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Pediatric Thoracic Trauma

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7/14/2011

Case Presentation

History

- 3 year old girl pedestrian struck. The child ran out of the laundry mat and hit by a car. Mother did not witness the event but found the child awake, alert, crying, and responsive.
- PMH/PSH: eczema
- Birth hx: unremarkable
- Medications: none
- Allergies: NKDA

Physical Exam

- T 98.8 BP 109/61 HR 147 Sat 98% Wt 15kg
- GCS 11
- HEENT: forehead laceration and left eyebrow laceration, pupils equal and reactive, c-collar intact
- Chest: equal chest rise, BS bilaterally, diminished L>R
- Cardio: regular rhythm
- Abdomen: soft, nondistended
- Ext: gross deformity of the left thigh, pulse palp
- DRE: normal tone

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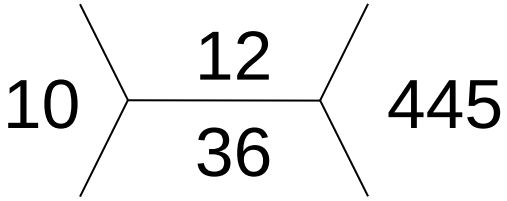
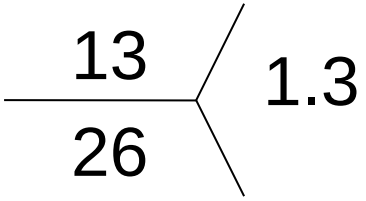
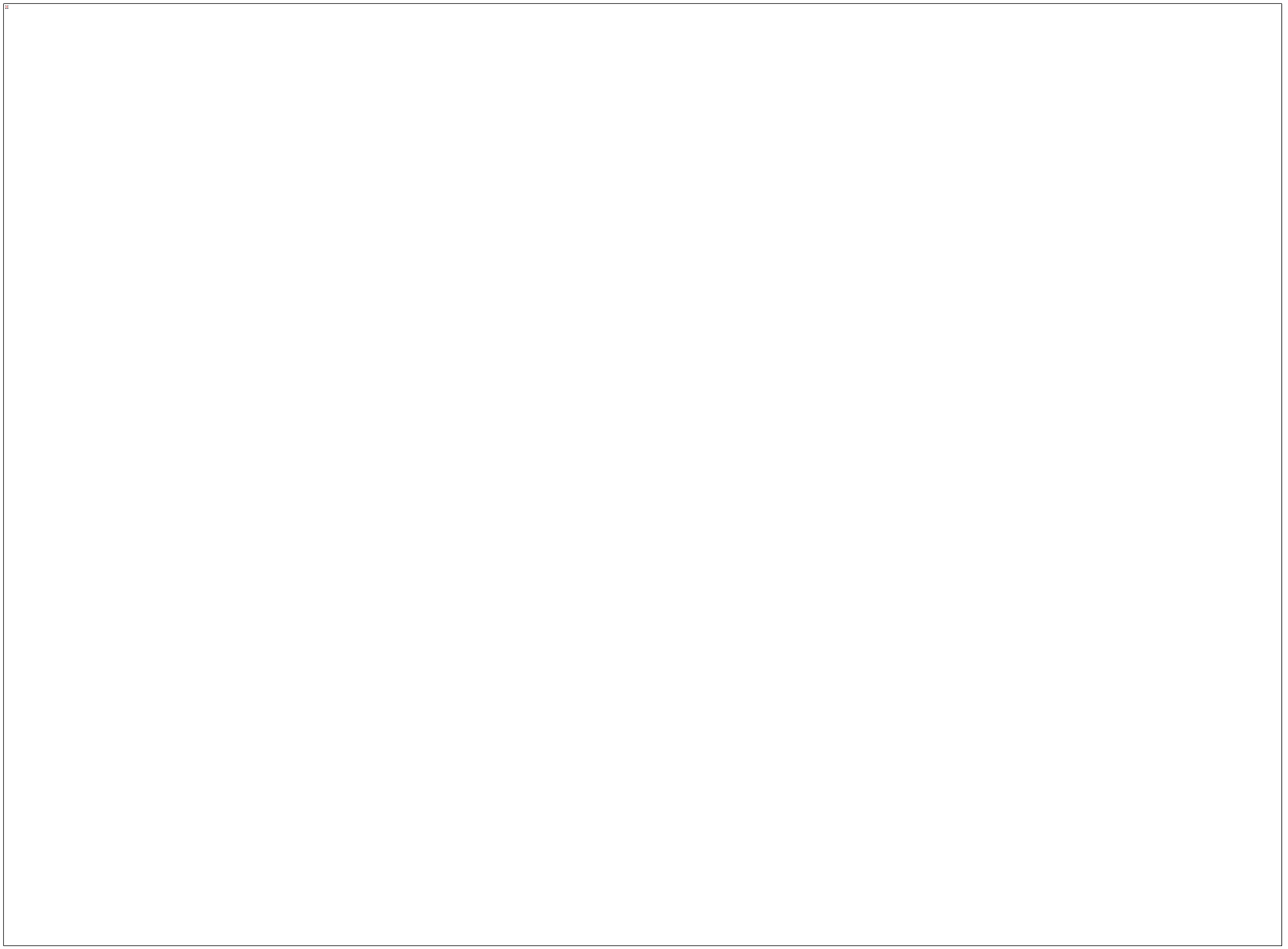
Labs



