MEDICAL IMAGING IN TRAUMATOLOGY

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RADIOLOGY AND MEDICAL IMAGING DEPARTMENT

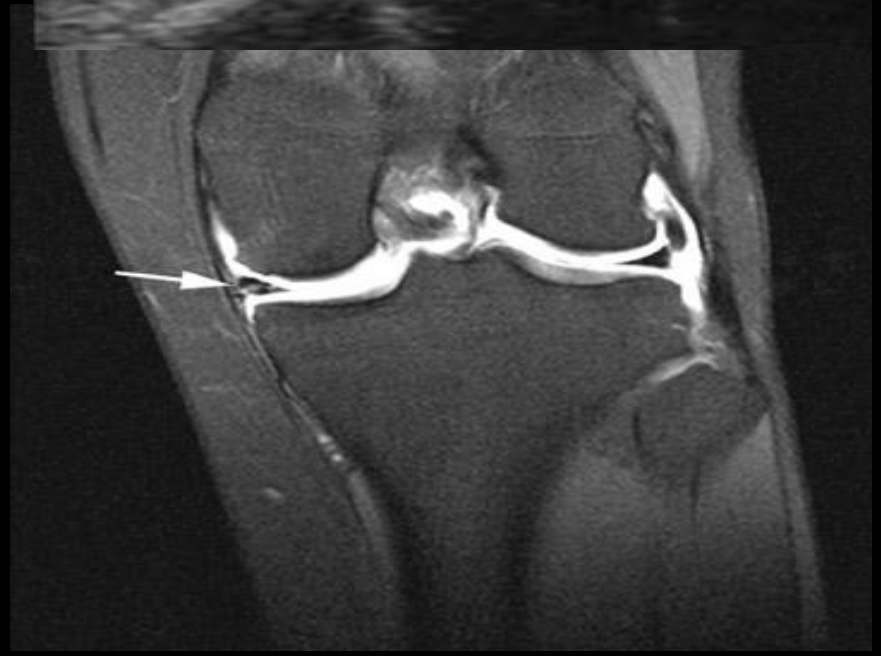
HOMEWORK

- 1. RADIOIMAGING METHODS USED IN VARIOUS TRAUMATIC PATHOLOGY OF THE CHEST
- 2. RADIOIMAGING METHODS USED IN VARIOUS TRAUMATIC PATHOLOGY OF THE ABDOMEN AND PELVIS
- 3. RADIOIMAGING METHODS USED IN VARIOUS TRAUMATIC PATHOLOGY OF THE HEAD
- 4. RADIOIMAGING METHODS USED IN VARIOUS TRAUMATIC PATHOLOGY OF THE SPINAL CORD AND EXTREMITIES

RADIOIMAGING METHODS IN TRAUMA

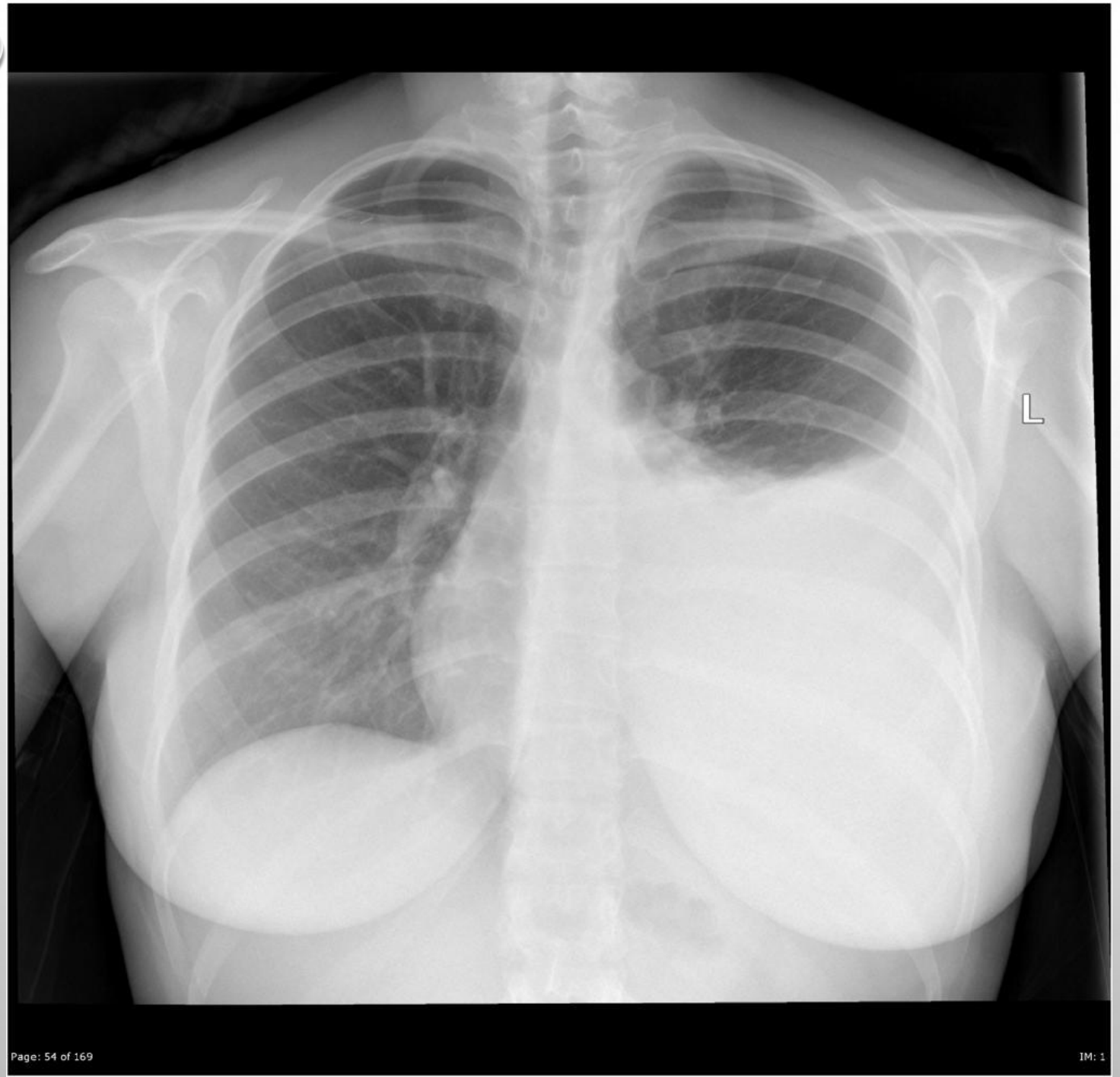
- STANDARD RADIOLOGICAL EXAM
- ULTRASOUND
- COMPUTER TOMOGRAPHY
- ANGIOGRAPHY
- MAGNETIC RESONANCE IMAGING
- NUCEAR MEDICINE

IMAGING MODALITIES



STANDARD RADIOLOGICAL EXAM

- First-rate method for evaluation of thoracic lesions, monitoring their development and treatment efficiency
- It is accessible, fast, easy to do and low cost
- It can be done at the patient's bed using portable radiological devices
- Provides sufficient information to diagnose many post-traumatic lesions with immediate lethal risk and provides indirect signs for others
- Allows control of therapeutic maneuvers, such as positioning of orotracheal intubation sondes, central venous catheters, pleural drainage tubes, nasogastric sondes.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ULTRASOUND

- It is used in the evaluation of thoraco-abdominal traumas because it allows for a rapid examination for the diagnosis of hemothorax, hydrothorax
- Transthoracic ultrasound - rapid evaluation of hemopericardium, cardiac tamponade, valvular lesions, parietal kinetic disorders
- Transesophageal ultrasound - alternative diagnosis to the CT (when CT is not possible) examination of the aortic rupture.

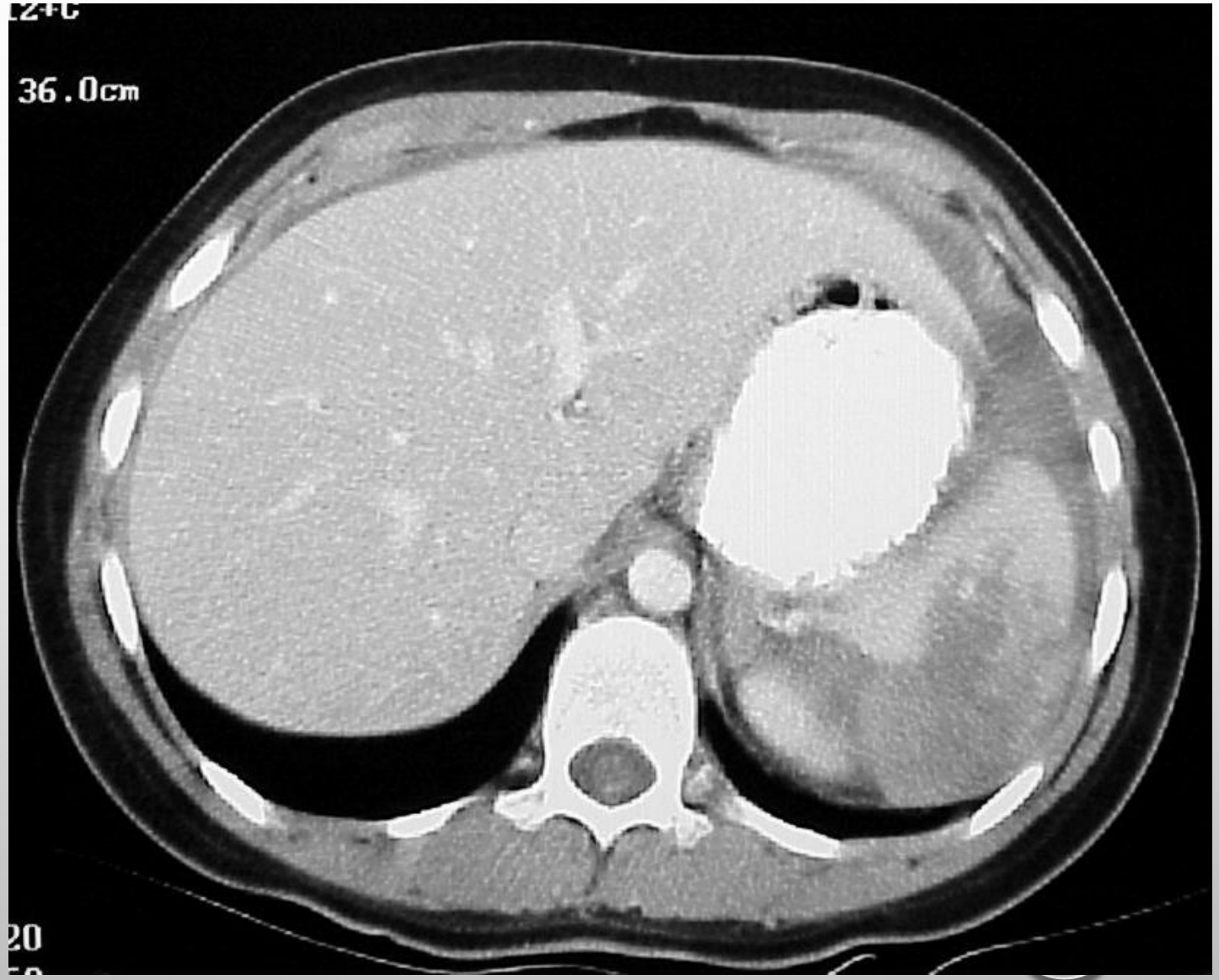
Advantages: accessible, cheap, fast, it does not require special training for the patient, non-irradiated, does not require contrast media, can be performed concurrently with resuscitation, intraoperative or patient bed procedures in intensive care units.

2. Ultra sonography of thorax

COMPUTER TOMOGRAPHY

- Evaluation of acute lesions to quickly establish a lesion score as complete as possible
- Monitoring of diagnosed lesions or diagnosis of intrathoracic complications
- Optimal in the diagnosis of TEP, hemothorax and pneumothorax, pulmonary parenchymal complications.

ABDOMINAL CT: SPLENIC INJURY



ANGIOGRAPHY

- If the CT aspect of the vessels is unclear or there is a mediastinal hematoma without evidence of aortic parietal changes, which may reveal minimal lesions
- Angiography can be used like **diagnostic method** (the presence or absence of an injury, it’s type, location, the existence or not of an active bleeding) or **therapeutically** (fast, efficient hemostasis with embolization, stent or stent-vascular graft).

KIDNEY EXPLOSION IN ANGIOGRAPHY

MAGNETIC RESONANCE IMAGING

- Useful in differentiating myocardial contusion from myocardial infarction
- In assessing vertebromedular lesions: place, extension and affected anatomical structures, integrity of disco-ligament structures, the presence or absence of the medullary cord affection, development of a possible compressive hematoma in the spinal canal.

