

Severe trauma

Definition

- Multiple trauma: injury of at least two organ systems, of which at least one is life-threatening.
- Severe trauma is defined by an Injury Severity Score (ISS) >15

Injury severity score

- Evaluation based on anatomical injury
- Anatomical regions:
 - Head or neck- including cervical spine
 - Face - including the facial skeleton, nose, mouth, eyes and ears
 - Chest - thoracic spine and diaphragm
 - Abdomen or pelvic contents - abdominal organs and lumbar spine
 - Extremities or pelvic girdle - pelvic skeleton
 - External
- Severity: none, minor, moderate, serious, severe, critical
- Calculation: $ISS = A^2 + B^2 + C^2$

Mechanisms of injury

- Blunt
- Penetrating
- Thermal (burns and cold injury)
- Blast

Epidemiology

- 250 per million population per year
- More in urban areas in countries such as South Africa and North American cities
- The challenge is to centralise trauma care

The team approach

- Team leader (intensivist, surgeon...)
- Trauma surgeon, general surgeon
- Intensivist, anesthesiologist
- Radiologist
- Optional:
 - Neurosurgeon, neurologist, urologist, neck-, face surgeon, urologist...

Generic approach to trauma care

- Detection and treatment of life-threatening injuries during a **primary assessment** and intervention phase.
- Detection of all the other injuries during a **secondary assessment** when a more detailed clinical examination is combined with investigations such as imaging. Definitive care plans are then made.
- Detection of missed injuries and early sequelae or complications (i.e. compartment syndrome after tibial fracture) in a **tertiary assessment**, performed within the next 24 hours.

Primary assessment -pre-hospital

- **A**irway with C-spine control: look, listen (stridor/wheeze), feel
- **B**reathing: look (symmetry, paradoxical movement), listen (symmetry), feel (symmetry, subcutaneous emphysema)
- **C**irculation: pulse (rate and pressure), peripheral perfusion, jugular venous distension, signs of external or internal bleeding
- **D**isability: Glasgow Coma Scale score, pupillary reactions and any suspicion of paralysis
- **E**xposure: in preparation for the head-to-toe examination that follows in the secondary assessment

	Main findings	Underlying threat to life
Airway	<ul style="list-style-type: none"> ◆ Obstruction ◆ Stridor 	<ul style="list-style-type: none"> ◆ Direct or indirect airway injury ◆ Foreign body
Breathing	<ul style="list-style-type: none"> ◆ Respiratory distress ◆ Respiratory depression ◆ Open chest wound 	<ul style="list-style-type: none"> ◆ Tension pneumothorax ◆ Open pneumothorax ◆ Major flail chest
Circulation	<ul style="list-style-type: none"> ◆ Shock ◆ Arrhythmia ◆ Cardiac arrest 	<ul style="list-style-type: none"> ◆ Exsanguinating haemorrhage ◆ Cardiac tamponade ◆ Severe cardiac contusion or co-existing heart disease
Disability	<ul style="list-style-type: none"> ◆ Depressed level of consciousness ◆ Paralysis 	<ul style="list-style-type: none"> ◆ Severe head injury ◆ Hypoxia or hypotension ◆ Spinal cord transaction

Exposure

- Falls >2 metres
- Pedestrian or cyclist hit by a car at speed >30 km/hr (18 miles/hr)
- Death or severe injury of another occupant in the same vehicle/accident
- Ejection from a vehicle
- Major deformity of the vehicle or intrusion into the passenger space, especially bent columns around the front doors
- Extrication time >20 minutes
- Vehicle roll-over
- Penetrating injury to the head or trunk

Secondary assessment- ED

- Clinical examination
 - Head to toe
 - Front and back
 - Surface–orifice–cavity–skeleton
- Imaging
 - plain radiographs
 - ultrasonography of the chest and abdomen
 - CT
 - angiography
- Laboratory tests
 - Haematology
 - Biochemistry
 - toxicology



Beware of the patient whose clinical presentation is not as expected (e.g. little pain with obvious injury or bradycardia with obvious pain or extensive blood loss), as these may be signs of severe underlying injuries.

CASE

A 50-year-old driver (restrained with a seat belt in a head-on collision) presented with mild head injury (GCS of 13: eye opening 3, verbal response 4, motor response 6) and fractures of his zygomatic arch, causing an impressive haematoma around his left eye. On examining him you note a fracture-dislocation of his left forearm, a nitroglycerin patch on his chest, and atrial fibrillation with a heart rate of 60/min. Interpret these findings and make a differential diagnosis.

Tertiary assessment- ICU

- Review the anatomical injuries and physiological disturbances as part of the handover process and review their management.
- Re-examine the patient for missed injuries and new complications, e.g. compartment syndrome of the limbs or abdomen.
- Review the imaging.
- Perform a more detailed physiological assessment, with clinical evaluation supplemented by intensive care monitoring.

Physiological assessment

- Respiration
- Circulation
- Nervous system
- Metabolism
- Host defence

TASK

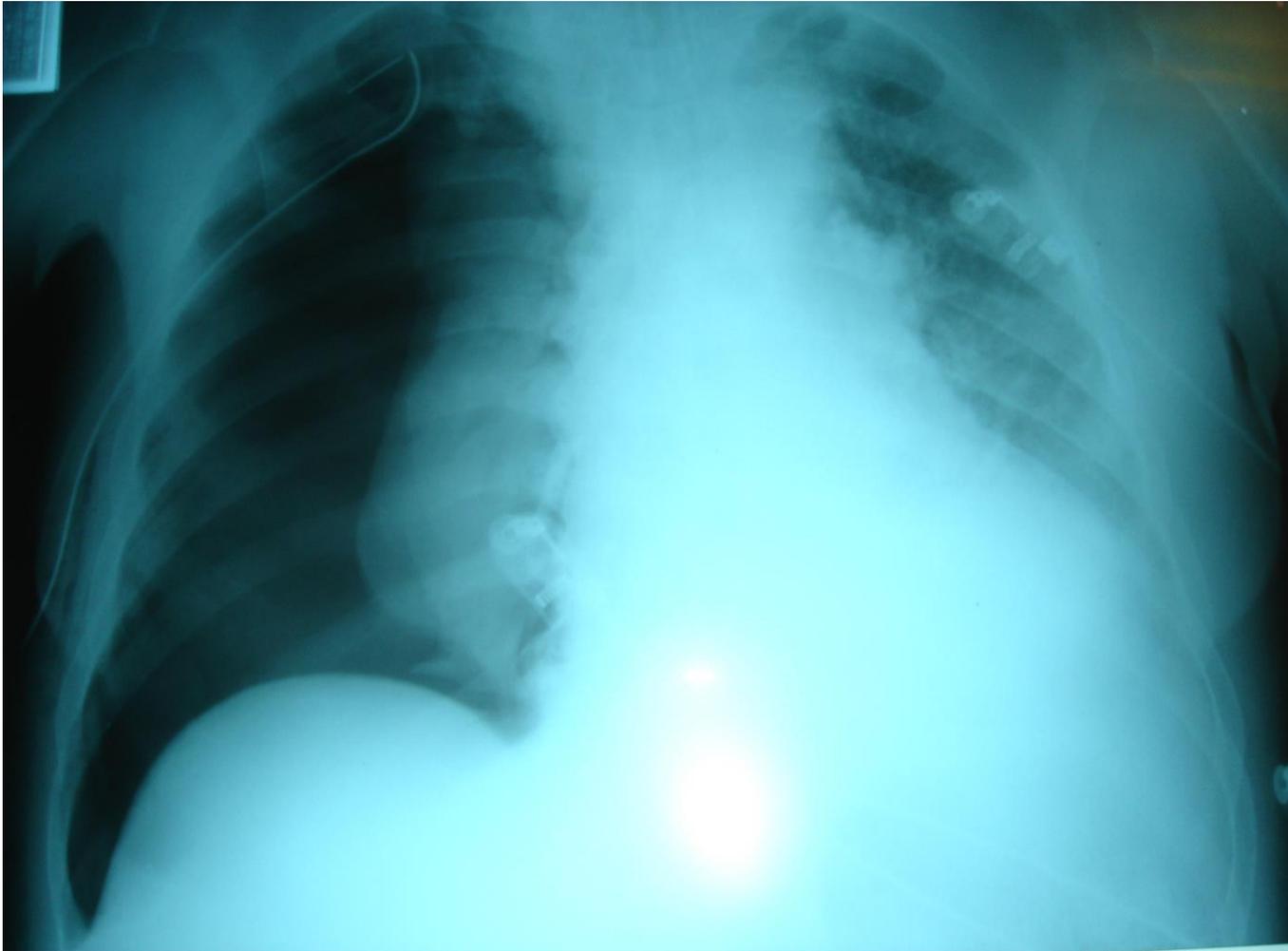
- auscultate the chest
- tightly control glycaemia
- assign tasks to team members
- give oxygen by face mask
- reposition a dislocated ankle fracture
- control the C-spine
- infuse 20 ml/kg Ringer's lactate
- give antibiotics
- perform neurologic assessment
- examine the prostate.

