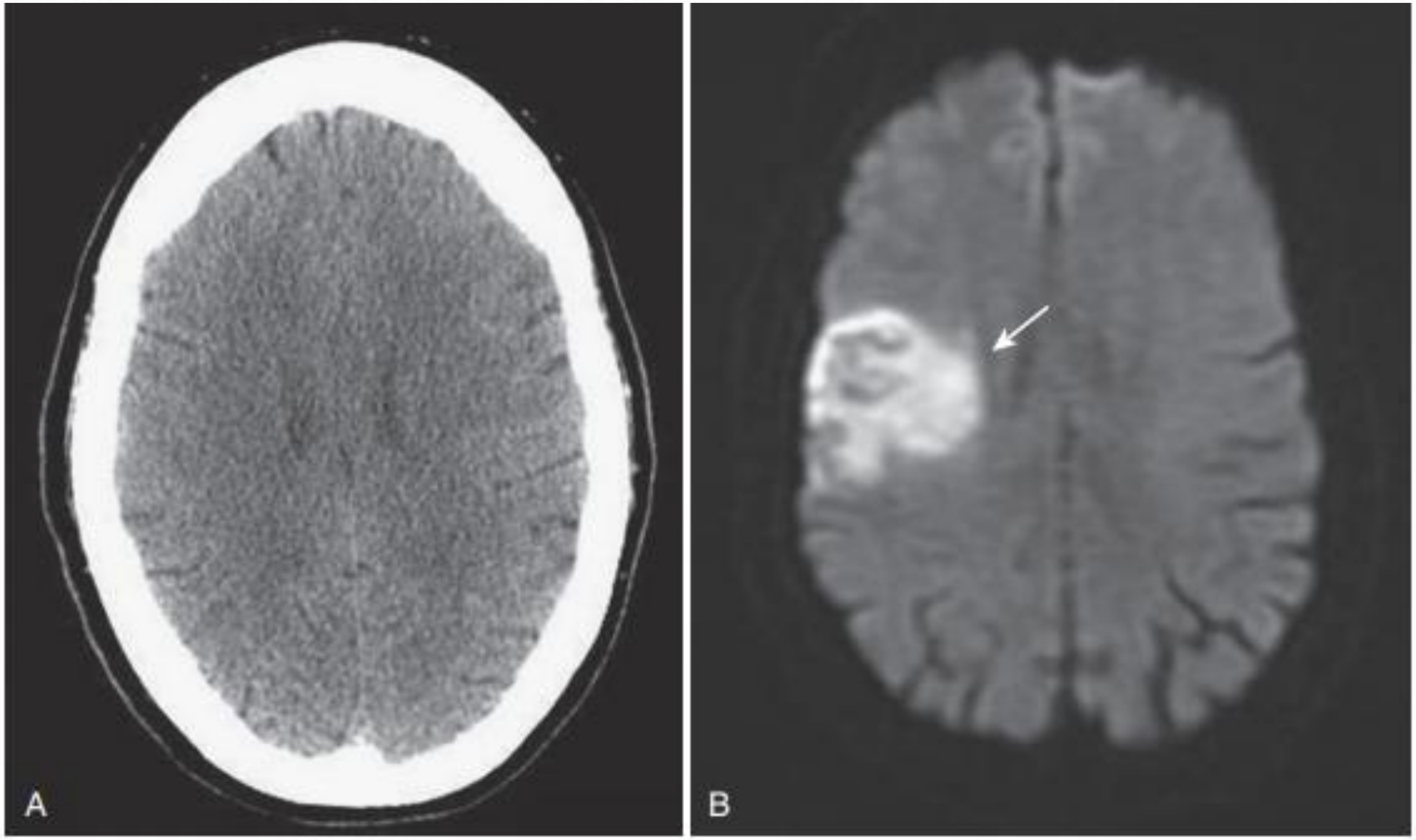


FIGURE 27-16 Computed tomography (CT) and diffusion-weighted magnetic resonance imaging (MRI) in acute stroke. A, The CT scan in this patient with symptoms for 2 hours prior to the study is normal. **B,** A diffusion-weighted MRI scan on the same patient a few minutes later shows an area of abnormally bright signal intensity in the right frontoparietal region *(white arrow)*. Diffusion-weighted imaging (DWI) is an MRI sequence that can be rapidly acquired and which is extremely sensitive to detecting abnormalities in normal water movement in the brain so that it can identify a stroke within 20 to 30 minutes after the event.

STROKE

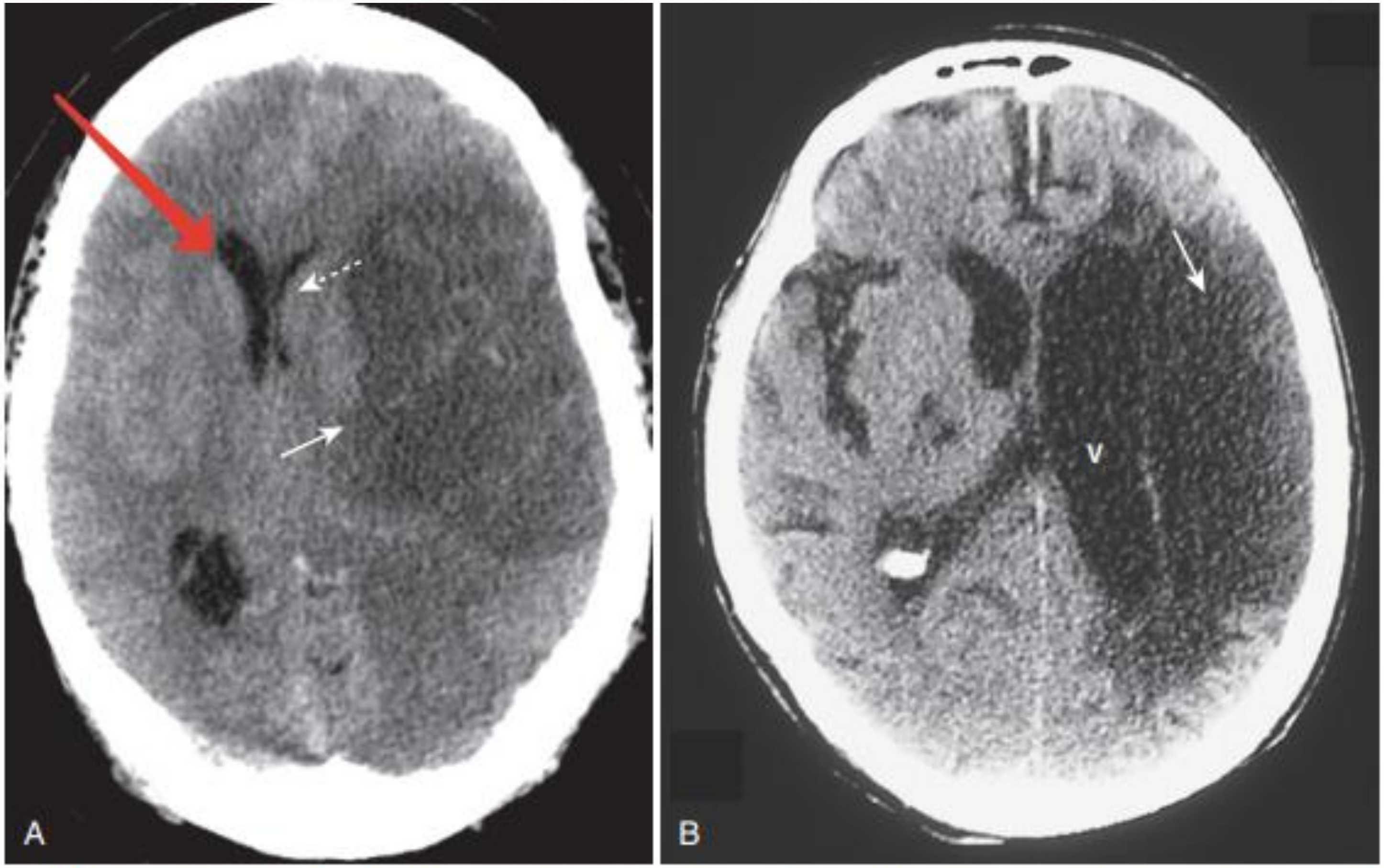


FIGURE 27-17 Computed tomography, ischemic stroke, newer and older. The findings in ischemic stroke will depend on the amount of time that has elapsed since the original event. **A,** At about 24 hours, the lesion becomes relatively well circumscribed *(solid white arrow)* with mass effect evidenced by a shift of the ventricles *(dotted white arrow)* that peaks at 3 to 5 days and disappears by about 2 to 4 weeks. **B,** As the stroke matures, it loses its mass effect, tends to become an even more sharply marginated low-attenuation lesion *(solid white arrow)*, and may be associated with enlargement of the adjacent ventricle (V) due to loss of brain substance in the infarcted area.

STROKE

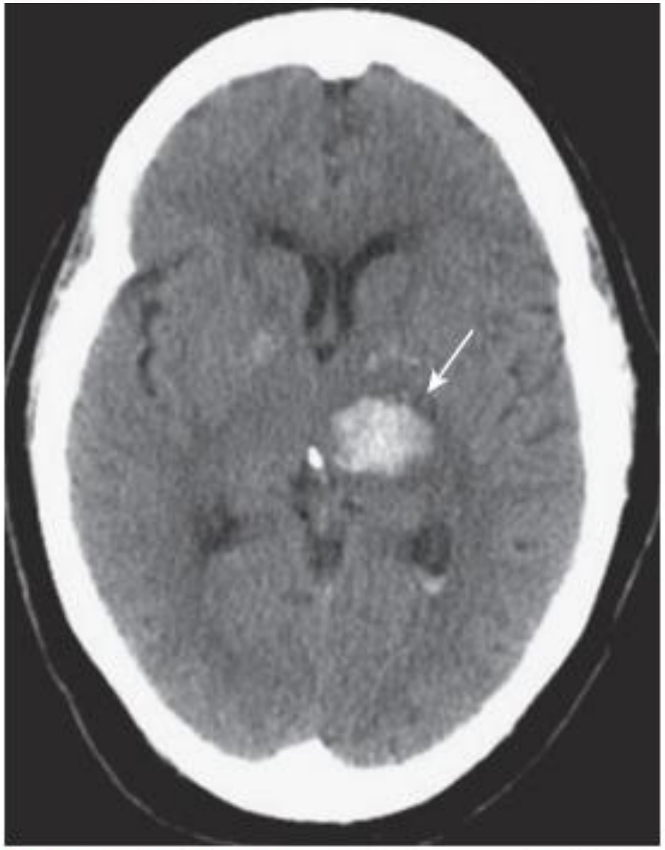


FIGURE 27-18 Intracerebral hemorrhage, acute. Freshly extravasated whole blood, as in this bleed into the thalamus *(white arrow)*, will be visible as increased density on nonenhanced computed tomography scans of the brain due primarily to the protein in the blood (mostly hemoglobin). As the clot begins to form, the blood becomes denser for about 3 days because of dehydration of the clot. After day 3, the clot gradually decreases in density from the outside in and becomes invisible over the next several weeks.

