

Chest Trauma

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Chest Trauma

- 25% of trauma deaths are due to chest injury
- 85% are treatable by simple procedures
- Only 15% or less require thoracotomy for repair
- Mechanisms of injury:
 - Penetrating
 - Blunt
 - Blast
 - Inhalation (fumes, water, etc.)

Potential Physiologic Results of Chest Trauma

- Hypoxia
- Hypercarbia
- Hypovolemic shock
- Obstructive shock
- Acidosis

Chest Trauma

The 6 quickly lethal types of chest injury: (these must be found on the primary exam)

- Airway obstruction
- Tension pneumothorax
- Open pneumothorax
- Massive hemothorax
- Flail chest
- Cardiac tamponade

Chest Trauma

The 6 potentially lethal types of chest injuries: (these should be identified on the secondary survey)

- Aortic disruption (dissection)
- Myocardial contusion
- Tracheobronchial disruption
- Esophageal disruption (perforation)
- Pulmonary contusion
- Diaphragmatic disruption (hernia)

The 8 Types of (Usually) Non-Lethal Chest Injuries

These should be identified on the secondary survey:

- Simple pneumothorax or small hemothorax
- Sternoclavicular dislocation
- Sternal fracture
- Clavicle fracture
- Scapular fracture
- Traumatic asphyxia
- Simple rib fracture
- Chest wall contusion

Quickly Lethal Chest Trauma: Airway Obstruction

- Should diagnose this “from across the room” by observing:
 - Decreased respiratory effort or rate < 12/min.
 - Cyanosis
 - Intercostal / sternal / subcostal retractions
 - Snoring / gurgling / hoarseness / stridor
 - Agitation or obtundation

Quickly Lethal Chest Trauma: Airway Obstruction

- Treatment (more detailed review is in the E.T.C. course section on airway)
 - Oxygen (high flow)
 - Airway opening maneuvers
 - Suction
 - Oropharyngeal or nasopharyngeal airway
 - Invasive airway management
 - Endotracheal intubation
 - Needle or surgical cricothyroidotomy
- These should be done as part of the primary survey

Quickly Lethal Chest Trauma: Tension Pneumothorax

➤ Signs:

- Respiratory distress
- Trachea deviated to opposite side
- Breath sounds decreased or absent on injured side
- Expansion or hyperinflation of injured side
- Tympanitic percussion on injured side
- Often neck veins distended

Emfizem subcutanat



Emfizem subcutanat



Emfizem subcutanat



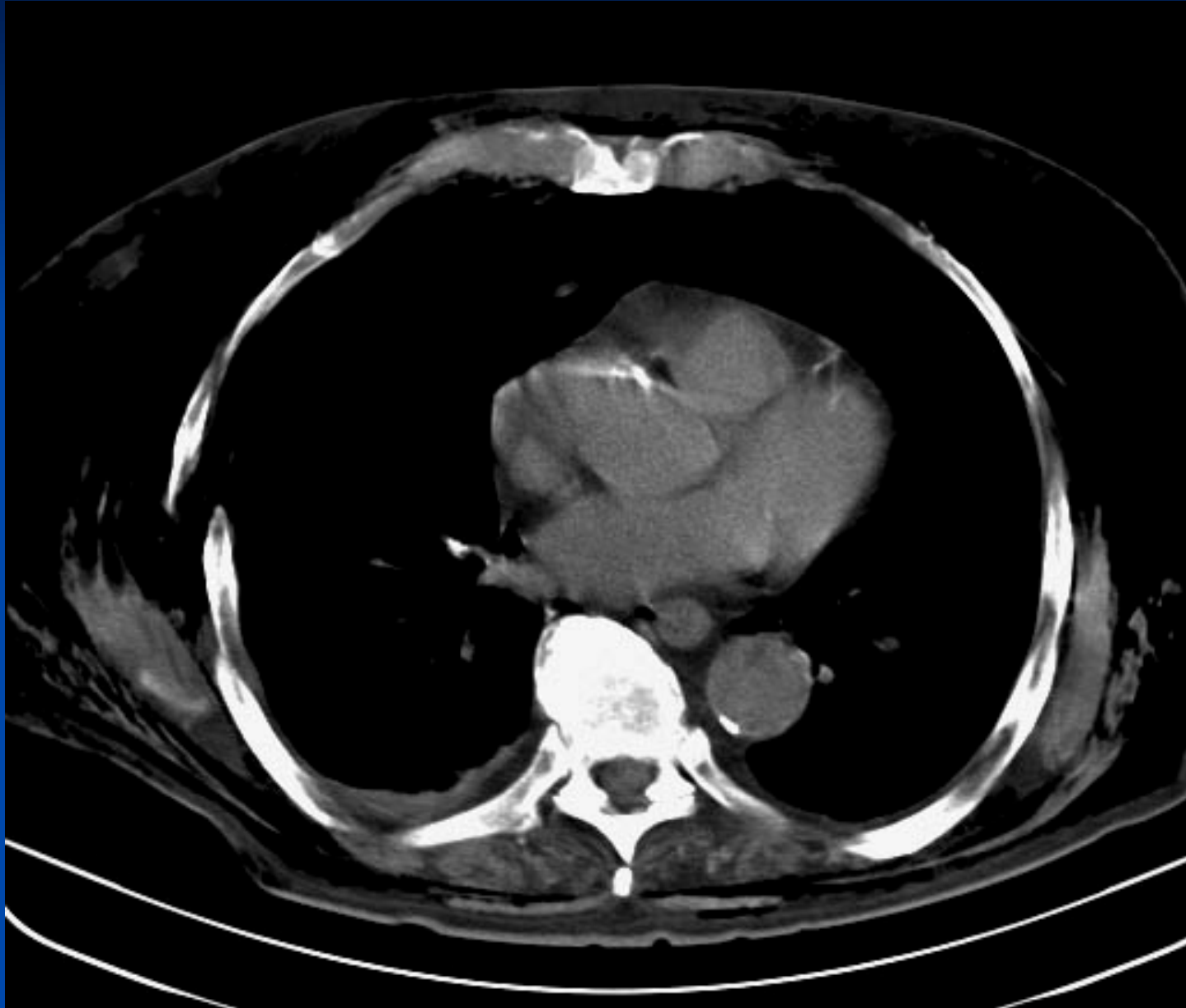
Emfizem subcutanat

Aspect radiologic

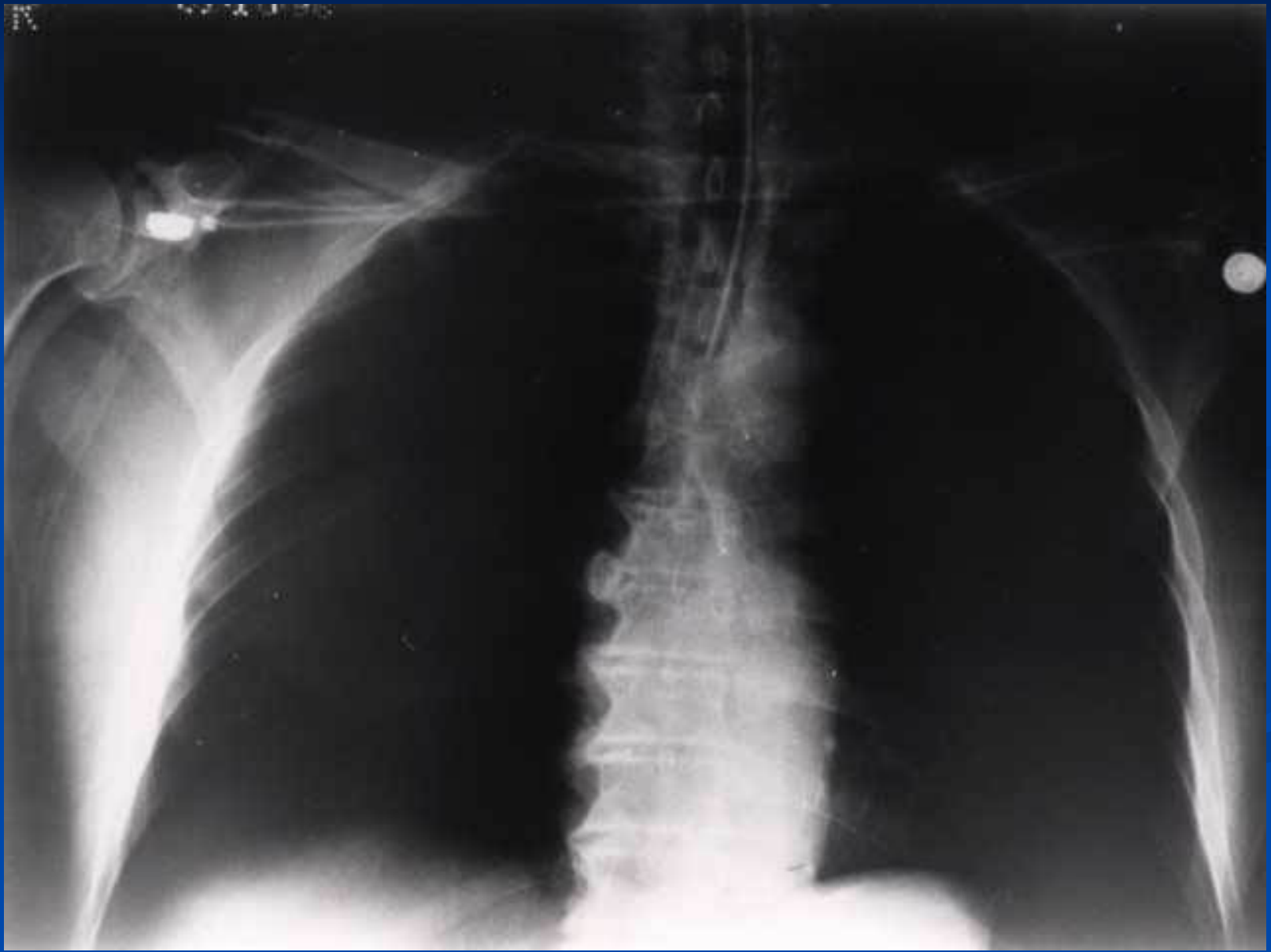


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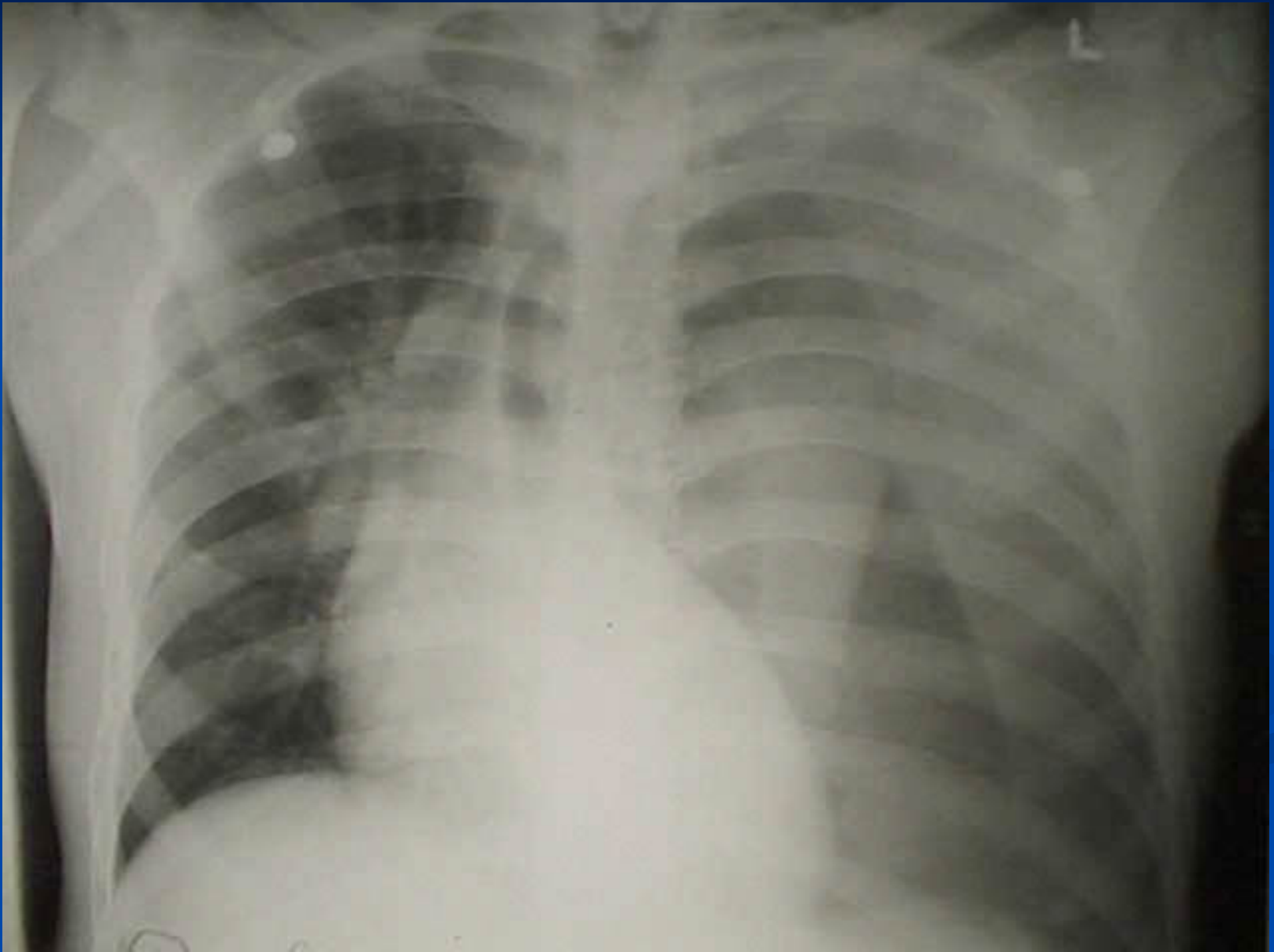
Imagine CT



Pneumotorace sufocant bilateral



Pneumotorace sufocant stâng



Pneumotorace sufocant stâng



Pneumothorax suffocant drept

Imagine CT



Pneumotorace sufocant drept

Imagine CT



Quickly Lethal Chest Trauma: Tension Pneumothorax

➤ Treatment:

- Do not wait for CXR confirmation
- Immediate decompression with 18 to 14 Gauge needle inserted in 2nd intercostal space in mid-clavicular line along upper edge of rib – allows air under pressure to escape to relieve the tension
- Should then insert thoracostomy tube to water seal

➤ Should do these as part of primary survey

Quickly Lethal Chest Trauma: Open Pneumothorax

- Occurs if open hole in chest wall is $> 2/3$ the diameter of the trachea (air flow via trachea is reduced)
- Treat by placing an occlusive dressing of vaseline gauze taped down to skin on 3 sides (if taped on 4 sides can lead to tension pneumothorax) allows vented air to escape
- Definitive treatment is surgical debridement and closure of the chest wall defect and concurrent tube thoracostomy

Pneumotorace deschis



Pneumotorace deschis



Traumatism toracic deschis cu
hernierea parenchimului pulmonar (stânga)
Contuzie pulmonară (dreapta)