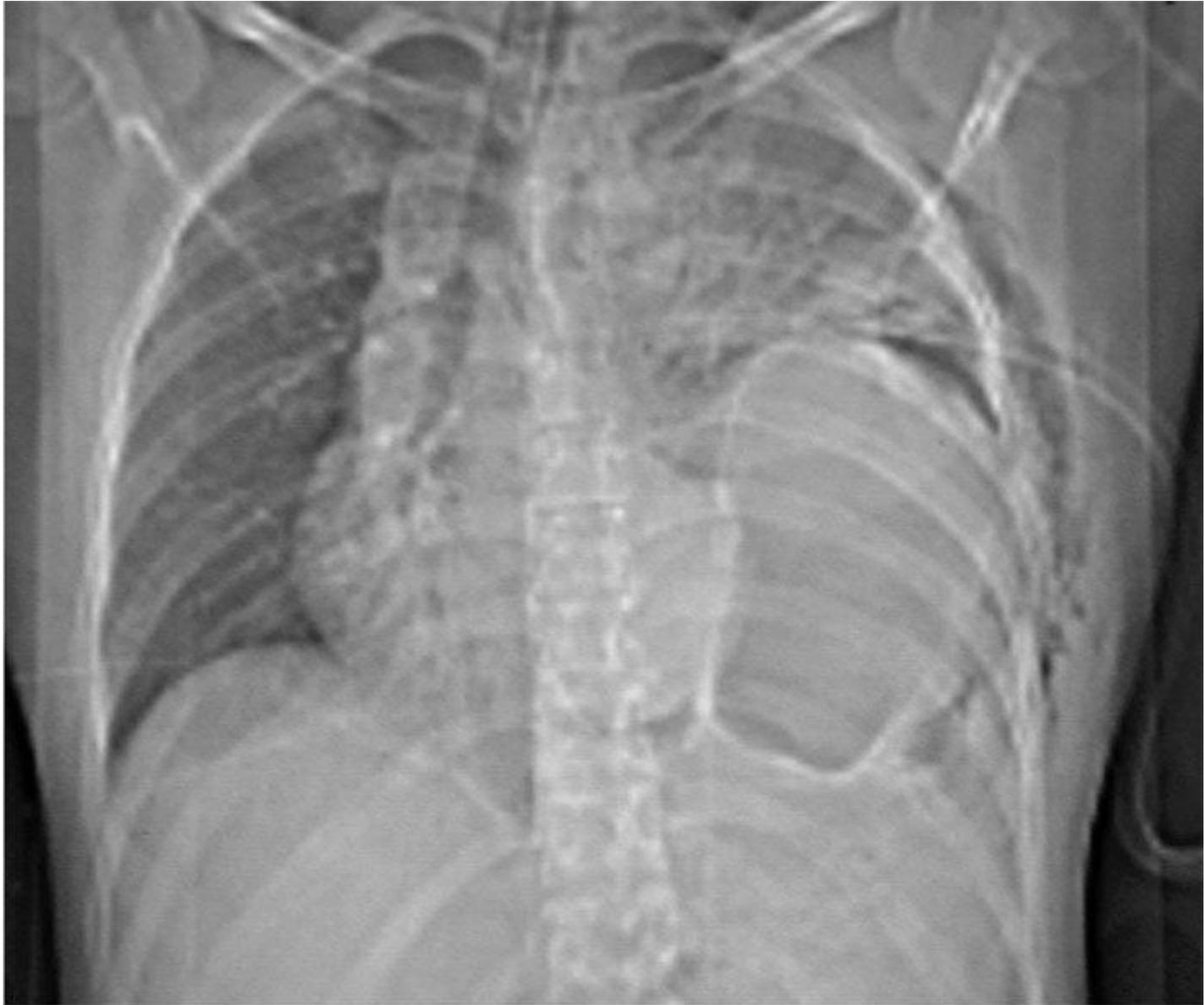
A- Airway problem

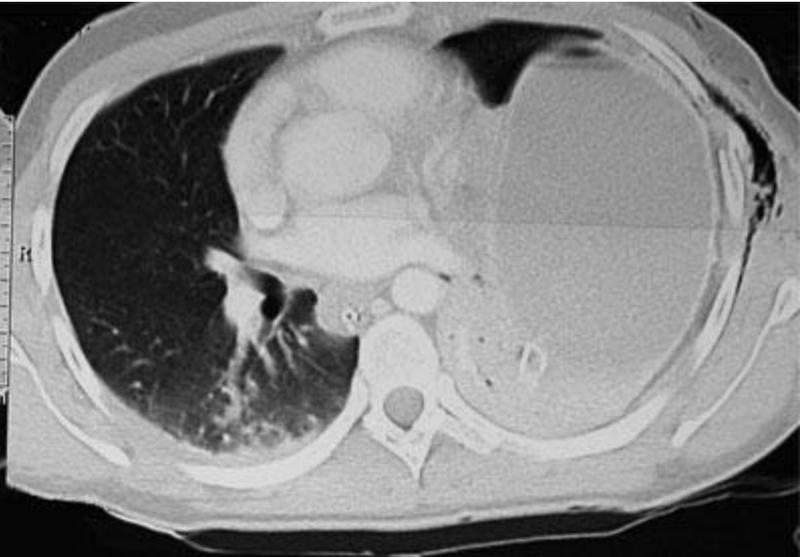
- f_iO_2 need
- Airway patency-
 - Obstruction
 - coma
- Spontaneous ventilatory activity
- Airway obstruction signs:
 - Stridor
 - Ineffective breathing attempts
- Causes of obstruction
 - Foreign body
 - Trauma to the neck
 - Burns- inhalation trauma