CLASSIFICATION OF THORACIC TRAUMA

1.Morphopathological classification:

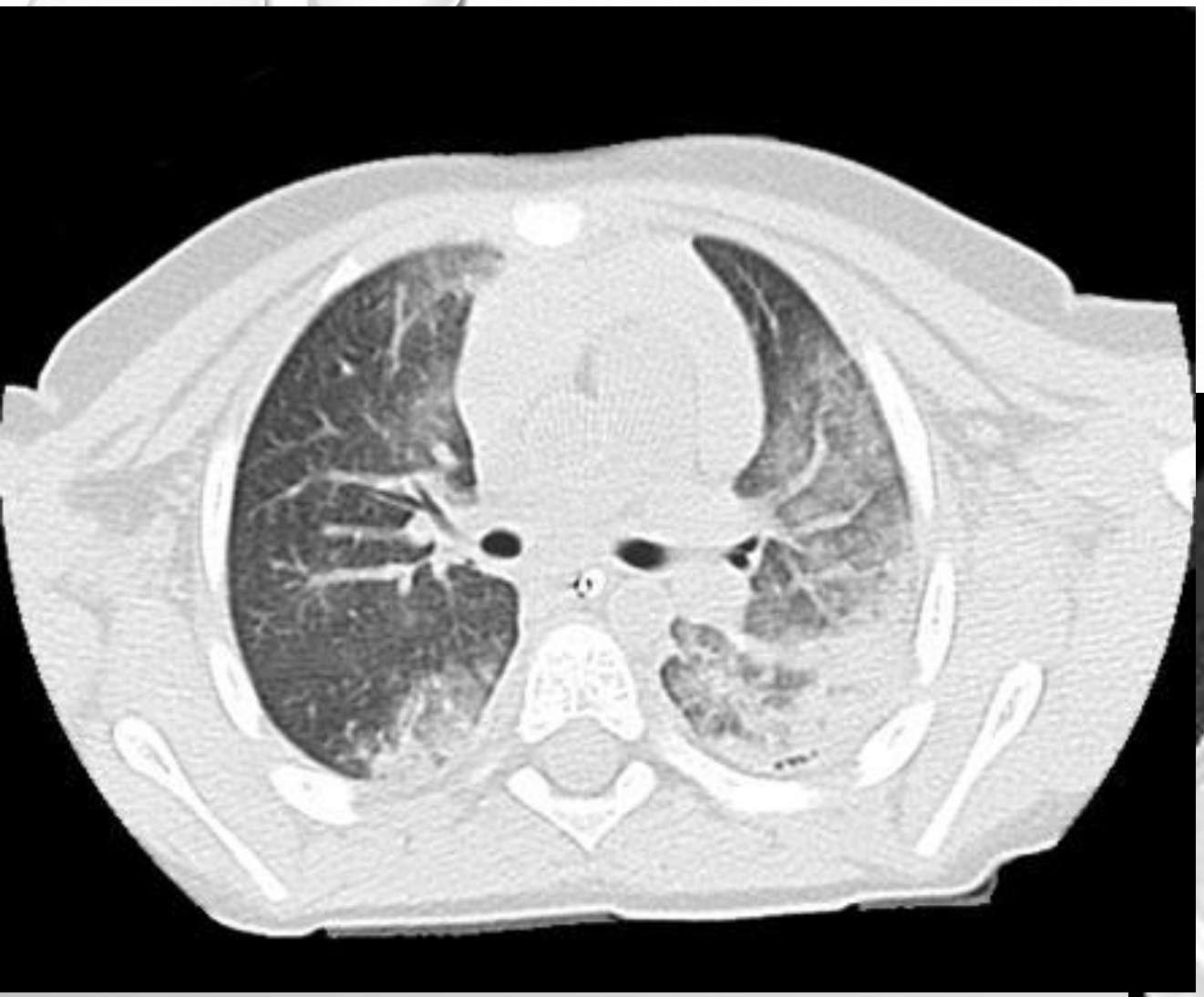
- Open trauma or plagues
- Closed trauma or contusions (with skin integrity)

2. Anatomical-lesional classification:

- Chest wall injuries
- Pleuro-pulmonary lesions
- Tracheo-bronchial lesions
- Mediastinal injuries
- Diaphragmatic lesions
- Associations of previous injuries

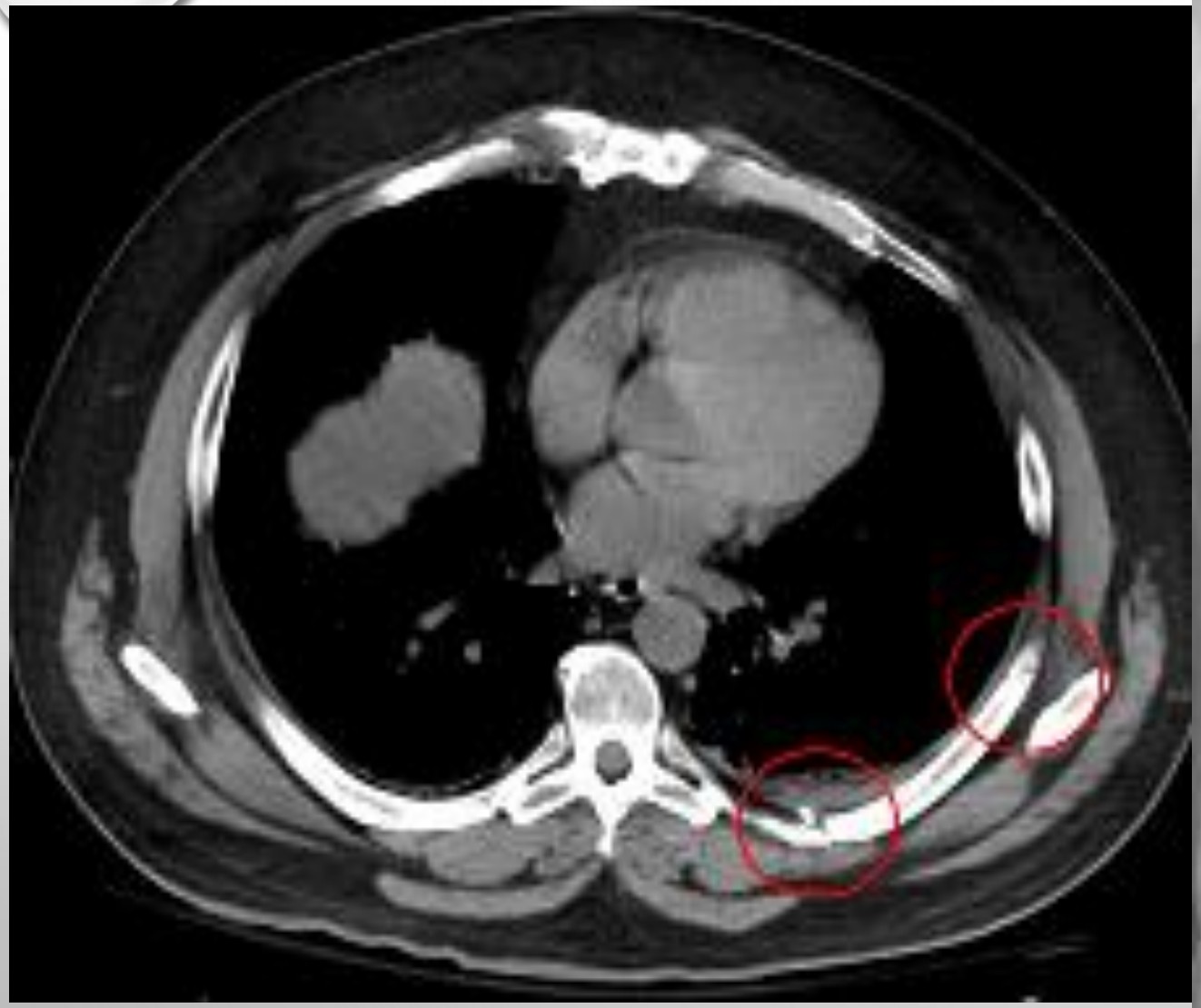
THE CHEST CONTUSION

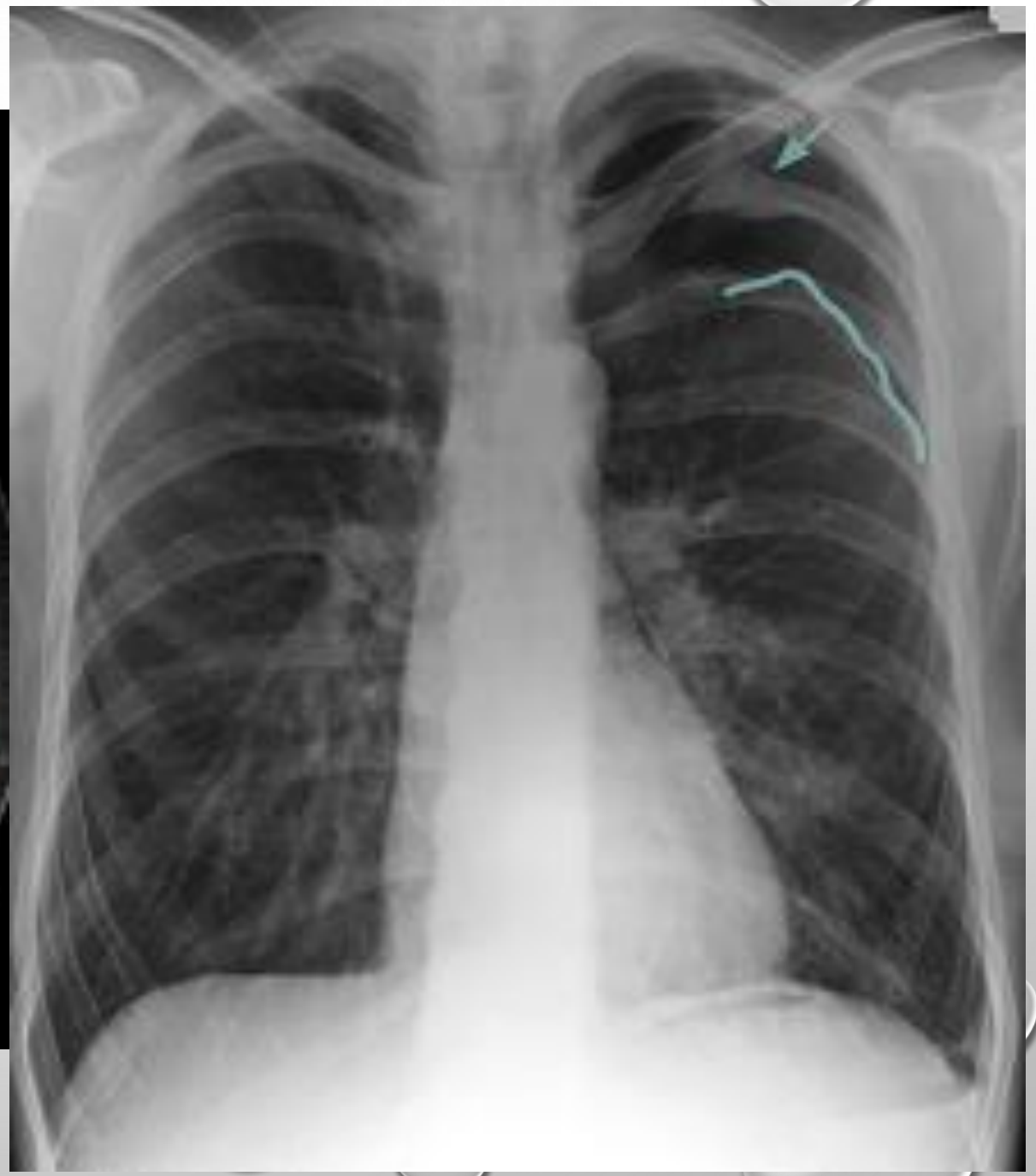
- The most common thoracic lesion
- Potentially lethal - because of intrapulmonary haemorrhage
- Associated with costal fractures, costal flap, penetrating wounds
- Progression in 24-48 hours with worsening of hypoxemia
- Hemoptysis
- Blood on the endo-tracheal sonde.



COSTAL FRACTURES

- The most common thoracic lesions
- It is associated with pulmonary contusion, pneumothorax or hemothorax
- Single or multiple
- At the condrocostal or condrosternal level they are called disjunctions (Ro-logically is not seen)
- More often, ribs 4-8, at the level of lateral arches
- Bone crepitation clinically and contour discontinuity of the ribs at the standard radiography
- Lower ribs fractures (8-12) may have splenic, liver and kidney ruptures
- In fractures of the first two ribs the probability of serious vascular damage is high - requires arteriography





STERNAL FRACTURES

- Local deformation in straddling fractures - sternum seems shortened, the lower fragment raises teguments and deforms the region
- Benign evolution when is isolated
- It can be associated with severe heart, aorta lesions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HEMOTHORAX