141	108	14	151
3.5	19	0.68	

6.4	319	241
4.3	147	0.2





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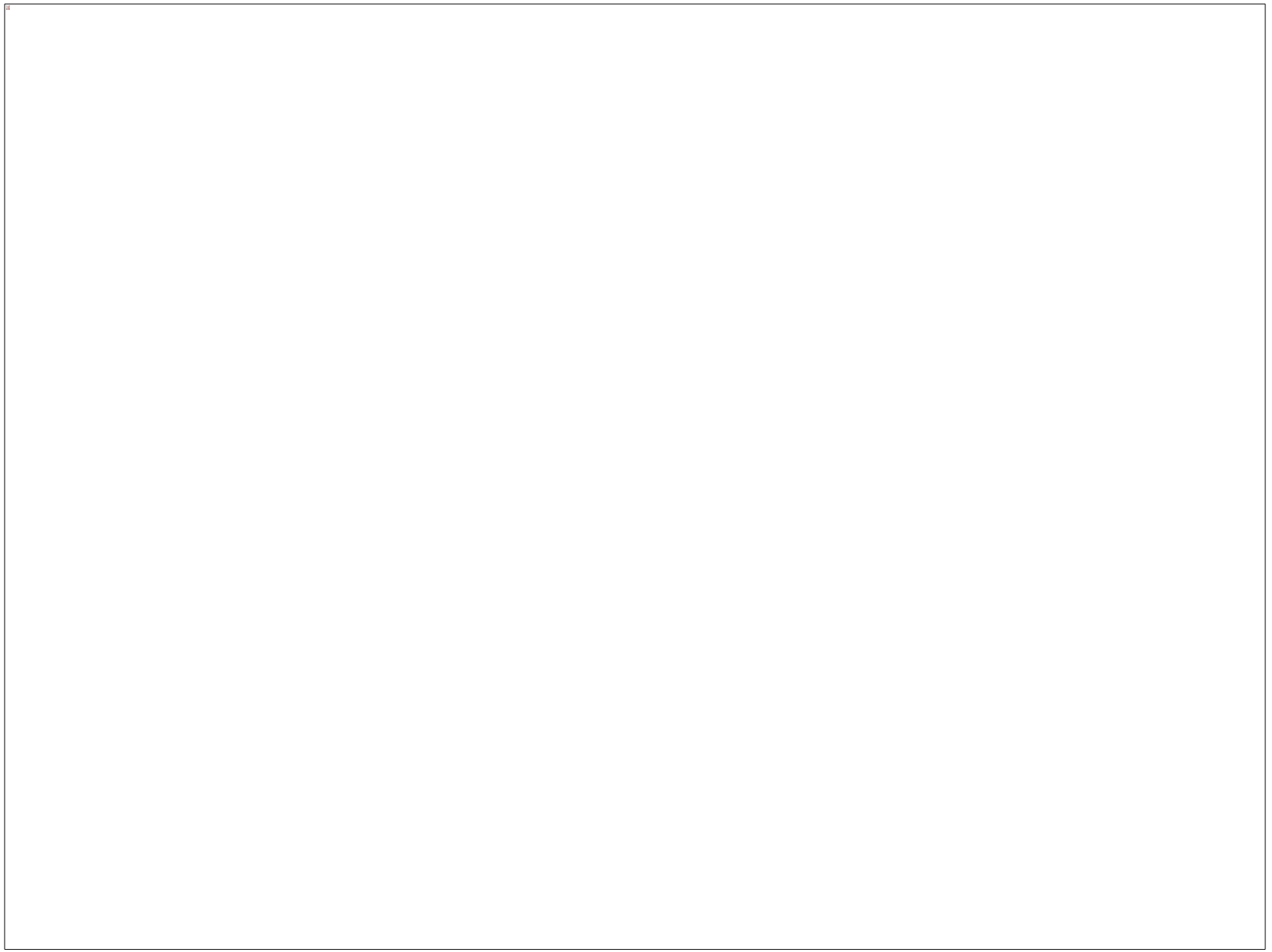
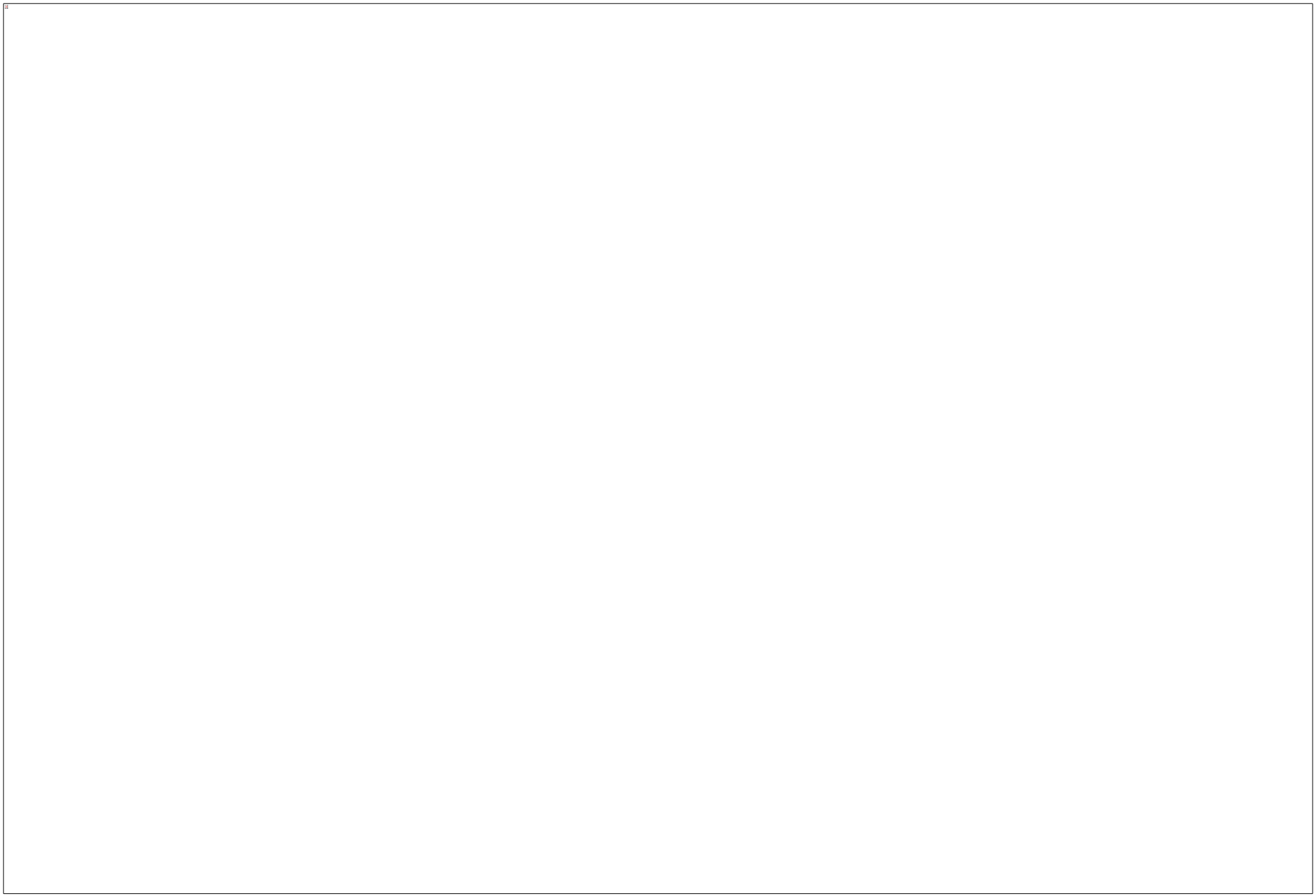