STROKE

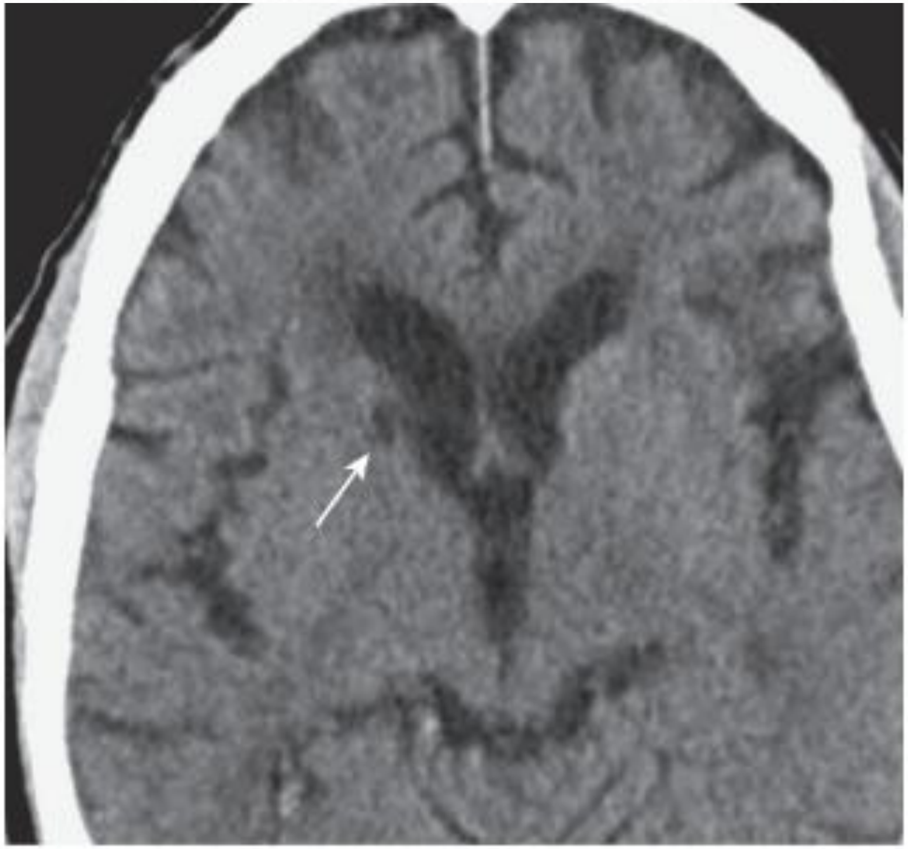


FIGURE 27-19 **Lacunar infarct.** A lacunar infarct, or **lacune,** is a small cerebral infarct produced by occlusion of an end artery. Lacunar infarcts have a predilection for the basal ganglia, internal capsule, and pons, primarily related to hypertension and atherosclerosis. The term *chronic lacunar infarct* is reserved for low-density, cystic lesions, 5 to 15 mm in size *(white arrow)*.

STROKE

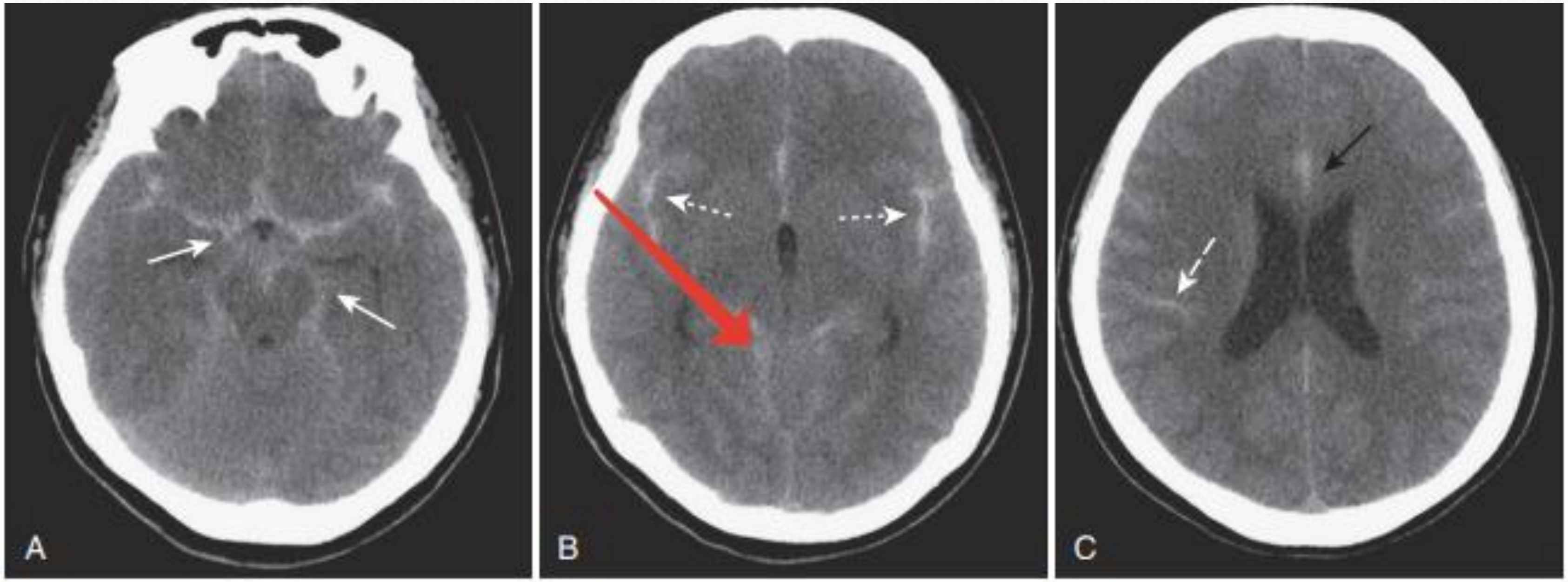


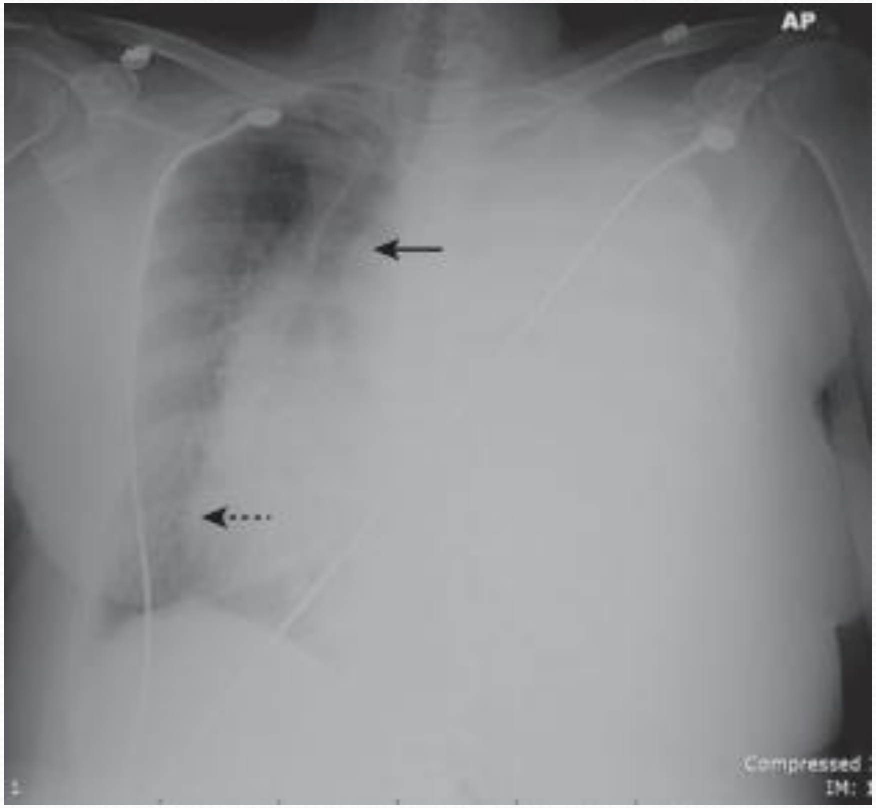
FIGURE 27-21 Subarachnoid hemorrhage, unenhanced computed tomography (CT) scans. Subarachnoid hemorrhage is frequently the result of a ruptured aneurysm. Blood may be most easily visualized within the basal cisterns *(white arrows)* **(A)**, in the fissures *(dotted white arrows)* **(B)**, and interdigitated in the subarachnoid spaces of the sulci *(dashed white arrow)* **(C)**. The region of the falx may become hyperdense, widened, and irregularly marginated *(solid black arrow)*.