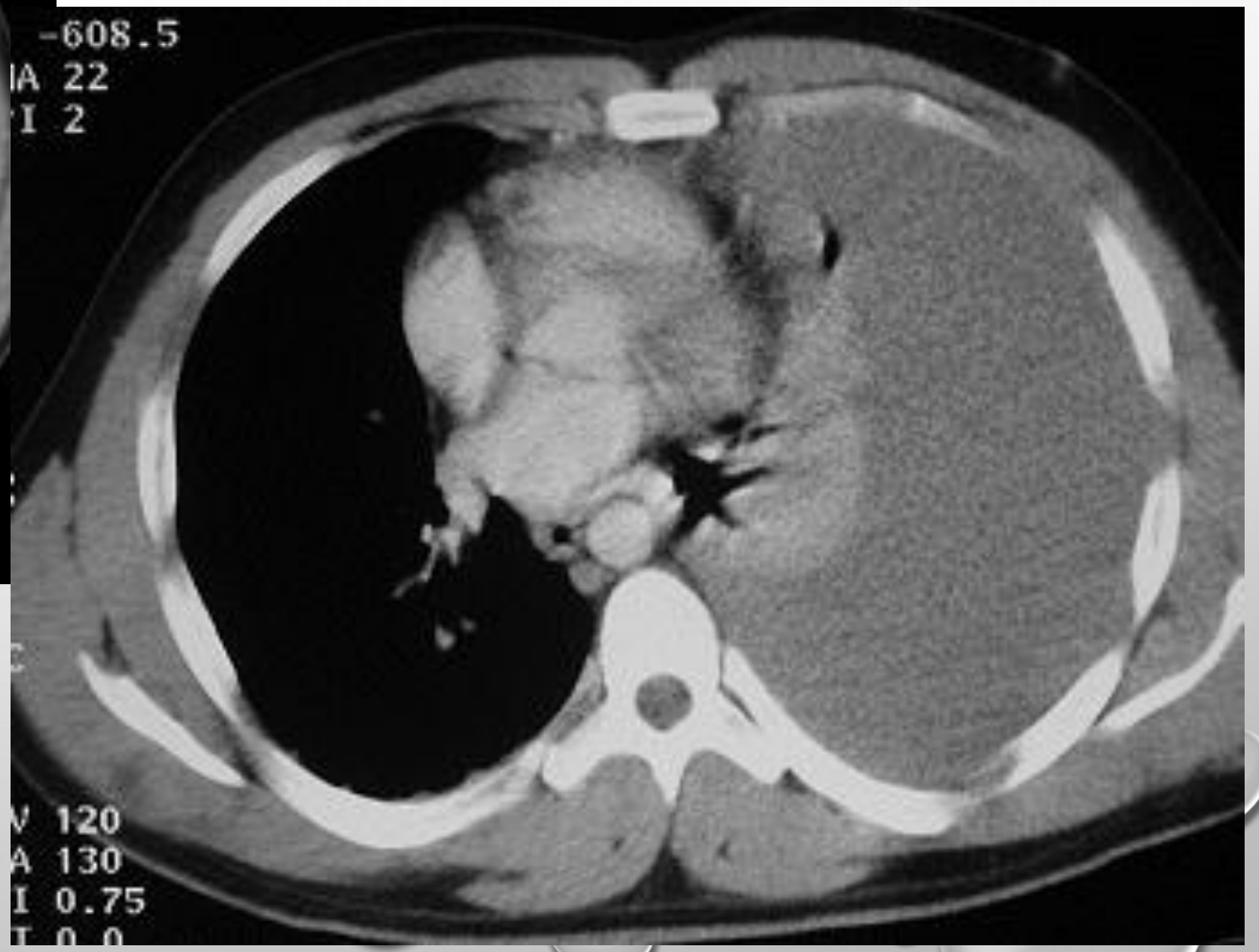
The source of bleeding may be:

- Parietal, by injuring of a. intercostalis or internal a. of breast
- Pulmonary, in ruptures or lung wounds
- Mediastinal, in heart and big vessel injuries
- Abdominal in the case of toracoabdominal penetrating wounds.

Clinical forms:

- Small hemothorax (150-500ml)
- Medium hemothorax (<1500ml)
- Massive hemothorax (> 1500ml).

Radiological – homogeneous opacification of the lung field.


-608.5
A 22
I 2
V 120
A 130
I 0.75

PNEUMOTHORAX

Mechanism:

- Closed chest trauma due to pulmonary, bronchial or tracheal ruptures
- Open thoracic trauma -parietal and / or pulmonary penetrating wounds

Forms:

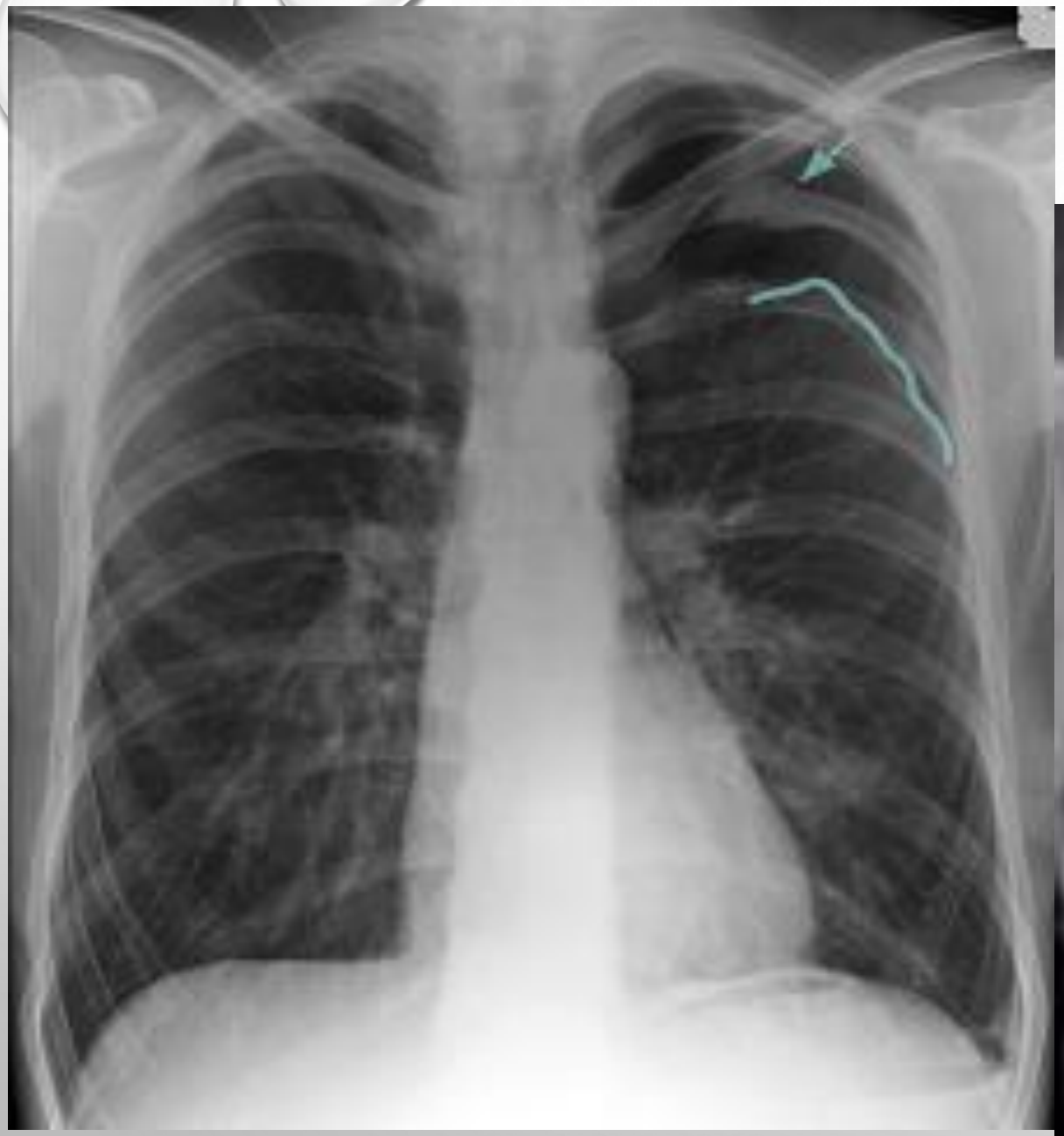
- Closed
- Open (external or internal)
- With valve (compressible, suffocating)

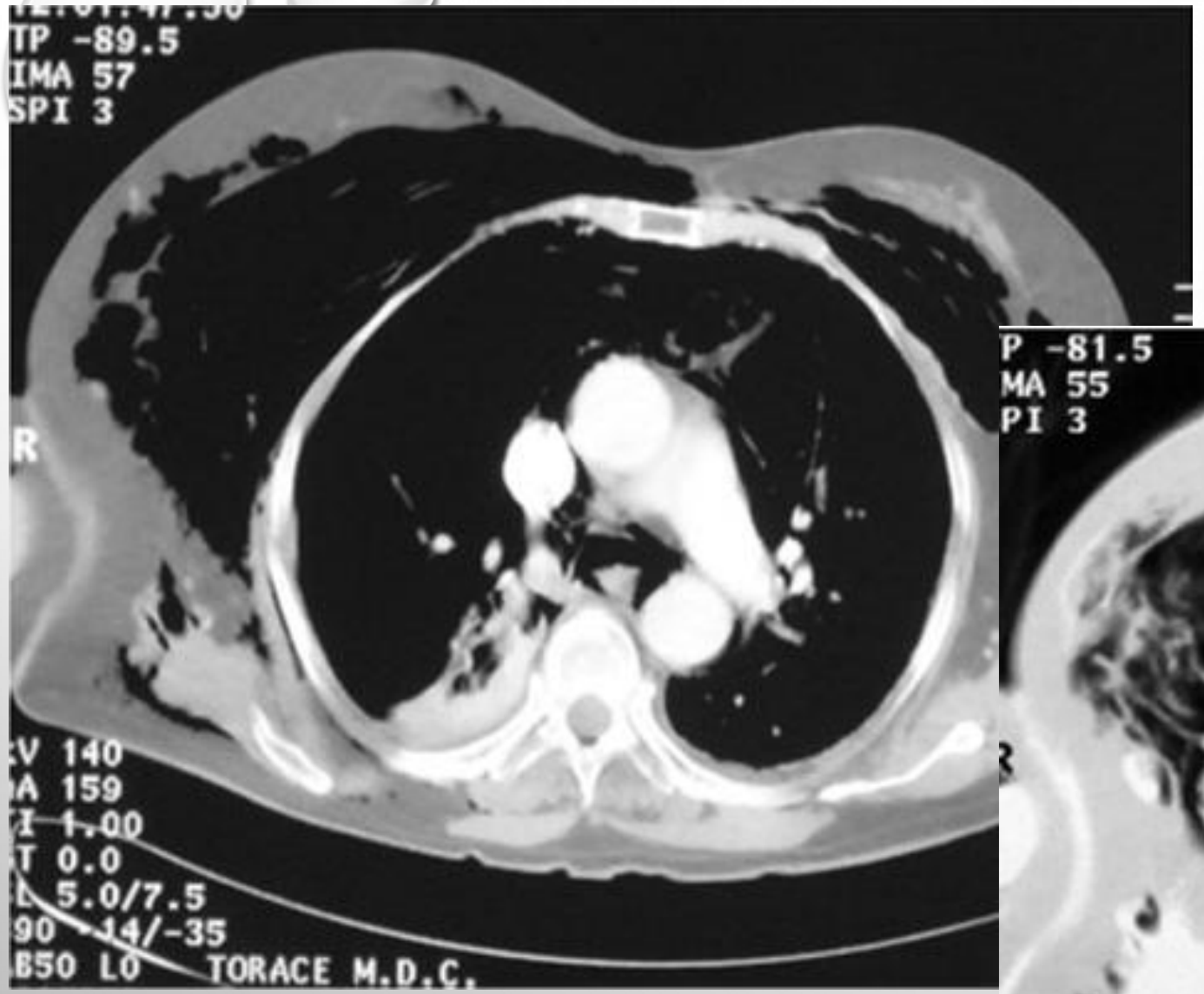
Radiological:

Lung is collapsed, forced to the hill

Hypertransparency in the pleural cavity (lack of lung pattern)

The cord and mediastinum moved to the healthy side.

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IMA 57
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V 140
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T 0.0
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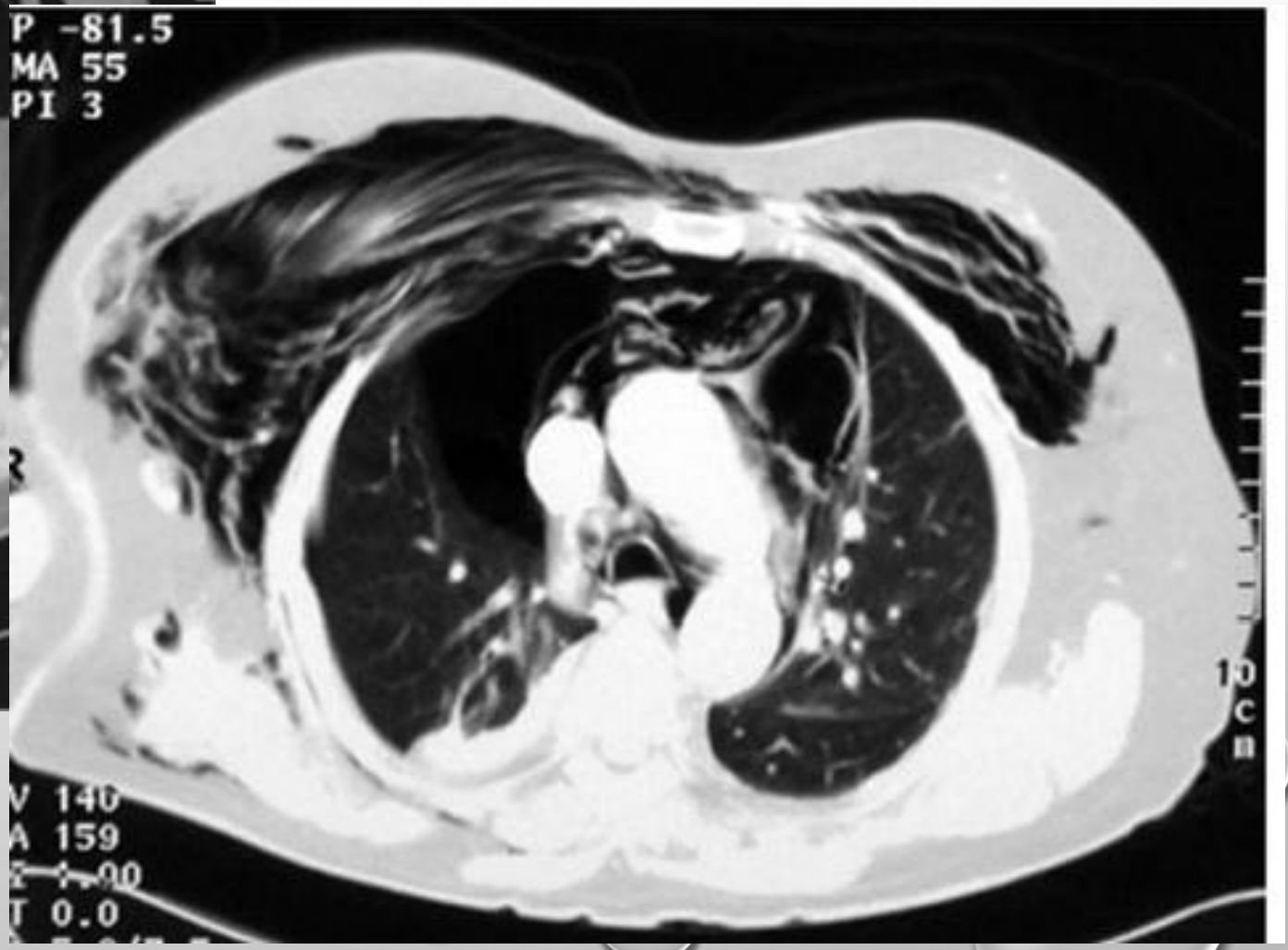
90 -14/-35
B50 LO TORACE M.D.C.