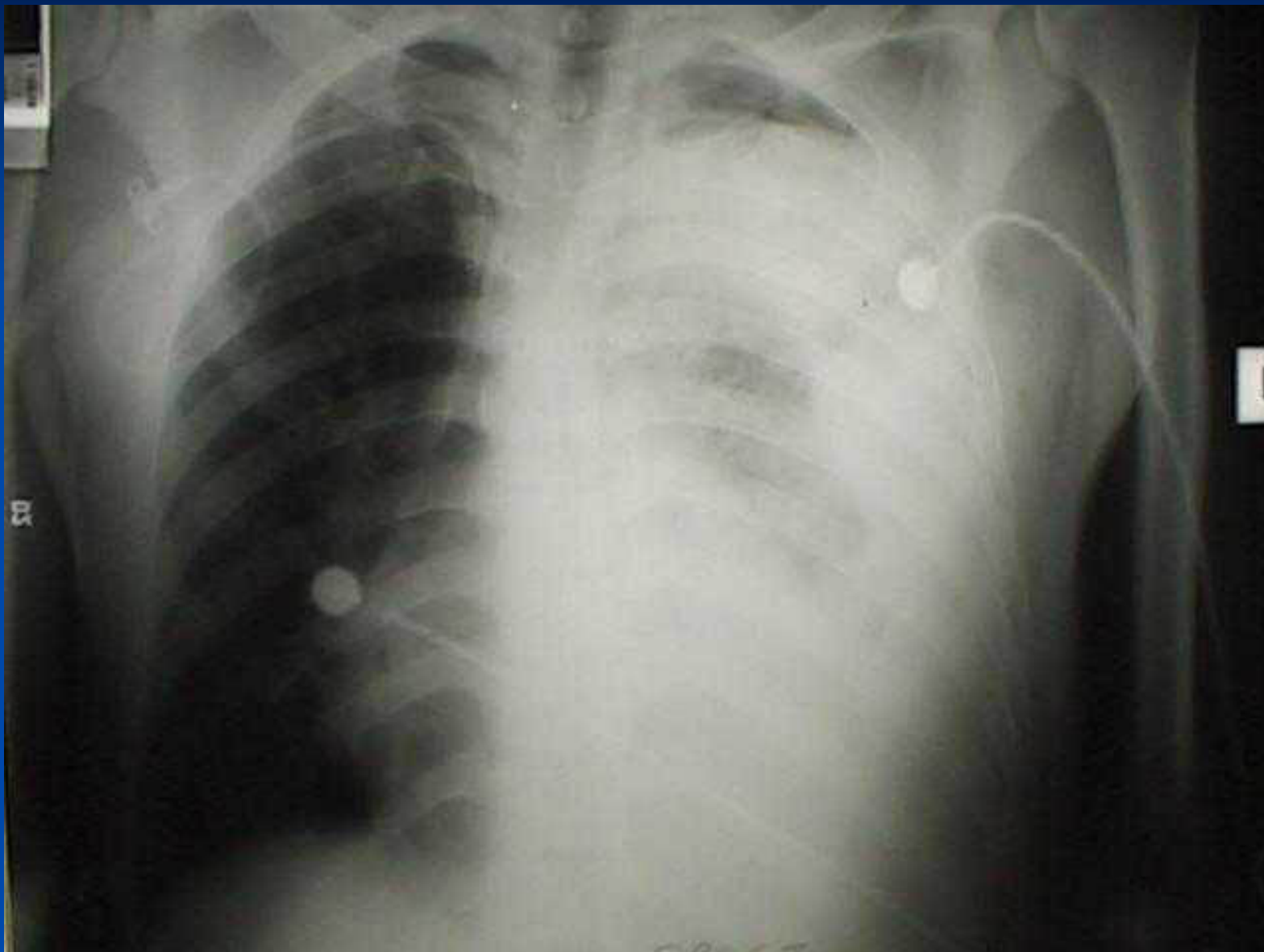
Traumatism toracic deschis cu
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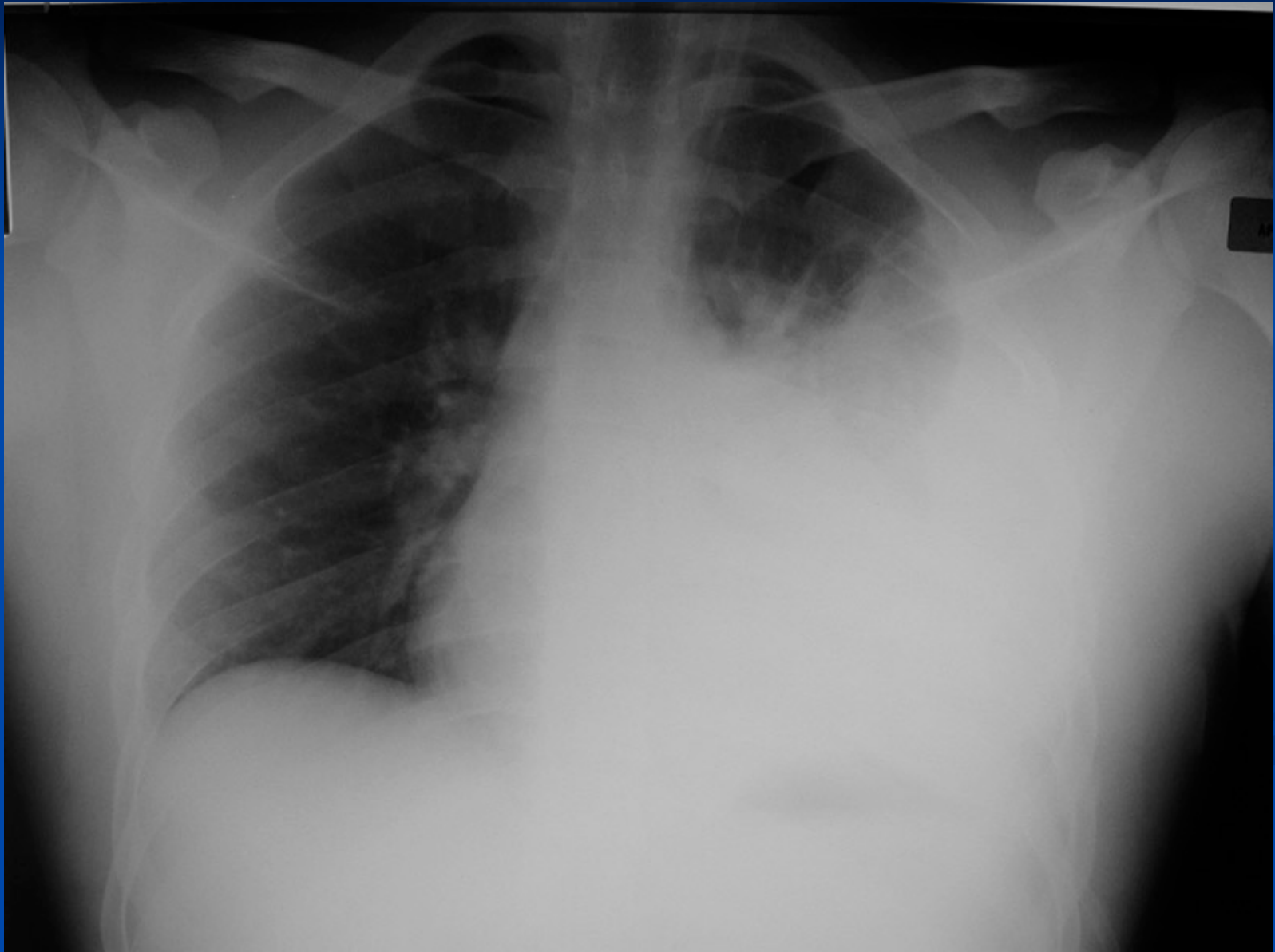
Quickly Lethal Chest Trauma: Open Pneumothorax

- Represents > 1500 cc blood in pleural cavity
- Signs:
 - Shock
 - Flat neck veins
 - Decreased breath sounds on injured side
 - Dullness to percussion on injured side

Hemotorace stâng masiv



Hemotorace stâng masiv



Hemotorace stâng masiv



Quickly Lethal Chest Trauma: Massive Hemothorax

➤ Treatment:

- Timing of chest tube placement is a tricky decision – if too early, bleeding point may untamponade and patient can exsanguinate
- Usually best to start to restore intravascular volume before chest tube placed
- Send type and cross and have blood ready
- Be ready to do thoracotomy
- “Cell saver” for autotransfusion may be very helpful.

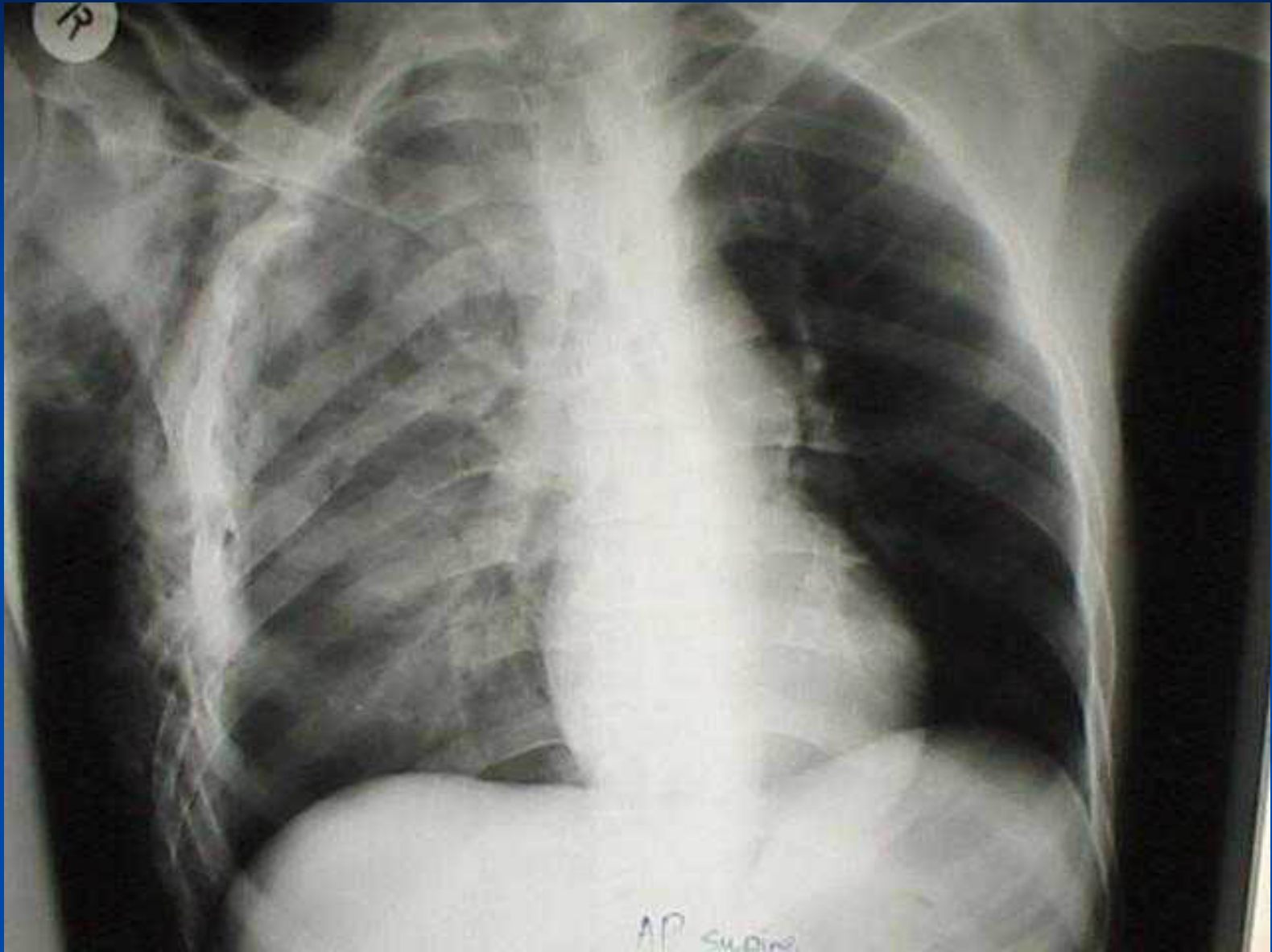
Hemotorace stâng

Radiografie efectuată în ortostatism



Hemotorace drept

Radiografie efectuată în clinostatism

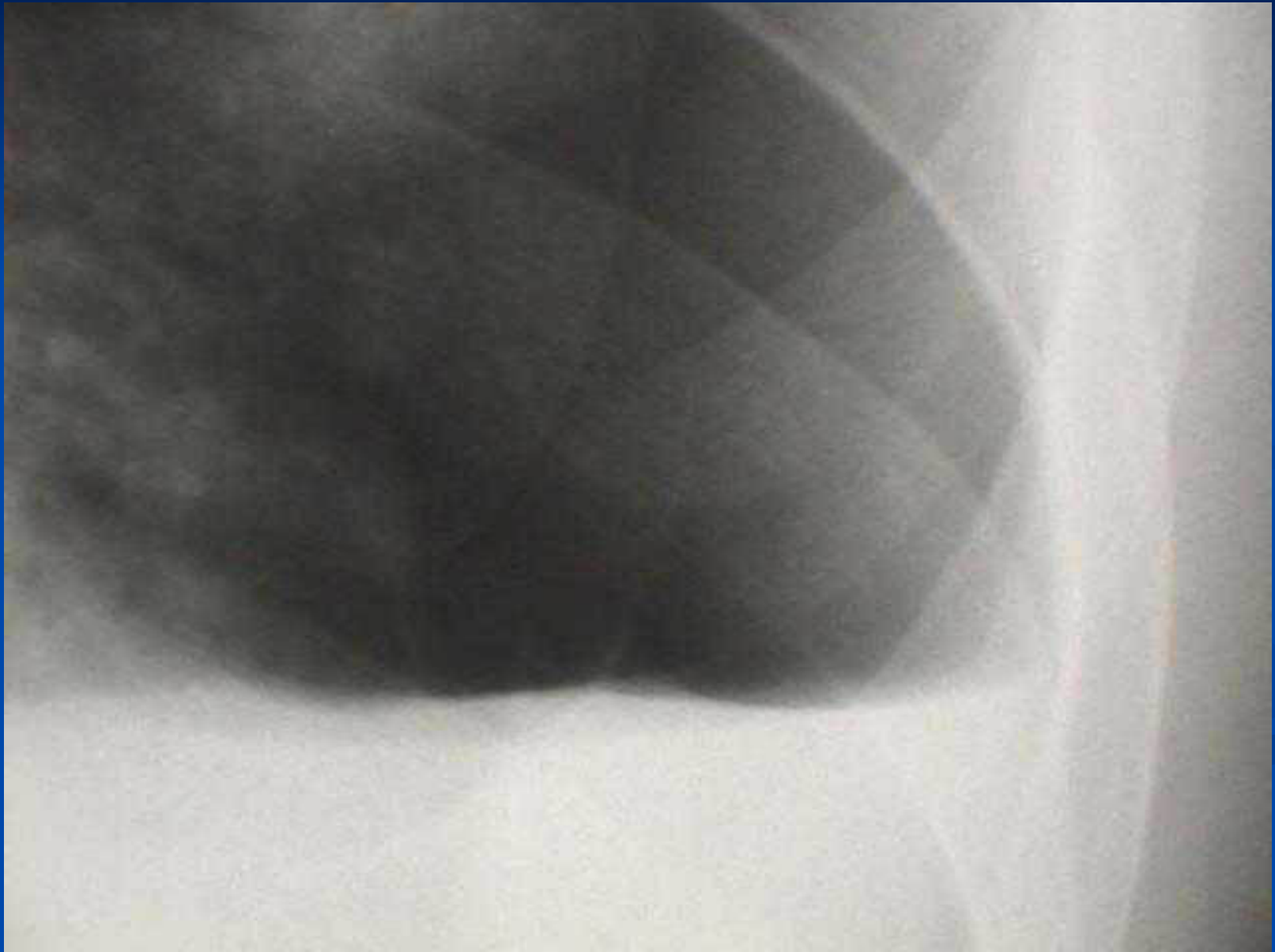


Hemo-pneumotorace stâng



Hemo-pneumotorace stâng

Detaliu



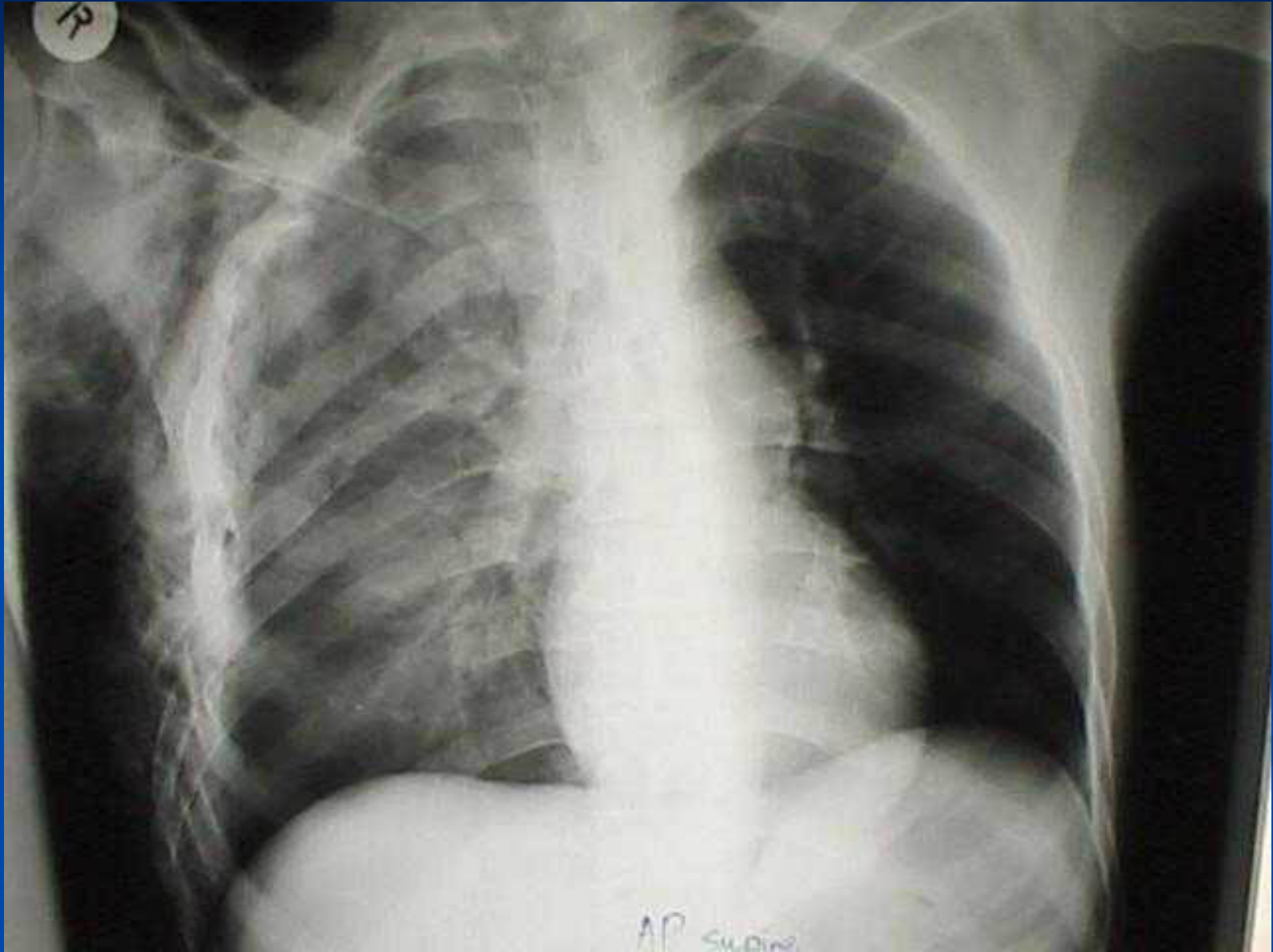
Quickly Lethal Chest Trauma: Flail Chest