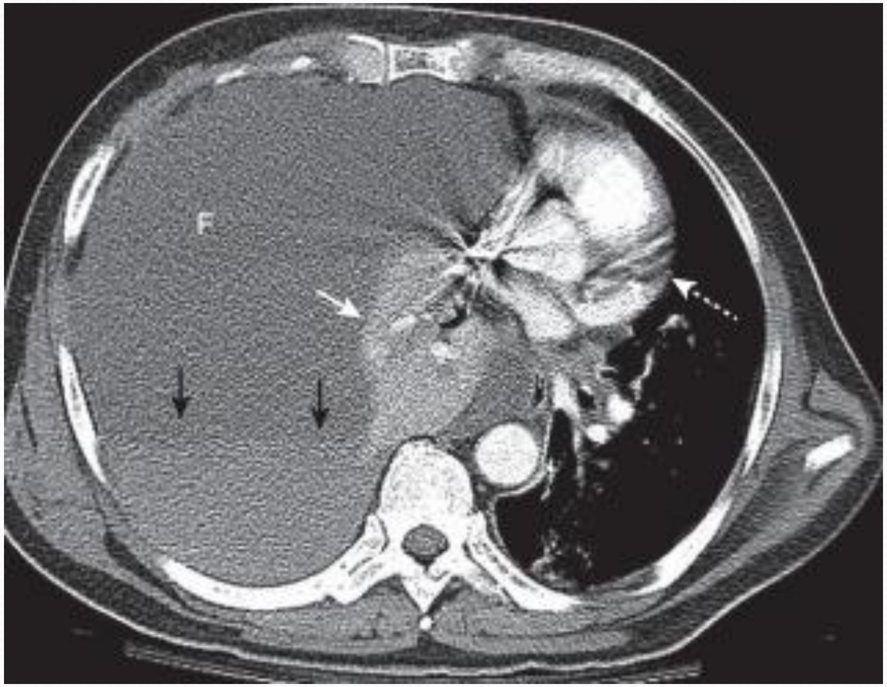
Pulmonary contusion

Emergency in the chest

Left pleural effusion

Right pleural effusion

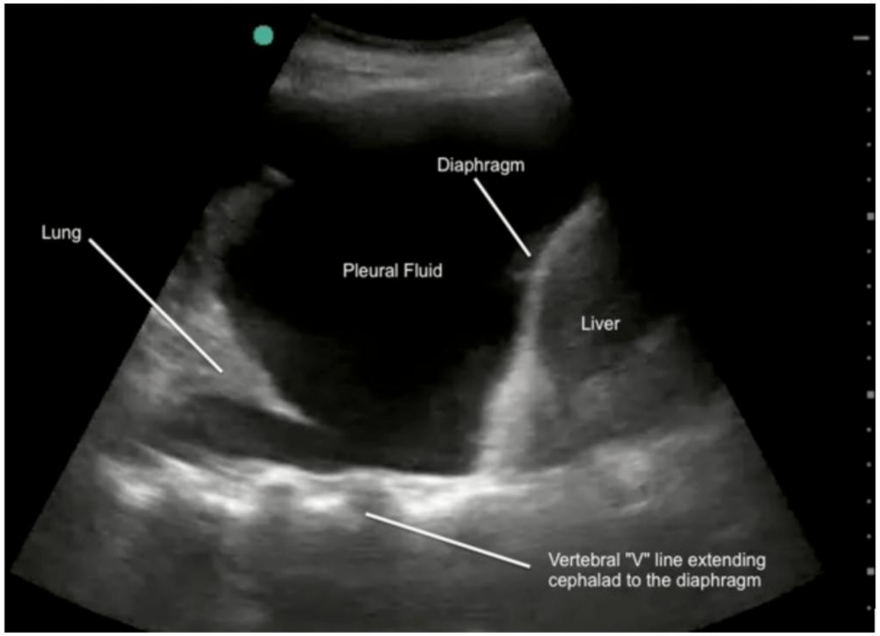




Emergency in the chest

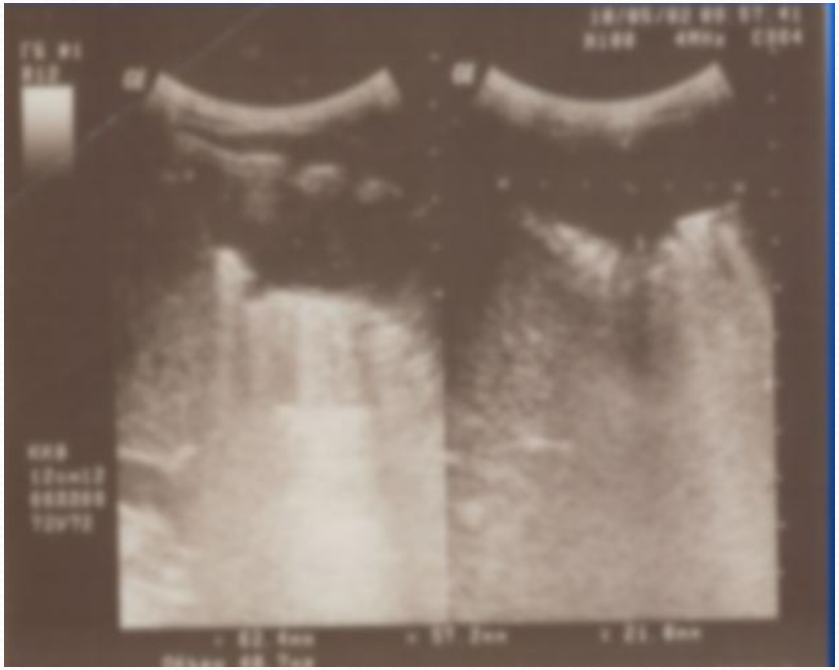
USG

pleural effusion

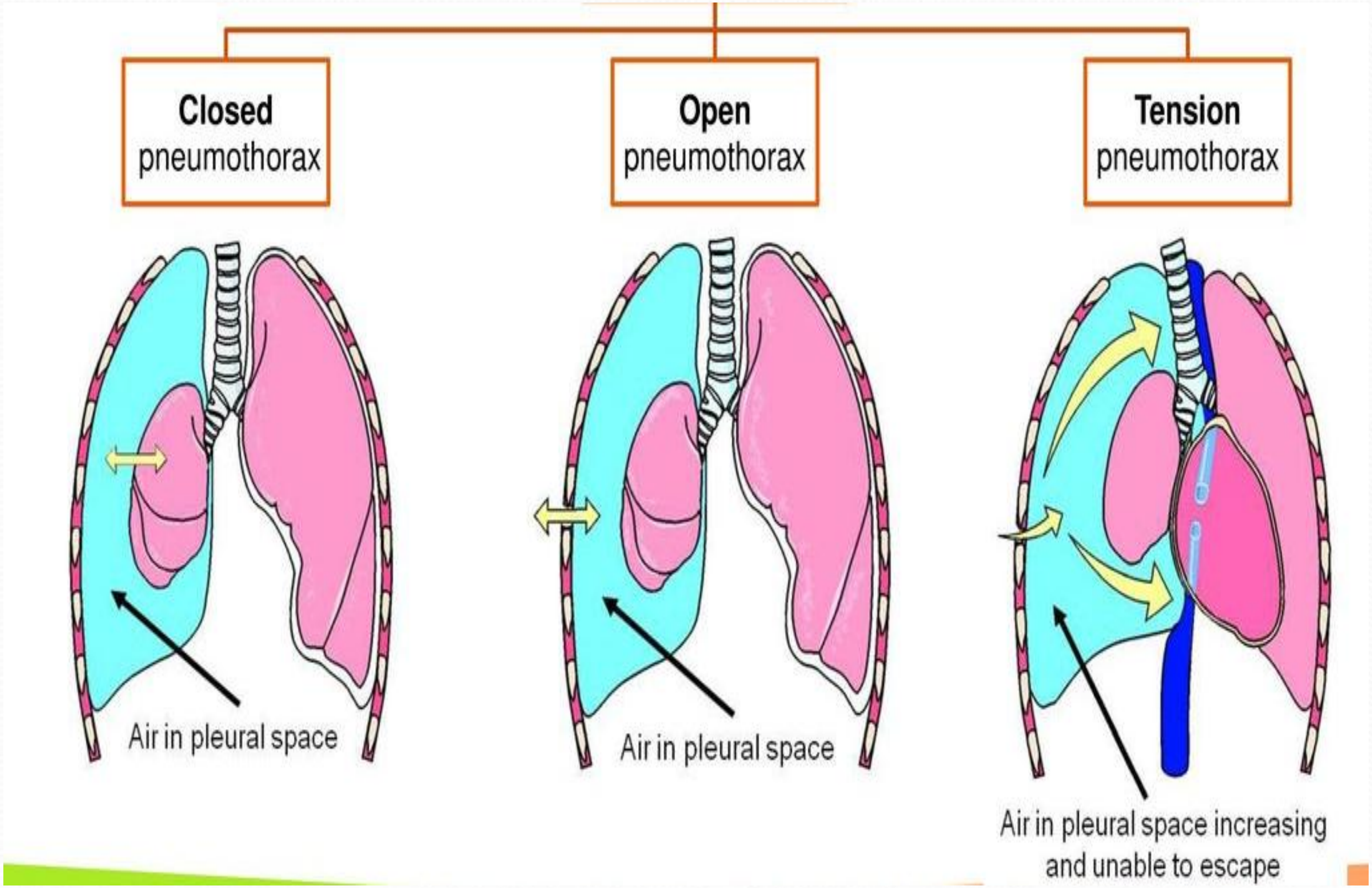


USG

Pyothorax