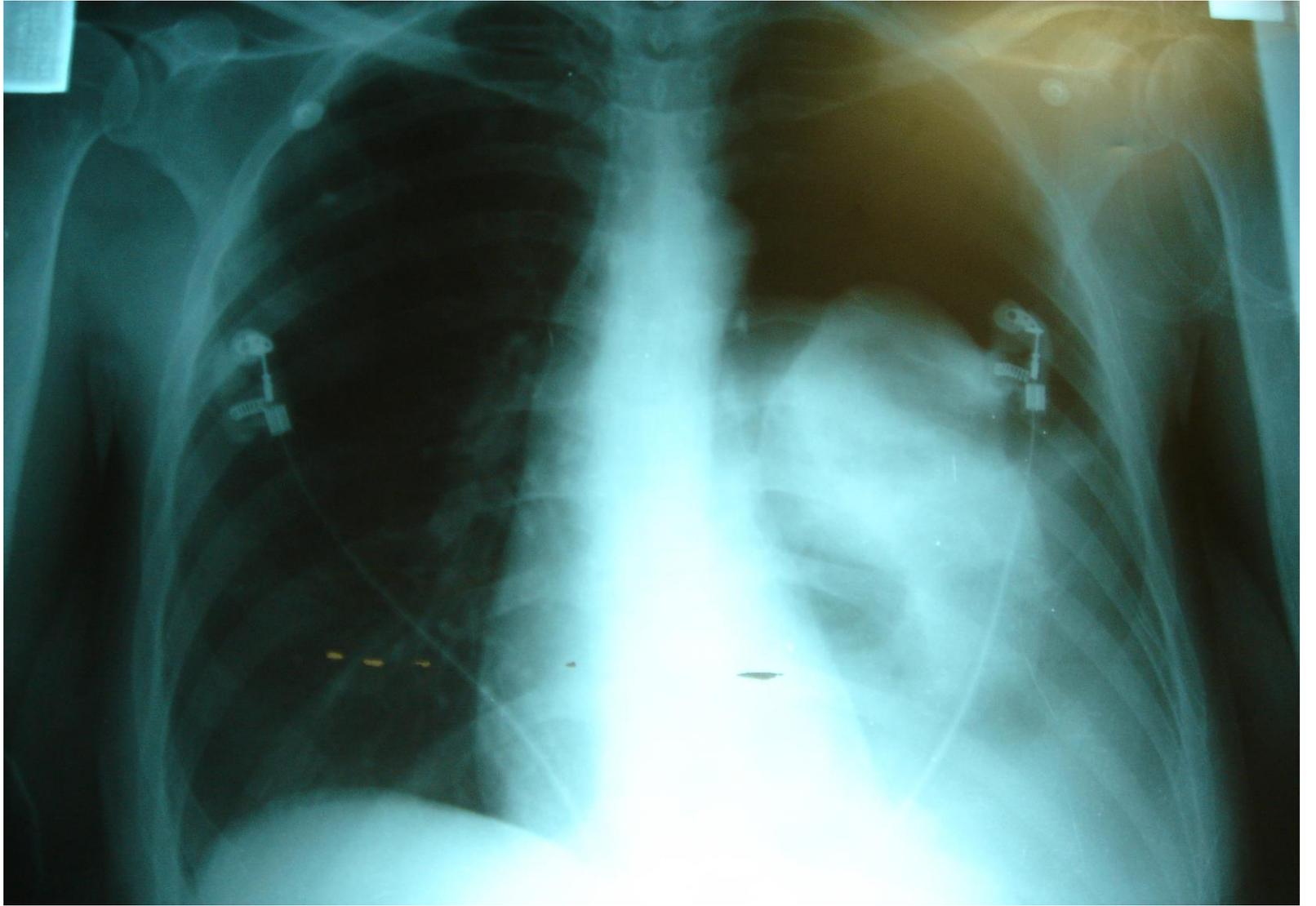
B- Breathing conditions

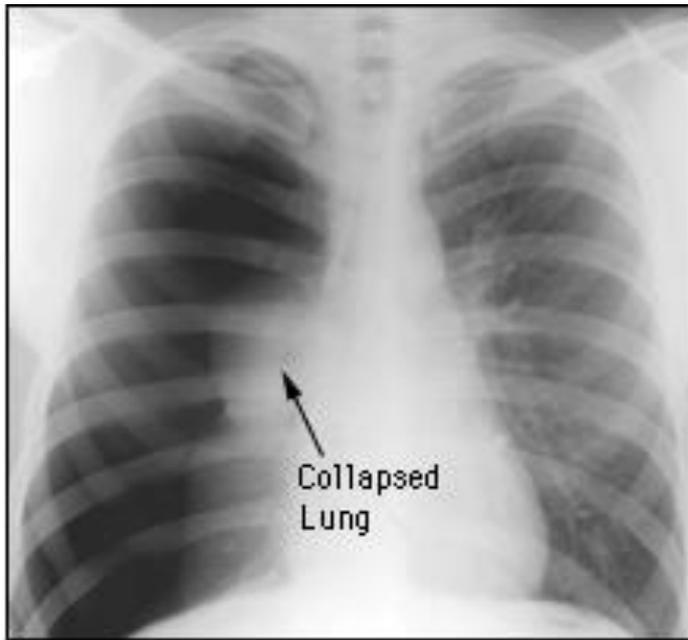
- Pneumothorax
- Haemothorax
- Flail chest
- Lung contusion