- Occurs if ≥ 3 ribs are fractured in 2 or more places
- Results in a “free-floating” section of chest wall and paradoxical respiratory phase movement of the flail segment, contributing to ventilatory insufficiency
- Underlying pulmonary contusion is often present
- Very seldom requires any type of surgical therapy

Fracturi costale multiple
Volet costal drept



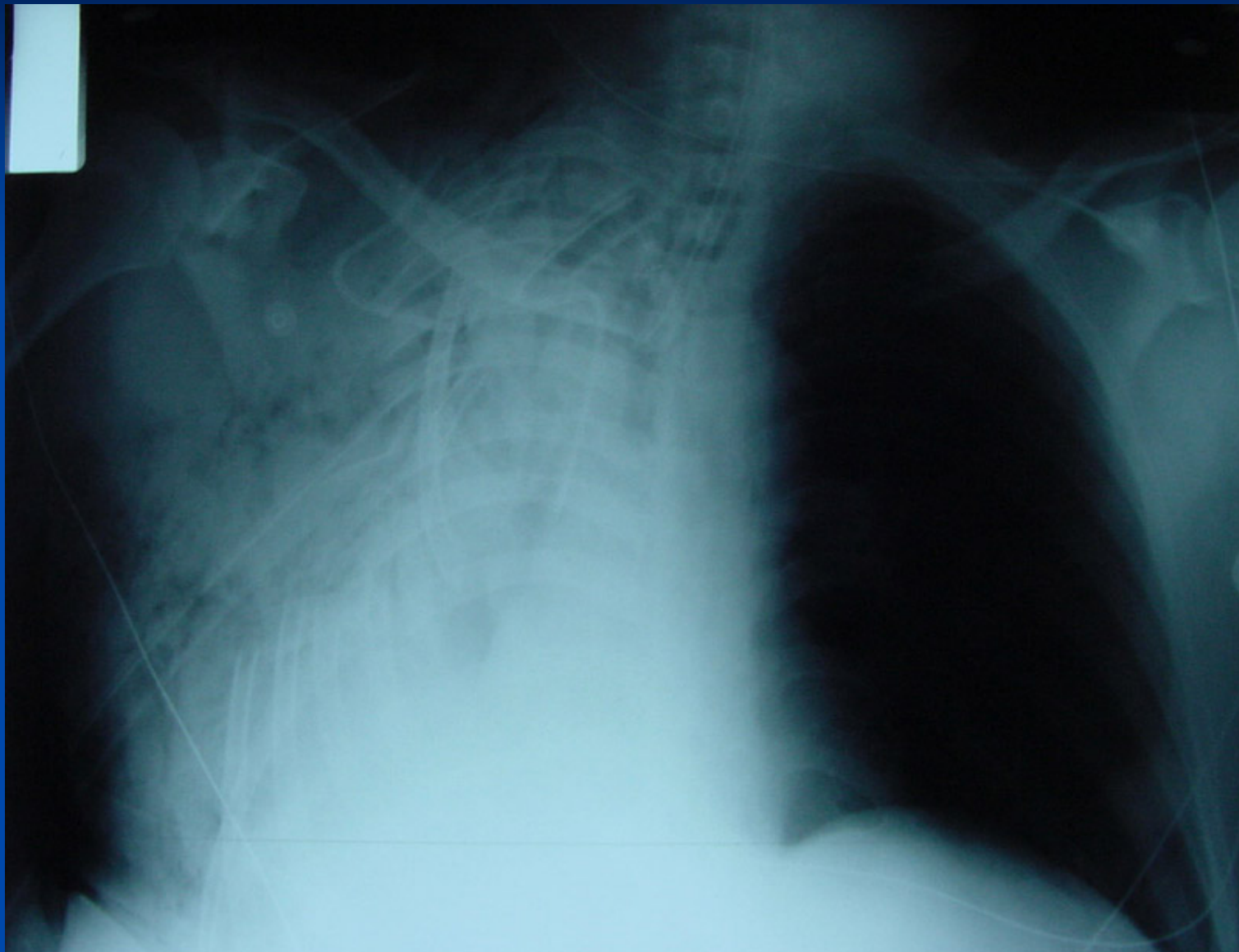
Fracturi costale multiple
Volet costal și hemotorace drept



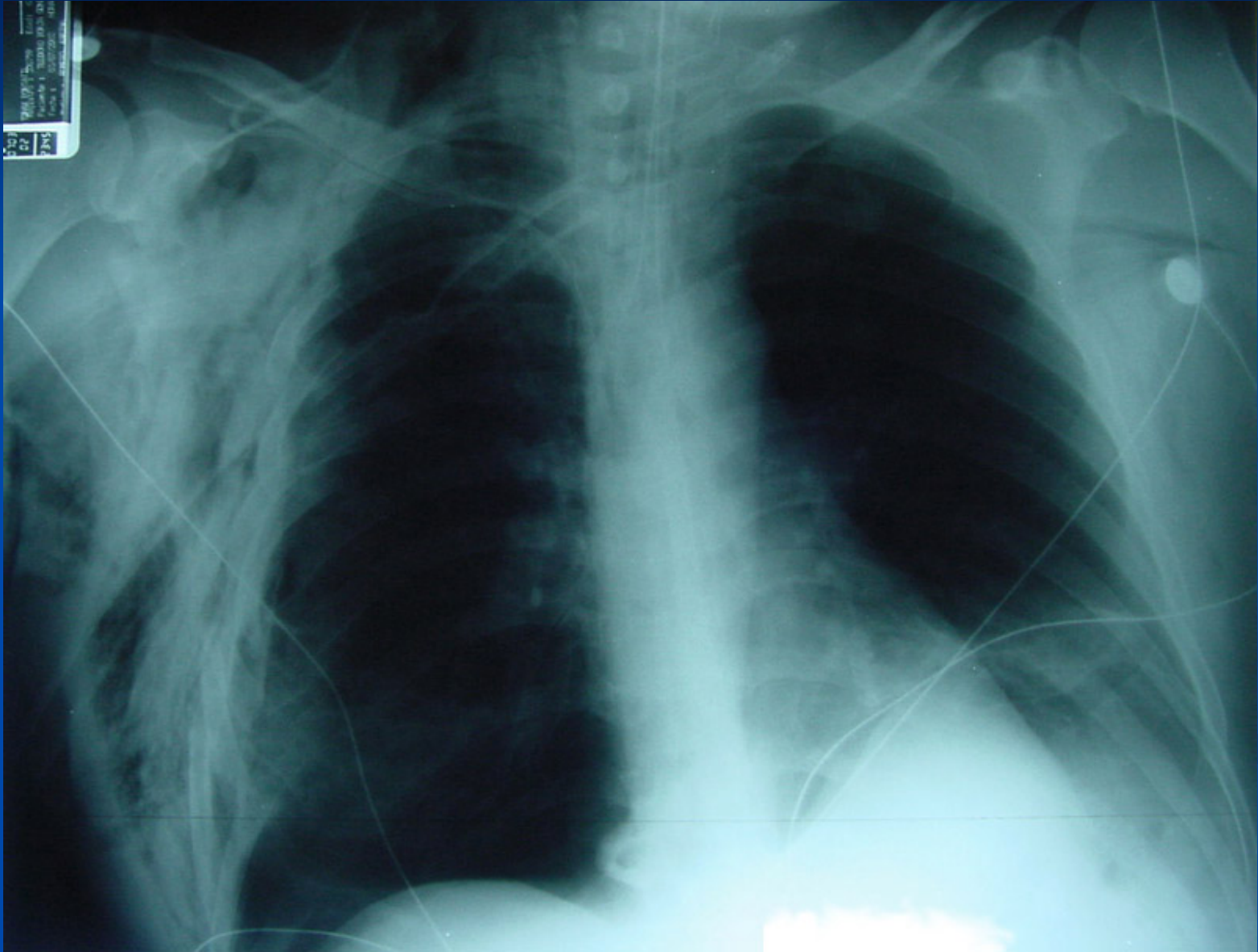
Quickly Lethal Chest Trauma: Flail Chest

- Often can treat this “conservatively” with broad taping of the flail segment, oxygen, fluid restriction, suction, intercostal blocks
- Consider early treatment with intubation, mechanical ventilation \pm PEEP if:
 - Age > 65 years
 - Other major injuries present
 - PCO₂ elevated (> 44 mmHg)
 - PO₂ decreased (<60 on 40% O₂ by FM)
 - Subjective respiratory distress or increased respiratory rate
 - Pre-existent COPD

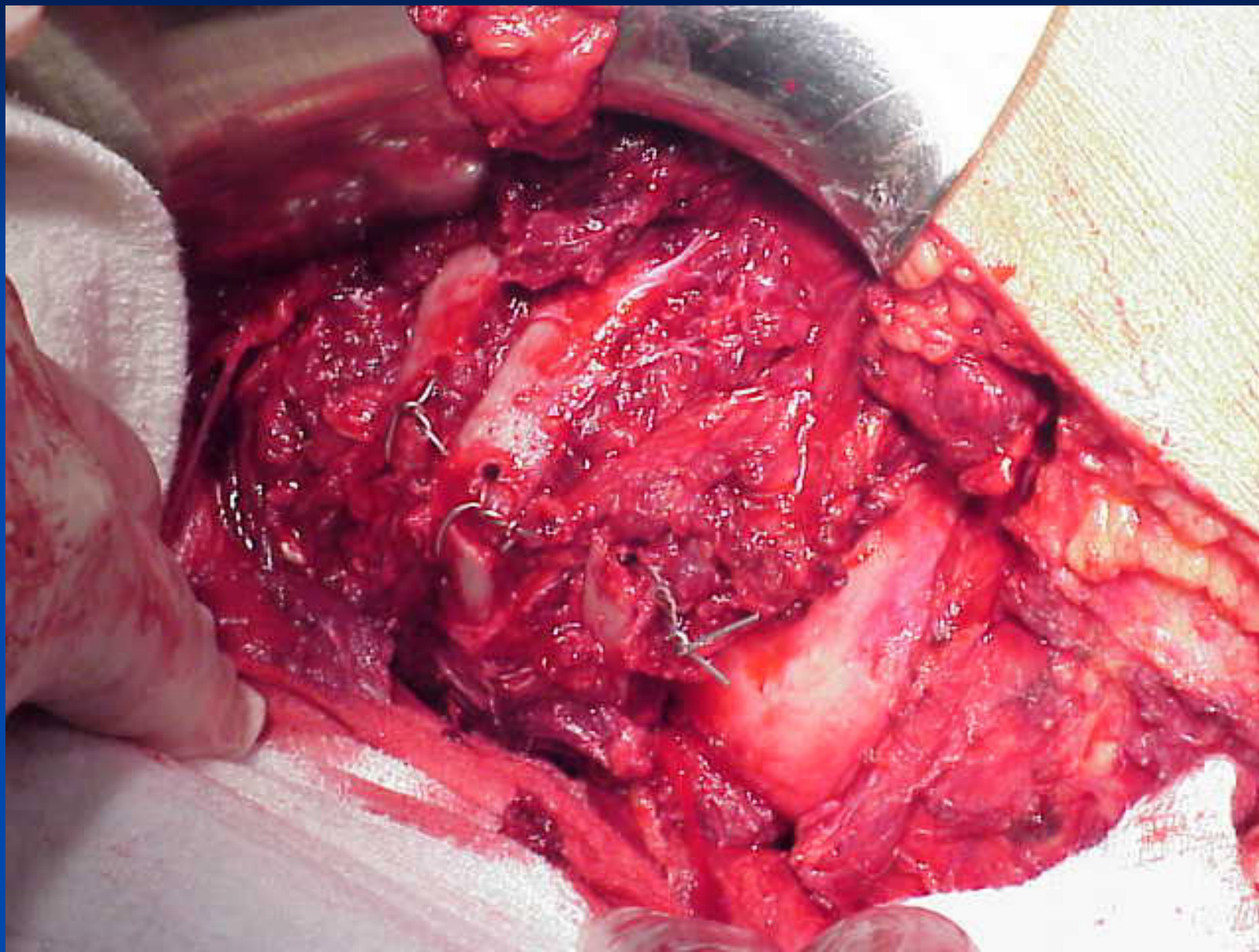
Hemitorace drept strivit
Fracturi costale multiple
Volet costal și hemotorace drept



Hemitorace drept strivit - după ventilație -

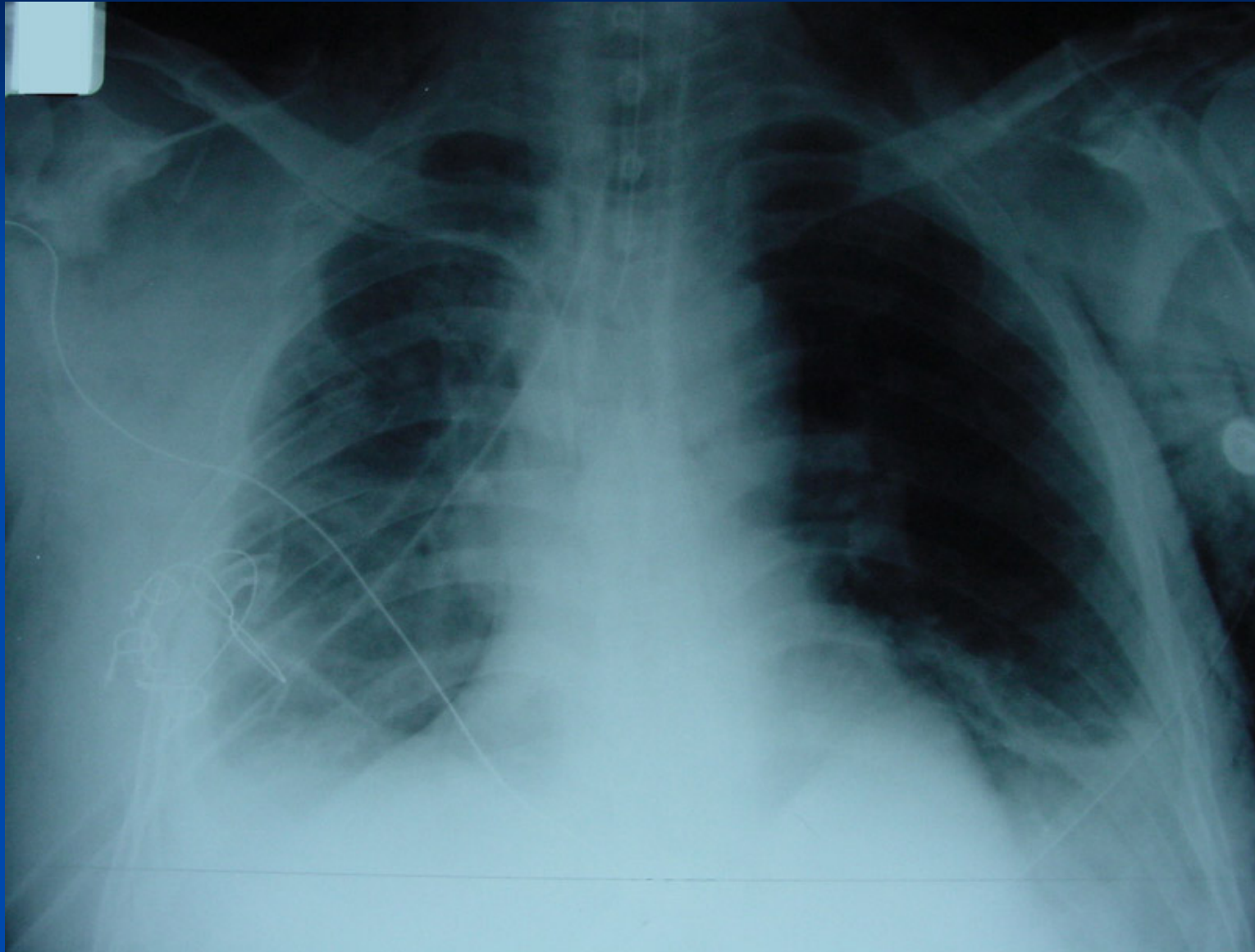


Hemitorace drept strivit Stabilizare internă chirurgicală



Hemitorace drept strivit

- după stabilizare chirurgicală internă -



Quickly Lethal Chest Trauma: Cardiac Tamponade

- Diagnose by Beck's Triad:
 - Hypotension
 - Distended neck veins (JVD)
 - Muffled heart tones
- Note: Tension pneumothorax and cardiac tamponade are the only acute traumatic causes of shock with distended neck veins

Quickly Lethal Chest Trauma: Cardiac Tamponade

■ Treatment:

- Nonsurgical measures can be used to temporize most patients till a chest surgeon is available
- IV fluids – push CVP to 18 to 20 cmH₂O
- Sometimes dopamine drip (2 to 10 µg/Kg/min.) helpful
- Consider needle pericardiocentesis (risk of coronary artery or ventricular wall injury)
- Consider subxiphoid pericardial window under local anesthesia
- Thoracotomy and repair of cardiac injury is definitive Rx

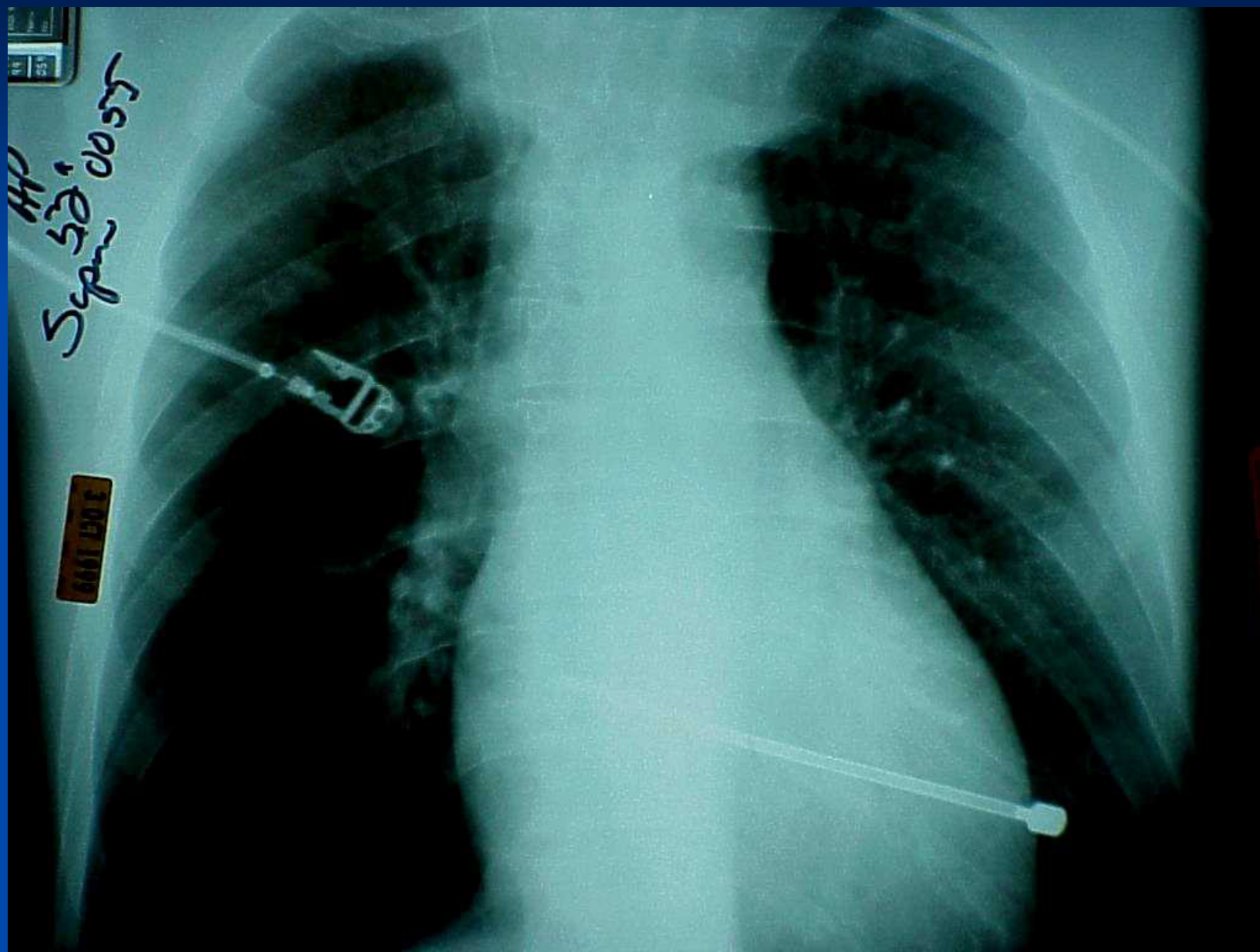
Plagă penetrantă în regiunea precordială



Plagă penetrantă în regiunea precordială



Corp ascuțit penetrat în regiunea precordială

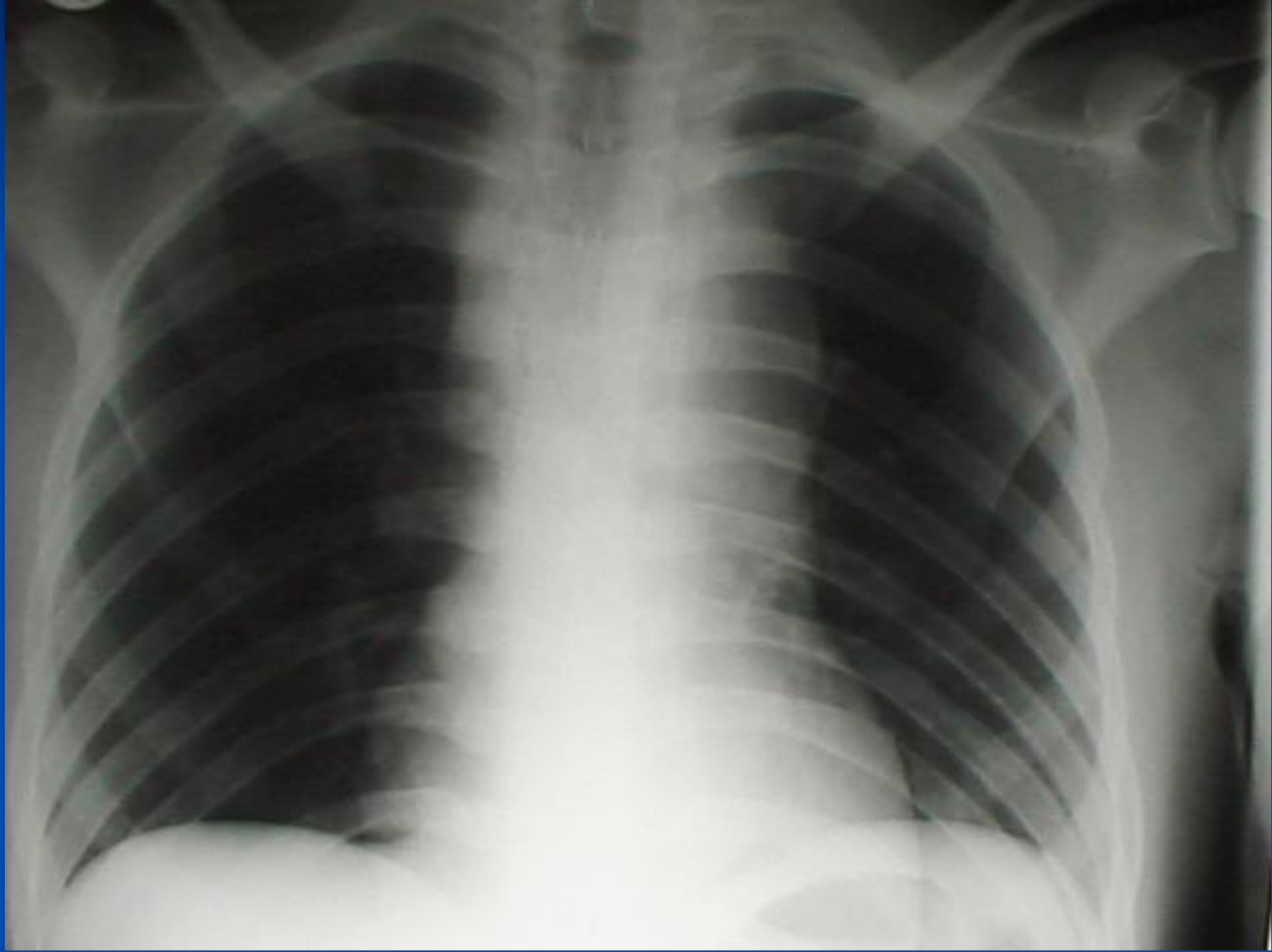


Potentially Lethal Chest Injuries:

Aortic Disruption (Rupture)

- Major cause of death from MVA's or falls from a height
- CXR signs:
 - Wide mediastinum (> 8 cm on AP view at level of aortic knob)
 - Blurring or obliteration of aortic knob
 - Left pleural cap \pm left pleural effusion
 - Deviation of trachea or NG tube to right
 - Depression of left mainstem bronchus
 - Separation of calcified aortic plaque from aortic edge > 3 to 5 mm
- Other signs:
 - Pulse deficit or BP difference between arms
 - Paraplegia
 - Lower extremity hypotension