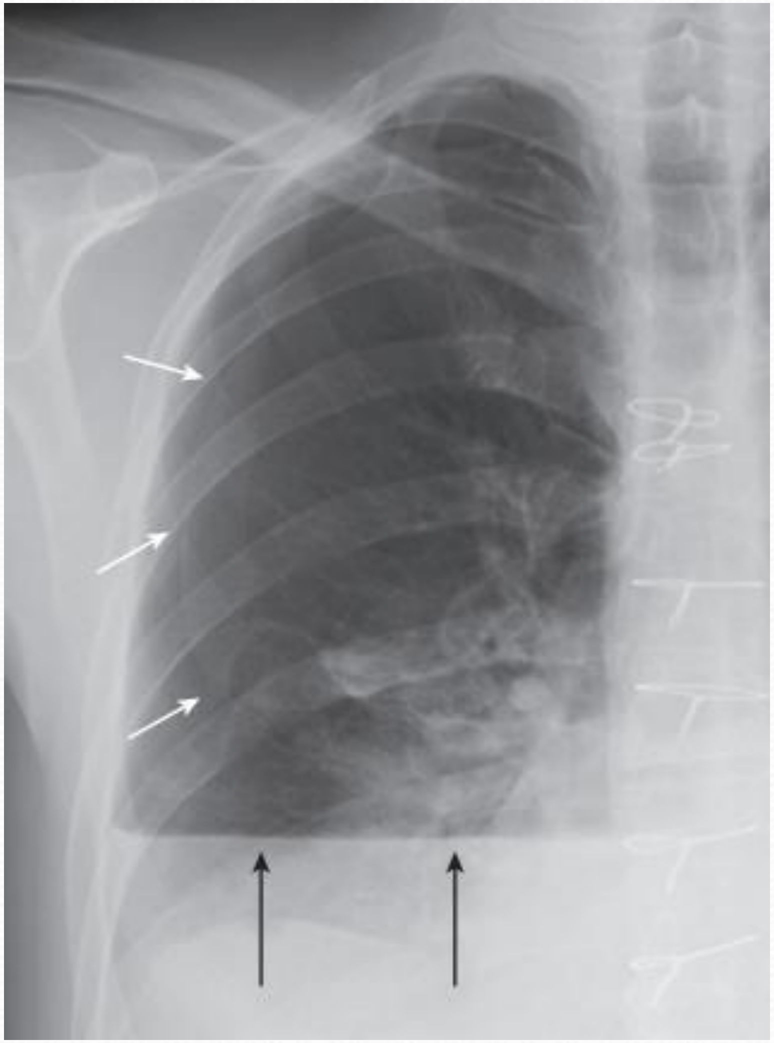


Emergency in the chest
Pneumothorax

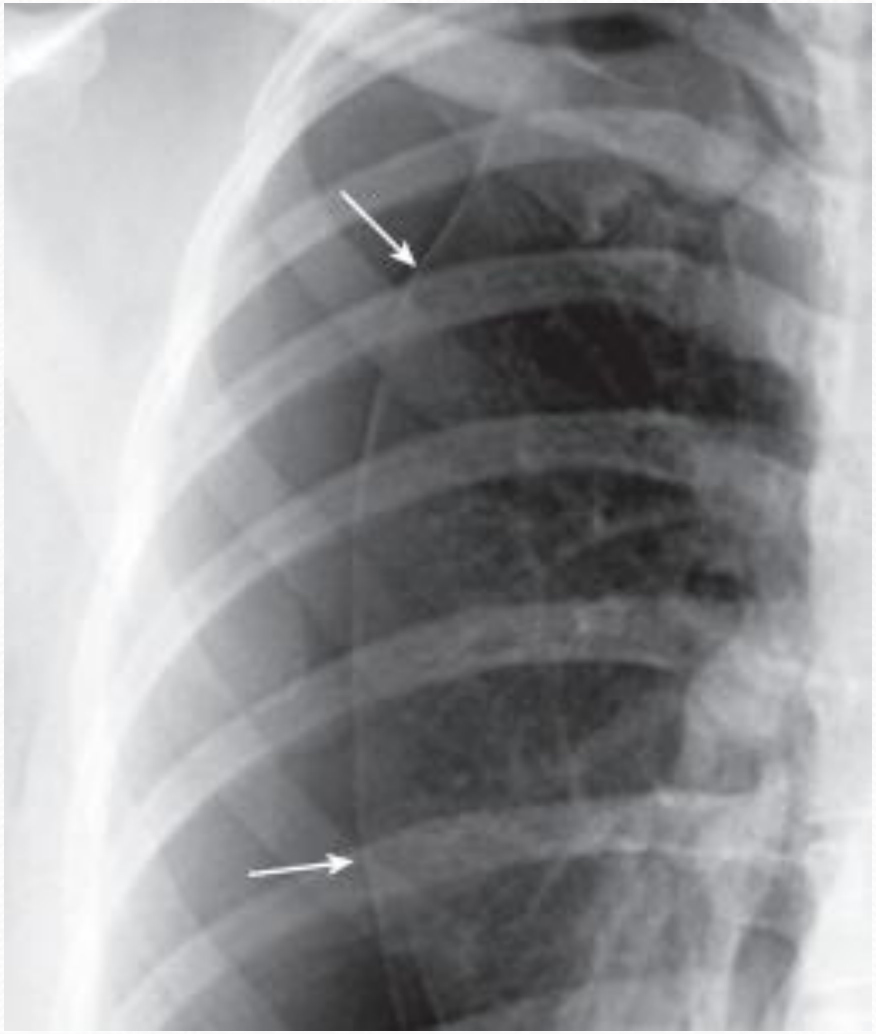


Emergency in the chest

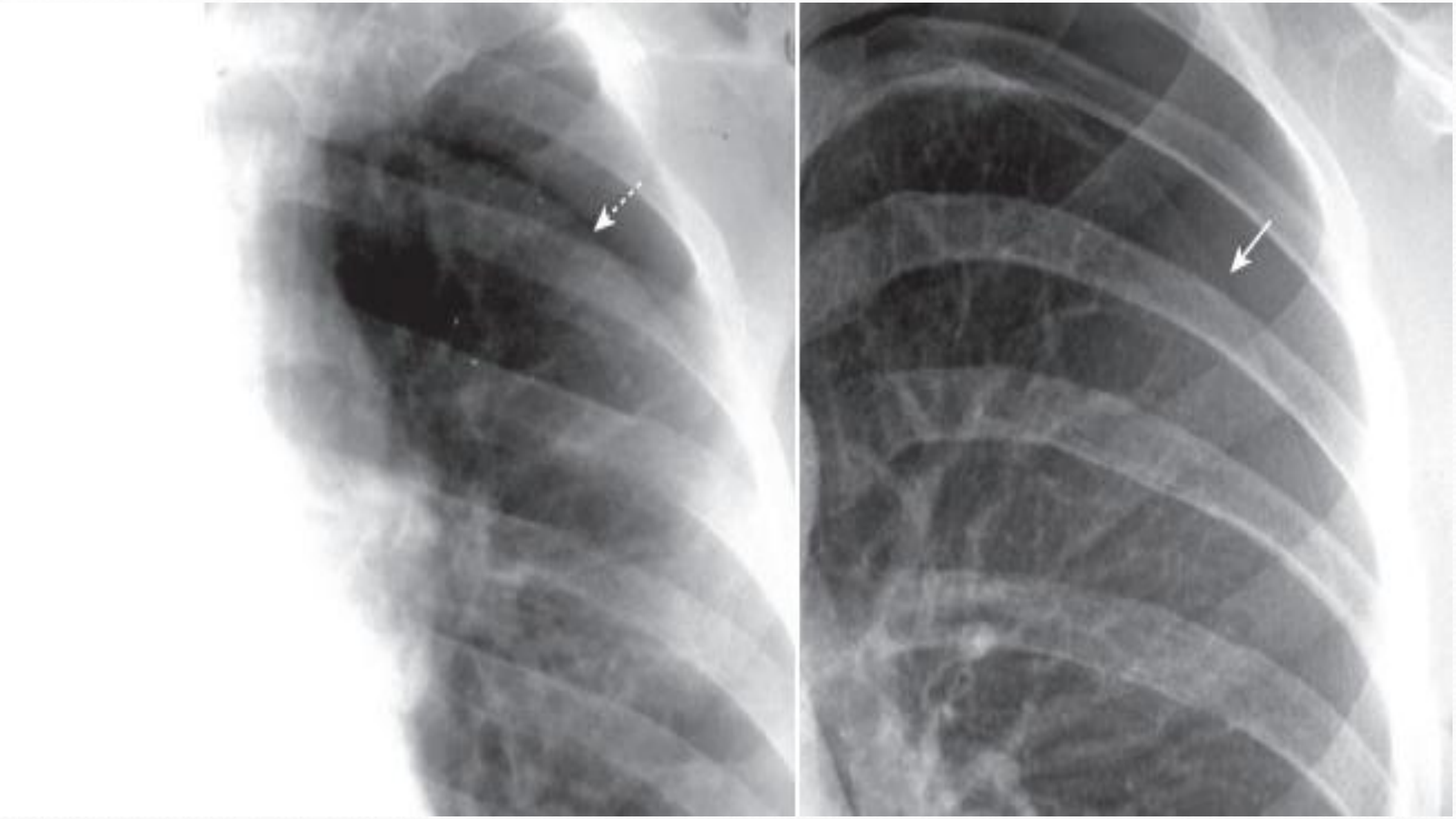
Hydropneumothorax



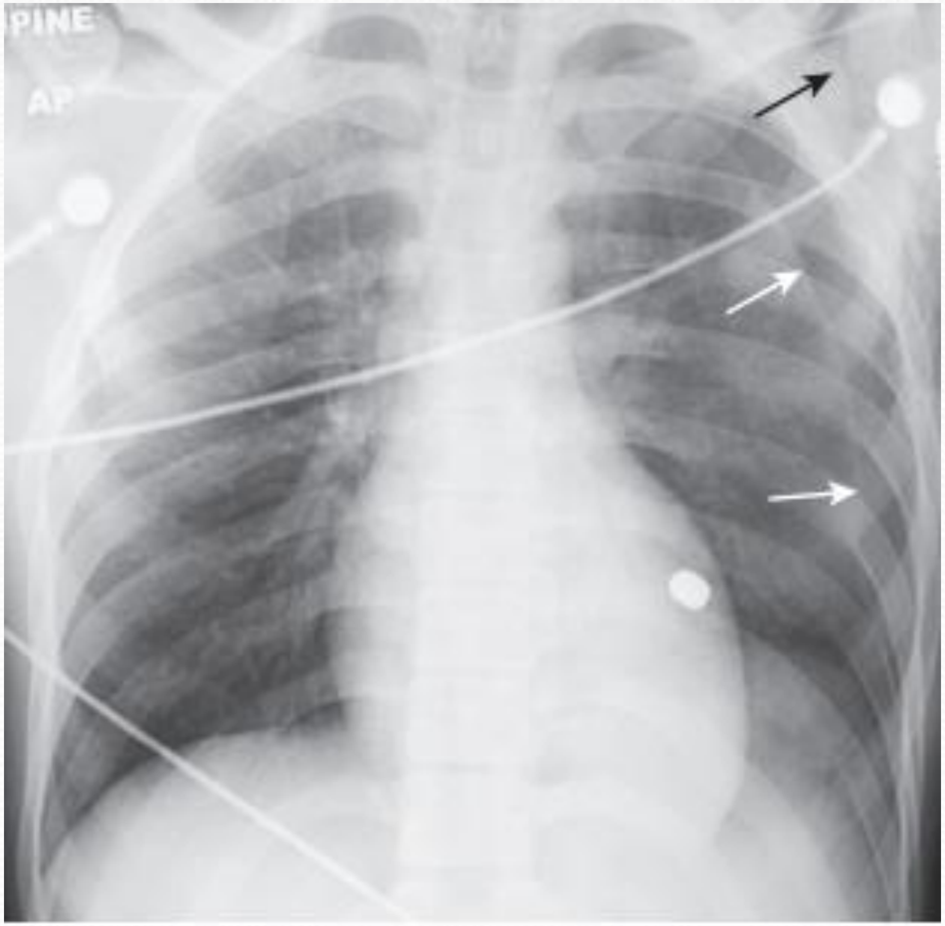
Pneumothorax

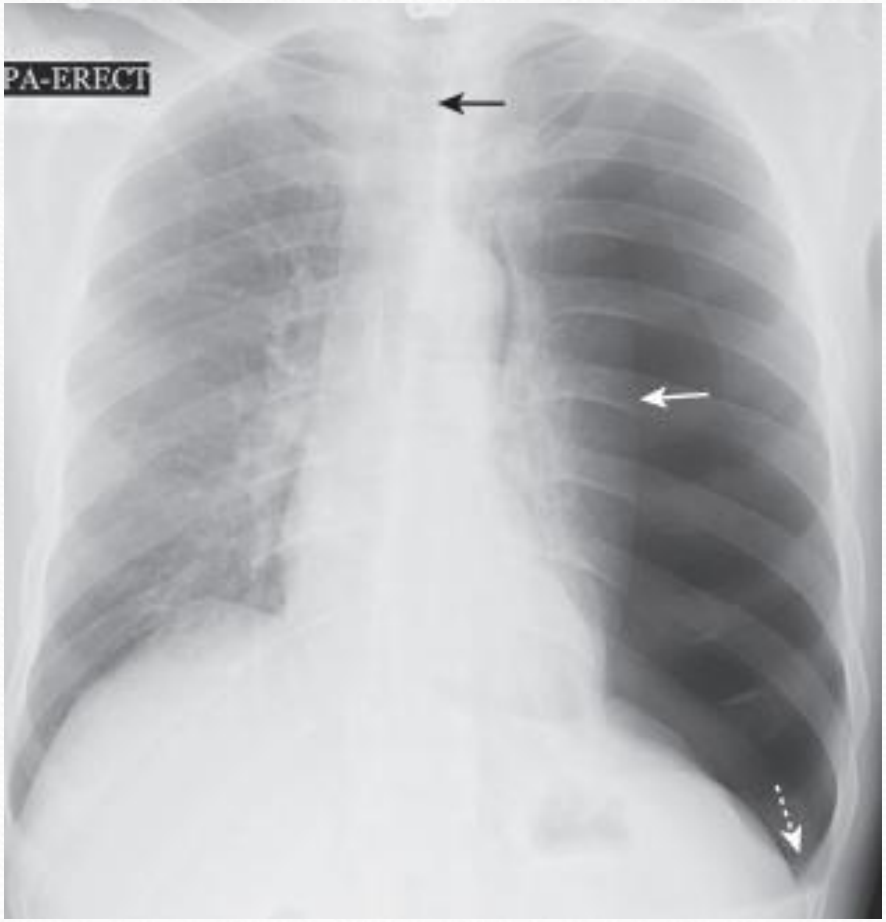


Emergency in the chest