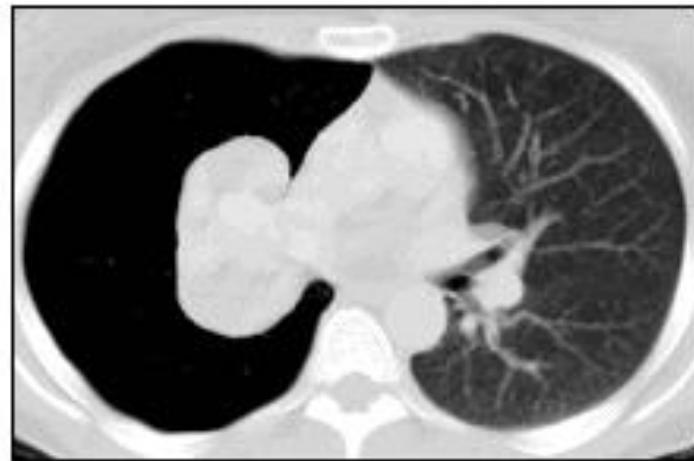




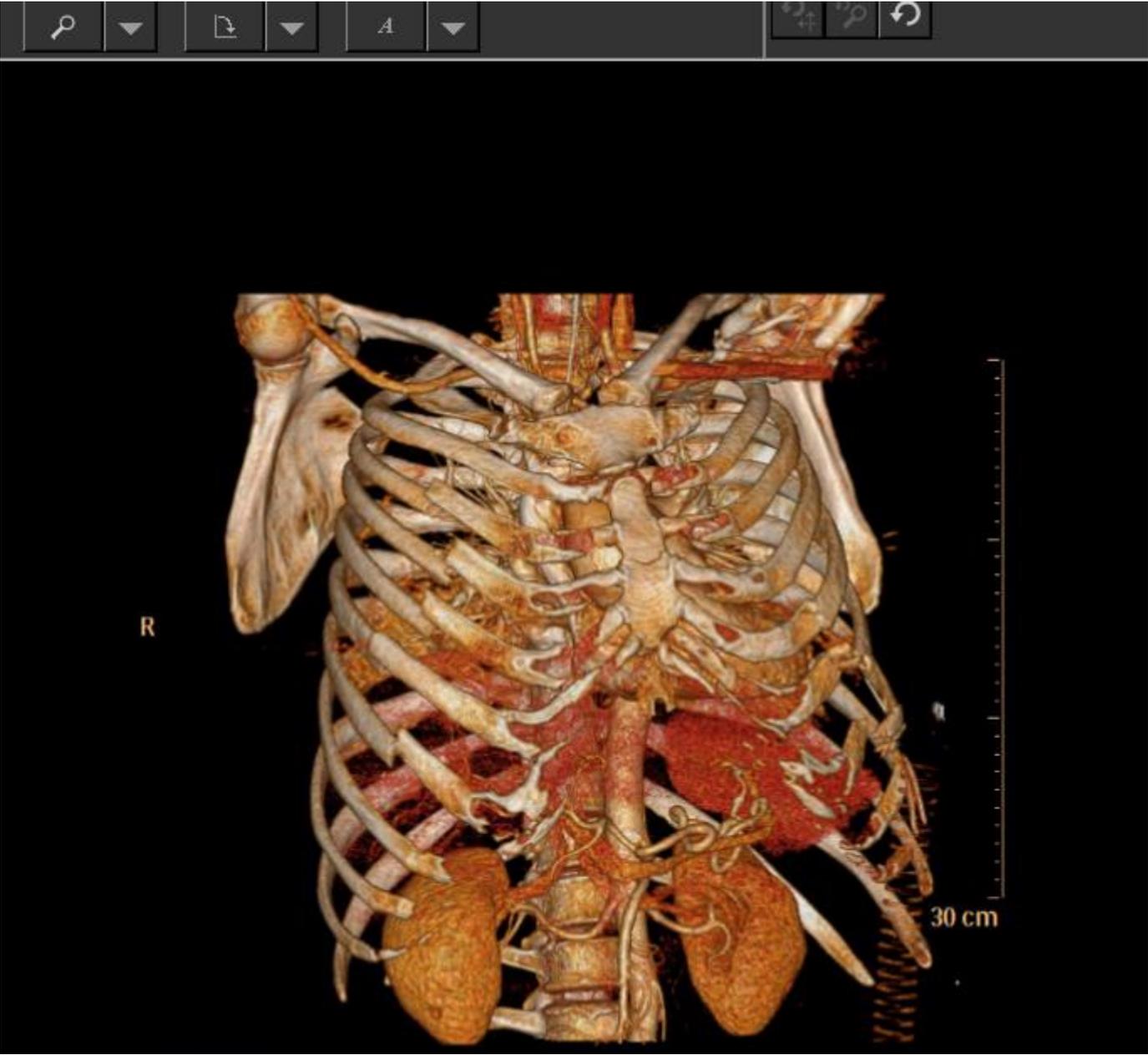


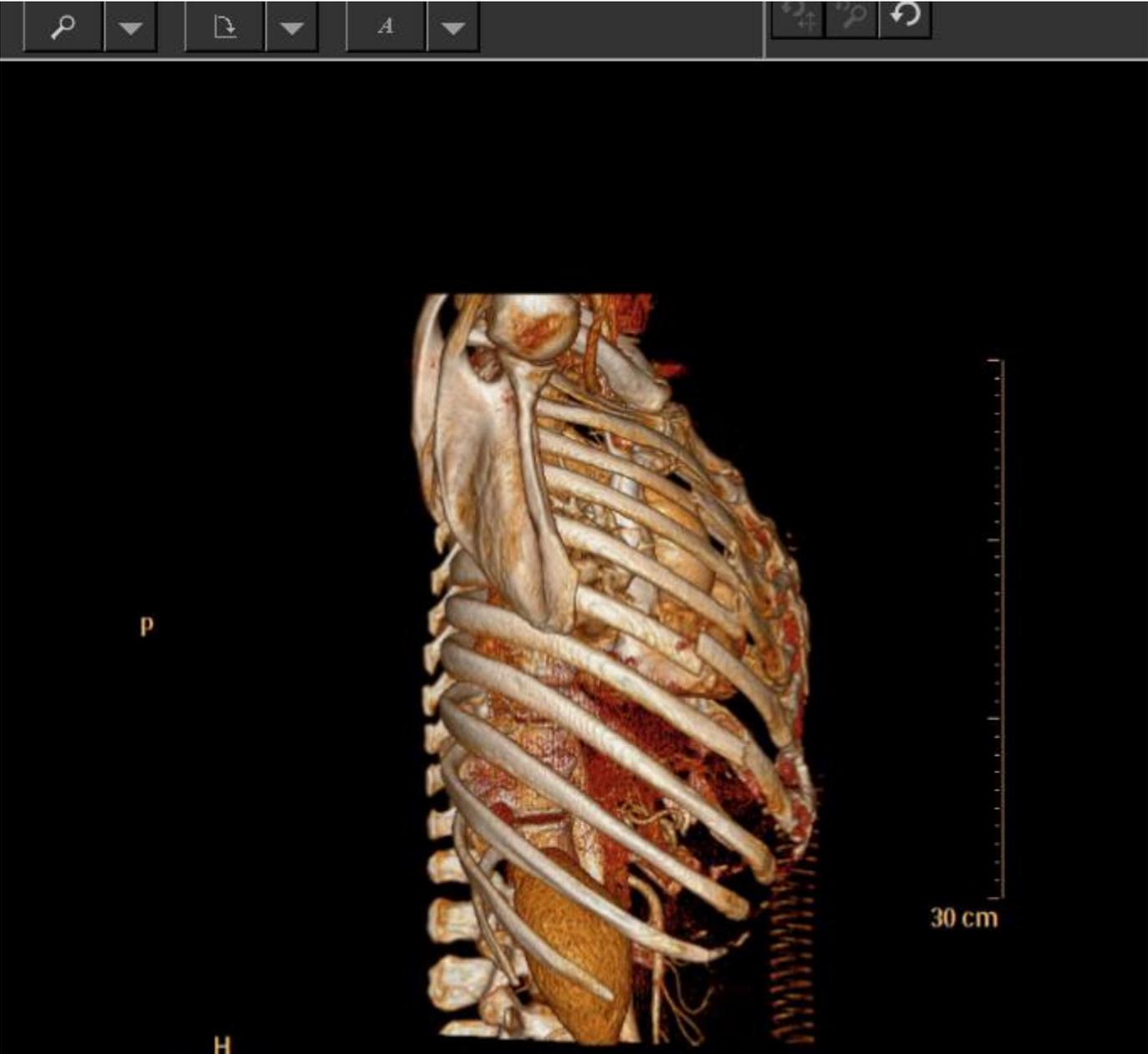


Right lung pneumothorax - Radiograph



Right lung pneumothorax - CT





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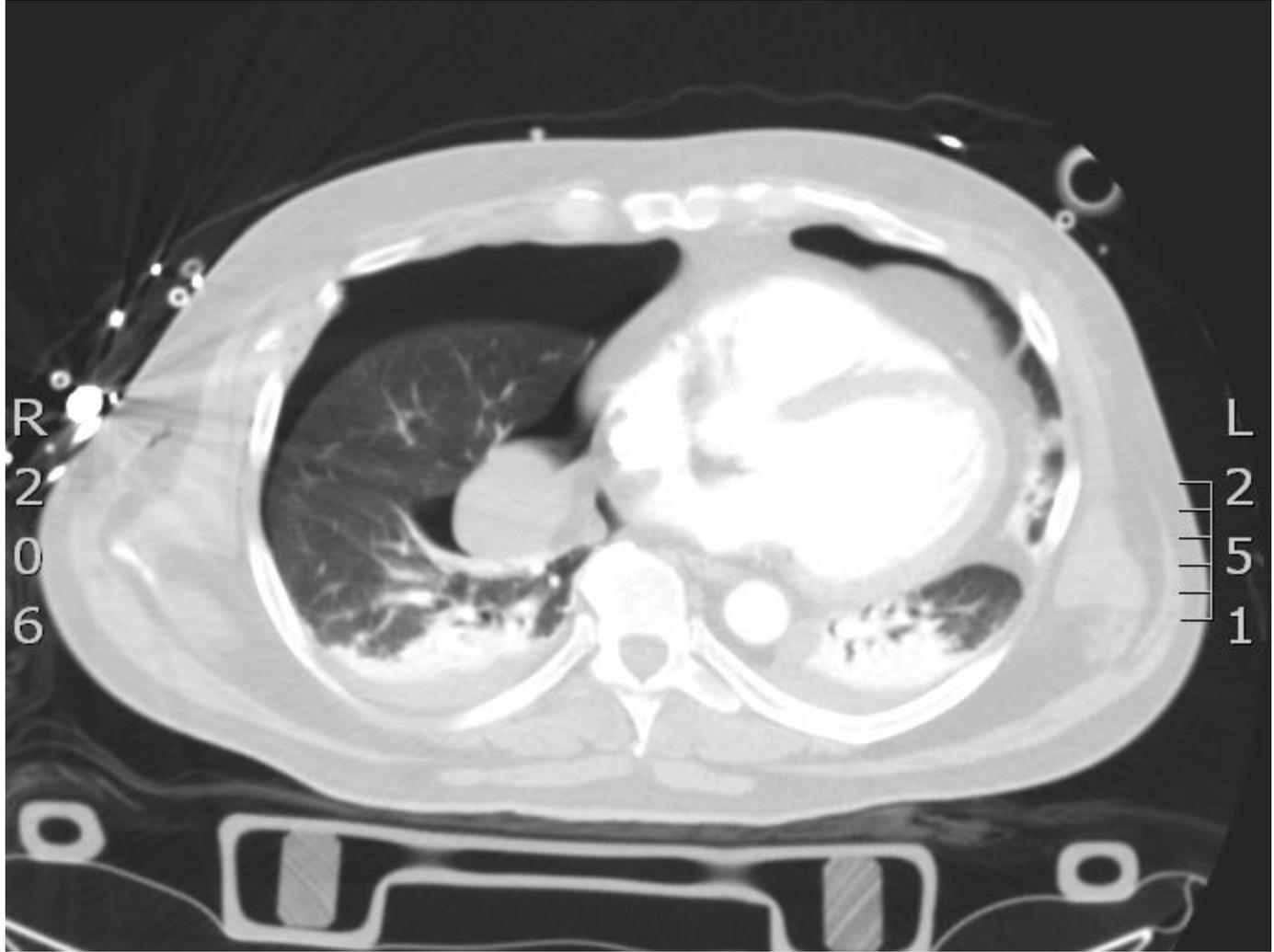