- In the ED, patient was noted to be more lethargic.
- Reassessed, GCS 8, vitals unchanged.
- Intubated.
- Imaging studies
  - Head CT
  - Cervical Spine CT
  - Chest CT
  - Abd/pelvis CT



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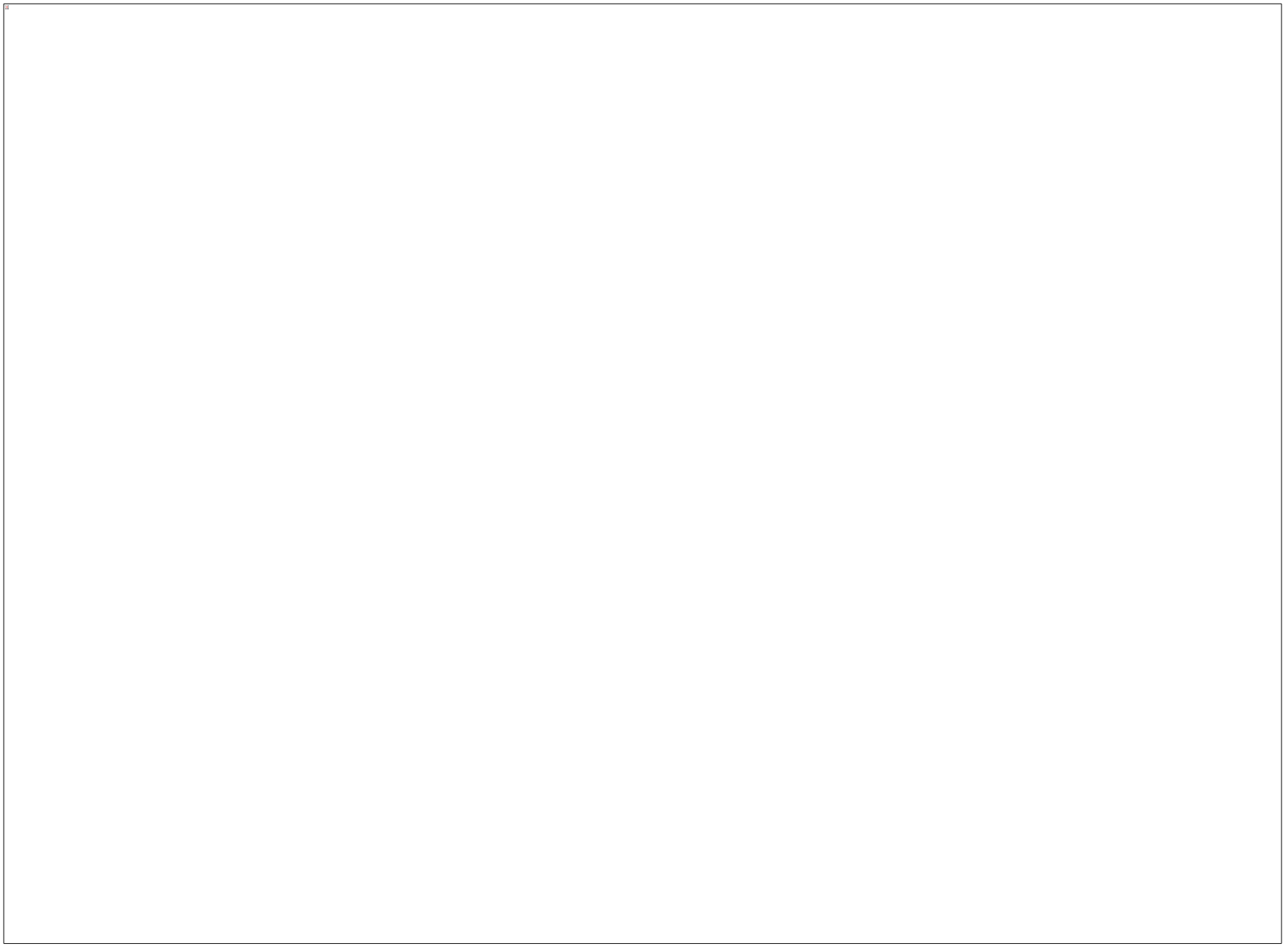