Pneumothorax

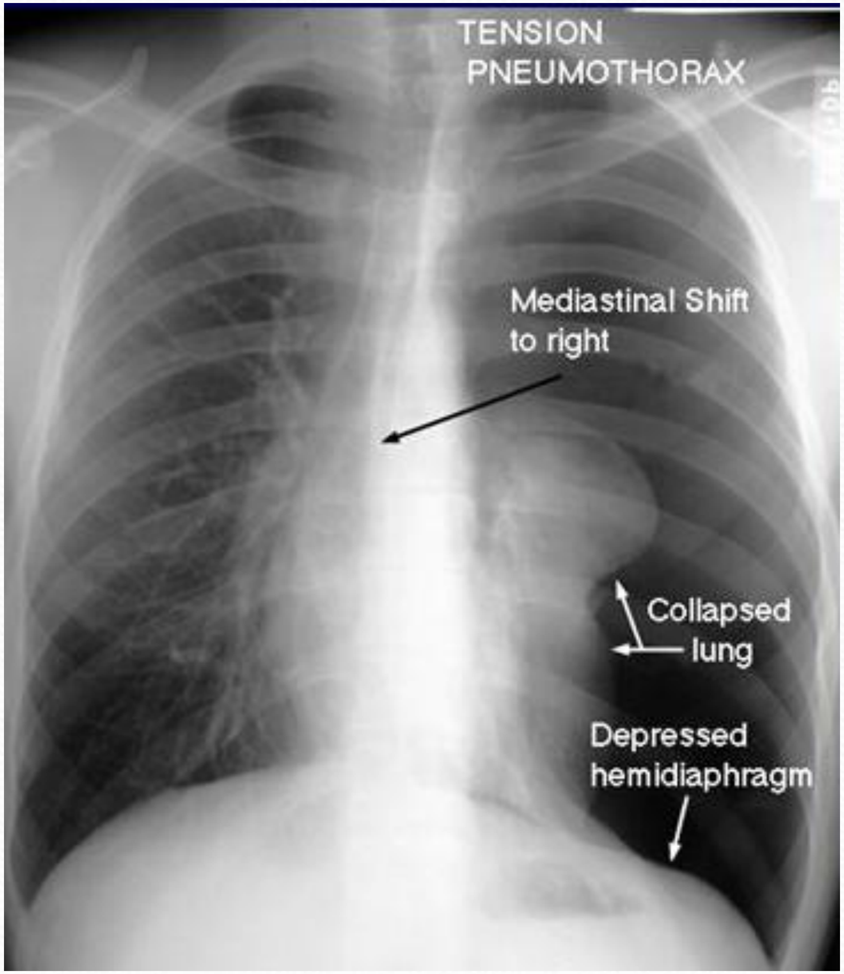


Emergency in the chest
Pneumothorax

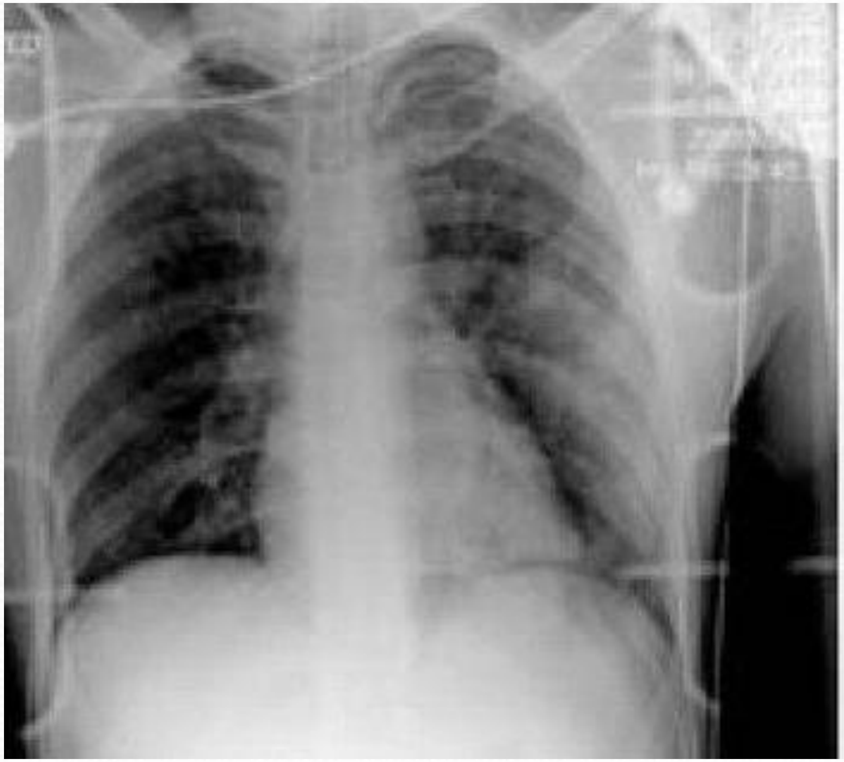


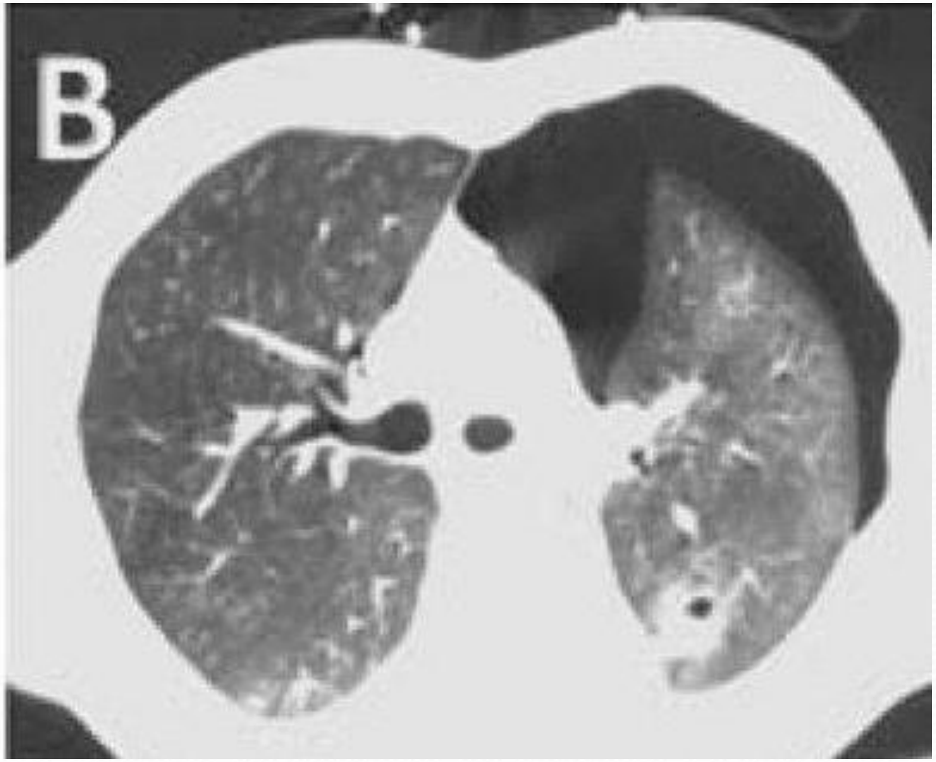


Emergency in the chest
Pneumothorax



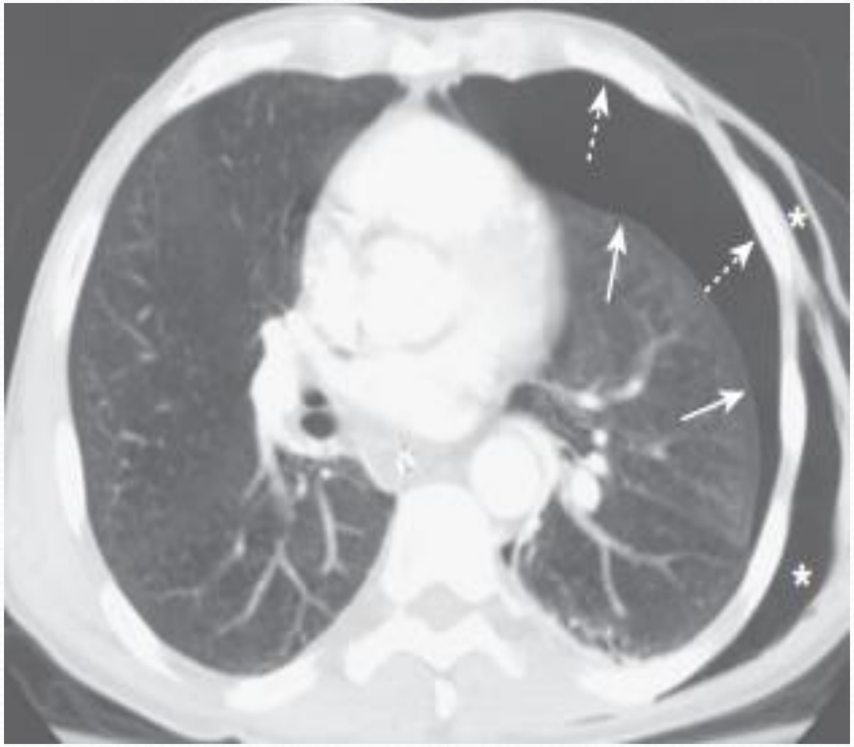
Emergency in the chest
Pneumothorax on Ro is not determined