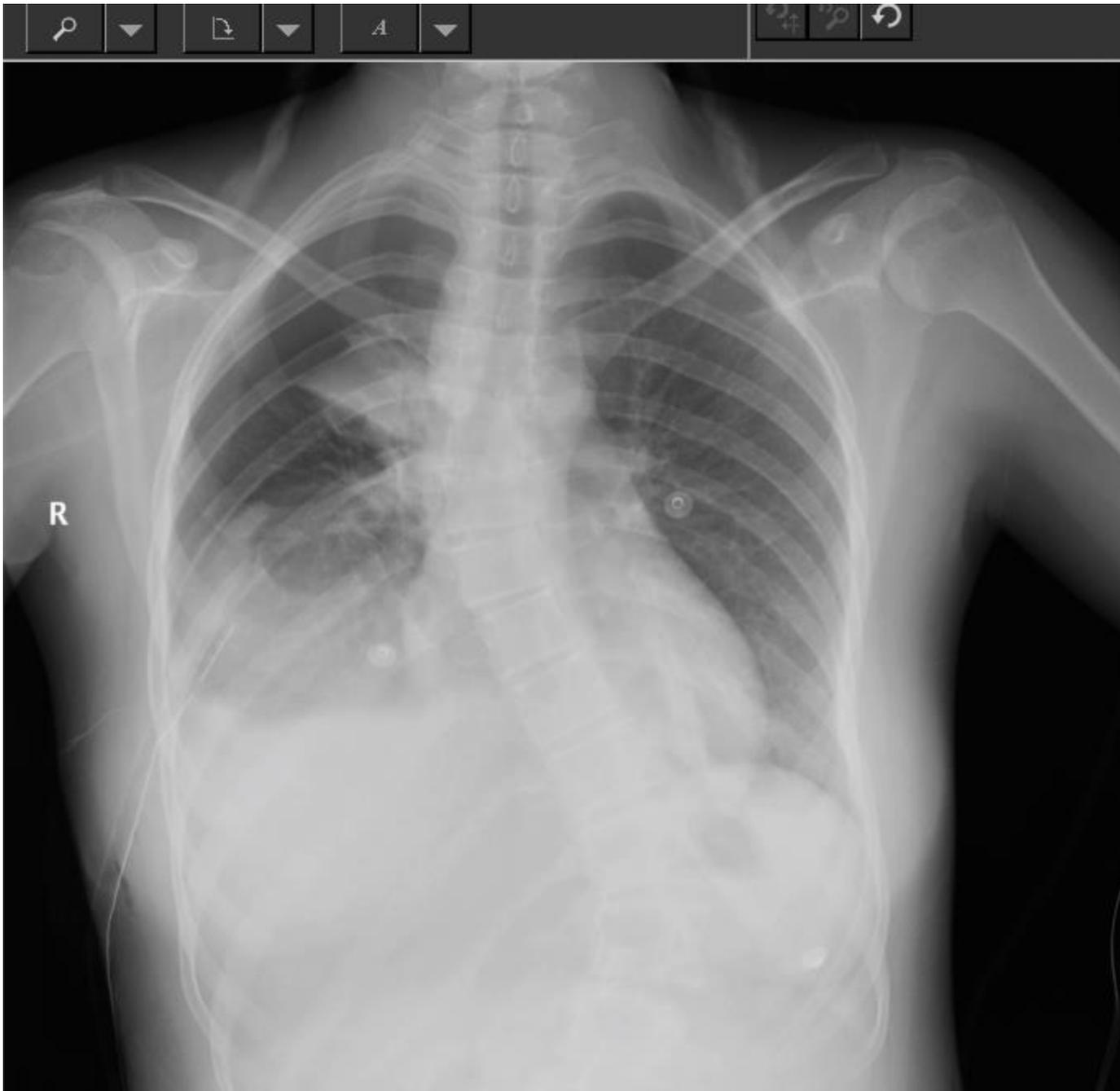
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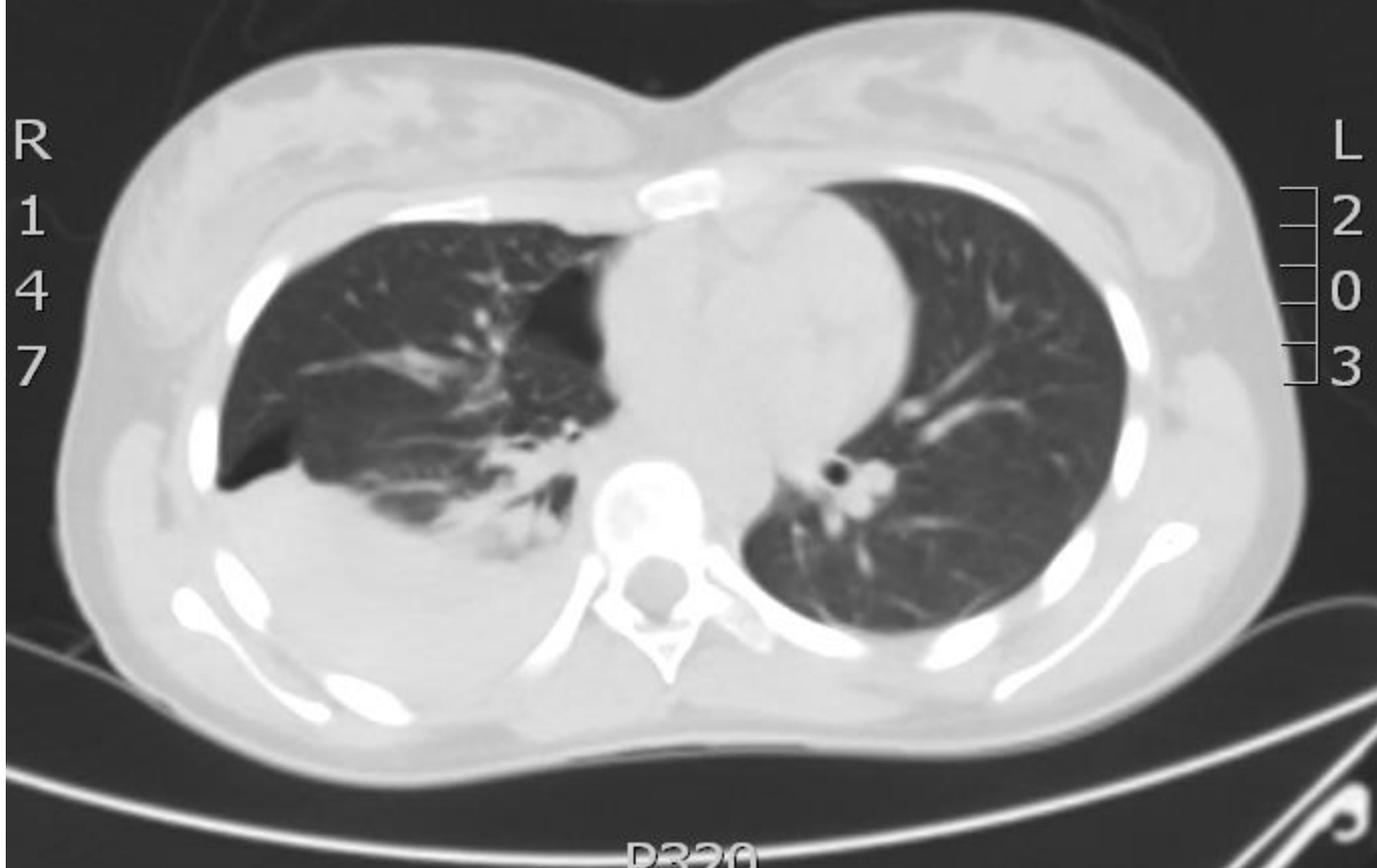
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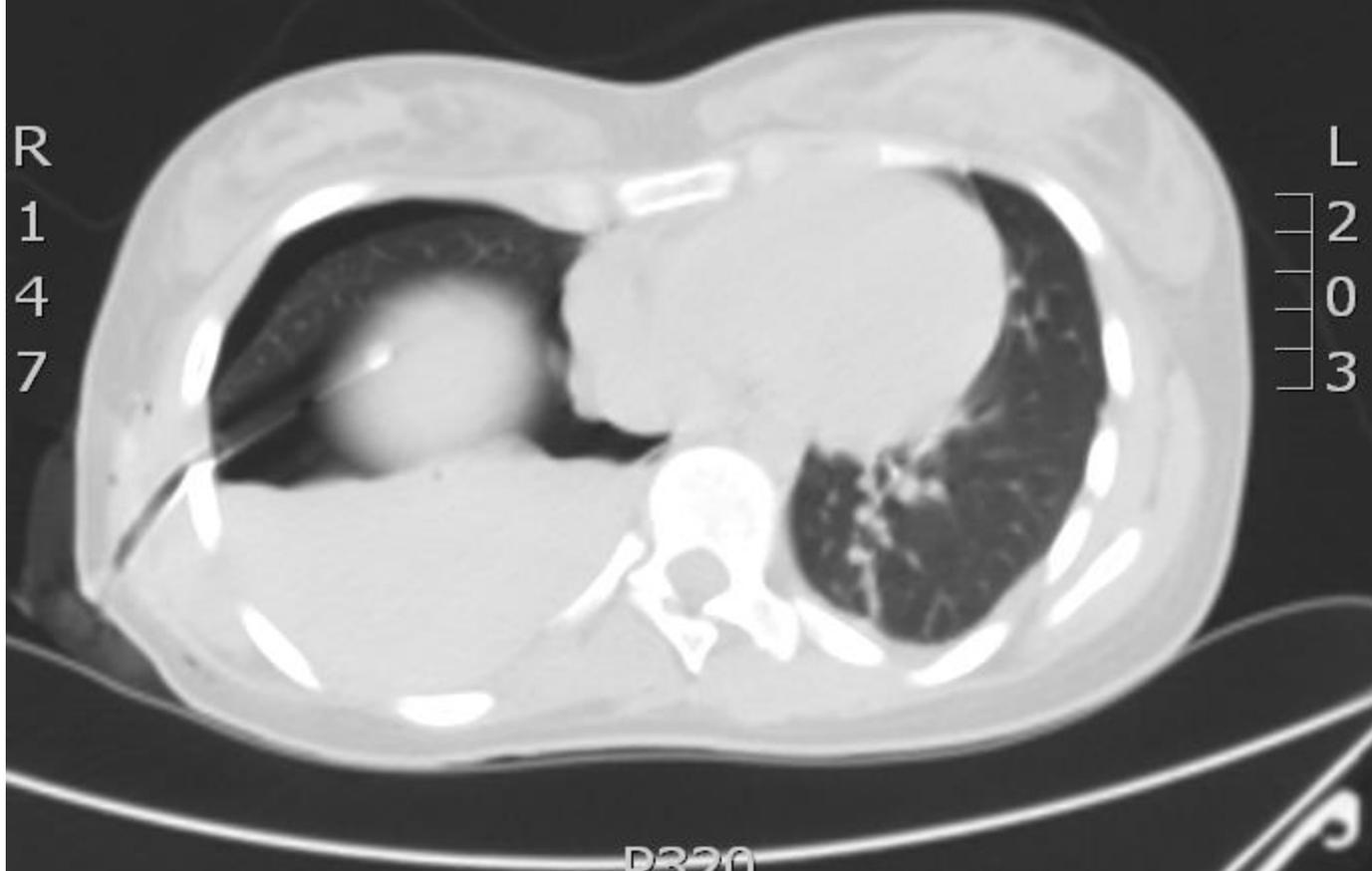
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Treating breathing problems

- Oxygen
- Intubation, mechanical ventilation
- Chest tubes
- Analgesia

C- Circulatory conditions

- **Types of shock: ????????**
 - Hypovolemic
 - Obstructive
 - Cardiogenic
 - Distributive
- **Haemorrhagic shock**
- **Cardiac tamponade, tension pneumothorax**
- **Cardiac contusion-** resembles AMI
- **Later- SIRS**

QUESTION

- What are possible causes of PEA in trauma victims? Are there differences as compared to non-trauma victims of PEA?
- 6 'H'
 - Hypovolaemia, hypoxia, H + ions (acidosis), hypo- and hyperkalaemia, hypothermia, and hypoglycaemia
- 6 'T'
 - Toxic ingestions, tamponade (cardiac), tension pneumothorax, thrombosis (coronary), thromboembolism (pulmonary), trauma

Treating circulation

- Two large peripheral intravenous lines
- Fluid resuscitation aliquots of 20 ml/kg body weight
- Beware of over-resuscitation
- Accept a lower pressure target
- Haemotherapy
 - Haemodynamics
 - Haemoglobin
 - Haemostasis

QUESTION

- What is the goal for blood pressure in a young victim of a bicycle accident with multiple fractures of his extremities?
- What is the goal for blood pressure in an old patient (>70 yrs.), with cardiovascular comorbidities, victim of the same accident?
- Blood flow, with satisfactory signs of tissue oxygenation, is more important than blood pressure.