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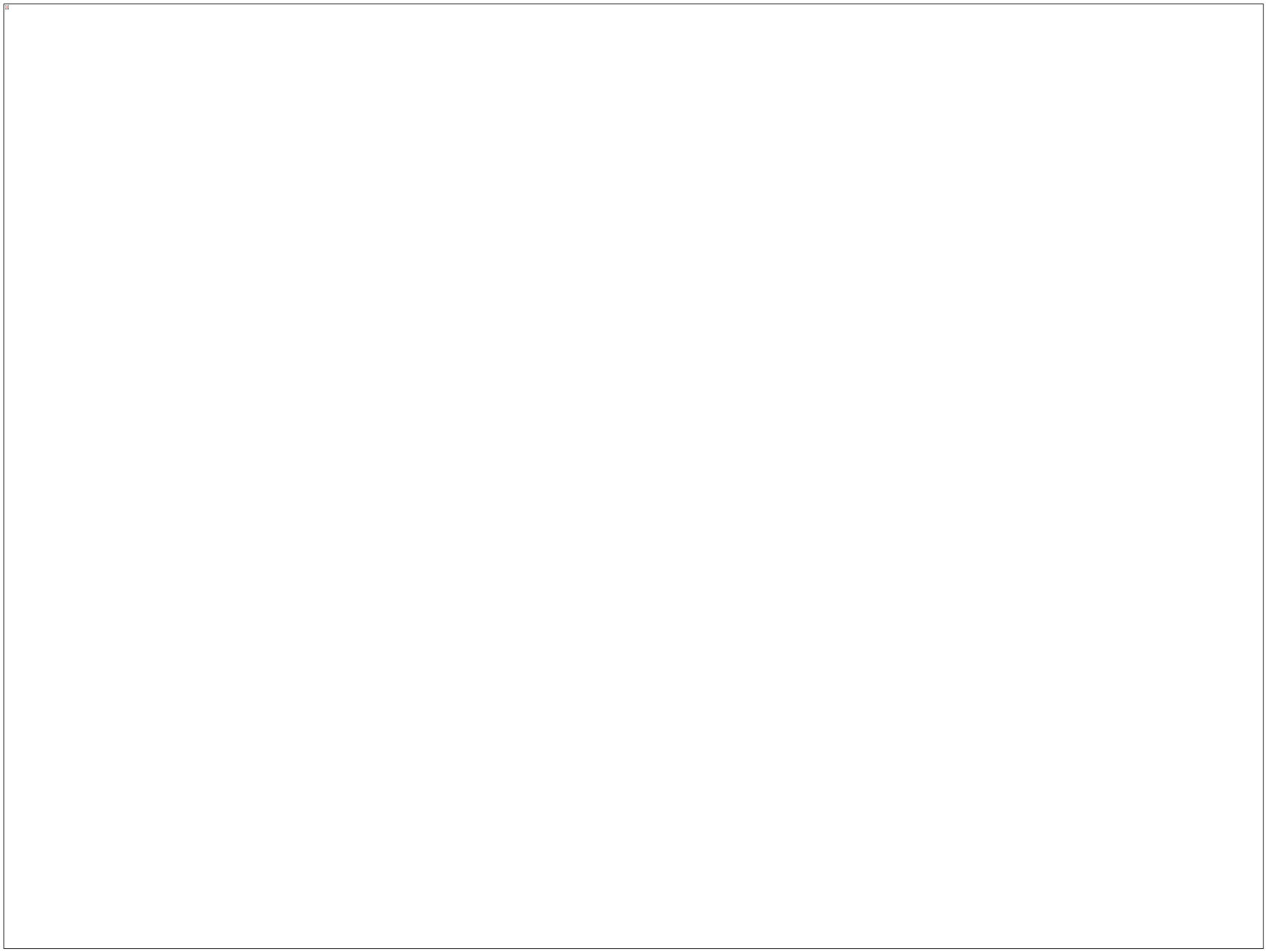