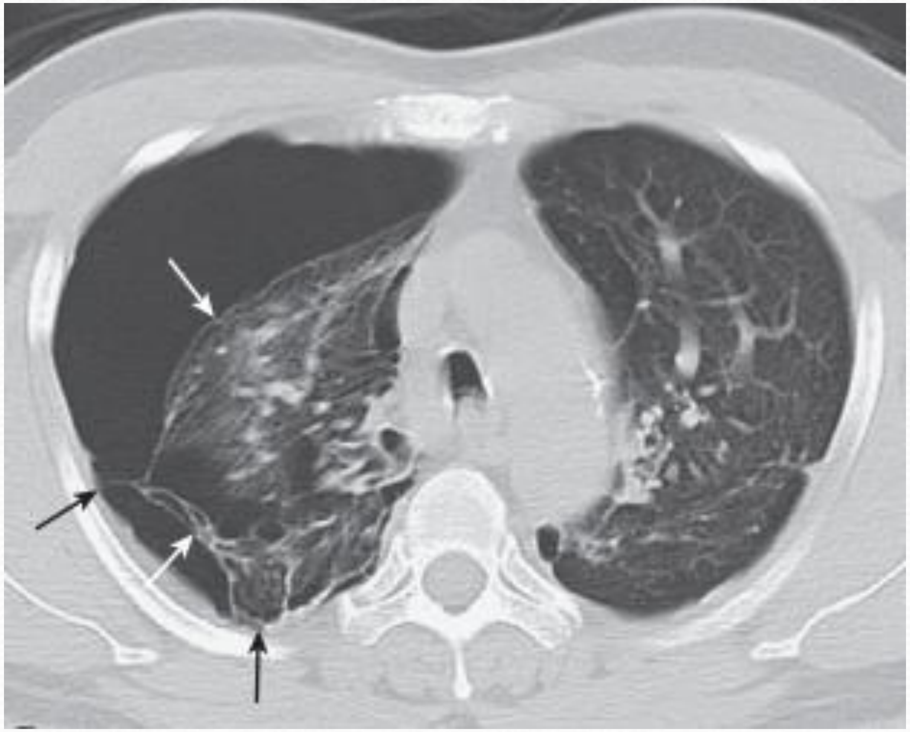


Emergency in the chest

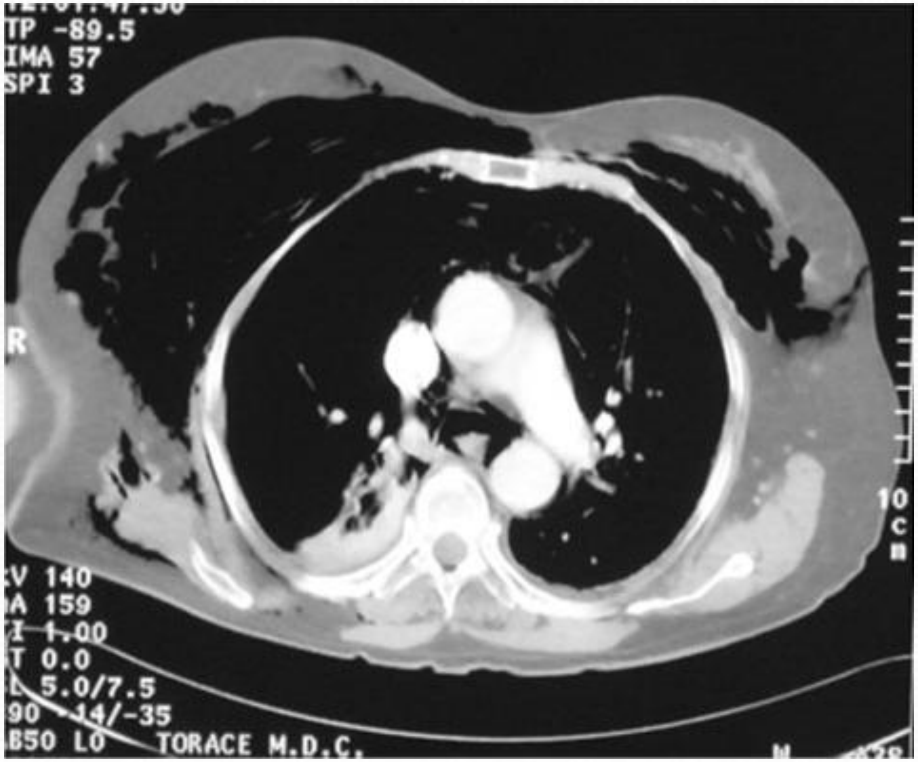
Pneumothorax, Pulmonary Emphysema

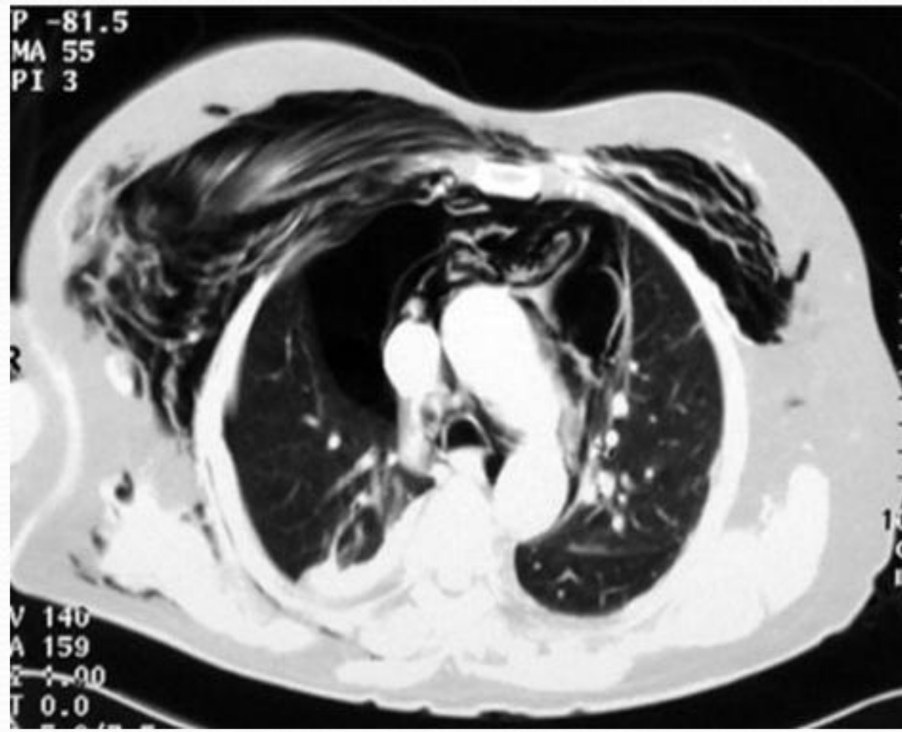


Pneumothorax

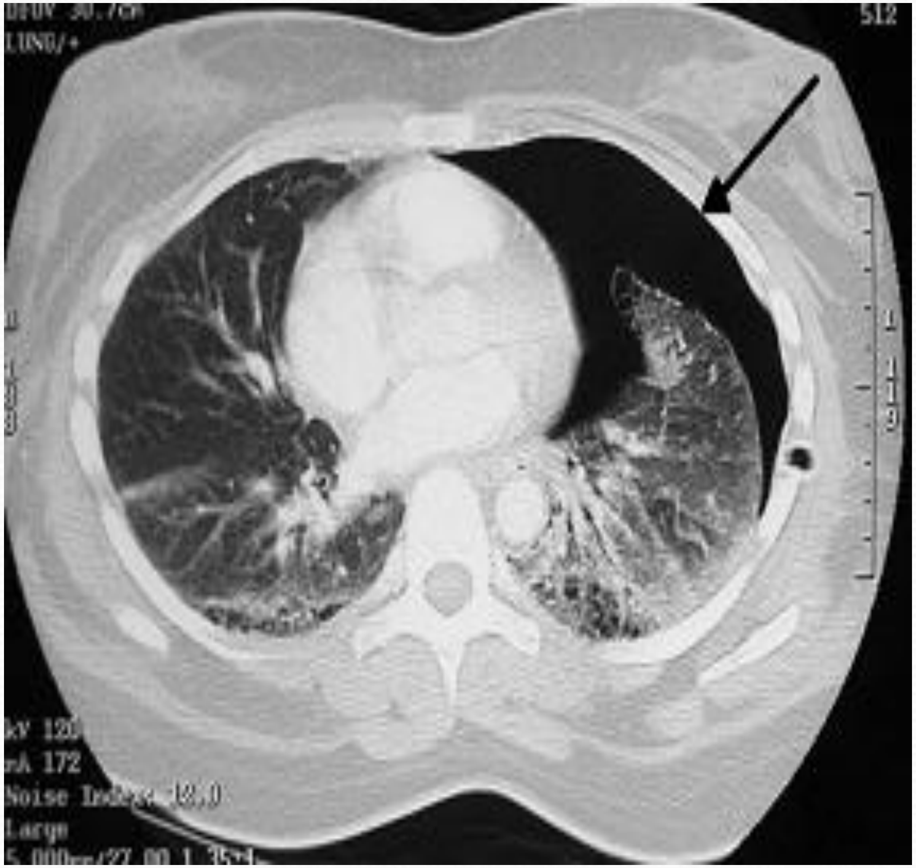


Pneumothorax, Pulmonary Emphysema

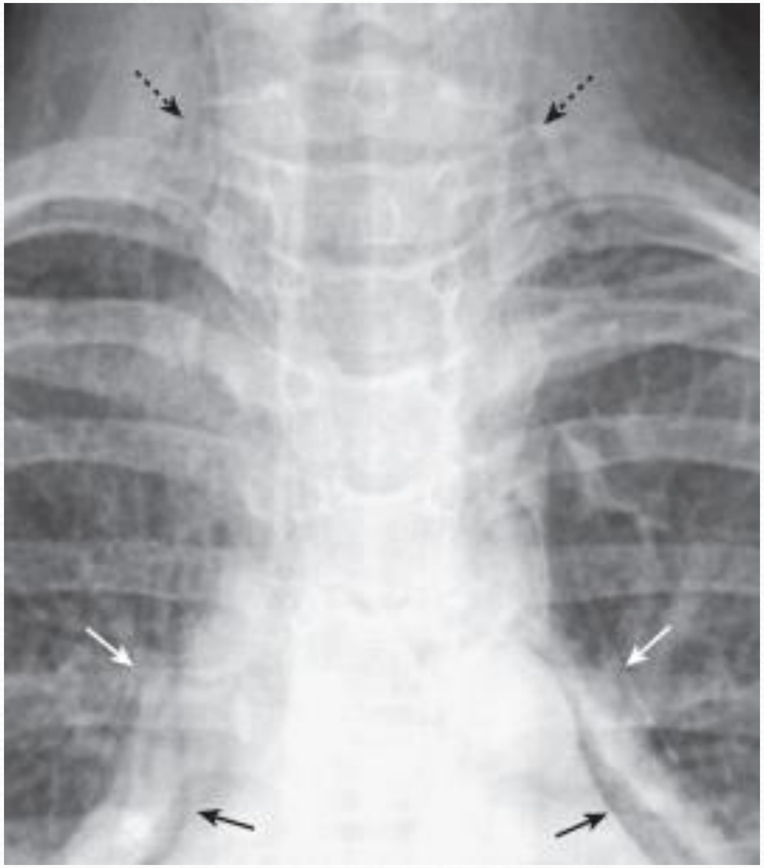


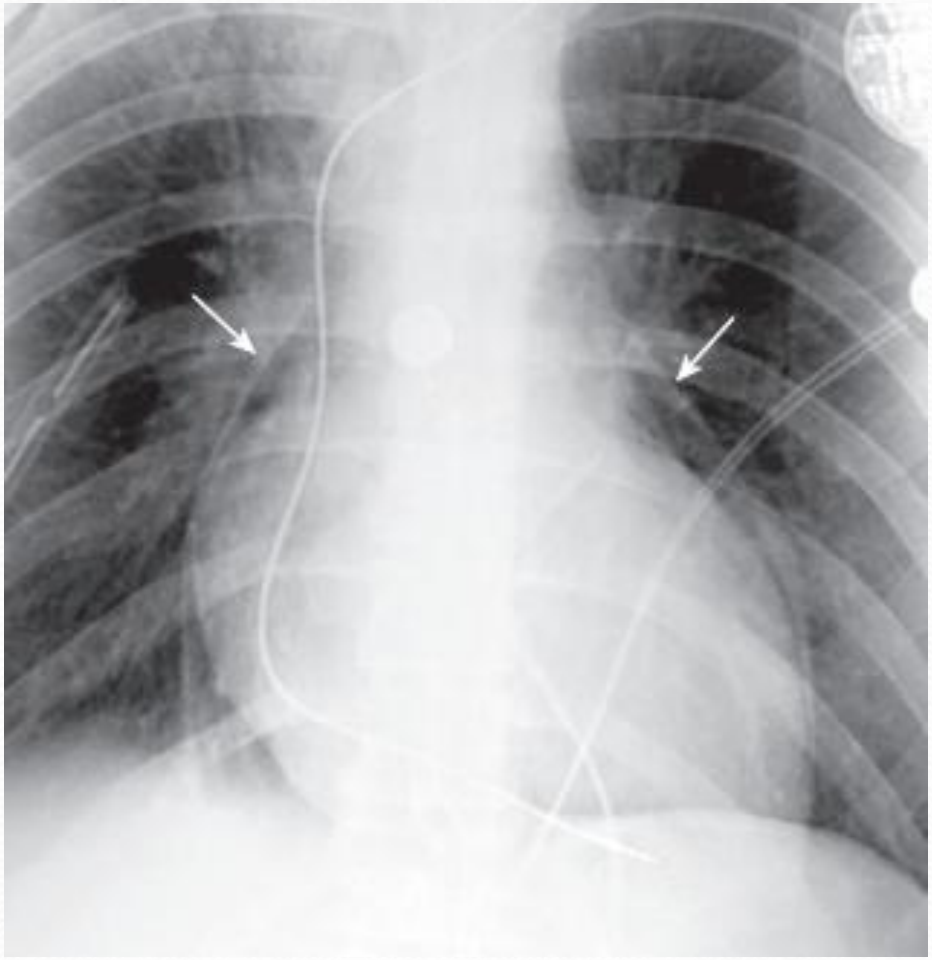


Pneumotorax, Subcutaneous Emphysema

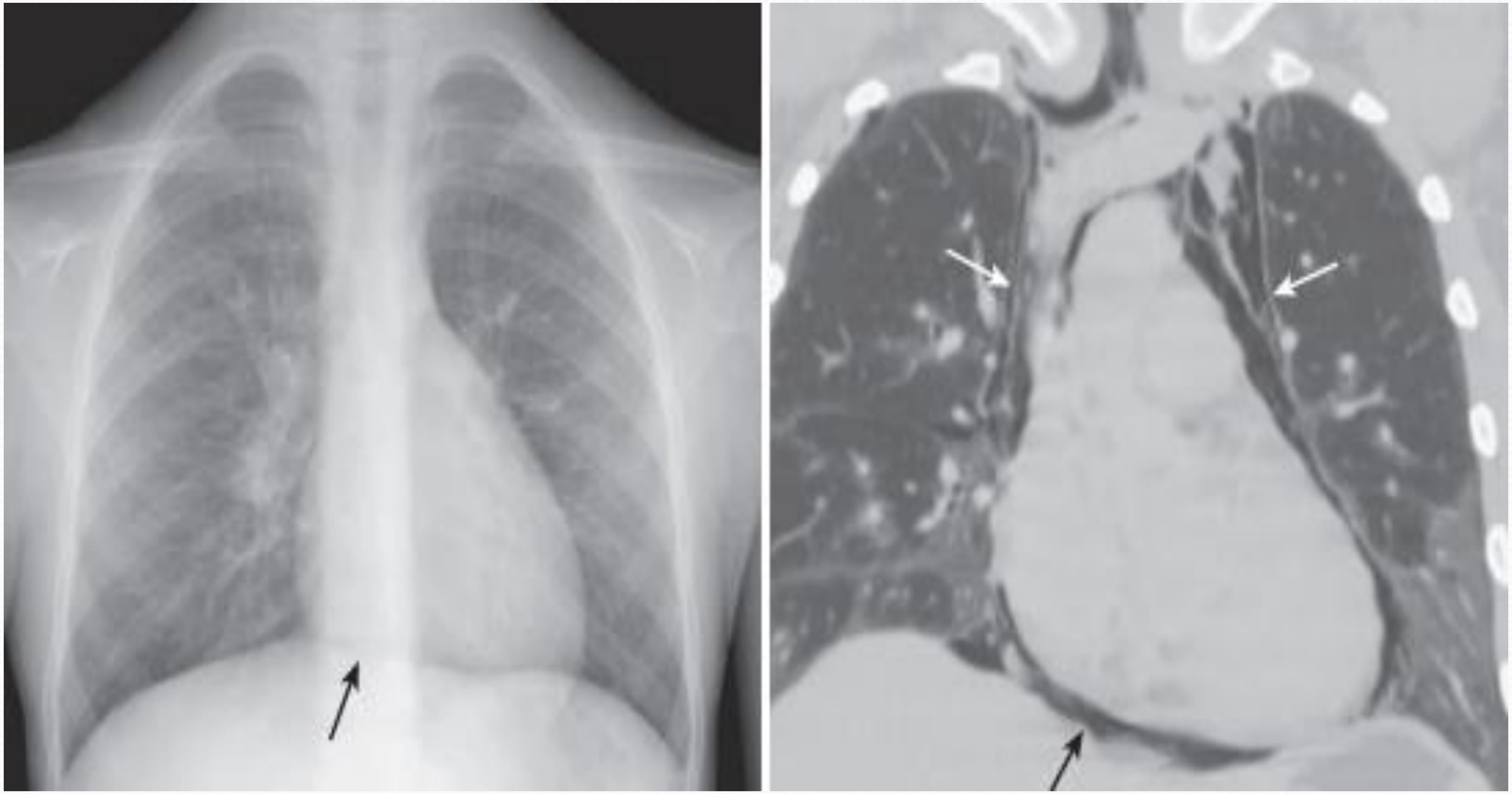


Pneumomediastinum

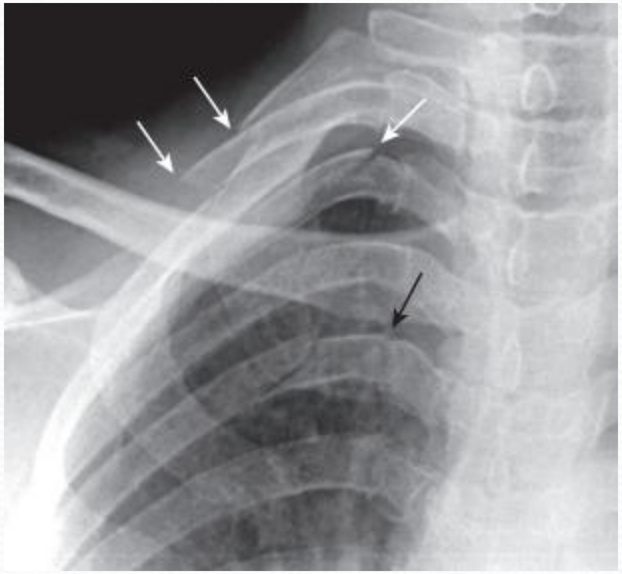


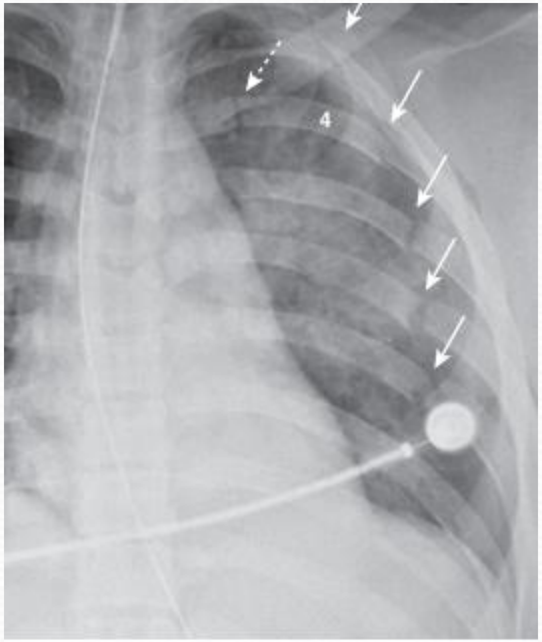


Pneumomediastinum

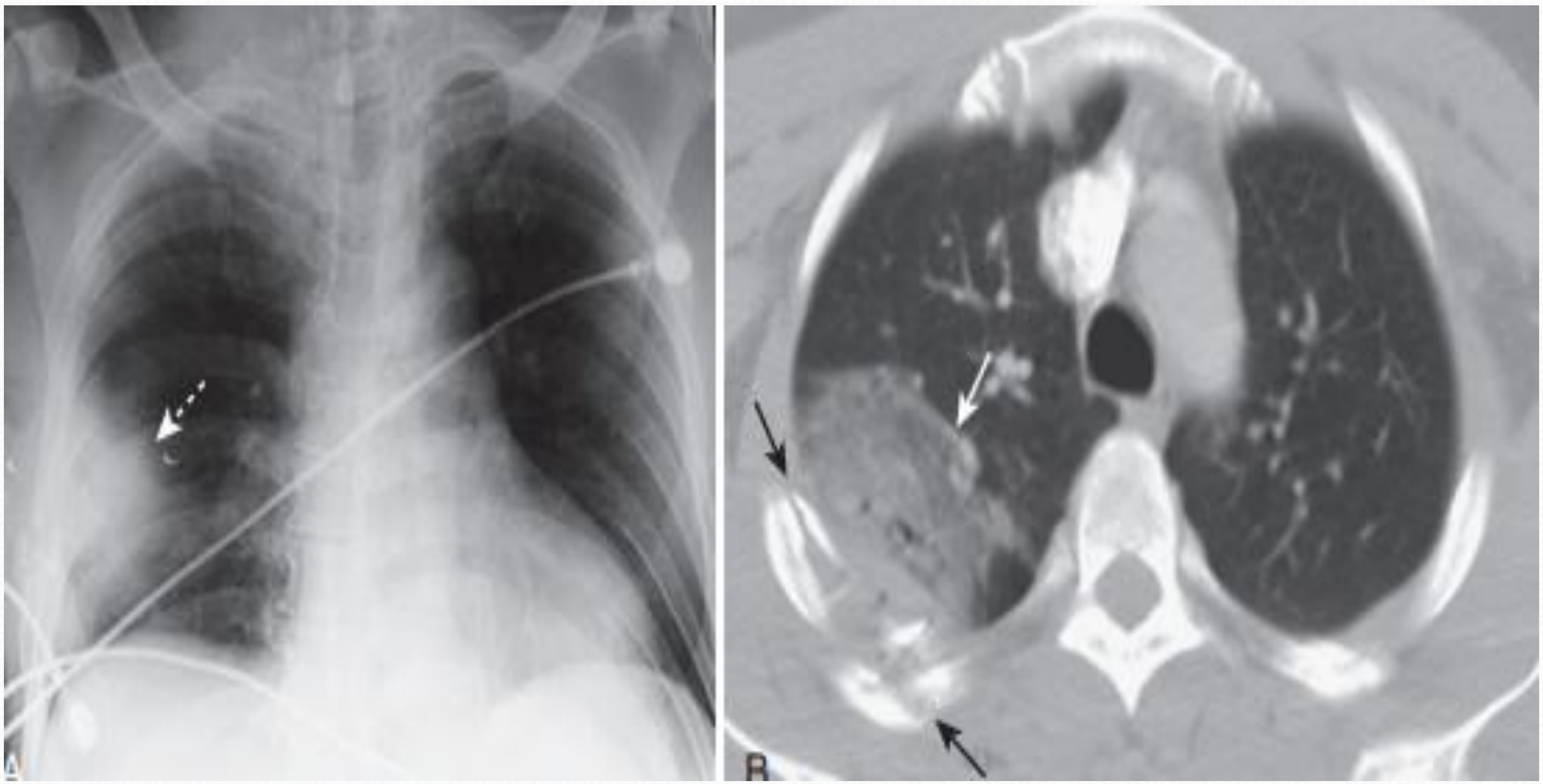


Emergency in polytrauma





Emergency in polytrauma



Emergency in polytrauma

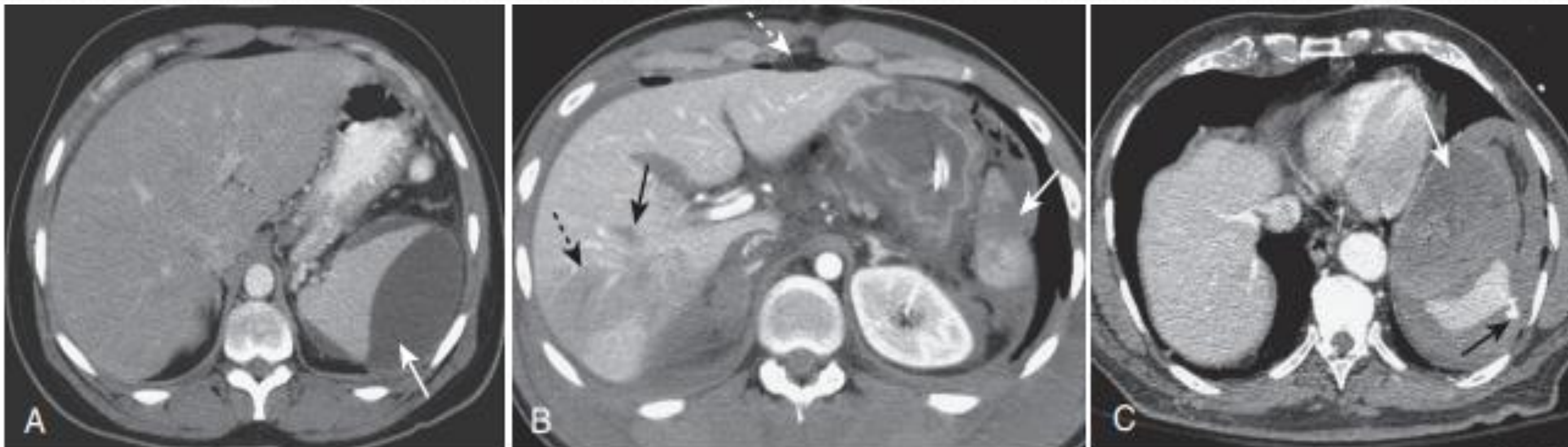


FIGURE 19-8 Splenic trauma, three different patients. A, There is crescent-shaped collection of fluid in the subcapsular space, which compresses the