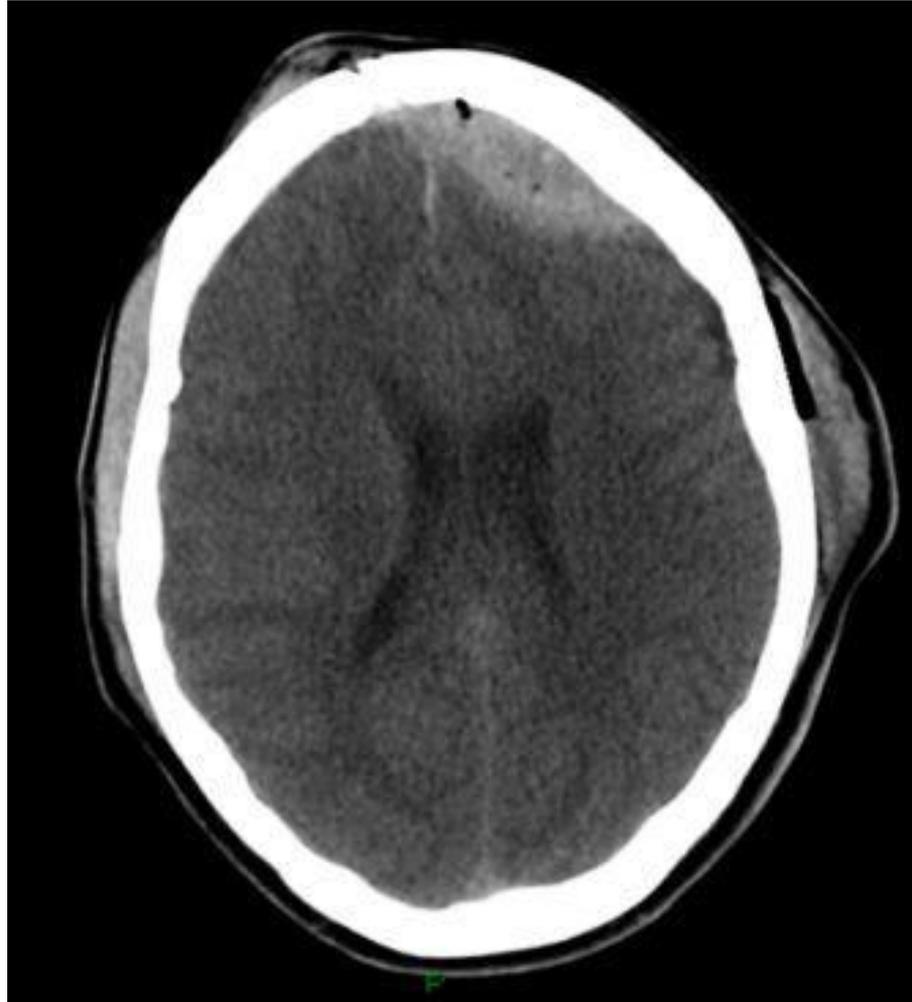
D - Nervous system

- TBI
- Spinal cord injury:
 - **respiratory arrest- Q: why?**
 - Interruption of the the phrenic nerve supply
 - **neurogenic shock:**
 - hypotension but with warm extremities- Q: why?
 - loss of sympathetic (vasoconstrictor) tone
 - Bradycardia- Q: why?
 - Loss of the sympathetic nerve supply to the myocardium

Imaging

- Plain radiograph- chest X-ray
- Ultrasonography- focused assessment by sonography in trauma (FAST):
 - liver, spleen, kidneys, pouch of Douglas, paracolic gutters, pelvic gutter, pericardium, pleural cavities
- CT

Traumatic brain injury



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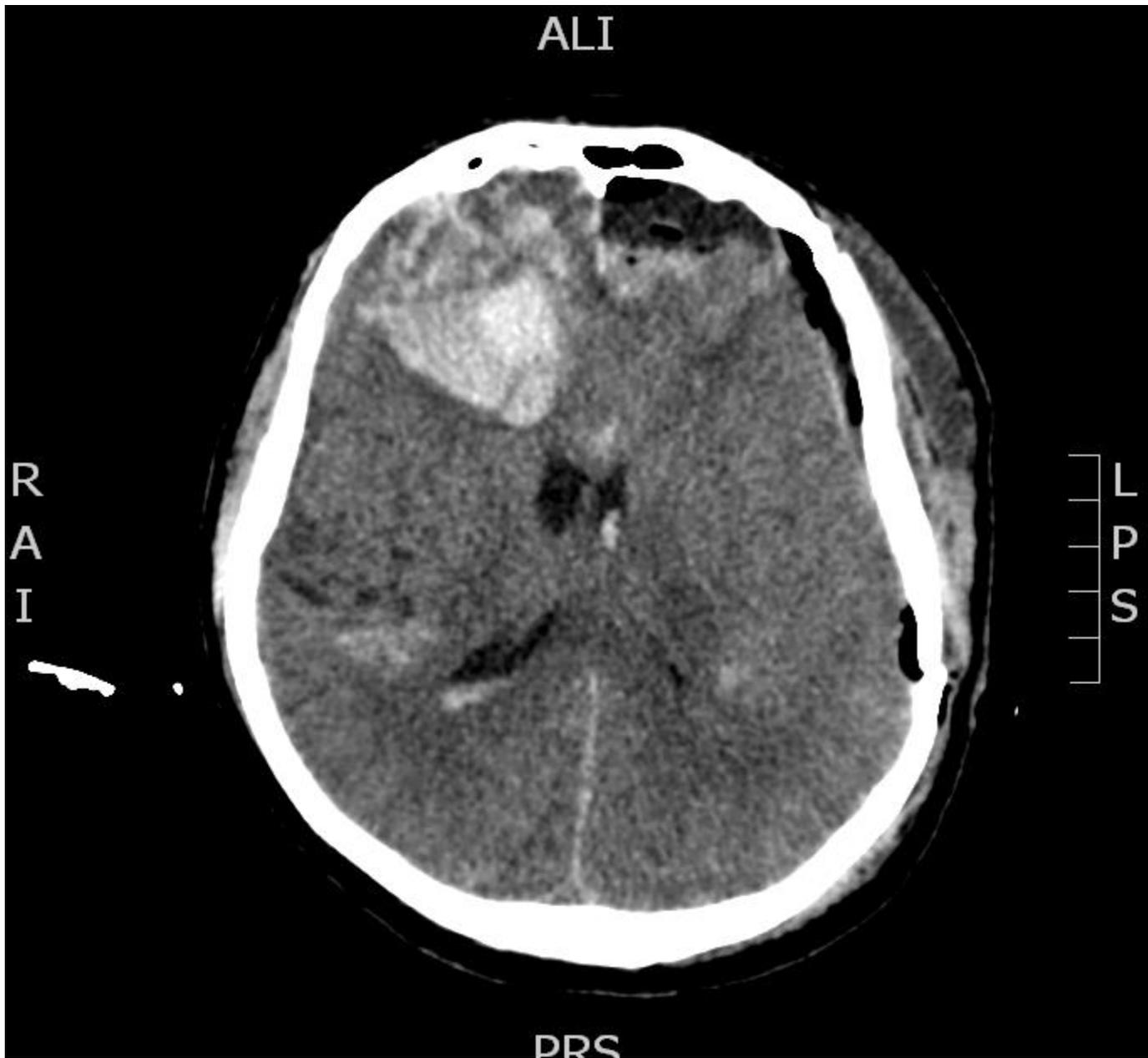
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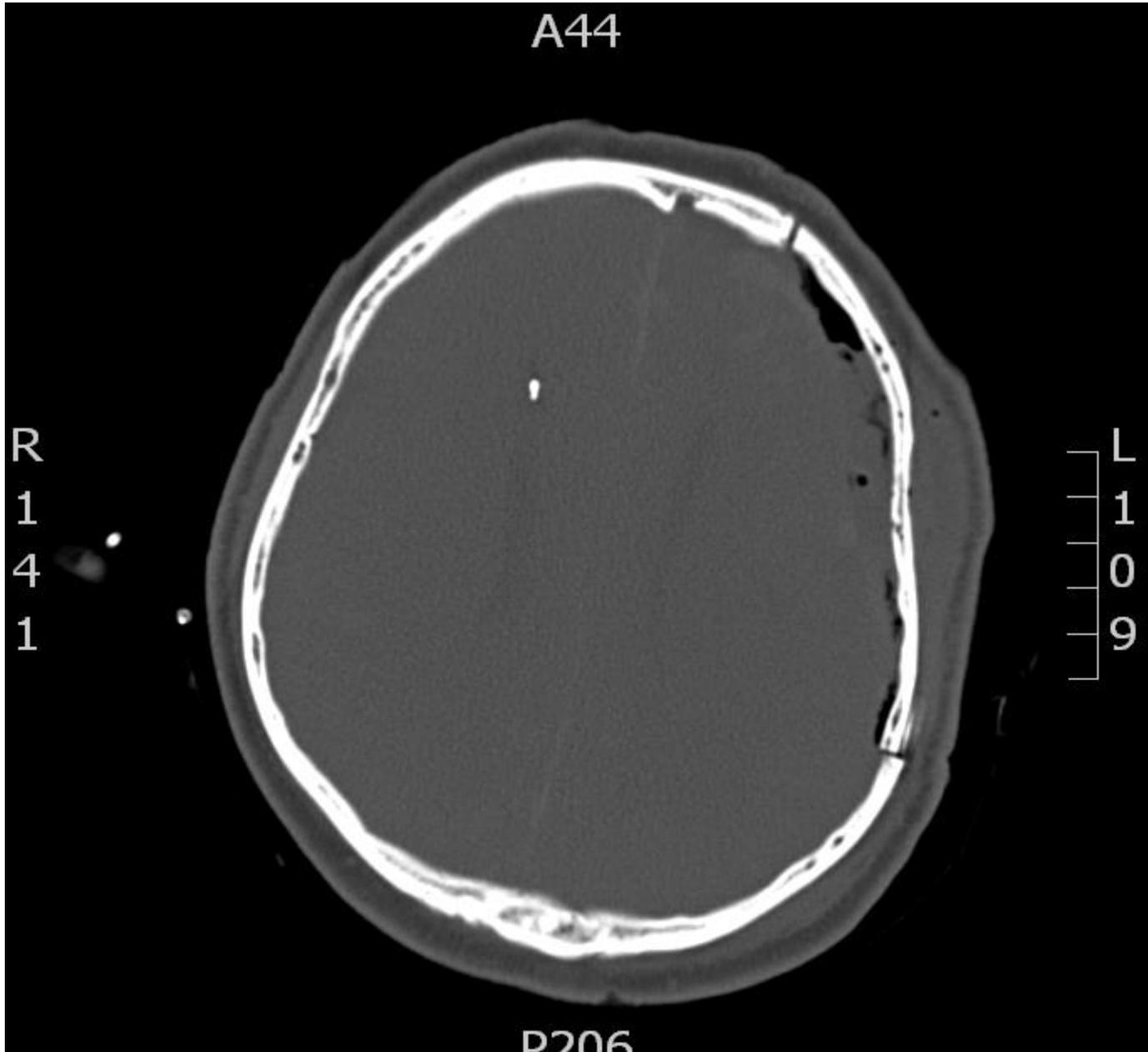