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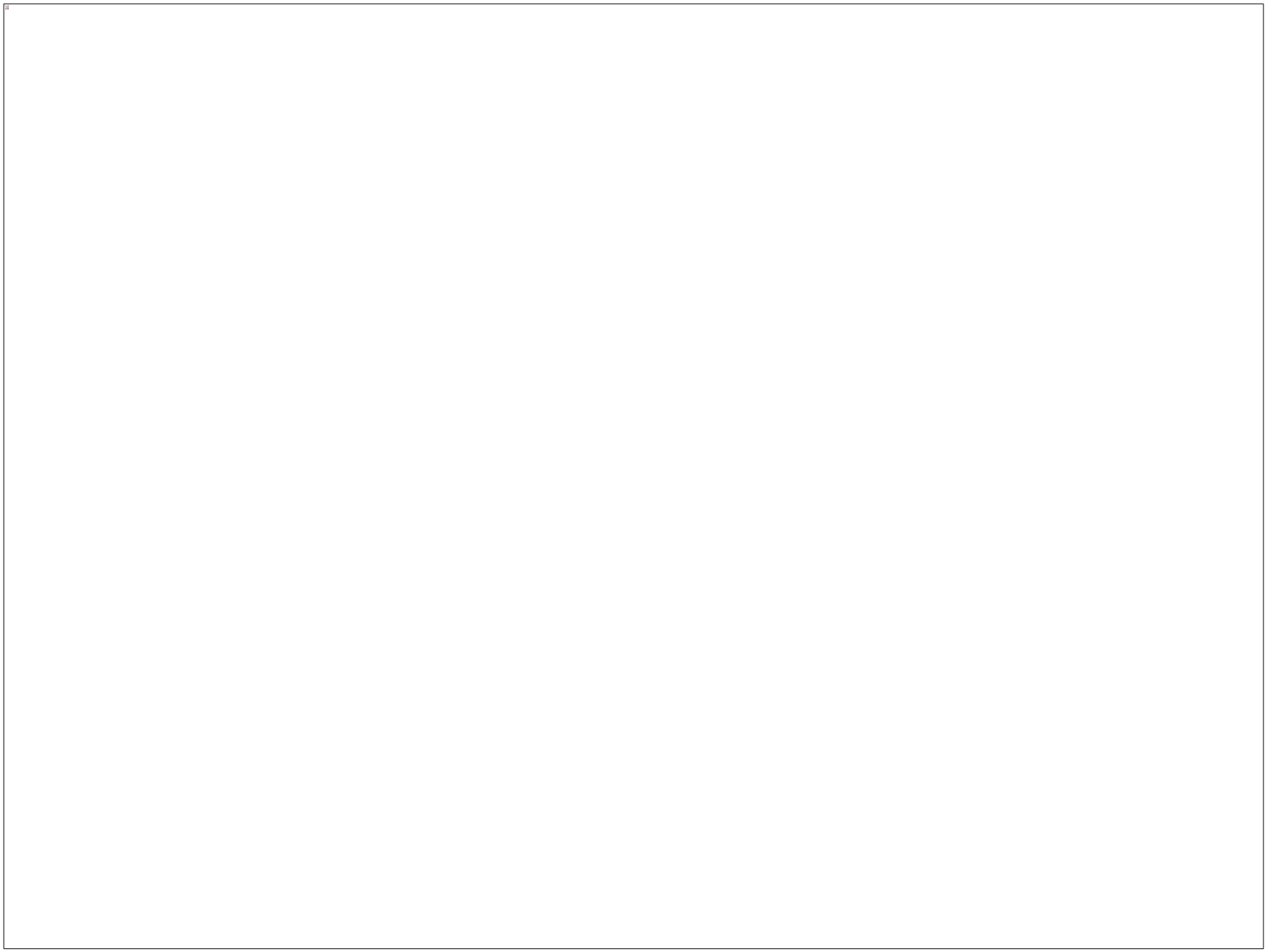

Hospital Course

- HD#2
  - Hct 24, transfused prbc 10cc/kg x 2
  - AST/ALT trending down
  - ABG 7.30/39/122/19/-5.9 on PEEP 5, FiO2 35%
- HD#3-4 – ventilator support
- HD#5 – extubated
- HD#7 – closed reduction of femur fx and placement of hip spica cast by ortho. Transferred to floor from PICU.
- HD#8 – discharged home
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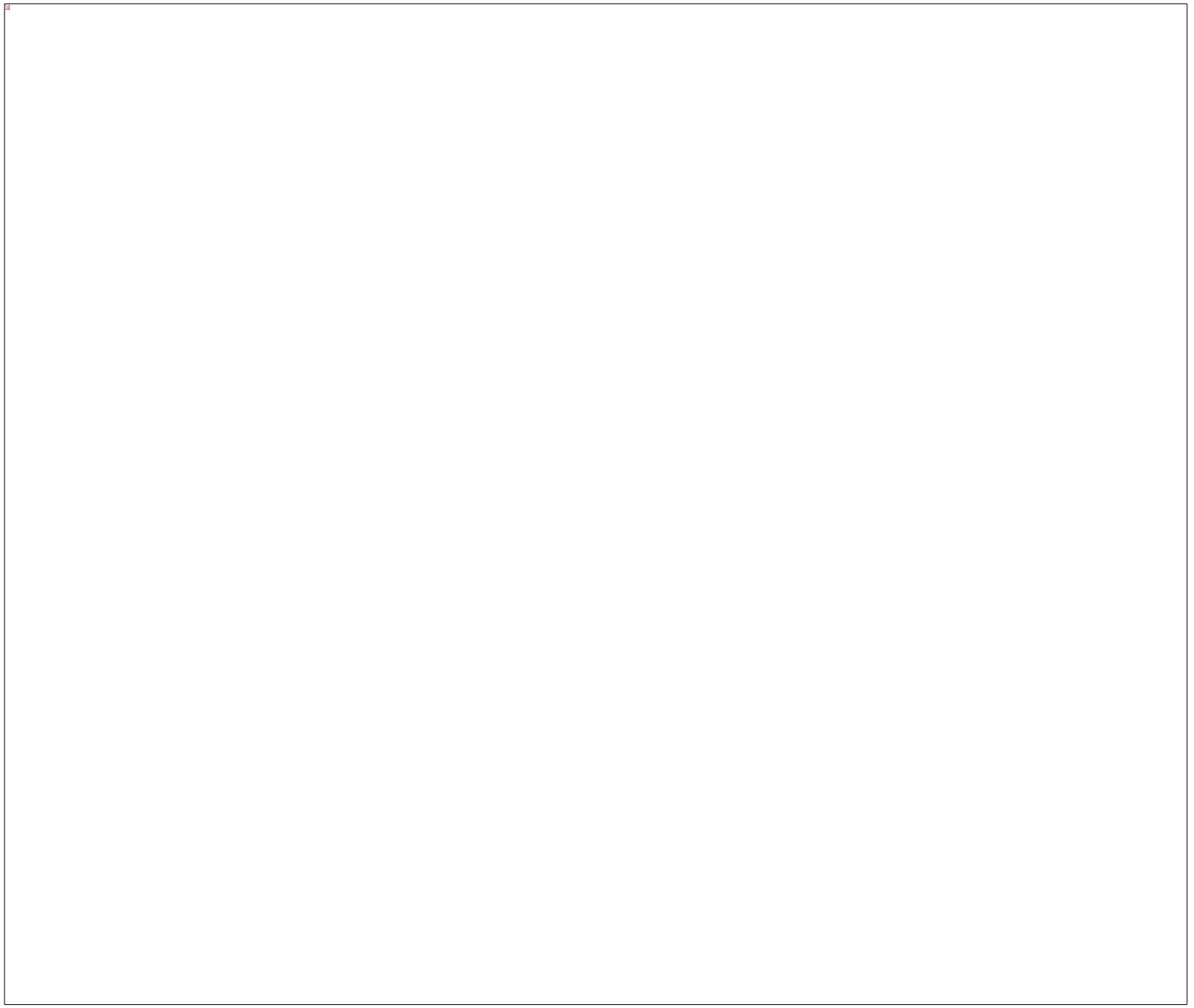