P -81.5
MA 55
PI 3
V 140
A 159
T 0.0


V 120
A 170
I 0.75
T 0.0
8.0/12.0
64 -27 -49


512
kV 120
mA 172
Noise Index 12.0
Large

ABDOMINAL TRAUMA

Diagnostic methods:

Simple radiography - to exclude pneumoperitoneum (suspected intestinal perforation, gastric ulcer perforation)

Ultrasound

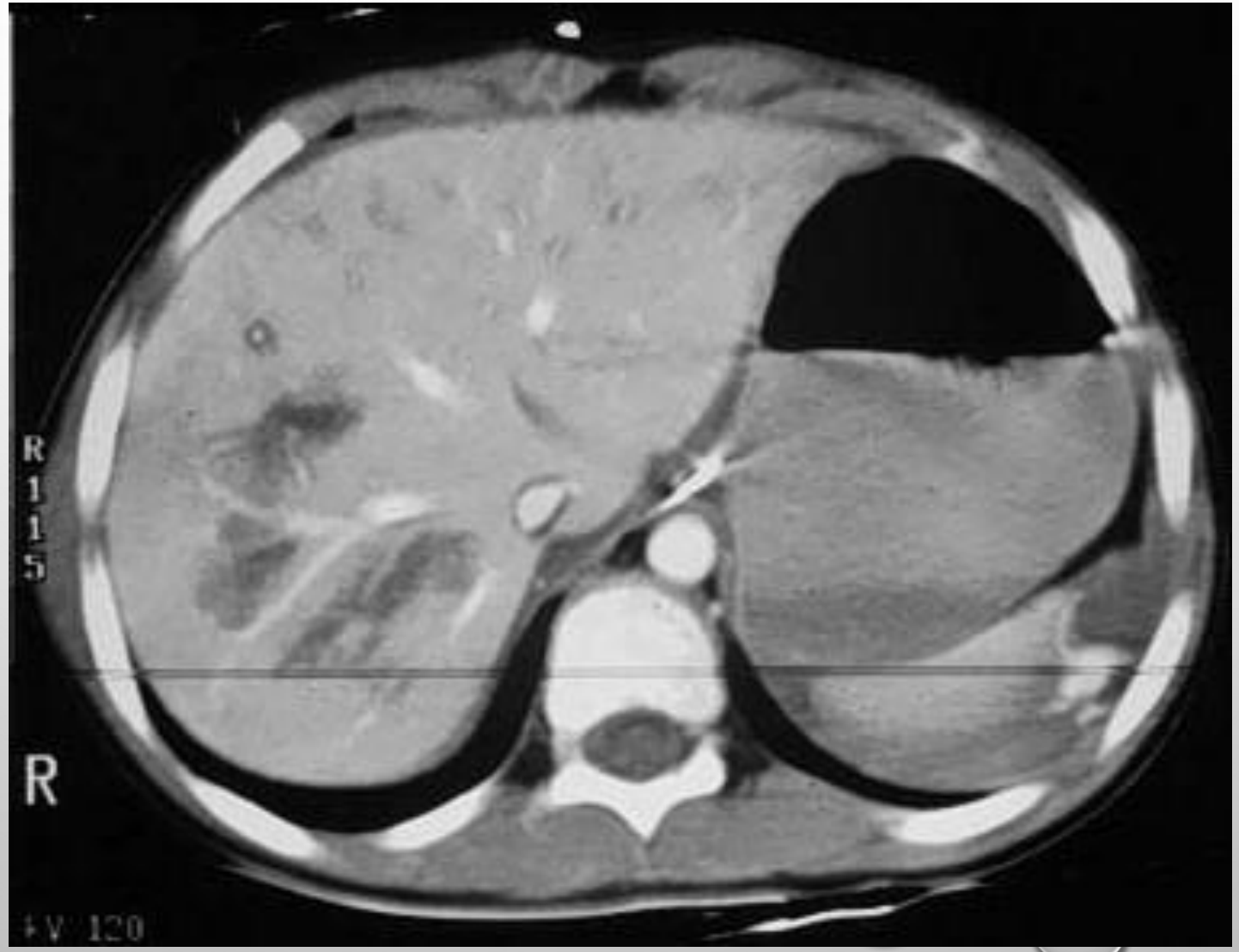
CT-scan with contrast substance (i / v or n / g sonde):

- Accuracy in dilacerations of parenchymal organs (spleen, liver)
- Identifies retroperitoneal lesions

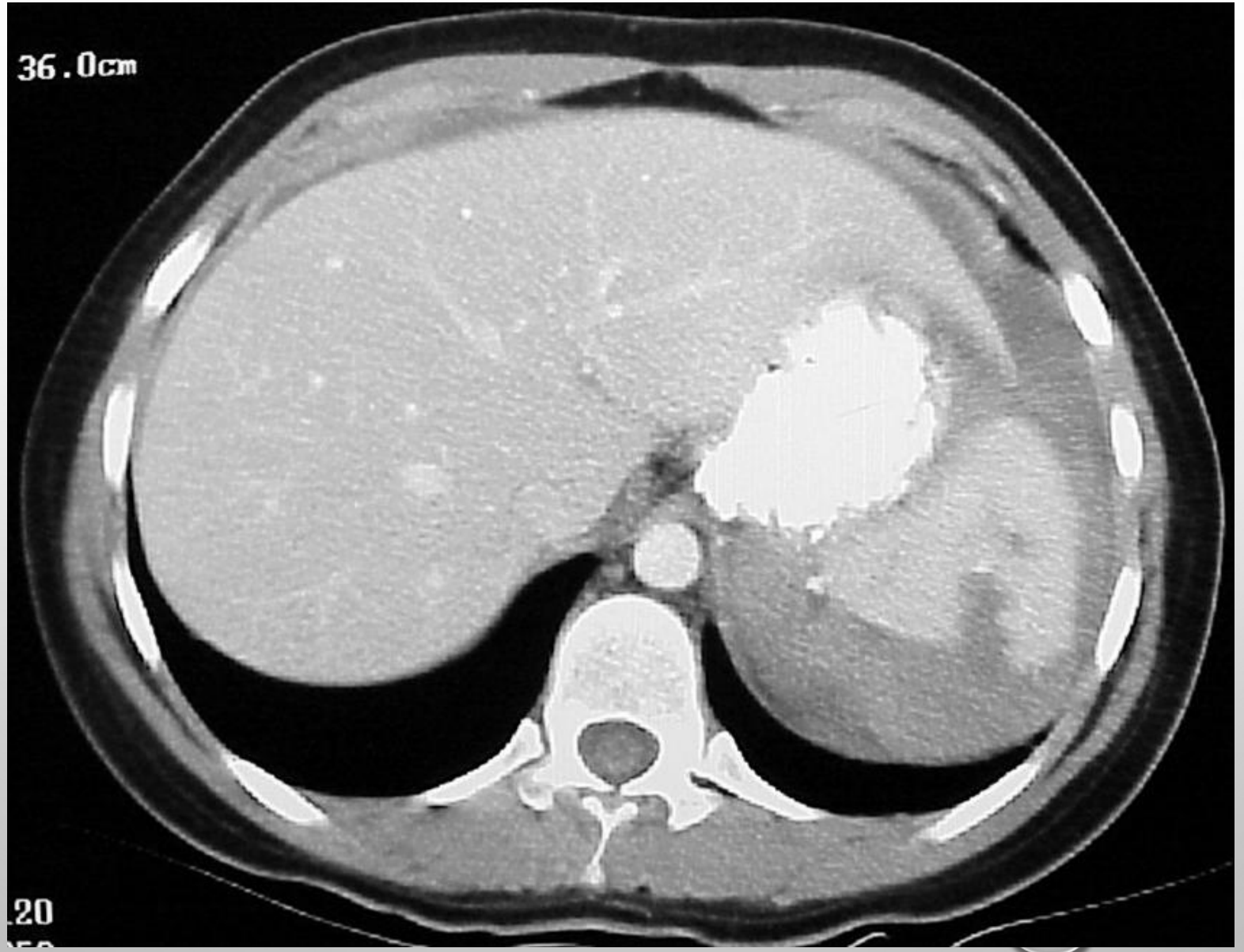
Angiography- possible arterial lesion

With contrast substance (for urinary tract, GIT)