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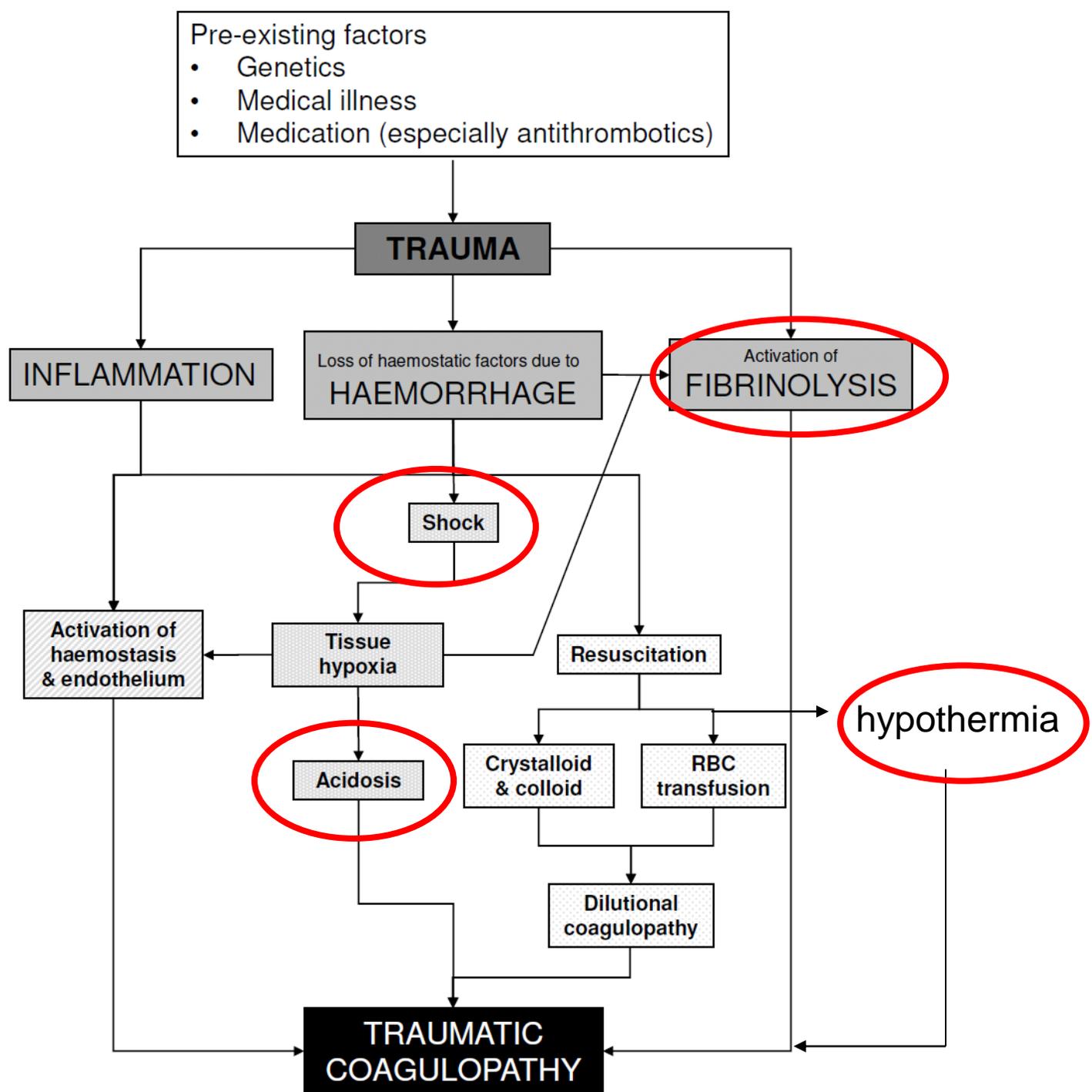
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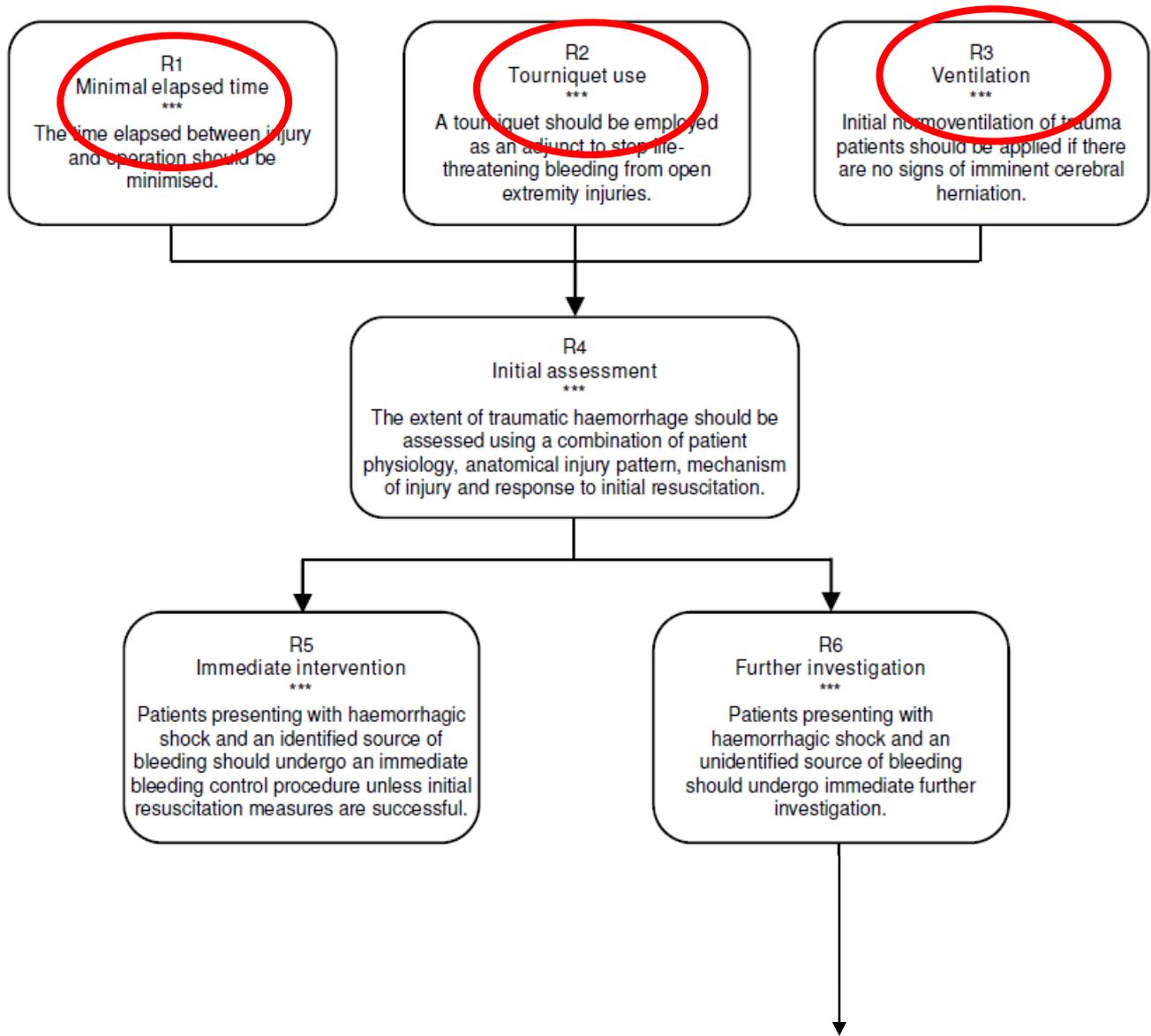
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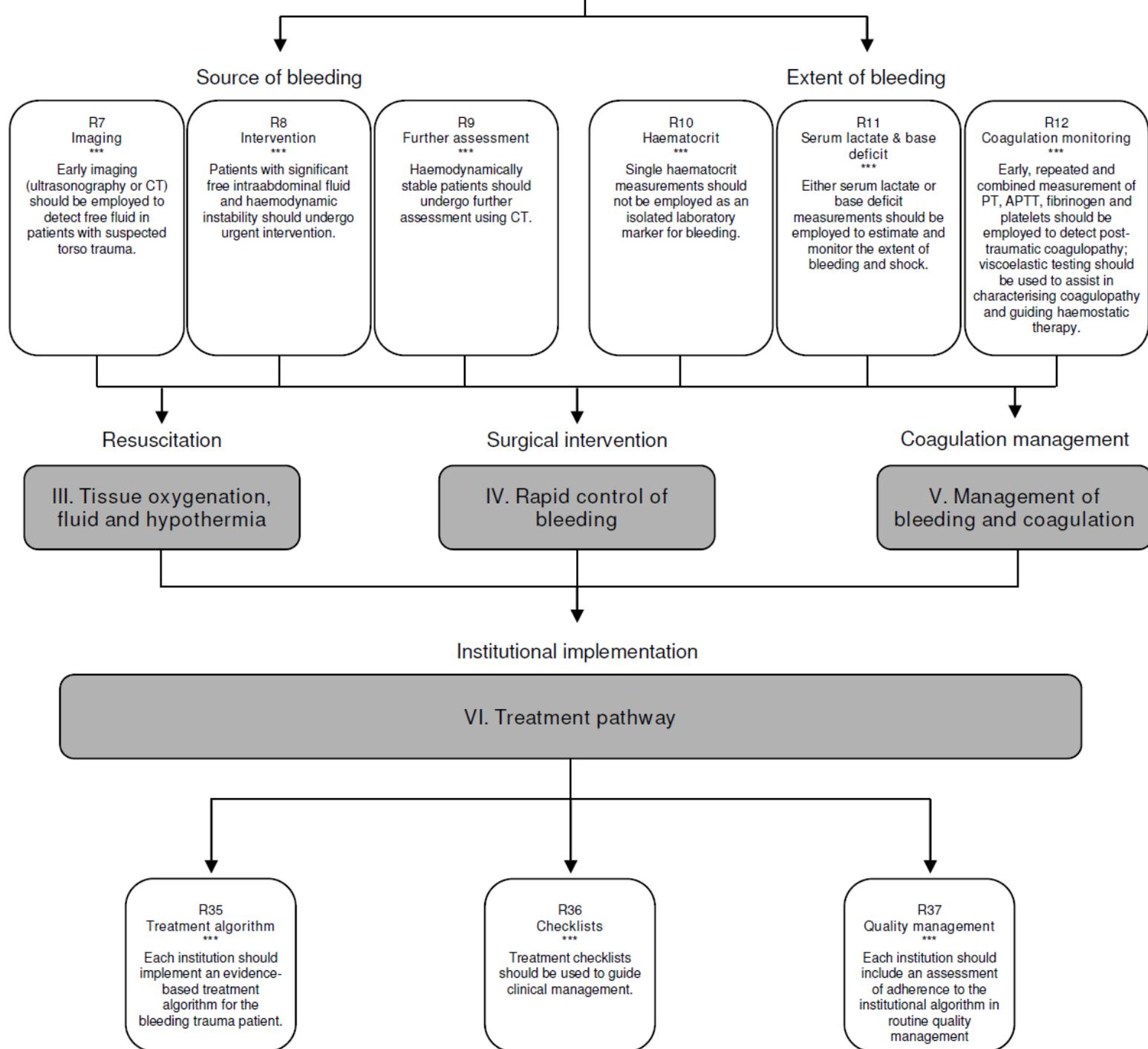
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I. Initial resuscitation and prevention of further bleeding