Mediastin lărgit

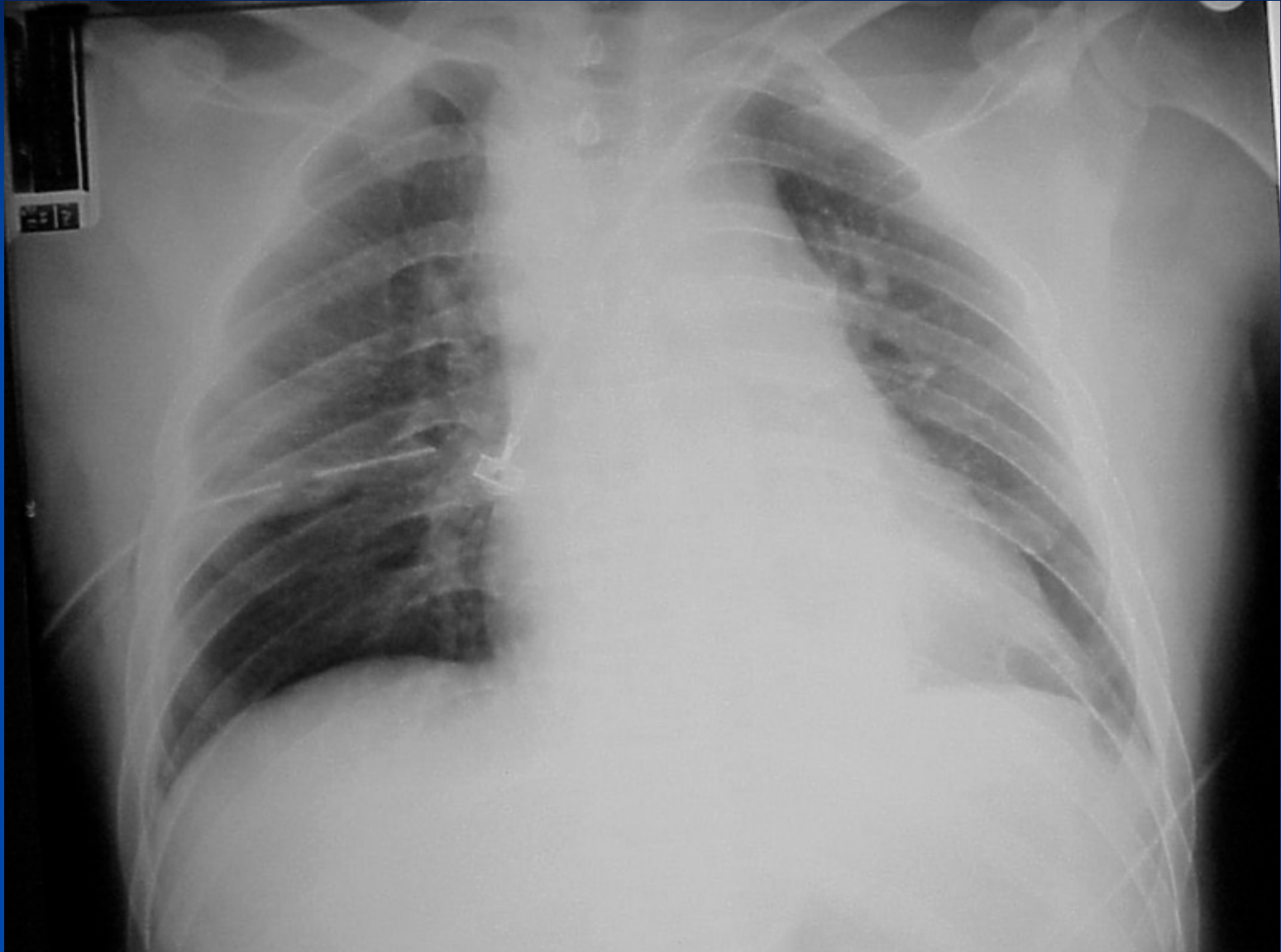


Aortogramă

Leziune la nivelul istmului aortic

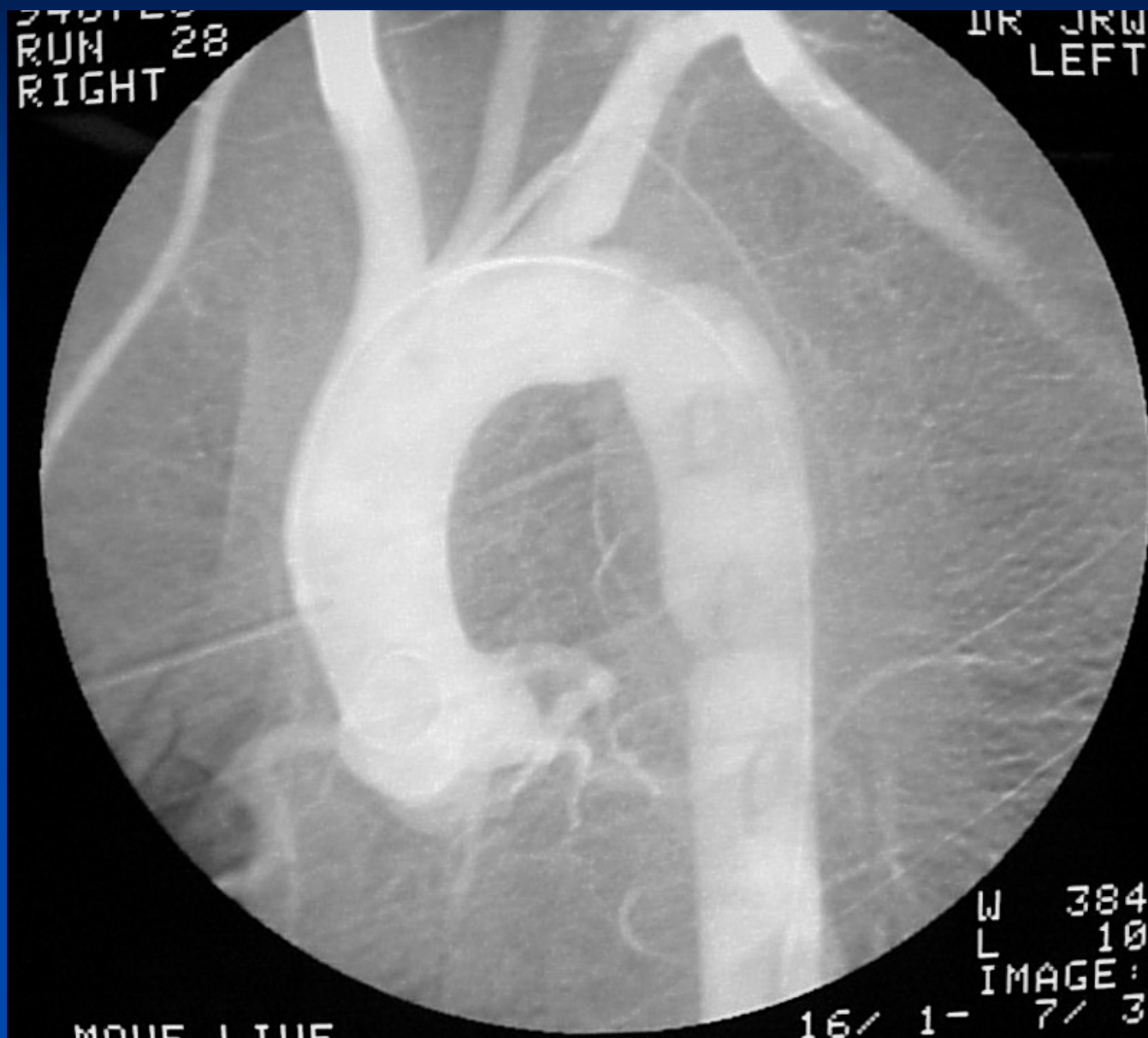


Mediastin lărgit

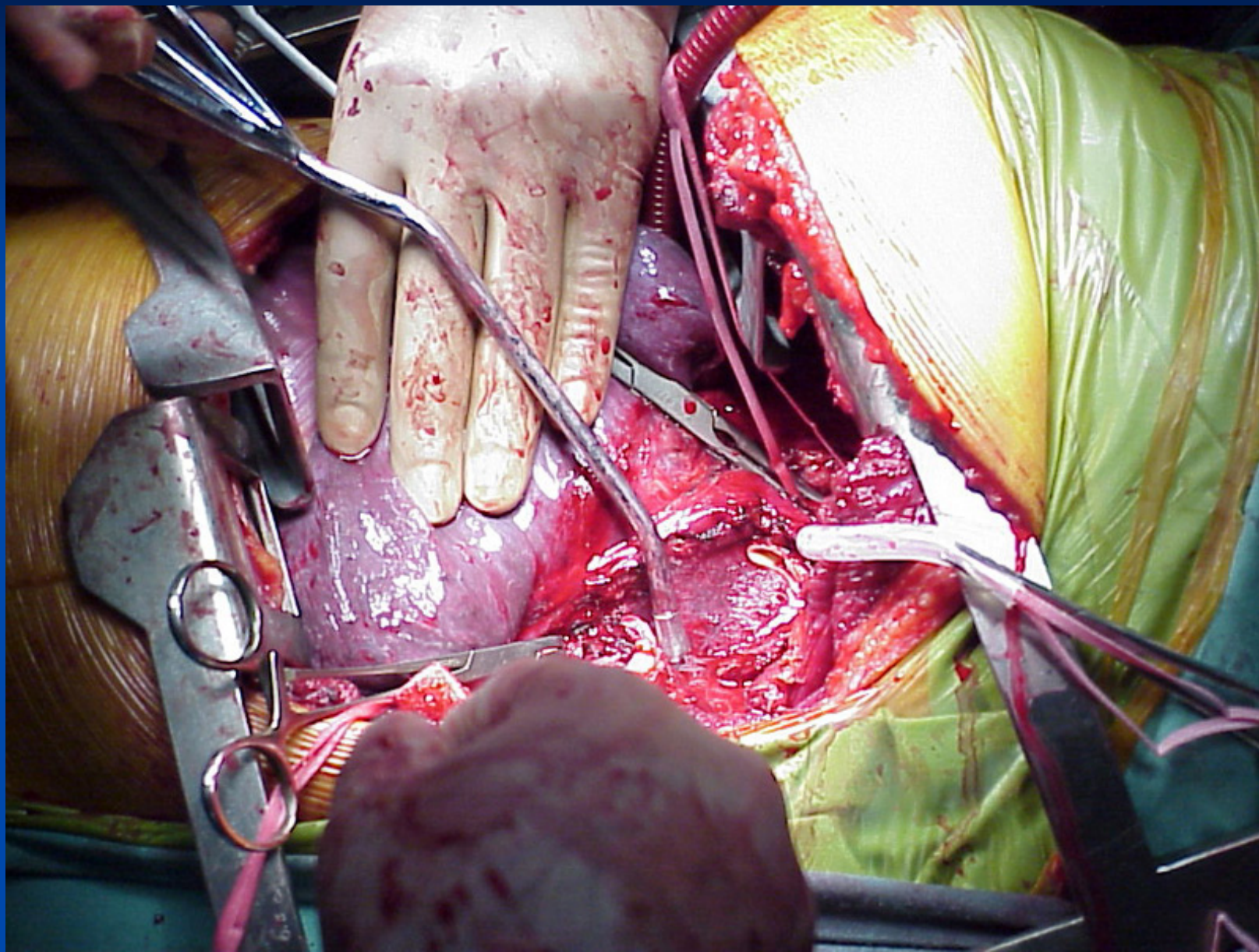


Aortogramă

Leziune situată distal de emergența arterei subclavii stângi



Aortă clampată
Segment lezat excizat



Potentially Lethal Chest Injuries:

Aortic Disruption

■ Sites of rupture:

- 80 to 90% just distal to takeoff of left subclavian (at ligamentum arteriosum)
- Remainder are at aortic root or diaphragm

■ Confirm diagnosis:

- Angiography is “gold standard”
- Recent reports indicate transesophageal echocardiography (TEE) is highly accurate (but is operator dependent)
- Computed tomography of chest may miss up to 30%

Potentially Lethal Chest Injuries:

Aortic Disruption

■ Treatment:

- Avoid “over-resuscitation” and hypertension (more likely to uncontrollably rupture if $BP > 140/90$)
- Type and cross for at least 10 units of blood
- To OR emergently for surgical repair (usually synthetic graft interposition required)
 - Only pre-emptive surgery is laparotomy for active bleeding in abdomen – then do thoracotomy and aortic repair after laparotomy

Potentially Lethal Chest Injuries:

Pulmonary Contusion

➤ Signs:

- Hemoptysis
- Decreased breath sounds
- Dullness on percussion
- Respiratory distress
- Hypoxemia
- Infiltrate on CXR

➤ Often associated with rib fractures

Contuzie pulmonară stângă



Contuzie pulmonară dreaptă

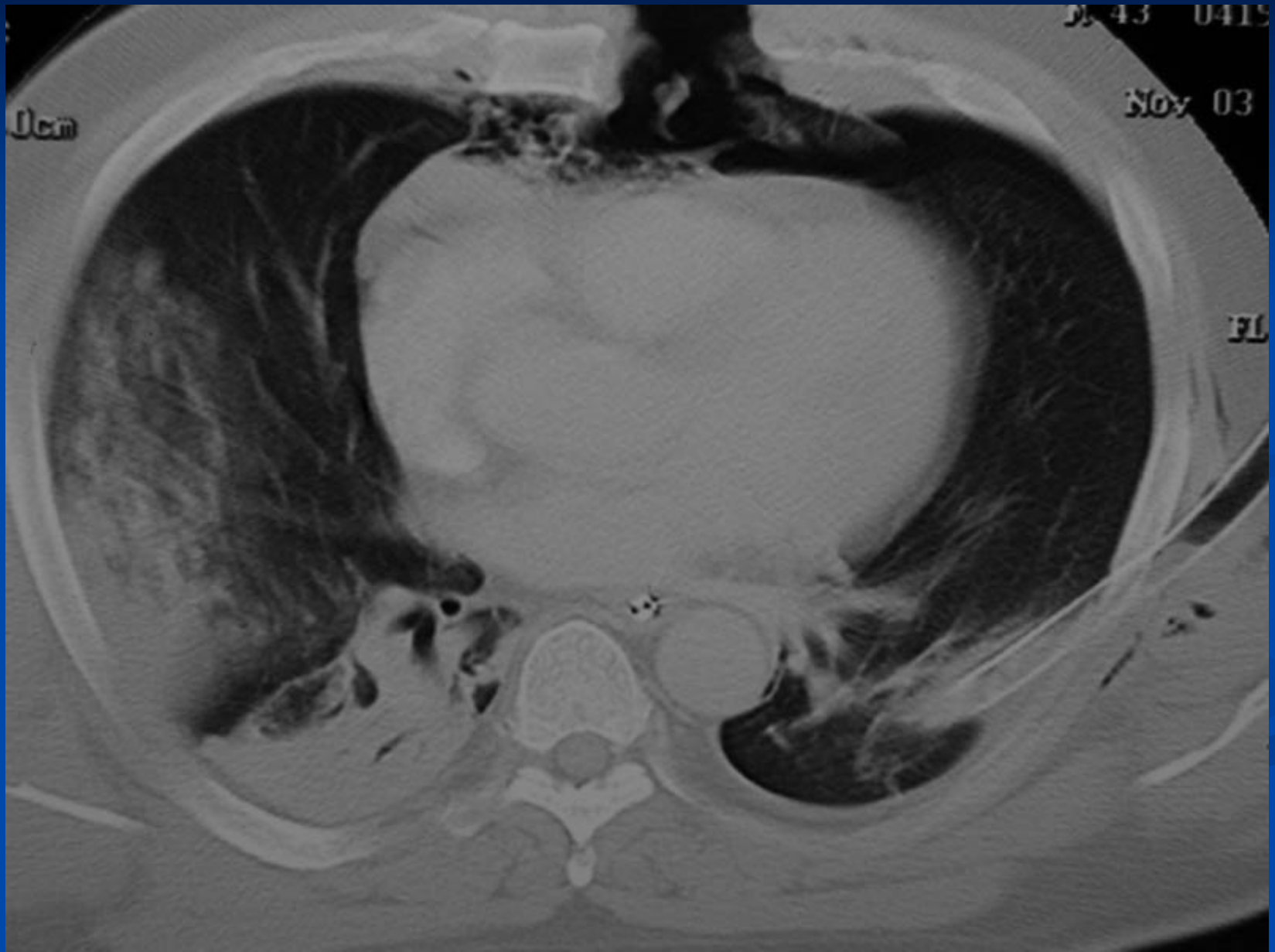


Contuzie pulmonară dreaptă

Imagine CT



Contuzie pulmonară dreaptă Imagine CT



Potentially Lethal Chest Injuries: Pulmonary Contusion

■ Treatment

- Oxygen
- Pulmonary toilet
- Restrict fluids
- Bronchodilators only if wheezing

■ Steroids contraindicated

■ Antibiotics not helpful initially

■ Follow with daily serial CXRs \pm ABGs \pm PFTs

Potentially Lethal Chest Injuries:

Tracheobronchial Disruption

- Due to major laceration in trachea or bronchus
- Diagnose by large air leak in chest tube
 - Often even a second chest tube cannot overcome the air leak and allow reexpansion of the lung
 - Often have very large amount of subcutaneous air
- Treatment
 - 2nd chest tube to suction
 - ± selective endobronchial intubation (Carlens tube)
 - To OR emergently for bronchoscopy + thoracotomy + surgical repair

Ruptură de trahee



Ruptură de trahee



Potentially Lethal Chest Injuries: Esophageal Disruption (Rupture)

- Most common with penetrating injury but can occur from blunt trauma
- Signs
 - Dysphagia
 - Deep chest pain
 - Subcutaneous \pm mediastinal air
 - Pneumothorax \pm pleural effusion
 - Cloudy fluid or high amylase in fluid from chest tube

Perforație esofagiană Pneumomediastin



Potentially Lethal Chest Injuries: Esophageal Disruption (Rupture)

■ If suspected:

- Gastrografin swallow or esophagoscopy
- Place chest tube as soon as possible to control drainage

■ If confirmed:

- To OR emergently for repair or esophageal diversion

Potentially Lethal Chest Injuries: Diaphragmatic Disruption (Rupture)

- Risk is herniation of abdominal viscera into chest with strangulation
- Also can result in lung compression and ventilatory compromise from viscera in chest
- If initially missed can present with complications even years later

Potentially Lethal Chest Injuries: Diaphragmatic Disruption (Rupture)

■ Suspect the diagnosis if

- CXR shows elevation or indistinctness of one hemidiaphragm
- CXR may show dense basilar infiltrate

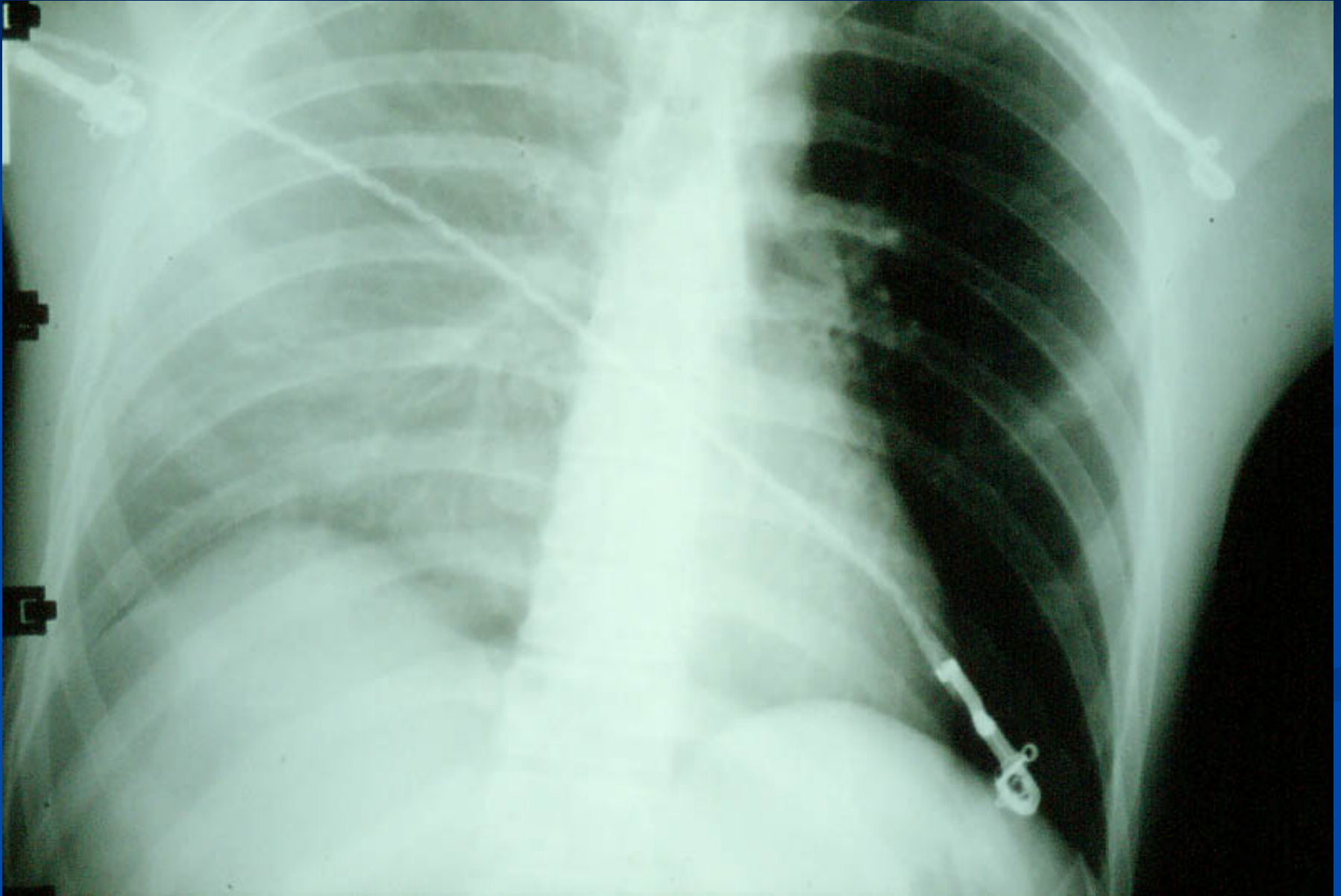
■ Diagnosis confirmed by:

- CXR showing bowel, stomach, or NG tube in chest
- Peritoneal lavage fluid exiting from chest tube
- Computed tomography of lower chest
- Sometimes need gastrografin UG

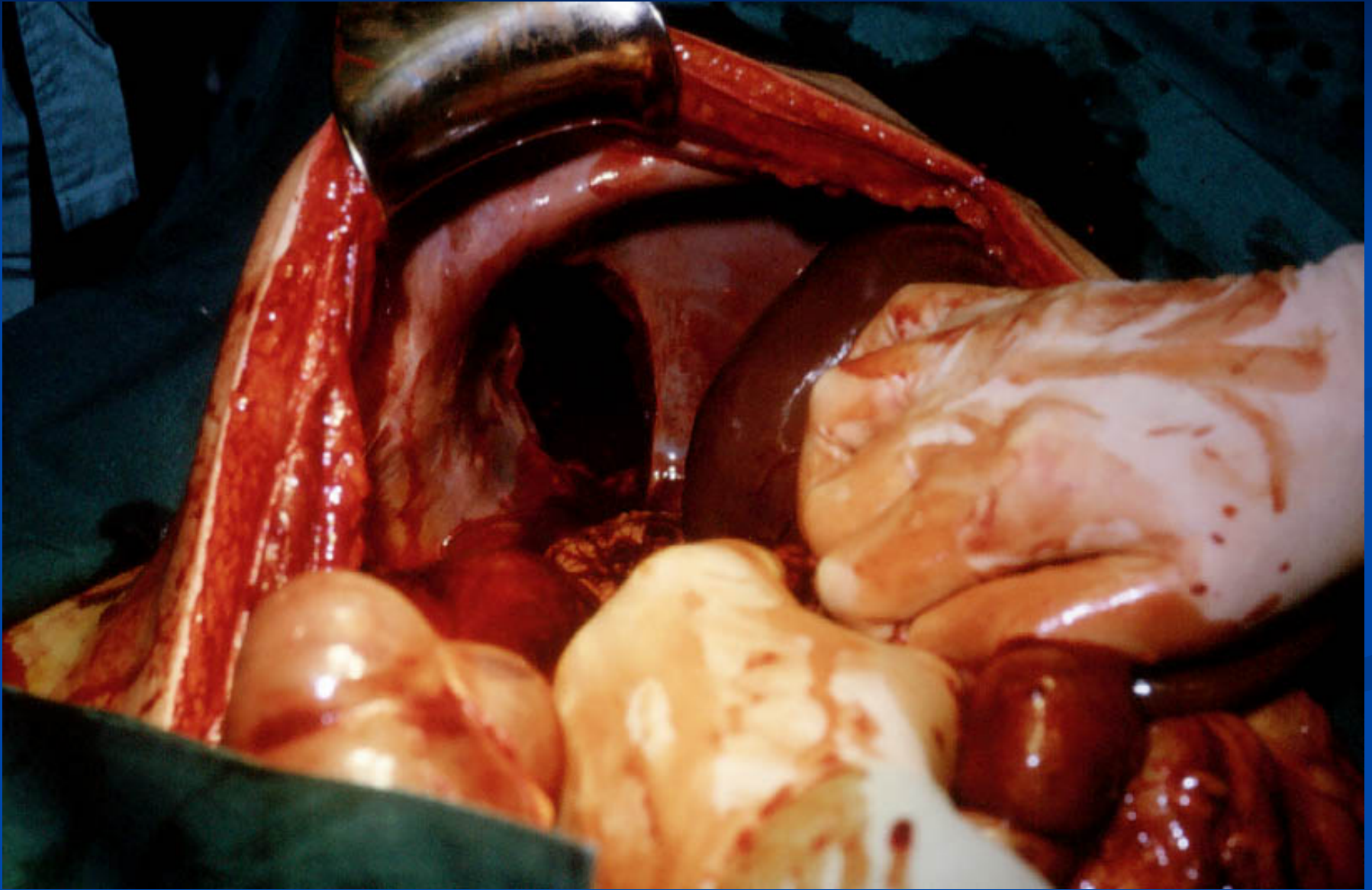
■ Treatment:

- To OR for laparotomy for repair
- NG tube preop to decompress stomach

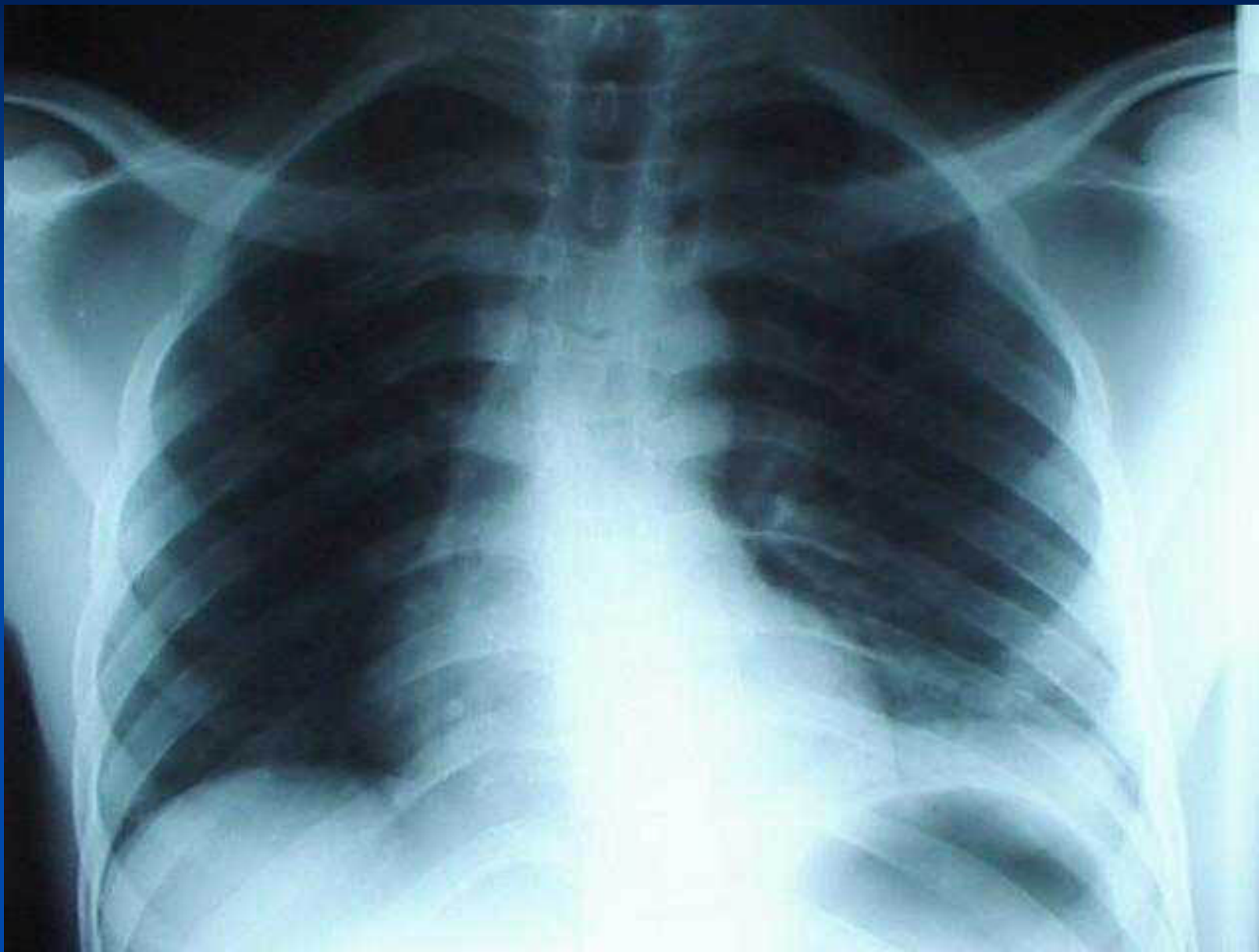
Leziune de hemidiafragm drept



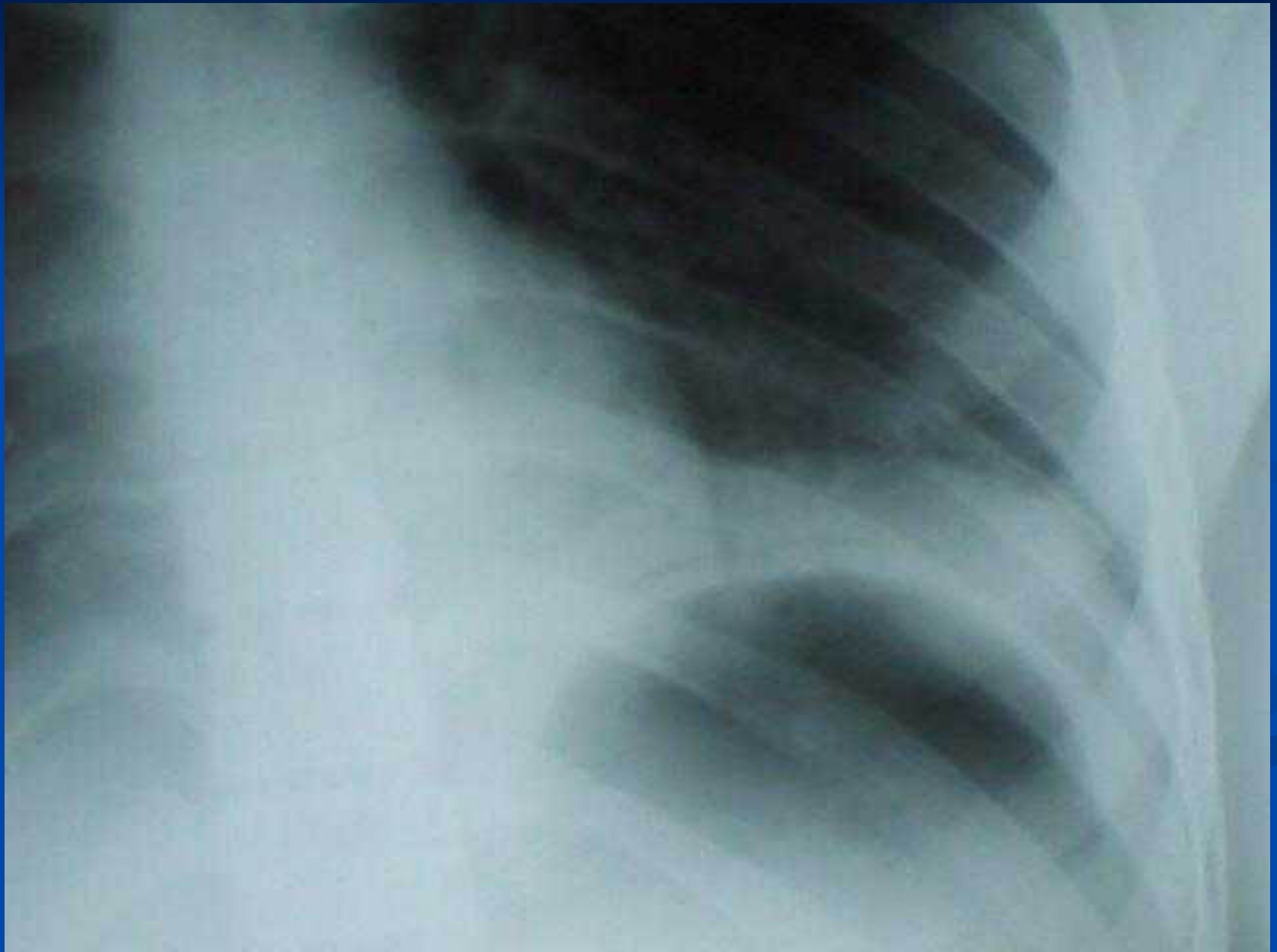
Leziune de hemidiafragm drept



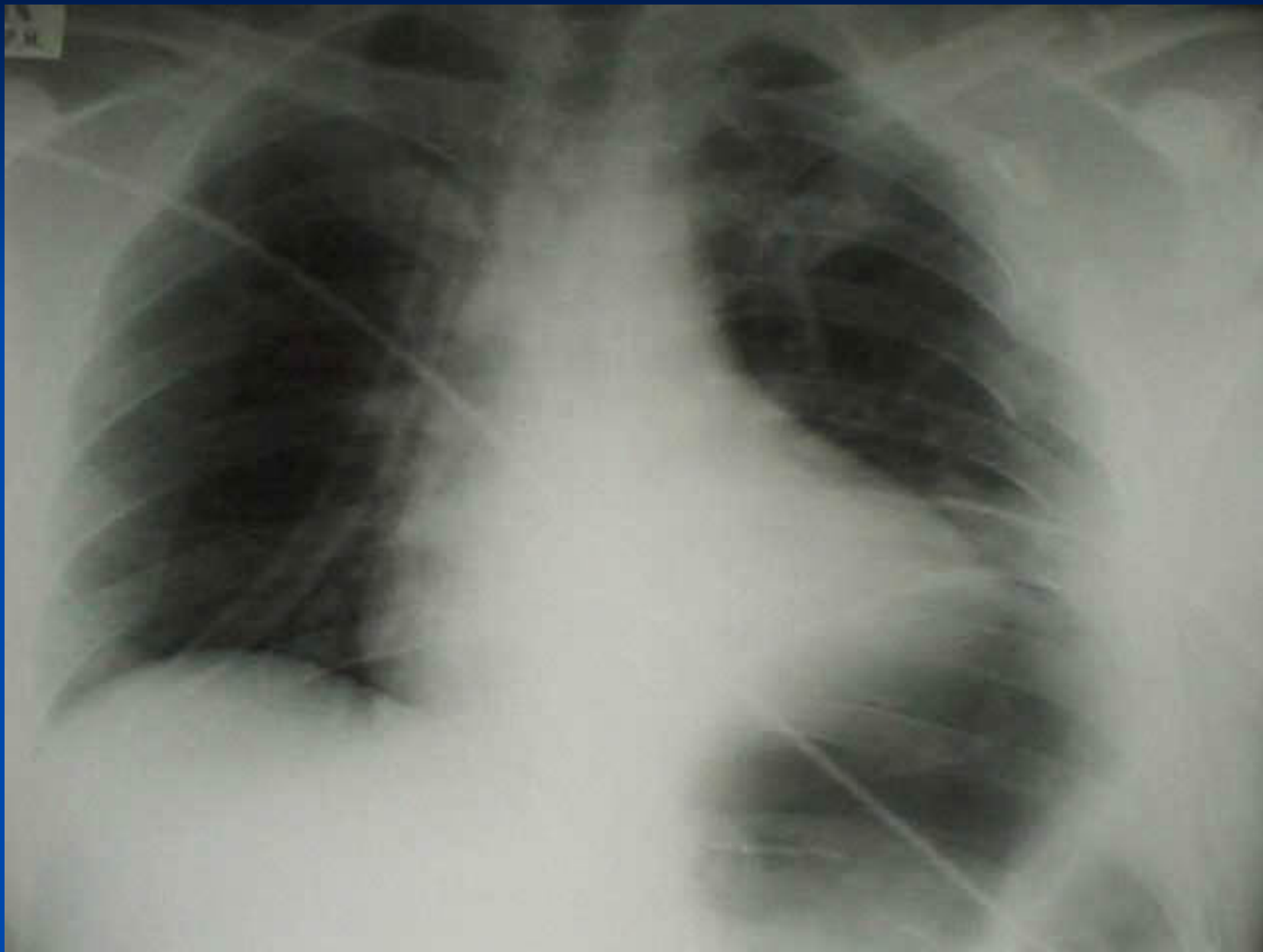
Leziune de hemidiafragm stâng



Leziune de hemidiafragm stâng



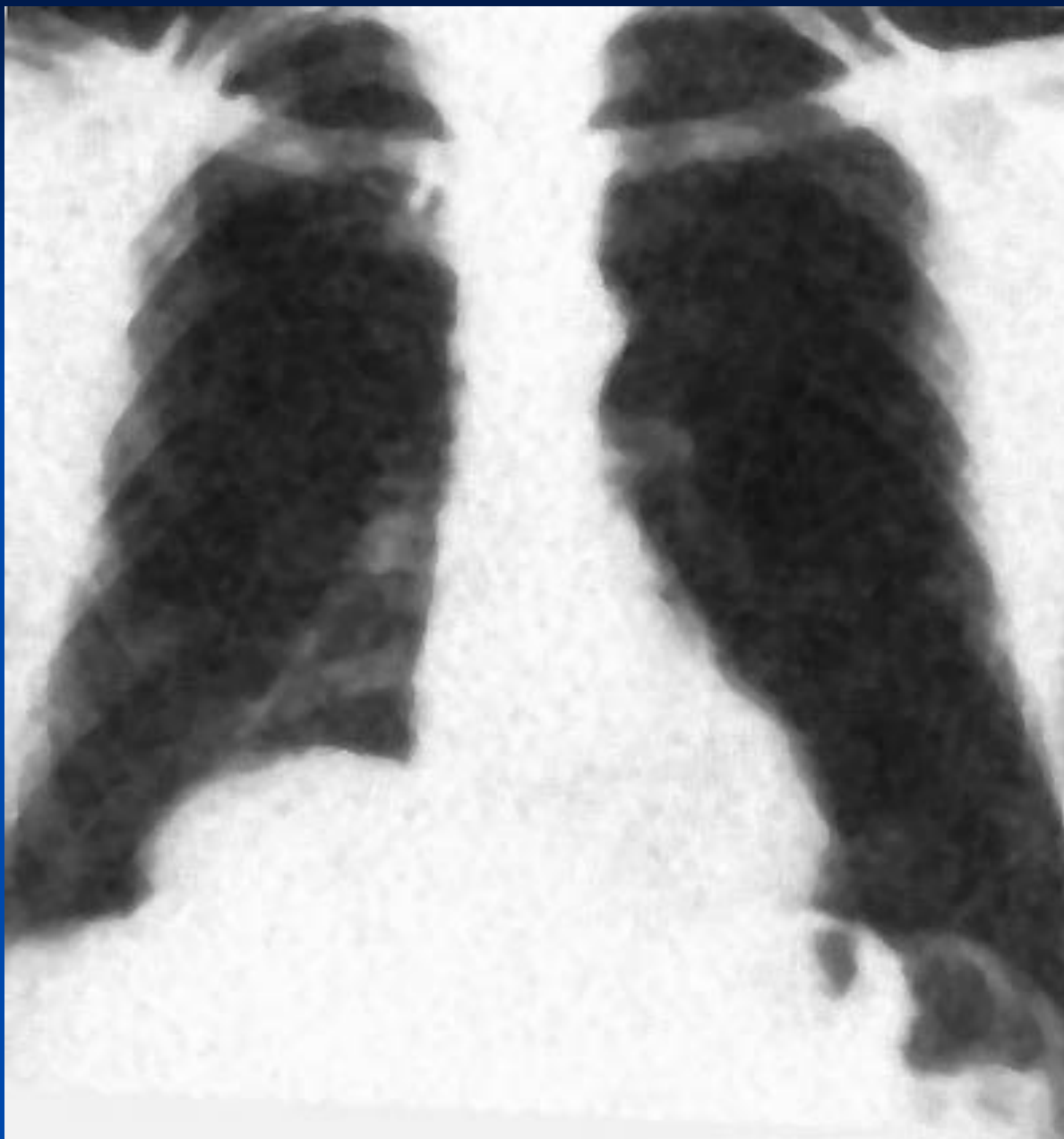
Leziune de hemidiafragm stâng



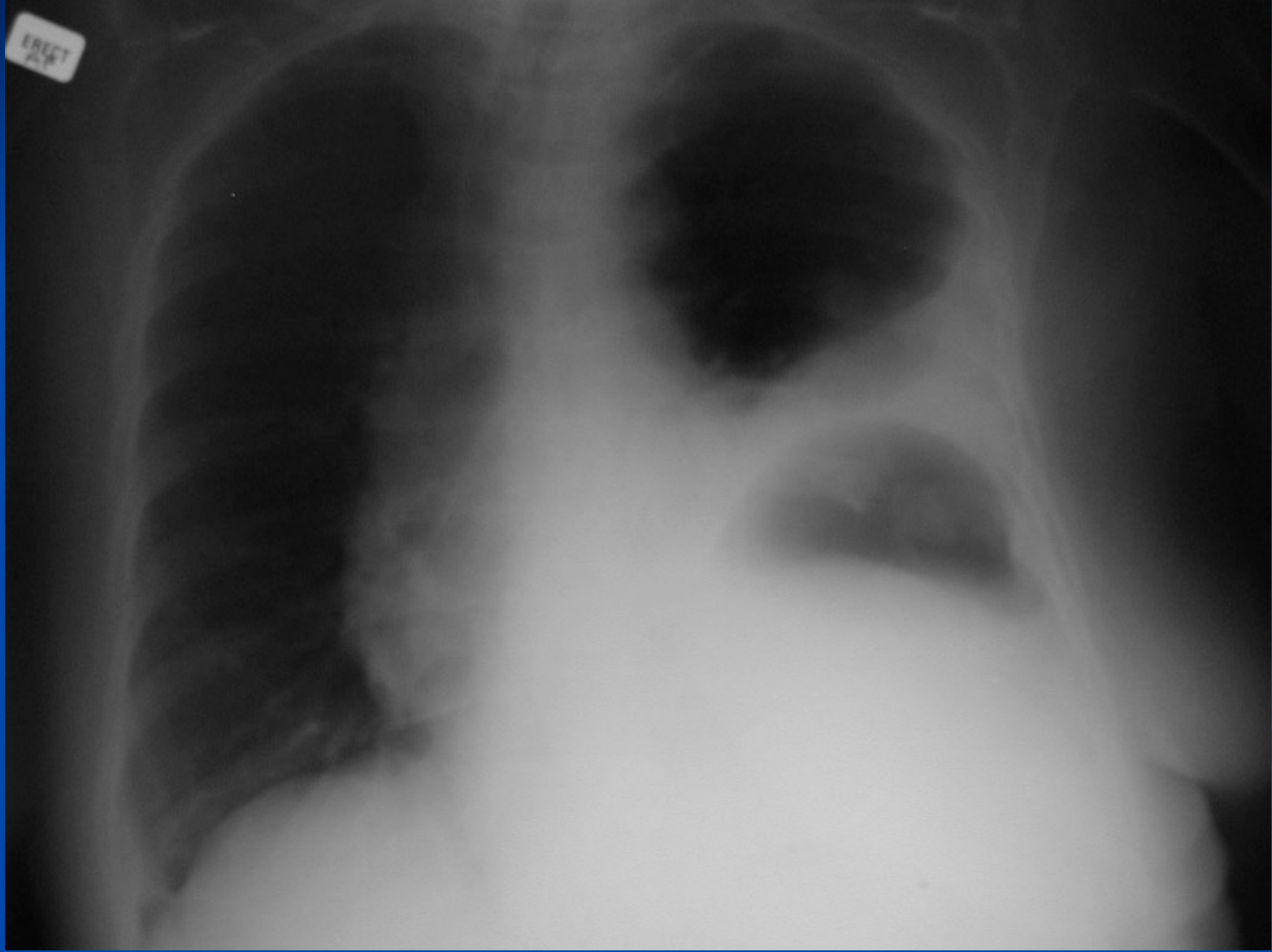
Leziune de hemidiafragm stâng



Leziune de hemidiafragm drept

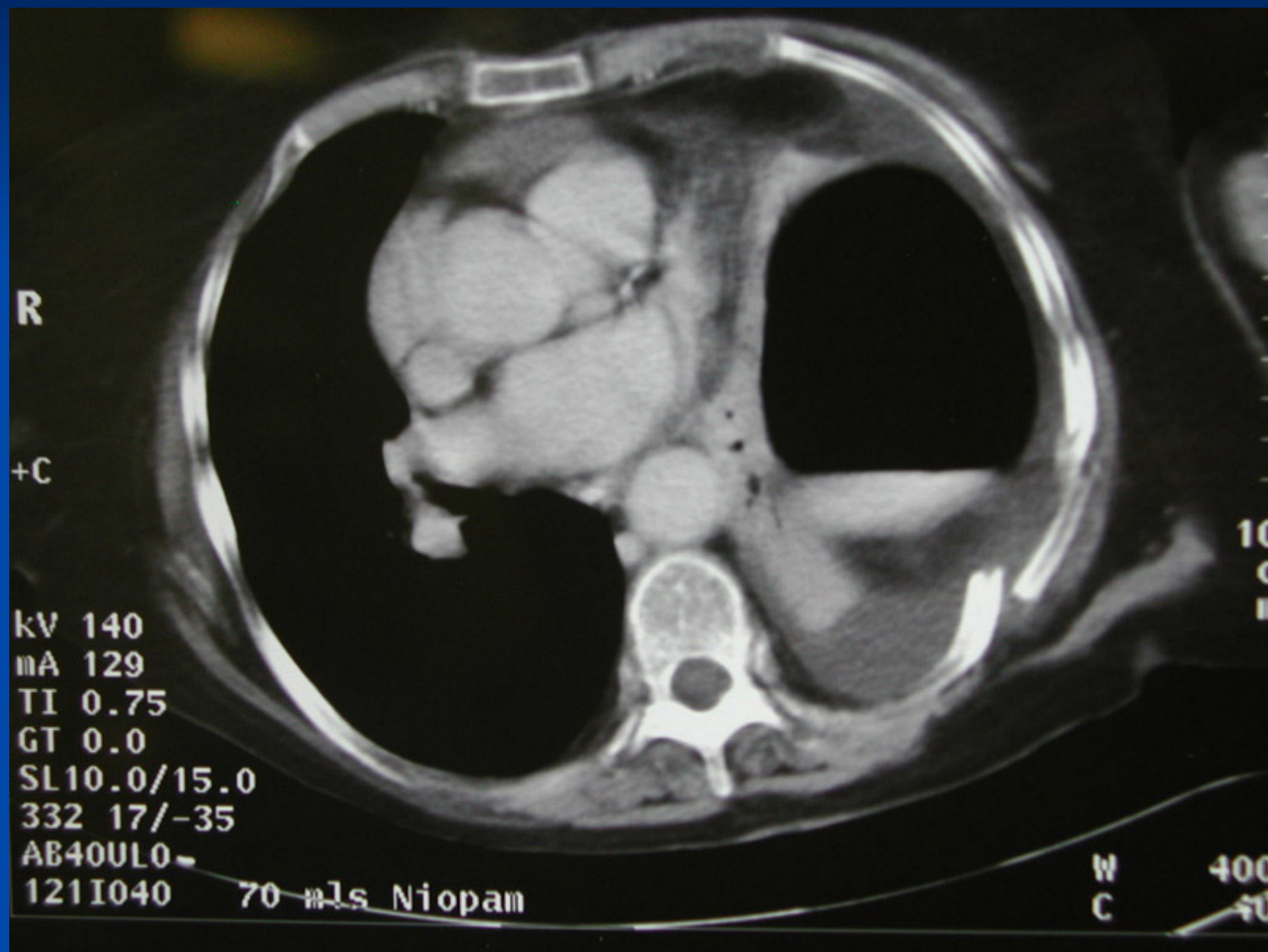