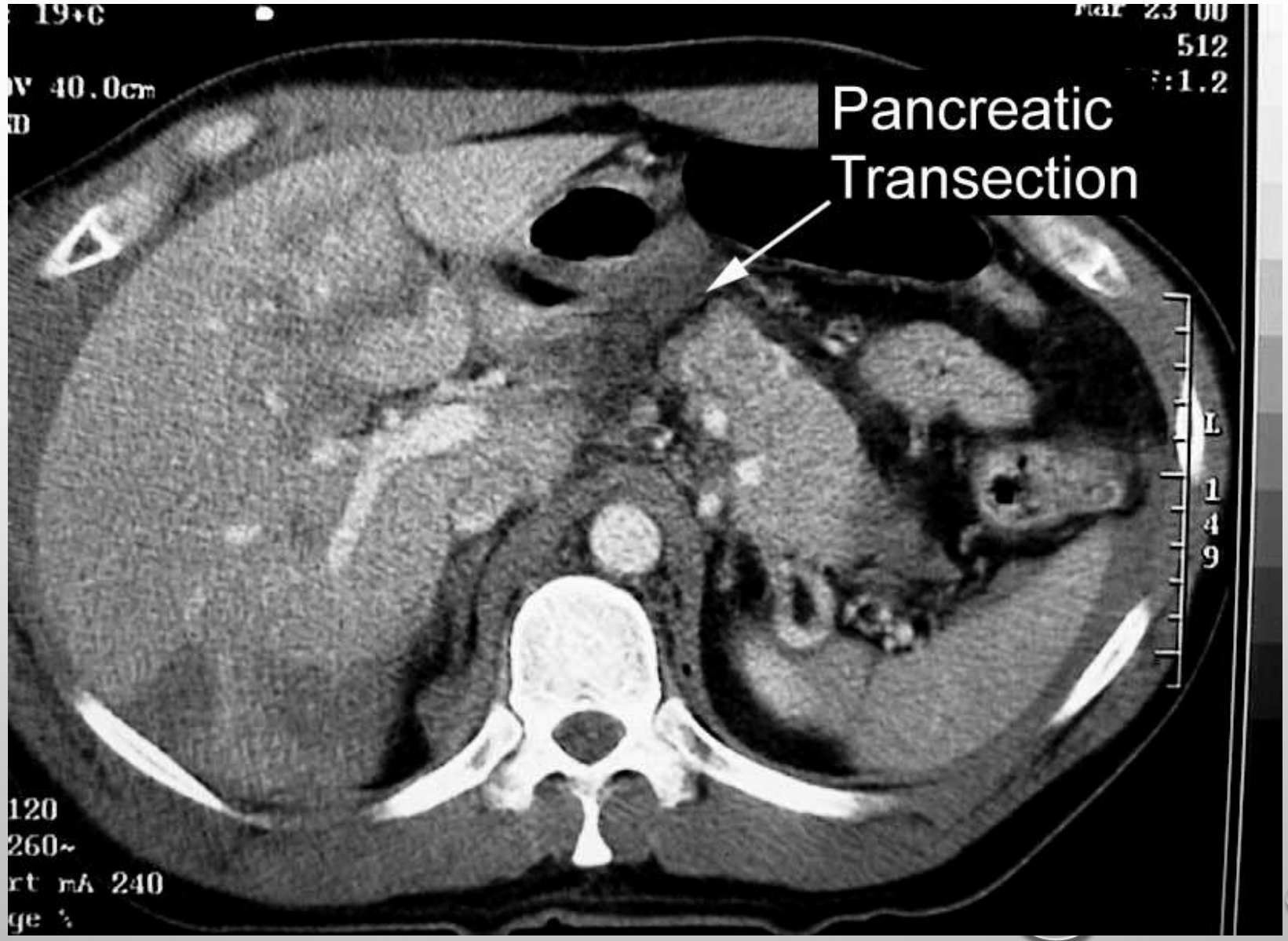
CLOSED ABDOMINAL TRAUMA: INTRAPARENCHYMAL HEPATIC INJURY



CLOSED ABDOMINAL TRAUMA: SPLENIC INJURY

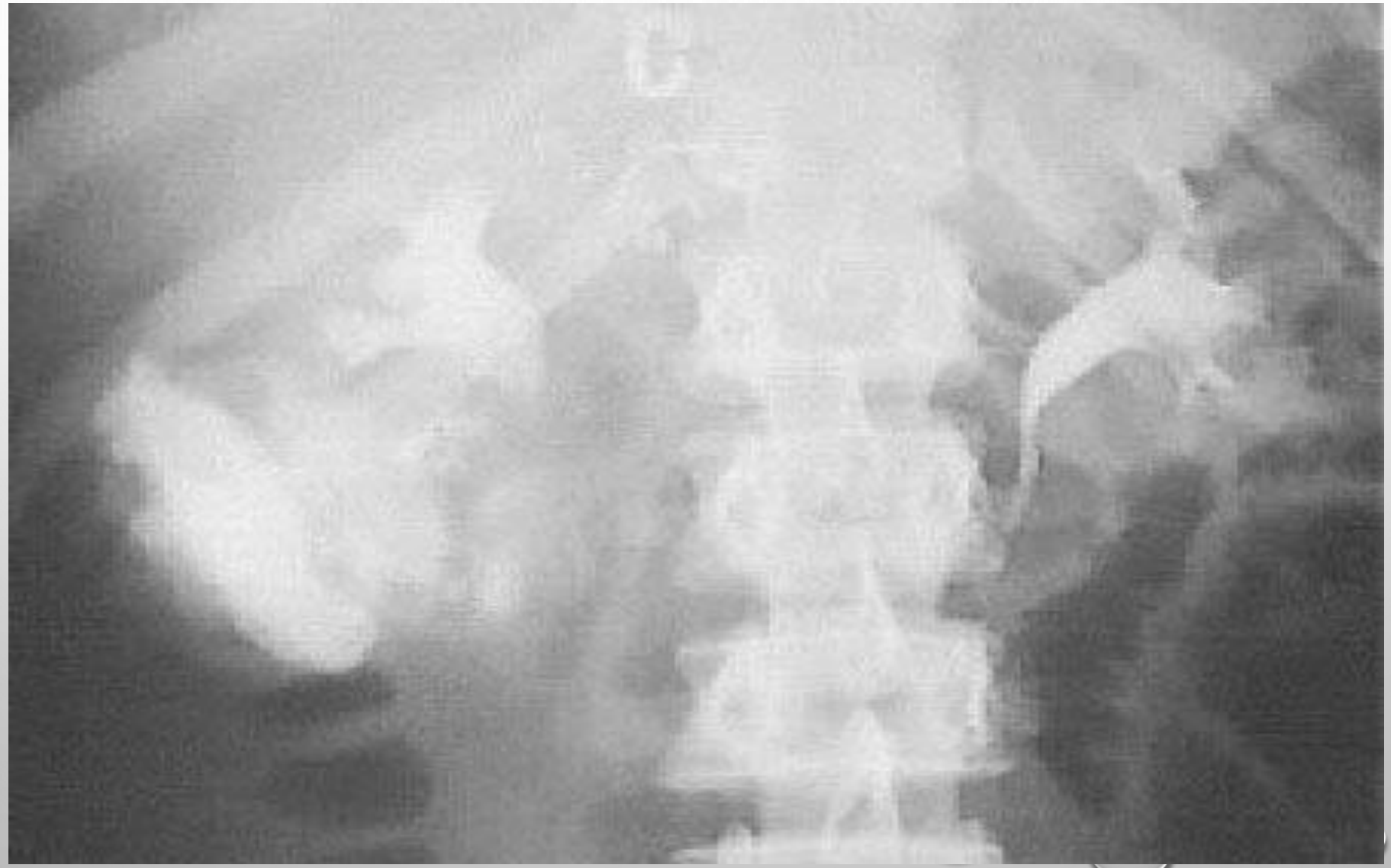


CLOSED ABDOMINAL TRAUMA: PANCREAS INJURY



LEFT KIDNEY, CALICIAL SYSTEM, URETER AND URINARY BLADDER OCCUPIED BY A BLOOD CLOT

EXTRAVASATION OF THE CONTRAST SUBSTANCE IN RIGHT KIDNEY



CRANIOCEREBRAL TRAUMA

Radioimaging methods used in the diagnosis of cranio-cerebral trauma:

Standard radiography – has importance when CT can not be performed

- Linear or depressive cranial fractures
- Pneumocefalia
- Air-liquid level in sinuses, penetrating foreign bodies

Computer tomography

Magnetic resonance imaging

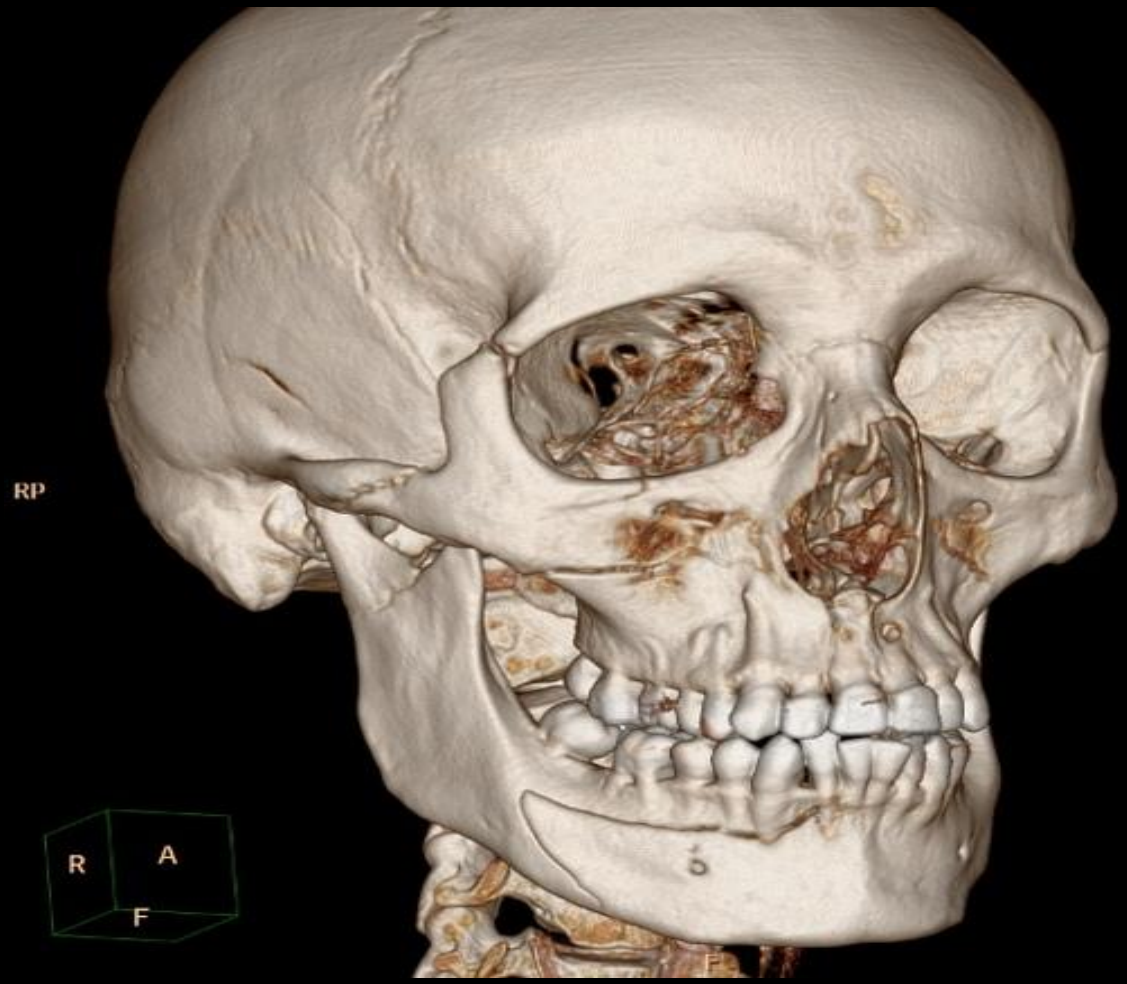
Angiography - rarely indicated, in suspicion of penetrating objects located around large cerebral arteries or near dural sinuses

COMPUTER TOMOGRAPHY

Election investigation in diagnosis of CCT, highlighting:

- blood (haemorrhages or hematoma): epidural hematoma, subdural hematoma, subarachnoid haemorrhage, cerebral haemorrhage, haemorrhagic contusion, intraventricular haemorrhage
- hydrocephalus
- cerebral edema (basal tank obliteration, small-sized ventricles, disappearance of cortical sutures)
- signs of cerebral anoxia: deleting the white matter- gray matter interface , edema
- fractures of the cranial base, including temporal bone fracture, orbital, calvaria
- ischemic infections - signs are minimal if the examination is less than 2 hours after stroke
- pneumocephalus - may indicate a fracture
- movement of median line structures (due to hematoma or asymmetric cerebral edema)

FACIAL FRACTURES



Complex facial fractures

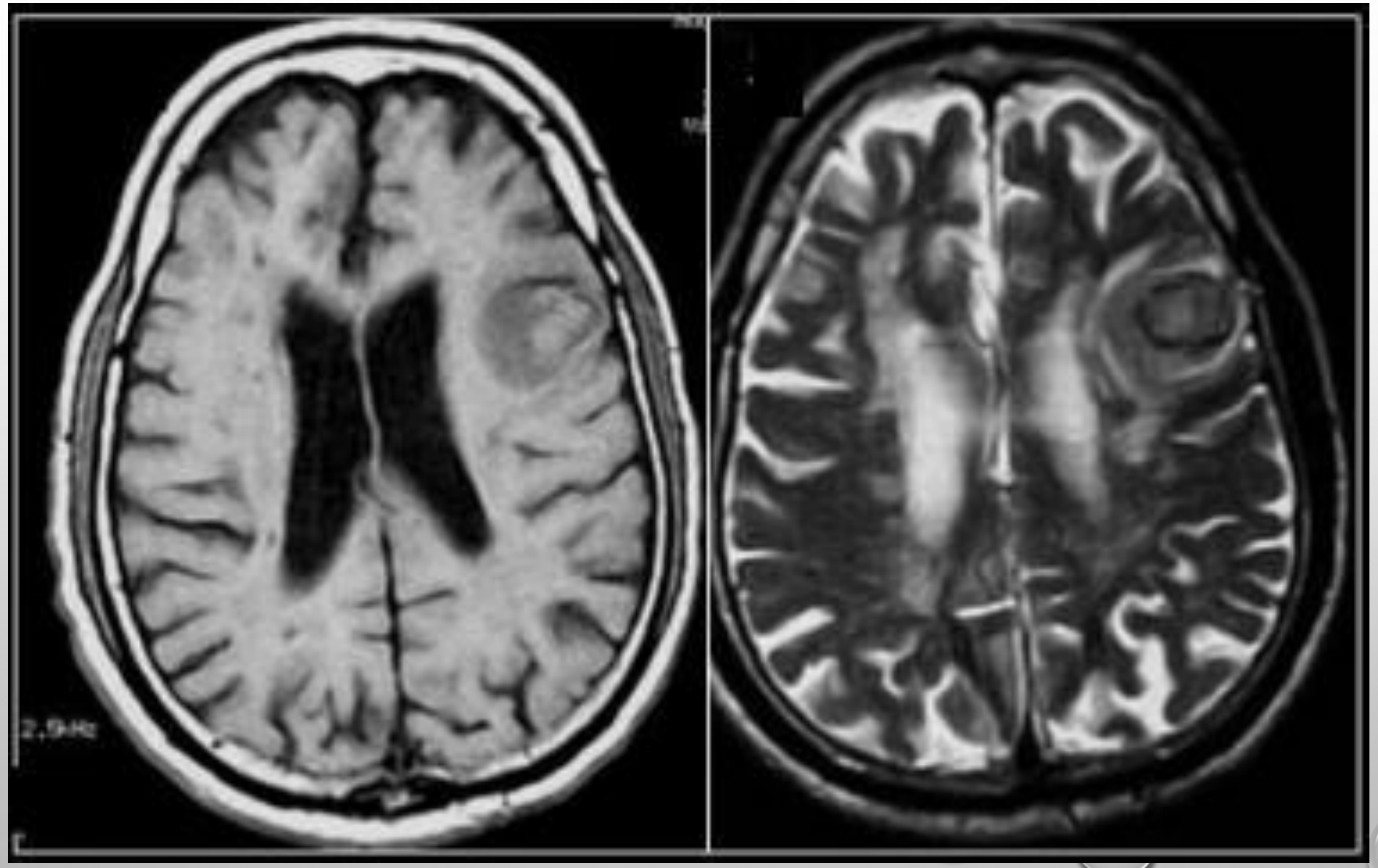
MAGNETIC RESONANCE IMAGING

- It is not necessary in acute lesions, being the most advanced imaging exam for mapping endocranial post-traumatic lesions
- It is useful later, after stabilizing the patient: for evaluation of cerebral cortex lesions or white matter lesions (hemorrhagic spots in the corpus callous in the diffuse axonal lesion)
- Situations of image-clinical dissociation (serious cranial trauma without cranio-encephalic lesions which will justify clinical condition)
- Prognostic value
- Angio-MRI: In traumas with deficient signs and normal CT signs – search for traumatic arterial dissection.