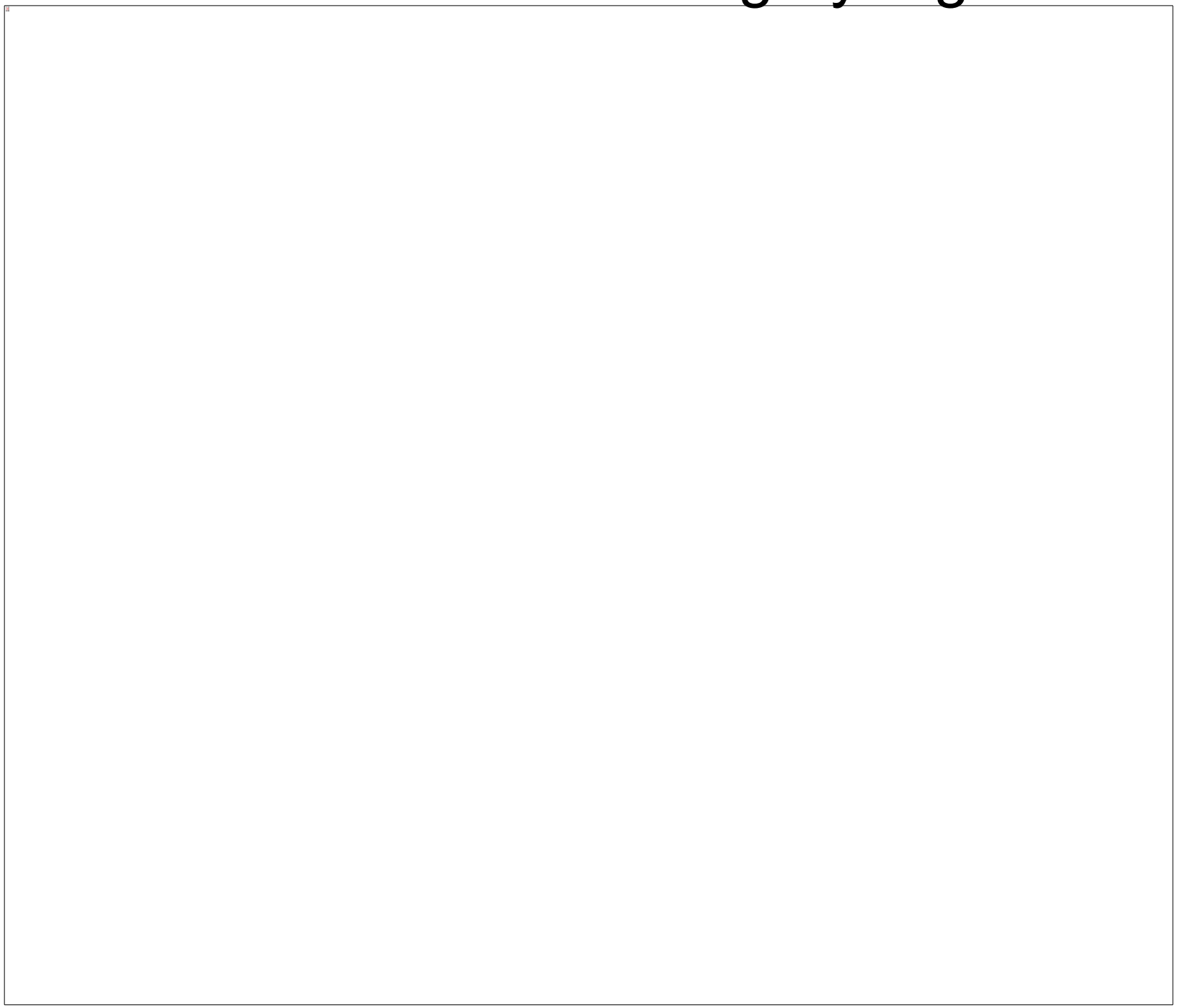

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Pediatric Thoracic Trauma

- Epidemiology
- Assessment
  - A-B-C's
  - Anatomic and physiologic differences
- Thoracic Injuries
  - Rib Fractures
  - Pulmonary contusions
  - Pneumothorax/hemothorax
  - Traumatic pseudocysts