normal splenic parenchyma, representing subcapsular hematoma *(solid white arrow)*. **B,** This patient has a splenic *(solid white arrow)* and hepatic *(solid black arrow)* laceration and a large hepatic contusion *(dotted black arrow)*. There is also pneumoperitoneum *(dotted white arrow)*. **C,** This patient has active extravasation of contrast-enhanced blood *(solid black arrow)* and a large intrasplenic hematoma *(solid white arrow)*.

Emergency in polytrauma

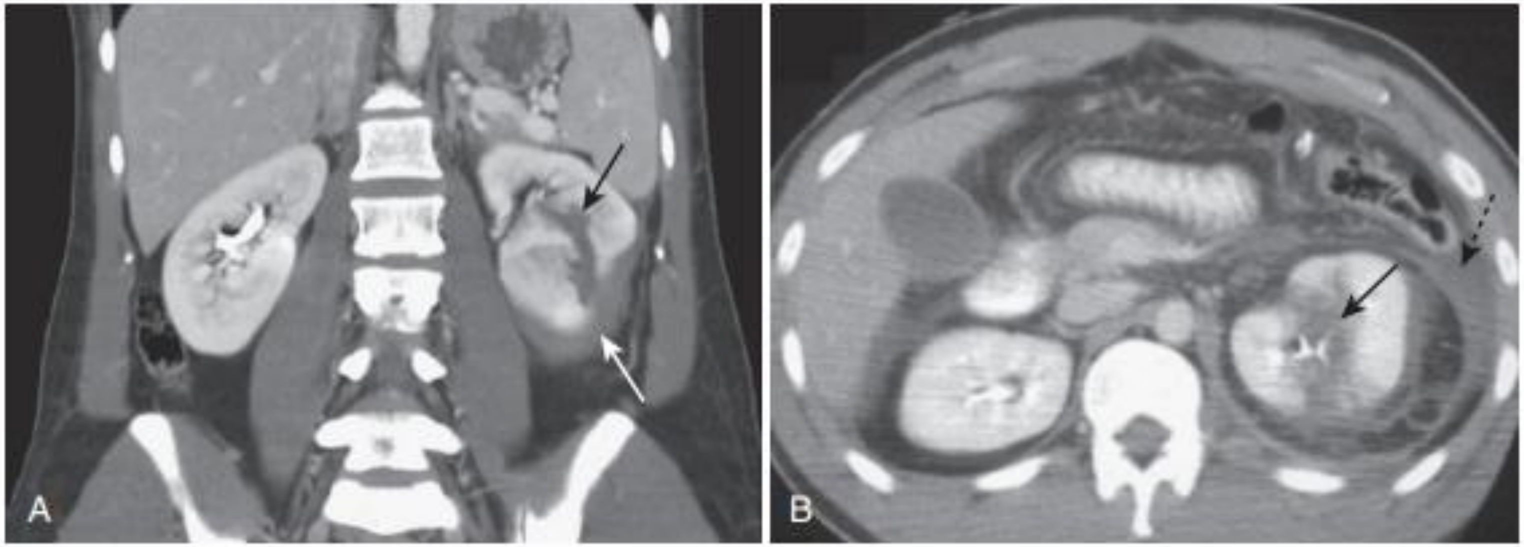


FIGURE 19-9 Renal trauma, two different patients. A, Coronal-reformatted contrast-enhanced CT scan shows a low-attenuation linear defect, representing a renal laceration *(black arrow)* and a subcapsular hematoma *(white arrow)*. **B,** Axial CT scan on another patient also shows a renal laceration *(solid black arrow)*, and a perinephric hematoma *(dotted black arrow)*.

Emergency in polytrauma

Emergency in polytrauma

- The radiologist will typically use a top-to-bottom approach as the brain and cervical spine are usually scanned first without intravenous contrast followed by assessment of the thorax, abdomen and pelvis with the focus on detecting the conditions with the highest mortality in trauma namely: traumatic brain injury and/or intrathoracic/intra-abdominal hemorrhage

Emergency in polytrauma

- **CT brain and cervical spine**
- brain: bleeding, evidence of increased intracranial pressure, skull fractures
- detection of cervical spine fractures or malalignment suggestive of an unstable injury
- CT thorax, abdomen and pelvis
- Contrast-enhanced CT is commonly performed in trauma patients, with a large number of different protocols that vary depending on the institution.

HOMEWORK

- What are radiological signs of pneumathorax