MRI limits:

- Limited accessibility (not available in all the hospitals)
- Contraindicated for metallically foreign body
- The lesions with neurosurgical indication are better and faster to CT.

MRI of brain: intracranial hemorrhage



EXTRA-AXIAL LESIONS

Types of extra-axial lesions: epidural hematoma, subdural hetamoma, subdural higroma, subarachnoid hemorrhage.

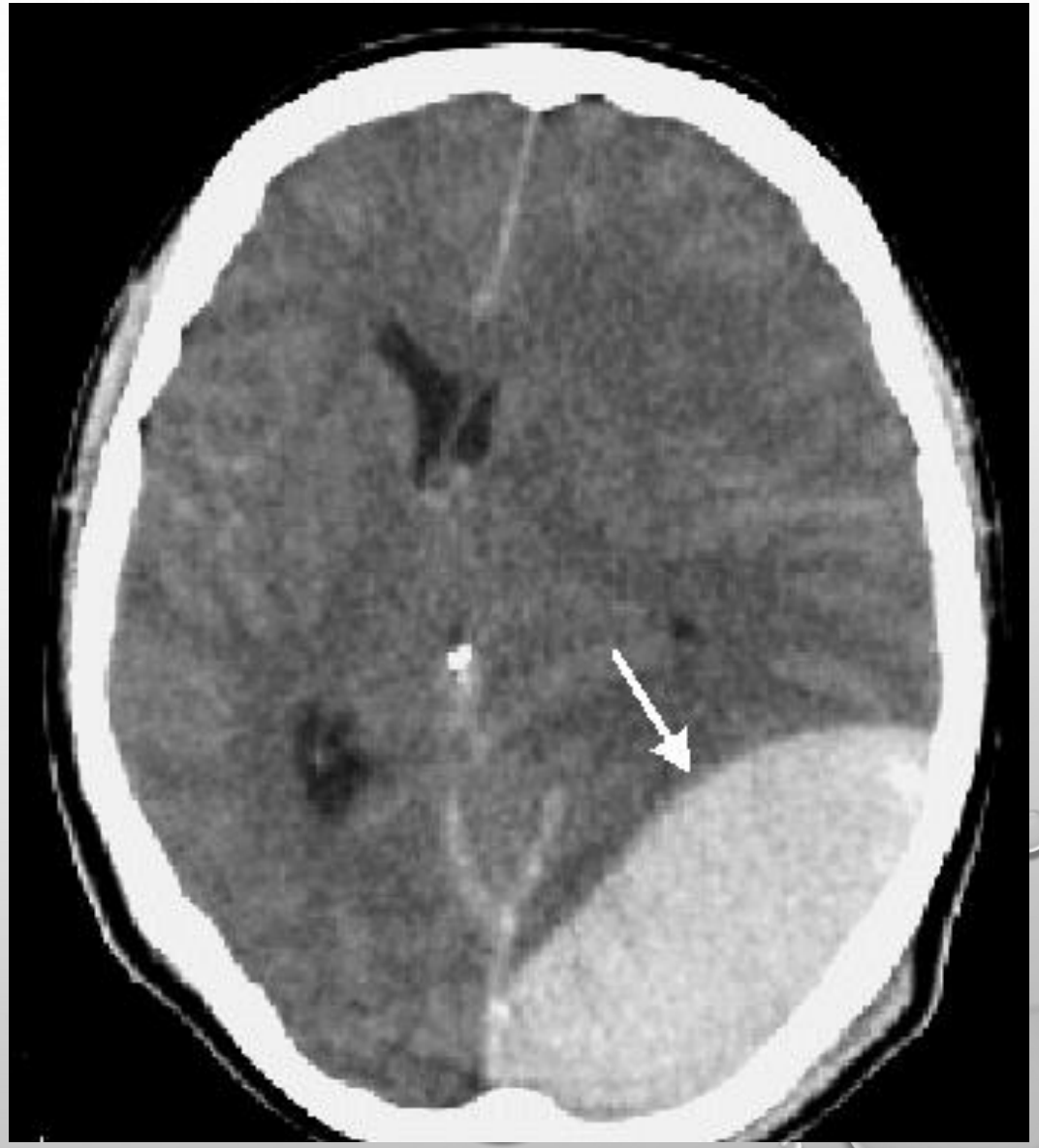
Epidural hematoma - intracranial blood flow, which develops between dura mater and endocranium

- Has evolutive character
- Can be encapsulated or not encapsulated
- 70% are supratentorial located in temporal region
- Source of bleeding - 85% arterial blood (a. Meningeea and its branches); venous (dural sinuses, medium meningeea vein); diploid vessels of bones.

EPIDURAL HEMATOMA

- Appearance of biconvex hyper density lens
- Placed exactly under the inner board
- Specifying localization (temporal, frontal, parietal, occipital or subtemporal)
- Examination in the bone window reveals the cranial fractures

EPIDURAL HEMATOMA

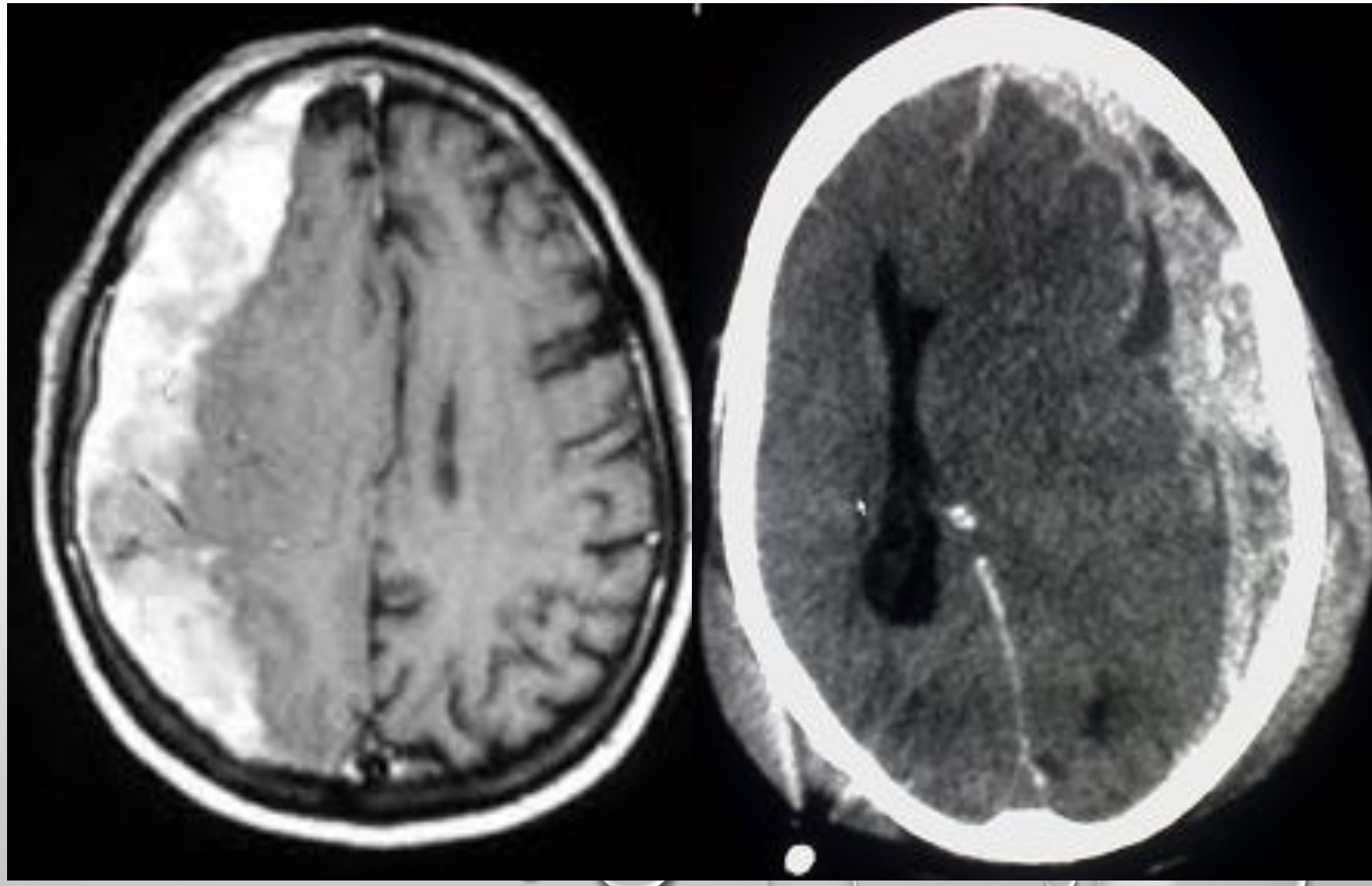


Subdural hematoma - hematic collection between dura mater and cortex:

- Accompanied by signs of intracranial hypertension
- Short bleeding, most often venous
- With hemispherical topography, fronto-temporo-parietal, rare occipital

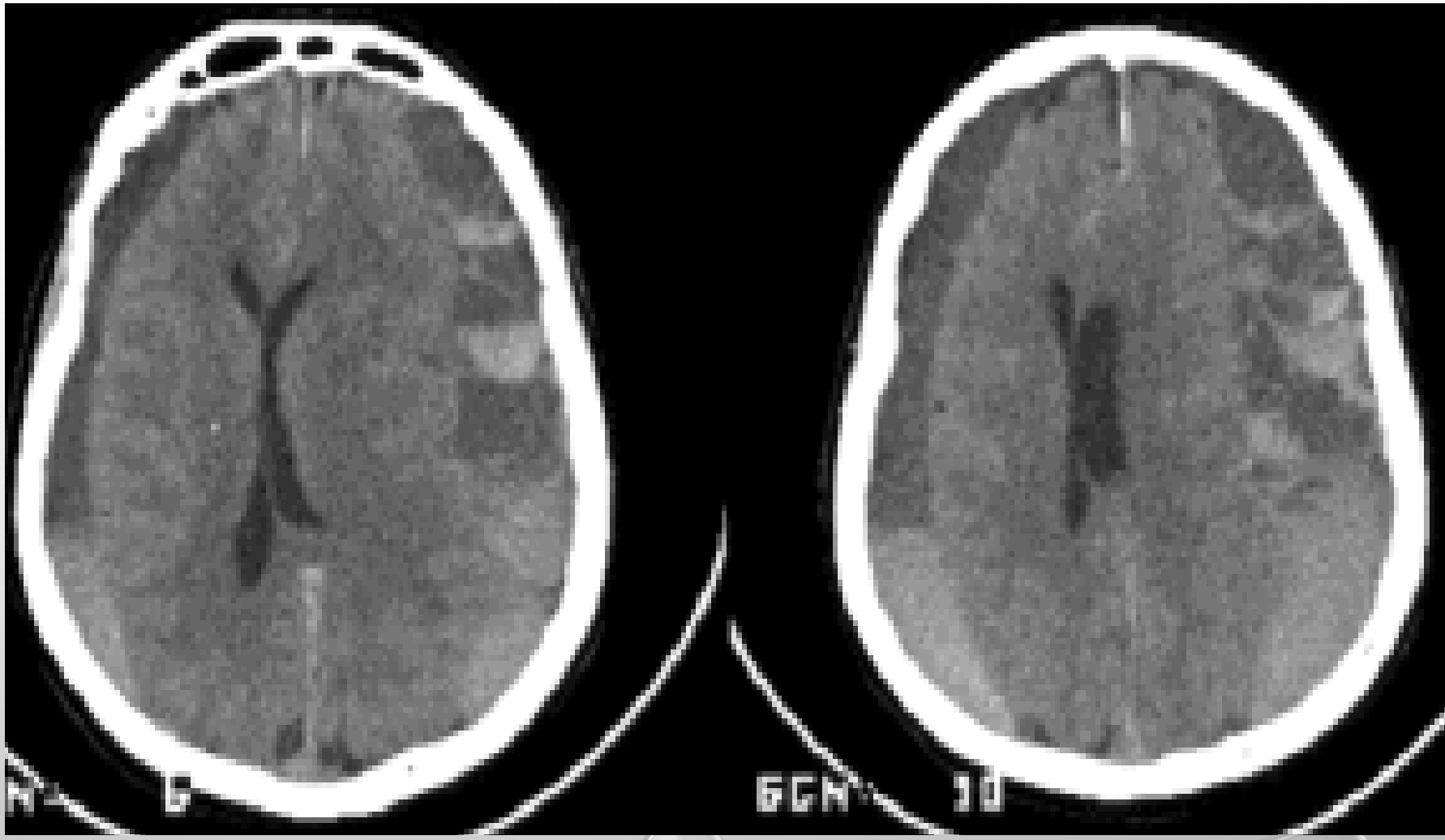
SUBDURAL HEMATOMA

- Homogeneous hyperdense collection
- Falciform and concave
- Placed hemispherically, just below the bones
- The contour is ill-defined
- At CT is possible to assess the volume of hematoma, location, mass-effect and associated lesions



CHRONIC SUBDURAL HEMATOMA

- Izodensis collection at the beginning, which becomes later hypodensis
- The heterogeneous hyperdensity in this case indicates a recent bleeding
- Contrast media load the outlines of the hematoma membrane