Trauma is the leading cause of death in the pediatric population

Epidemiology

- Thoracic injuries is the second leading cause of death in pediatric trauma following head injuries
- 3x more common in males than females
- Primarily due to blunt trauma (85%):
  - Motor vehicle collisions (passenger/pedestrians)
  - Falls
  - Child abuse
  - Sports injuries (adolescents)

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- Most common thoracic injuries
  - Pulmonary contusion
  - Pneumothorax
  - Hemothorax
  - Rib fractures
- 60-85% of thoracic injuries have other significant injuries
- Overall mortality from thoracic trauma is 15 – 25%
  - Isolated thoracic trauma – 5%
  - Thoracic and head or abdominal trauma – 28-37%
  - Thoracic, head and abdominal trauma – 40%

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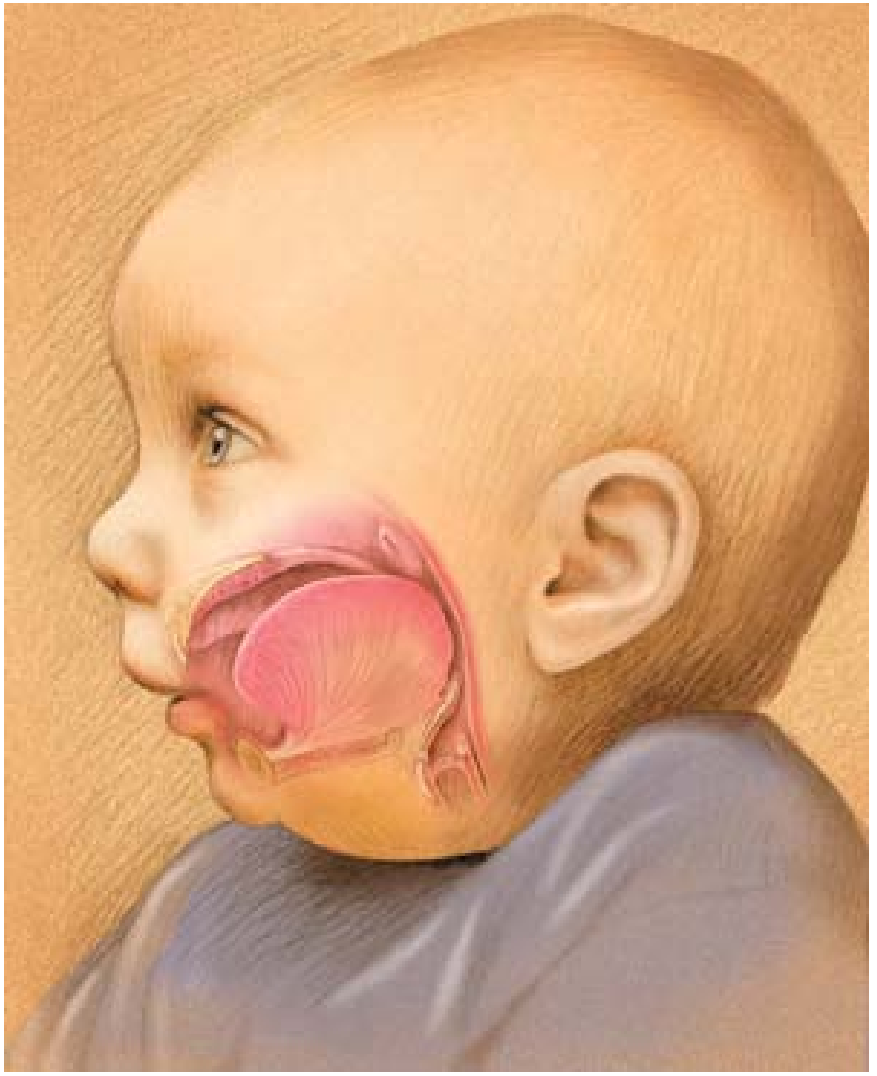
Children are NOT the same as adults!

Airway

- Large head and short neck – neck passively flexed
- Large tongue - upper airway obstruction
- Narrowest point at subglottis
  - ET tube size – size of 5th digit
- Short trachea – right main stem intubation
- Surgical airways
  - Surgical cricothyrotomy not recommended <10yo
  - Prefer needle cricothyrotomy



Breathing

- Smaller chest transmit breath sounds more readily – large ptx can be present with what sounds like equal breath sounds
- Chest wall is more compliant = increase work of breathing
- High basal metabolic rate = rapid oxygen consumption = hypoxia
- Functional residual capacity is smaller in proportion to total lung volume – less reserve to preoxygenate with 100% O2 = rapid desaturation during intubation

Circulation

Table 5 Normal Vital Signs by Age

Age	Weight (kg)	Heart rate (beats/min)	Pressure[a] (mmHg)	Respirations (breaths/min)	Urine output (mL/kg/hr)
0–6 months	3–6	160–180	60–80	60	2
Infant	12	160	80	40	1.5
Preschool	16	120	90	30	1
Adolescent	35	100	100	20	0.5

[a]Systolic blood pressure should be 80 + 2 age (yrs).
Source: Taken from Advanced Trauma Life Support® for Doctors Instructor Manual.