Ruptură de hemidiafragm stâng cu hernierea stomacului și splinei

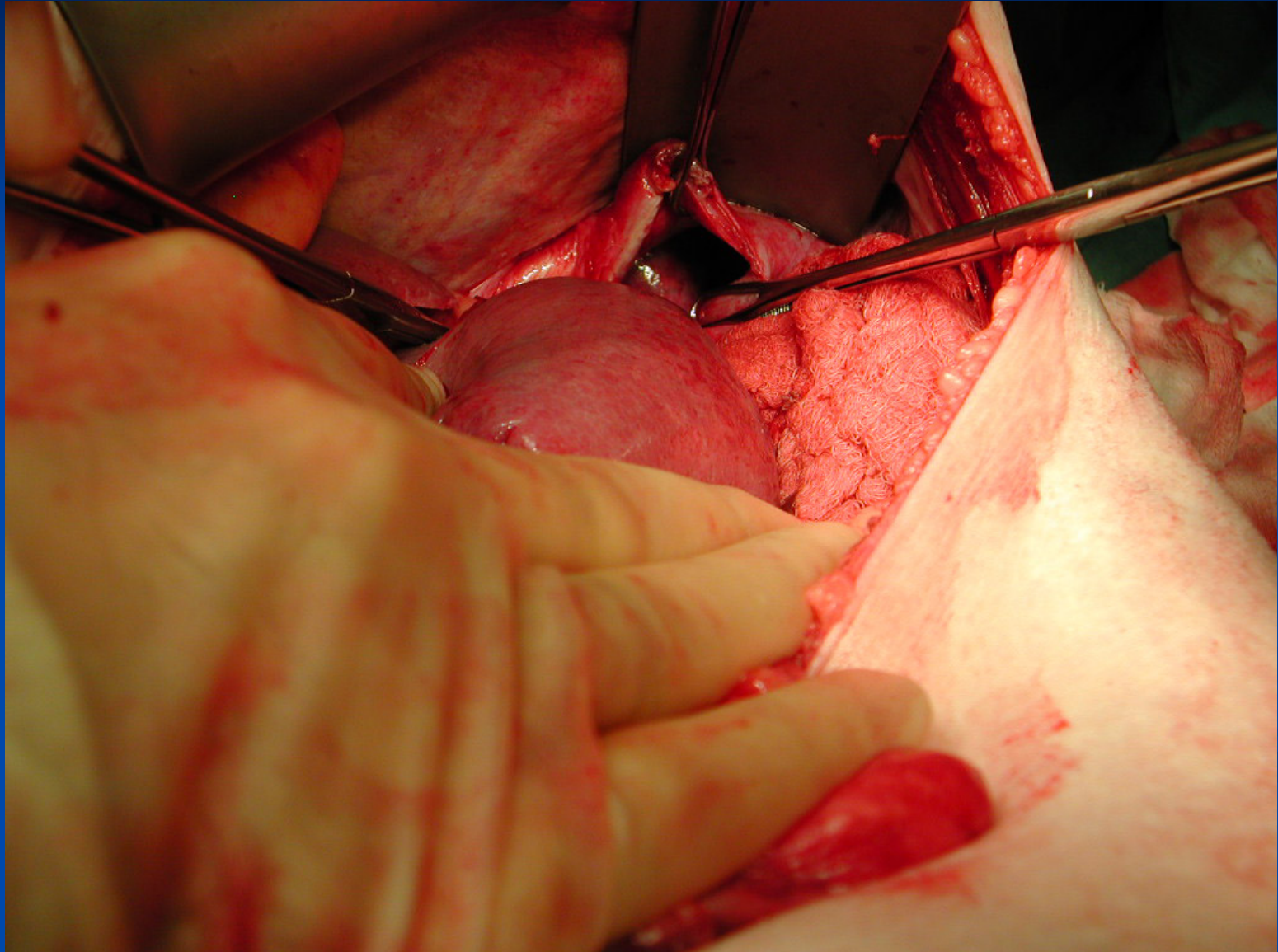


Ruptură de hemidiafragm stâng cu hernierea stomacului și splinei

Imagine CT



Ruptură de hemidiafragm stâng cu hernierea stomacului și splinei

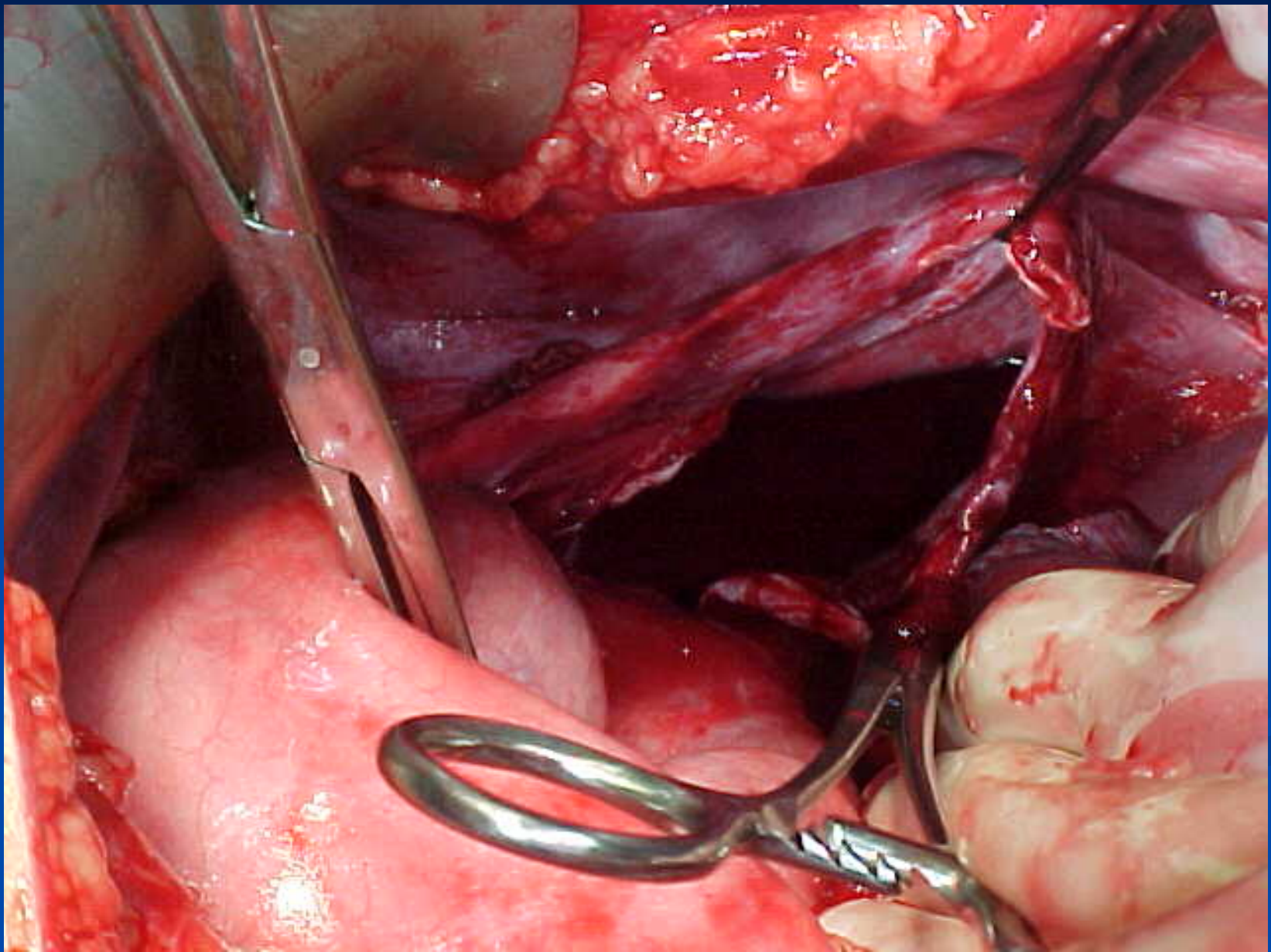


Ruptură de diafragm

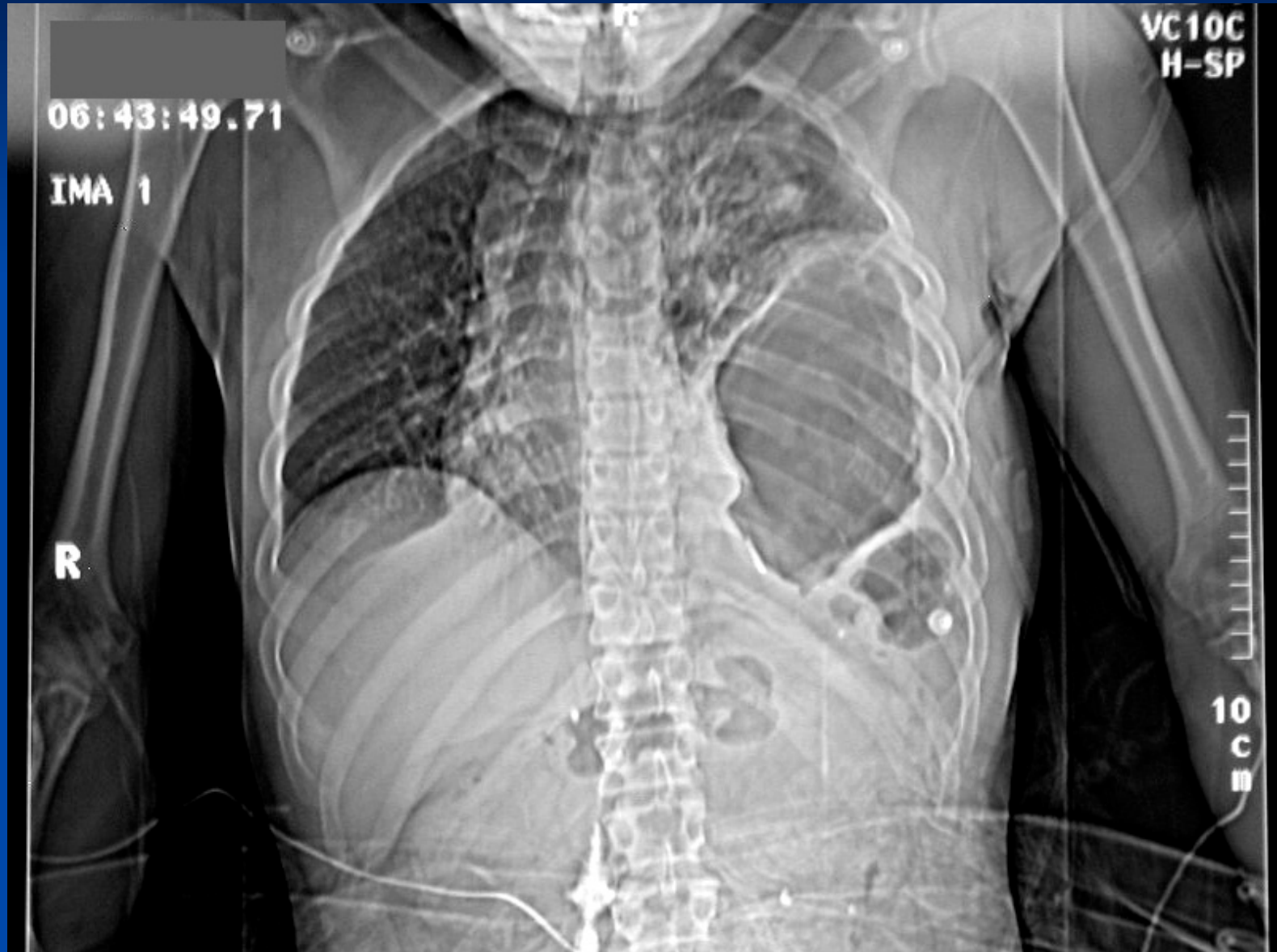
Radiografie cu substanță de contrast



Ruptură de diafragm



Ruptură de diafragm Gastrotorax



Ruptură de diafragm

Gastrotorax

Imagine CT



Imagine CT



Potentially Lethal Chest Injuries:

Myocardial Contusion

- Often diagnosed and actually uncommon
- Pathologically and prognostically not the same as an acute MI
- Diagnosis
 - EKG – PVCs, PACs, inverted T waves, elevated ST segments; may have atrial fibrillation or bundle branch block
 - Echocardiography: shows wall motion abnormalities; \pm pericardial fluid
 - Cardiac enzymes: MbCPK usually elevated

Potentially Lethal Chest Injuries:

Myocardial Contusion

■ Treatment

- Cardiac monitor for 24 to 48 hours
- Lidocaine for ventricular arrhythmias
- Follow-up echocardiogram if major wall motion abnormalities

■ Prognosis

- Usually good (better than for acute MI)
- Usually no residual cardiac function abnormalities

■ Other cardiac injuries often rapidly fatal

- Exception is blunt atrial rupture; sometimes treatable by thoracotomy and repair

Indications for Emergency Thoracotomy in the Emergency Department

- Penetrating chest trauma with at least some signs of life (agonal respirations, etc.) initially and rapid transport to ED
- Penetrating chest trauma and cardiac arrest after arrival in the ED
- CPR needed and flail chest, or major chest wall abnormality, or advanced pregnancy present (need to do open heart massage)
- Uncontrolled intraabdominal bleeding (need to apply aortic clamp at level of diaphragm)

Precedure for Emergency Thoracotomy

- Intubate and ventilate the patient
- Quick iodine prep of left chest wall
- Incision from 2 cm left of sternum to beneath nipple in 4th left intercostal space – keep incision on upper border of rib (avoid intercostal nerves and vessels on lower edge of rib) – extend to at least the anterior axillary line
- Insert rib spreader and crank open
- Open pericardium horizontally (parallel to phrenic nerve)

Procedure for Emergency Thoracotomy (con't)

- Cardiac massage / digital control of any cardiac lacerations
- Cross clamp aorta just above diaphragm (with vascular clamp) – dissect bluntly around aorta with finger
- Use vascular clamps on any major bleeding pulmonary lacerations
- Pack off any major bleeding from the subclavian area
- Can place IV tubing into right atrium with purse-string suture to allow large volume fluid resuscitation quickly

Indications for Urgent Thoracotomy for Trauma (Move Patient for ED to OR for Thoracotomy)

- Early bleeding for chest tube > 5000 cc/hr
- Continued bleeding from chest tube > 200 cc/hr X 1 to 2 hours
- Massive air leak (persistent pneumothorax despite 2 chest tubes)
- Suspected cardiac tamponade
- Suspected major pulmonary hilar vessel bleed
- Suspected aortic disruption
- Persistent nonresponsive hypotension not due to neurogenic shock

Tube Thoracostomy for Trauma

➤ Always indicated for:

- Tension pneumothorax
- Massive hemothorax
- Suspected tracheo-bronchial laceration
- Suspected esophageal rupture
- Small pneumothorax and need for intubation and general anesthesia

➤ Not always indicated for:

- Simple pneumothorax < 5 to 10%
- Small hemothorax (if from rib fractures)
- Flail chest

Insertion Procedure for Tube Thoracostomy

- Prep side of chest with iodine
- Preferred site usually 5th or 6th intercostal space in midaxillary line
- Inject local anesthetic
- Make 2 cm skin incision
- Tunnel up over one rib with clamp
- Incise intercostal muscles above the rib
- Enter pleural space
- Do finger sweep to check for adhesions
- Place tube into pleural space using finger as guide
- Suture tube in place – attach to waterseal
- Check tube position by CXR

Procedure for Pericardiocentesis

- Prep left chest with iodine
- Consider local anesthesia
- Attach EKG lead to needle – monitor EKG for ST segment elevation
- Best to use a catheter over needle or Seldinger placement technique
- Insert needle just to left of xyphoid and advance toward tip of scapula (pulling back on syringe)
- Stop advancing if blood return in syringe or elevated ST on EKG (signifies ventricular wall contact)
- Leave catheter (not needle) in place and attach to close stopcock once aspiration complete (allows recurrent aspiration if needed)
- Obtain CXR to R/O pneumothorax

Peritoneal Lavage for Chest Trauma

➤ Indicated for:

- Penetrating trauma below level of nipple (4th interspace)
- Suspected diaphragm rupture
- Red cell count criteria for laparotomy should be only 10.000/mm³ for these 2 situations

Chest Trauma: 8 Types of (Usually) Non-Lethal Chest Injuries

1. Simple pneumothorax or small hemothorax
 - Usually treat with chest tube after secondary survey
2. Sternoclavicular dislocation
 - If posterior – emergent reduction (elevation) may be needed – can press on brachiocephalic artery – pull proximal clavicle up with towel clip
 - If anterior – just treat with pain meds and sling
3. Sternal fracture
 - Usually only need Rx with pain meds
 - Usually not associated with myocardial contusion

TRAUMATISMELE TORACICE

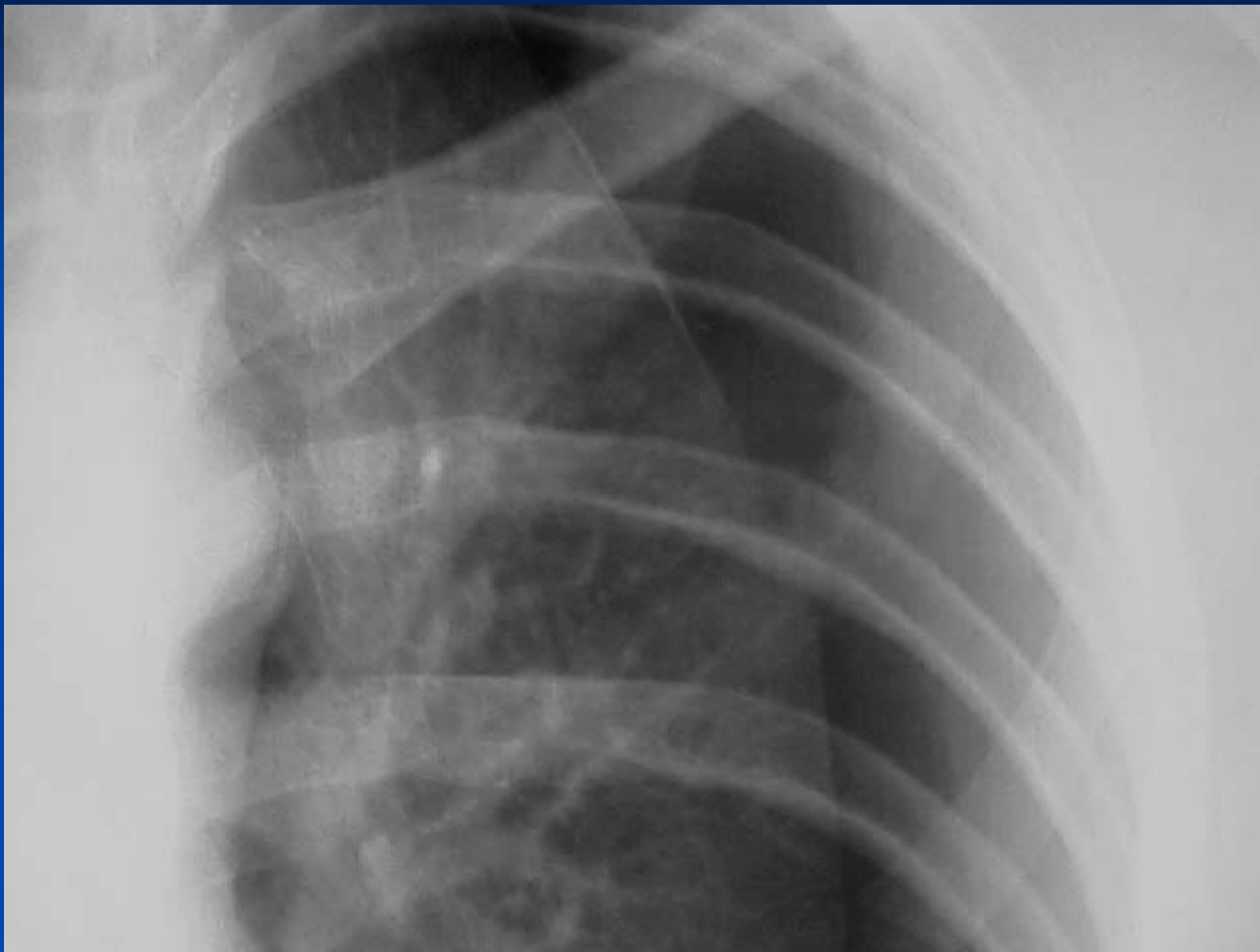
8 TIPURI (DE OBICEI) NELETALE

- 1. Pneumotoracele simplu sau hemotoracele redus
 - de obicei tratate prin drenaj toracic după examenul secundar
- 2. Luxația sternoclaviculară
 - dacă este posterioară: se impune reducerea de urgență deoarece poate cauza compresie asupra trunchiului brahiocefalic
 - dacă este anterioară: analgetice și bandaj triunghiular
- 3. Fractura sternală
 - de obicei necesită doar Rx și analgetice
 - de obicei nu este asociată cu contuzia miocardică

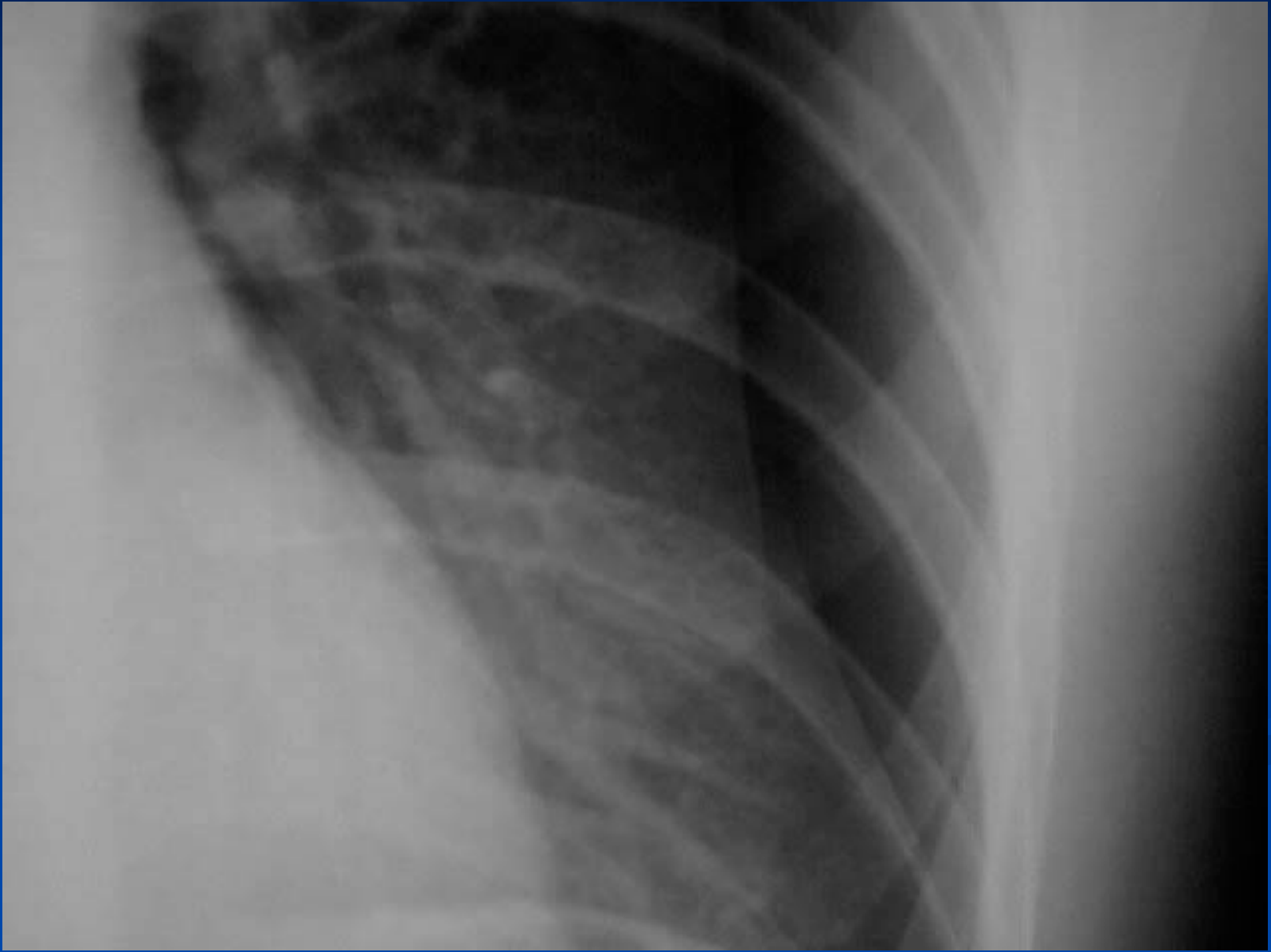
Pneumotorace simplu stâng



Pneumotorace simplu stâng



Pneumotorace simplu stâng



Chest Trauma: 8 Types of (Usually) Non-Lethal Chest Injuries

4. Clavicle fracture

- Treat with figure 8 bandage \pm sling
- Operative treatment needed only for open fracture

5. Scapular fracture

- Usually heal well (surrounded by muscle)
- Treat with pain meds and sling
- Only need surgical treatment if open or involving glenoid surface

Chest Trauma: 8 Types of (Usually) Non-Lethal Chest Injuries

6. Traumatic asphyxia

- Occurs from compression of the chest and resultant sudden increase in pressure in the vena cava
- Signs: subcutaneous hemorrhages, petechiae, retinal hemorrhages, facial edema
- Usually does not need direct treatment; just treat associated injuries

Chest Trauma: 8 Types of (Usually) Non-Lethal Chest Injuries

7. Simple rib fracture

- Treat with pain meds only
- “Rib belts” contraindicated (predispose to atelectasis and pneumonia)
- Do not need rib X-rays to document (just get CXR to R/O pneumothorax or pulmonary contusion; rib films are painful for the patient, and represent unnecessary expense and radiation exposure)

Chest Trauma: 8 Types of (Usually) Non-Lethal Chest Injuries

8. Chest wall contusion

- Treatment same as for rib fracture (thus X-ray confirmation of rib fracture does not affect treatment)
- Advise patient that the area may remain painful for an extended time period (days to weeks)

Chest X – Ray Findings and Associated Injuries

Abnormal Findings	Diagnosis to Consider
Any rib fracture	Pneumothorax, hemothorax
Fracture of 1 st or 2 nd ribs	Tracheal or great vessel injury
Two or more rib fractures in 2 or more places	Flail chest, pulmonary contusion
Bowel or stomach gas pattern in chest	Diaphragm rupture
Nasogastric tube in the chest	Diaphragm rupture or ruptured esophagus
Air fluid level in the chest	Hemothorax, esophageal or diaphragm rupture

Chest X – Ray Findings and Associated Injuries (con't.)

Abnormal Findings	Diagnosis to Consider
Sternal fracture	Myocardial contusion, cervical spine or head injury
Mediastinal hematoma	Great vessel injury, thoracic spine or sternal fracture
Disrupted diaphragm	Abdominal visceral injury
Respiratory distress without chest X-ray findings	CNS injury, aspiration, smoke inhalation, acidosis
Persistent large pneumothorax after chest tube insertion	Bronchial tear, esophageal disruption
Mediastinal air	Esophageal disruption, pneumoperitoneum, tracheal injury
Scapular fracture	Airway or great vessel injury
Free air under the diaphragm	Ruptured hollow abdom. viscus

Chest Trauma Summary

- Categorize chest injuries into 3 groups:
 - Quickly lethal – Recognize and treat as part of primary survey
 - Potentially lethal – Recognize and treat as part of secondary survey
 - Usually non-lethal – Treat after secondary survey
- Reassess patient if any change in chest symptoms or findings