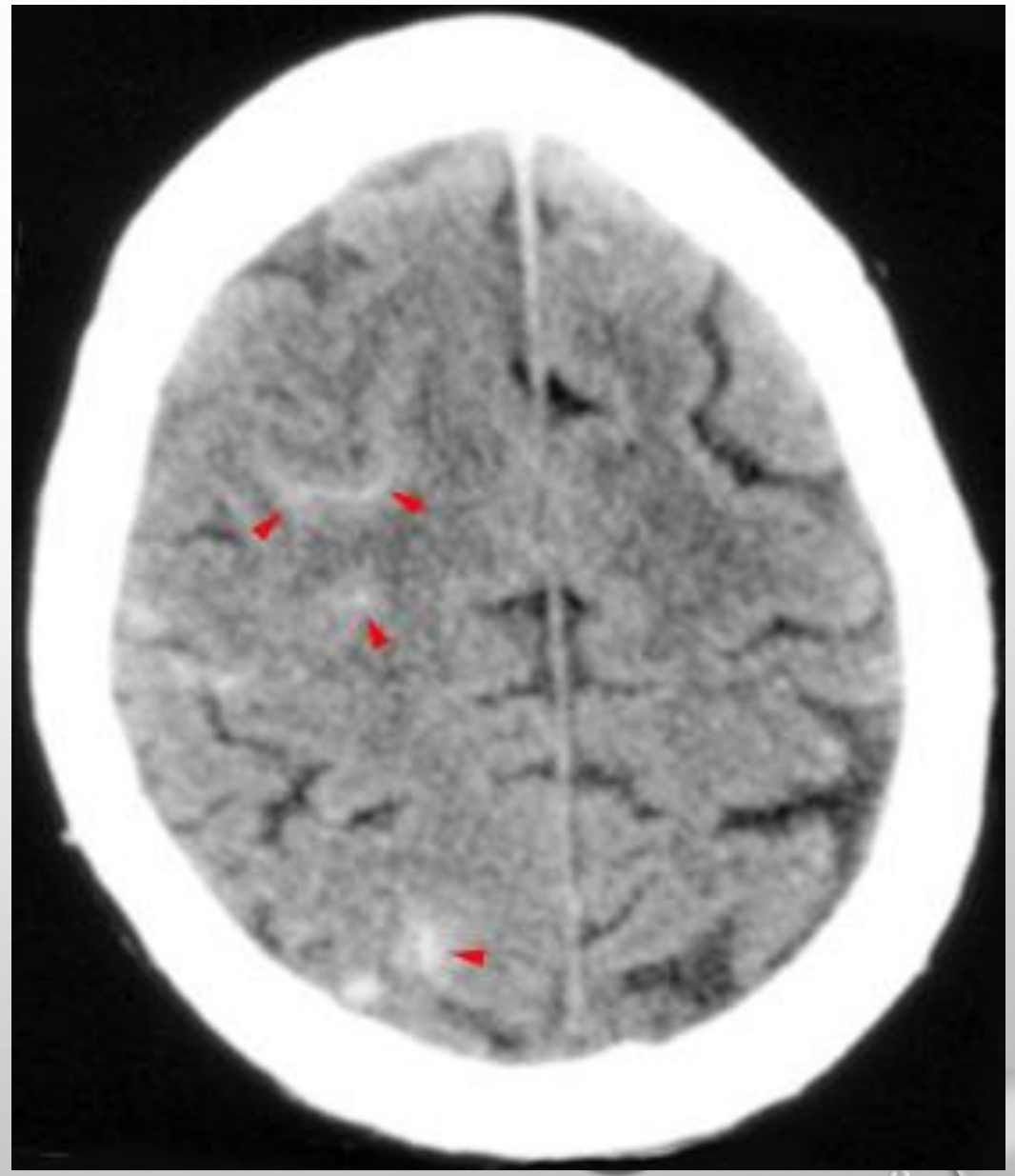


Subdural hygroma – it develops after trauma, after 1 month and more

- Is a subdural effluent liquid, that can be delimited by a membrane and containing xanthromic liquid, or without membrane and containing a clear liquid
- Is formed by breaking the arachnoid or by slowing the absorption of CRL
- At CT/ MRI scan- liquid collection with density / signal similar to CRL

SUBARACHNOID HEMORRHAGE

- CT is the only non-invasive diagnostic method recommended in emergency situations
- Hyperdense images located at hemispheres, cerebral cisterns and other side of the brain
- It occurs by breaking an aneurysm or a AVM (arterio-venous malformations)
- Location between arachnoid and pia mater



SUBARACHNOID HEMORRHAGE

INTRA-AXIAL LESIONS

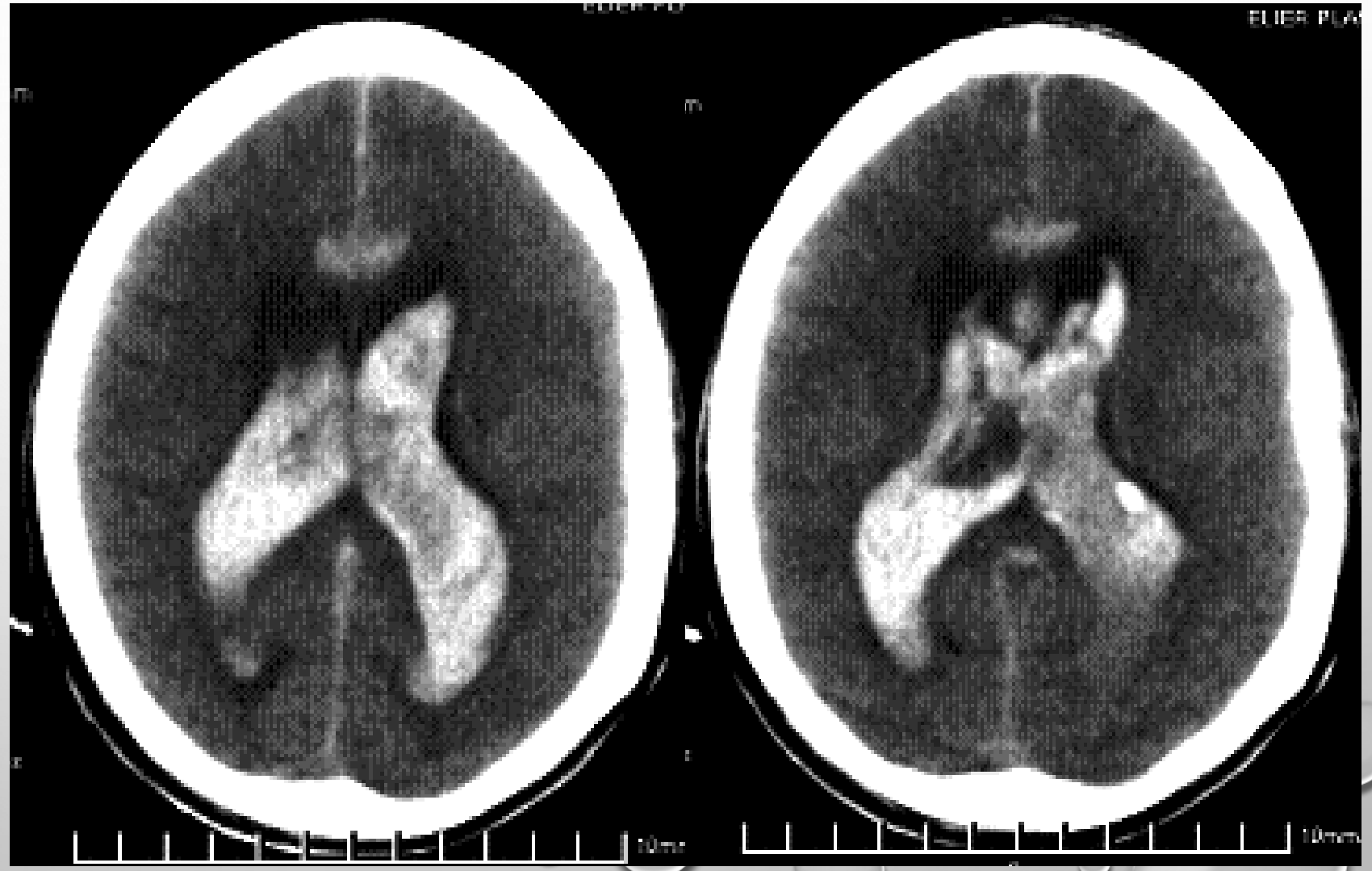
Brain contusions - focal traumatic effect

Intracerebral hematoma - intra-parenchymatous accumulations of blood, secondary to trauma

- Result of cerebral contusions or rupture of a deep penetrant vessel of white matter
- Distribution similar to that of contusions, more frequently frontal and temporal
- CT appreciates the character of all intracranial traumatic lesions, localization and volume of intracerebral hematoma
- The intracerebral blood collection appears spontaneously, are hyperdens, localized intraparenchymatously

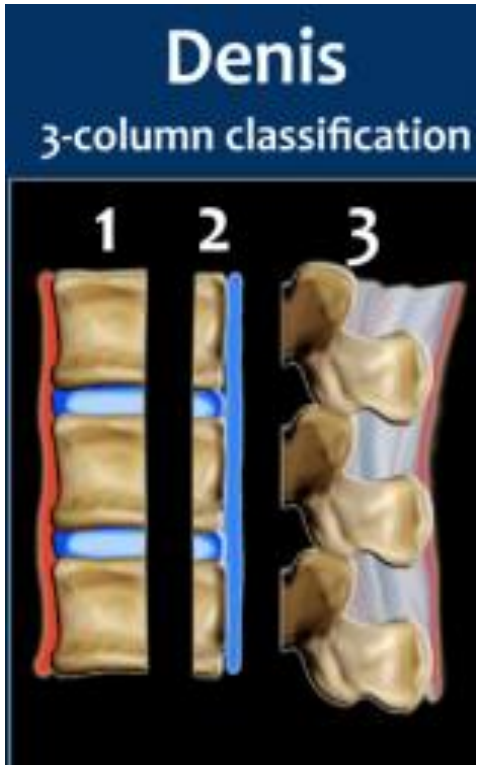
POSTTRAUMATIC INTRAVENTRICULAR HEMORRHAGE

- It is constituted as an intra-axial hyperdensity located at the level of all the ventricles or only in certain areas of the ventricular system



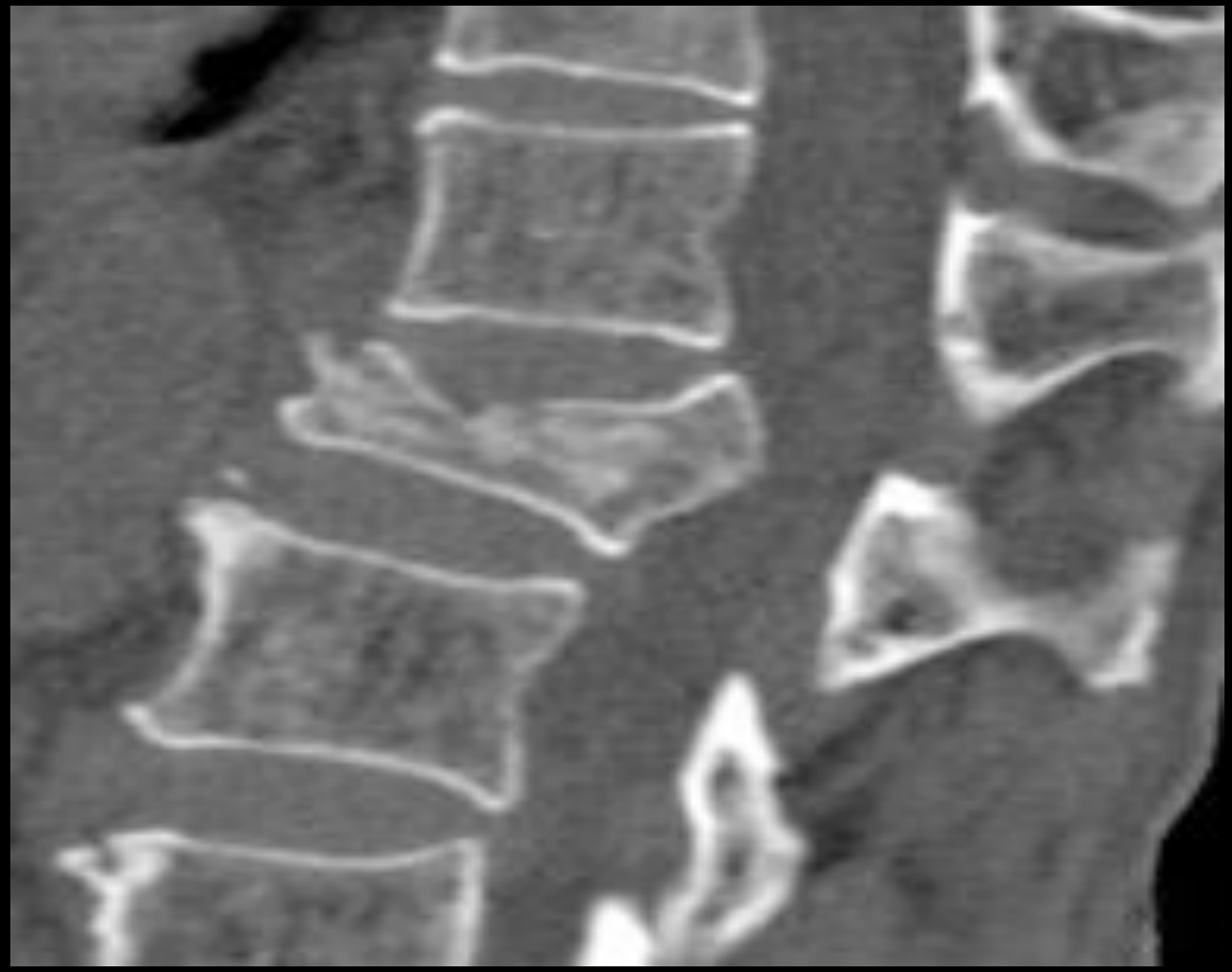
INTRACEREBRAL HEMATOMA

SPINAL INJURY



- C1-C2 region: Jefferson fracture (ring fracture of C1), Hangman fracture (bilateral pedicle or pars fracture of C2)
- Thoracolumbar injury:
  - stable and unstable fractures (based on three column model of Denis)
  - Hyperflexion Injury (wedge fracture)
  - Jumper's fracture (burst fracture)
  - Chance fracture: three column injury with a horizontal orientation of the fracture