II. Diagnosis and monitoring of bleeding



Heamostasis disorders treatment

- Damage control
- Treat:
 - Shock
 - Acidosis
 - Hypothermia
- Substitution of thrombocytes and heamocoagulation factors
- Antifibrinolytics

Damage control

- Addresses bleeding and contamination promptly
- Objective: interrupt the downward spiral of acidosis, coagulopathy and hypothermia
- Involves rapid surgery to stop bleeding and decontaminate wounds, deliberately postponing definitive repair until physiological stability has been re-established

The phases of damage control

- **Initial assessment and stabilisation in the Emergency Department**
- **Immediate, limited surgical intervention:** haemorrhage and contamination are controlled using **temporary methods**- closure and stabilisation of pelvic ring disruptions, packing, embolisation and local haemostatic measures.
- **Continuing stabilisation on the ICU:** physiological system control, monitoring for wound complications (e.g. abdominal compartment syndrome, if the abdomen has been closed) and continual vigilance for missed injuries.
- **Re-operation:** definitive repair can now take place. If the original wound was left open at the initial operation, wound closure and definitive repair may be possible now.

Management of Coagulopathy of trauma

- Coagulation monitoring and measures to support coagulation should be implemented as early as possible following traumatic injury and used to guide haemostatic therapy.
- A damage control approach to surgical procedures should guide patient management, including closure and stabilisation of pelvic ring disruptions, packing, embolisation and local haemostatic measures.
- Use appropriate physiological targets and use and dosing of fluids, blood products and pharmacological agents in the bleeding trauma patient.
- The growing number of older patients requires special attention to appropriately manage the inherent thromboembolic risk profiles and possible pre-treatment with antiplatelet agents and/or oral anticoagulants.
- A multidisciplinary approach to the management of the traumatically injured patient remains the cornerstone of optimal patient care, and each institution needs to develop, implement and adhere to an evidence-based management protocol that has been adapted to local circumstances.

Continuing acute care in the ICU

- Respiratory control
- Circulatory control
- Nervous system control
- Metabolic control
- Host defence

Haemodynamics

- Ongoing bleeding
- Cardiac tamponade
- Cardiac contusion
- Traumatic rupture of the heart valves
- Neurogenic shock – spinal cord injury
- Brain stem compromise
- Septic shock (unlikely at early stage)
- Over- sedation
- Allergy to administered drugs or fluids

Haemoglobin

- Before bleeding has been controlled haemoglobin level can be allowed to drop to 100 g/l
- Once bleeding is controlled, a target haemoglobin level of 70-80 g/l is appropriate in most patients.

Take-home messages

- Centralization of trauma care
- Generic approach
- Damage control
- Deliberate under-resuscitation, under-repair
- Correction of haemostasis
- Weight risk vs. benefit