SPINAL INJURY



Jumper's fracture at CT

PELVIC FRACTURES

Unstable pelvic fractures:

- anteroposterior compression: result in open book or sprung pelvis fractures
- lateral compression: result in a windswept pelvis
- vertical shear: results in Malgaigne fracture or bucket handle fracture
- combined mechanical: occur when two different force vectors are involved and results in a complex fracture pattern

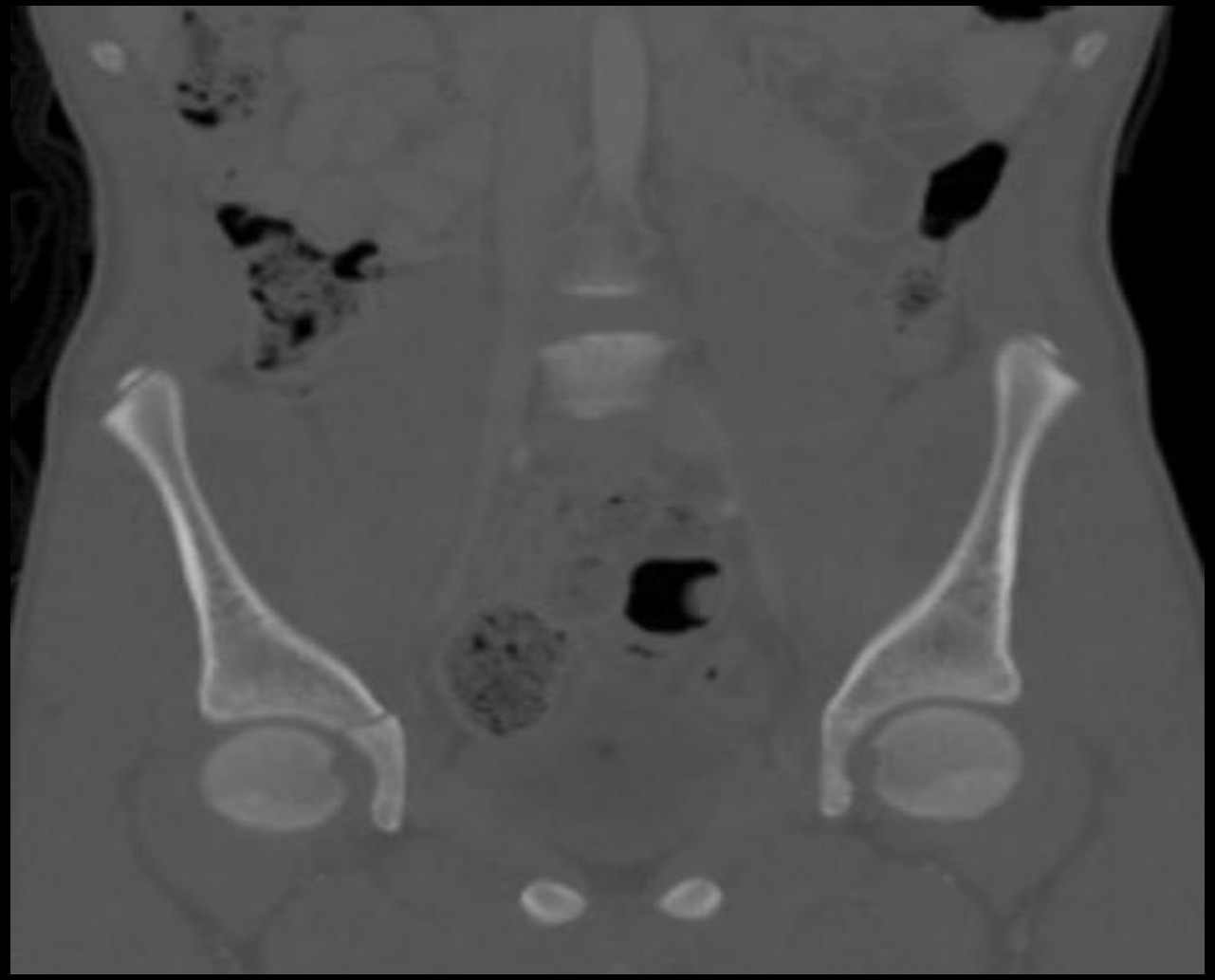
Isolated stable pelvic fractures :

- acetabular fracture
- pubic ramus fracture
- iliac wing fracture (Duverney fracture)
- avulsion fractures (e.g. ASIS, iliac crest, ischial tuberosity)

PELVIC FRACTURES

Combined mechanical fracture

PELVIC FRACTURES



Acetabular fracture right sided

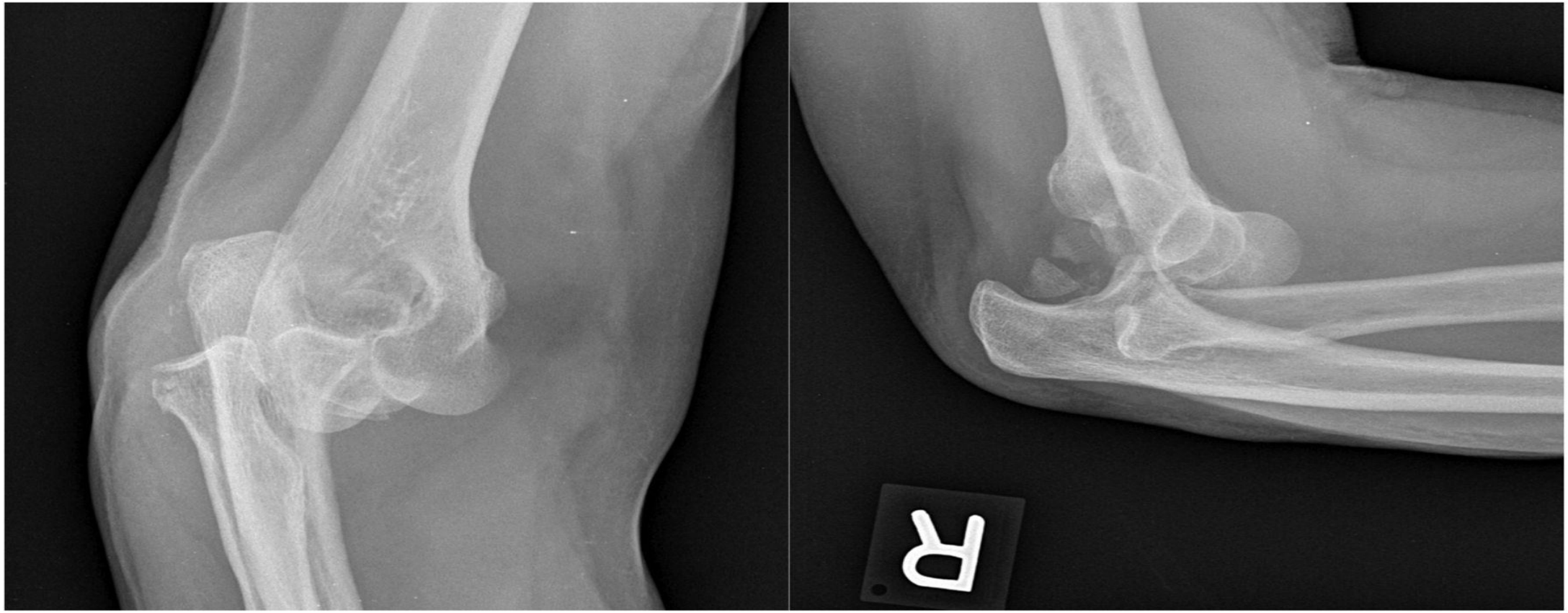
FEMORAL FRACTURES

Subcapital femoral neck fracture

ELBOW INJURY

- **Paediatric common pathology**: supracondylar fracture, lateral condyle fracture, medial epicondyle avulsion, radial head dislocation, radial neck fracture
- **Adult elbow pathology**: posterolateral rotatory instability, osteochondral lesions, ulnar collateral ligament tears, lateral epicondylitis, medial epicondylitis, radiobicipital bursitis, chronic avulsion etc.

ELBOW INJURY



“Terrible triad of the elbow”
Posterior elbow dislocation
with fracture of the coronoid process
and radial head fracture

WRIST INJURY

- **Fractures in children**: Torus fracture, green stick fracture, epiphysiolysis fracture
- **Adult common injuries**: Colles' fracture, Smith's fracture, Barton's fracture, Die-punch fracture, Chauffeur's fracture, carpal instability

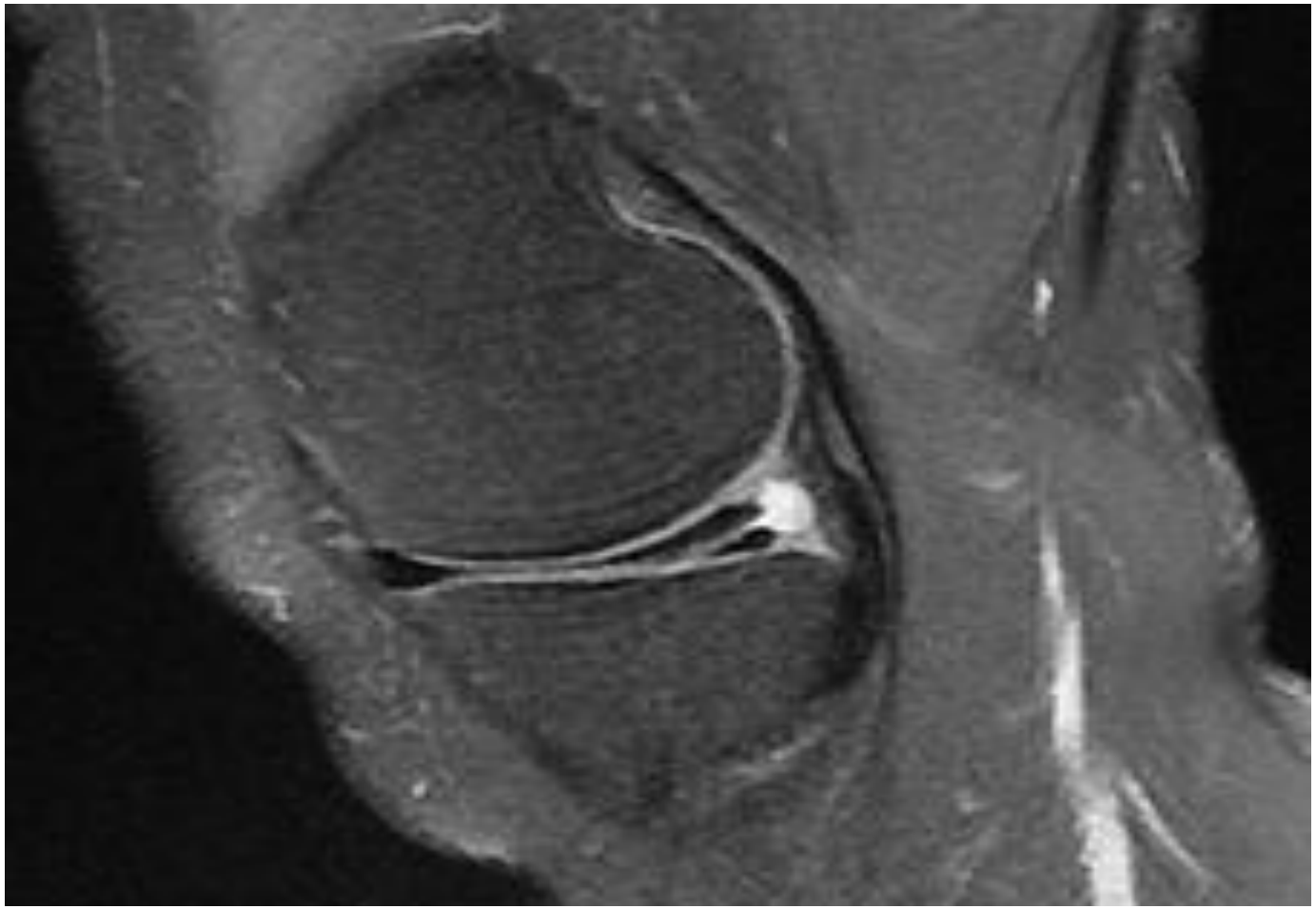
WRIST INJURY

"Colles' fracture

KNEE INJURY

- Meniscal lesions
- Avulsion fractures of the knee
- Anterior and/or posterior cruciate ligament tears
- Posterolateral Corner injury (fibular collateral ligament, biceps femoris muscle and tendon, popliteal tendon)
- Pre-, supra- and infrapatellar bursitis
- Patellar tendinopathy
- Patellar dislocation
- Osteochondritis Dissecans

KNEE INJURY



Meniscal lesions