- Blood pressure is not a reliable assessment
- Rate, quality of peripheral pulse, skin color/temp, capillary refill are better indicators of adequate perfusion

Circulation

- Normal blood volume = 70-80ml/kg
- What appears to be a small amount of blood can be significant blood loss in child
- Compensate up to 40% blood loss
- Access: intravenous, intraosseous, saphenous cut-down
- Resuscitation
  - 20ml/kg Lactated Ringers/Normal saline bolus
  - 10ml/kg prbc

Rib Fractures

- Uncommon in younger children
- Thoracic cage is more compliant
  - Increase cartilage content
  - Incomplete ossification of ribs
- Significant injuries can be present WITHOUT rib fractures – Increase compliance allows greater transmission of kinetic energy to the underlying lung parenchyma
- Presence of rib fractures is a marker of severity of injury
  - Mortality rate 42% vs 2% comparing children with and without rib fractures

Pattern and presentation of blunt chest trauma among different age groups.

Moataz Hanafi, Nael Al-Sarraf, Hazem Sharaf, Atef Abdelaziz.

Asian Cardiovascular and Thoracic Annals 2011; 19:48-51

Table 2. Isolated chest injuries stratified by age

Isolated chest Injury	Pediatric	Adult	Elderly	*p* Value
No. of patients	30 (65%)	260 (68%)	45 (82%)	
Rib fractures only	7 (15%)	132 (34%)	5 (9%)	0.02
Rib fractures with hemothorax/ pneumothorax/hemopneumothorax	23 (50%)	72 (19%)	40 (72%)	0.03
Bilateral rib fractures + emphysema requiring bilateral chest tubes	0	56 (15%)	0	>0.05
Parenchymal lung injury	0	30 (8%)	2 (4%)	0.01
Lung contusion	2 (4%)	40 (10%)	3 (5%)	>0.05

Pulmonary Contusion

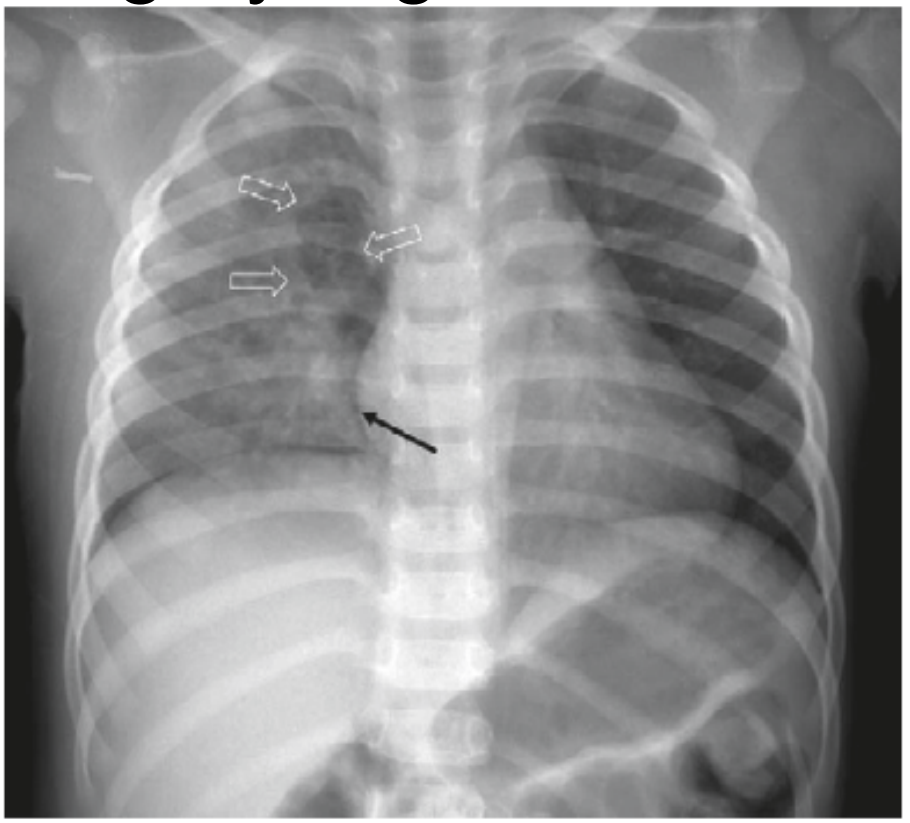
- More common in children and will often present without rib fractures
- Appear as irregular infiltrates in nonanatomic distribution
- Decrease lung compliance and ventilation/perfusion mismatch leads to hypoxia
- Treatment: supportive – analgesia, supplemental oxygen, mechanical ventilation

Pneumothorax/Hemothorax

- Pneumothorax
  - Breath sounds may sound equal, sound easily transmitted from contralateral side
  - Observation of asymmetric chest rise
  - Tension pneumothorax – high risk of cardiopulmonary collapse due to mobile mediastinum
- Hemothorax
  - Commonly from penetrating trauma, rib fractures, high speed collison
  - Indication for thoracotomy
    - Initial drainage >15-20ml/kg
    - Ongoing drainage >3ml/kg/hr

Traumatic Pneumatocele/Pseudocyst

- Cavitary lesions without an epithelial lining that develop in lung parenchyma after blunt trauma
- Rare finding, 3-4% of thoracic trauma
- Occurs in children and young adult
- Rapid compression/decompression causes lung parenchymal lacerations resulting in thin-walled cavity lesions filled with air and fluid
- Associated with pulmonary contusion, hemothorax, pneumothorax, rib fracture
- Symptoms: hemoptysis, cough, chest pain, dyspnea
- Dx: clinical history of trauma and CXR/**CT scan**
- Course is usually self-limited, resolves spontaneously weeks-months
- Treatment is conservation management unless complicated by infection, bleeding, increasing size



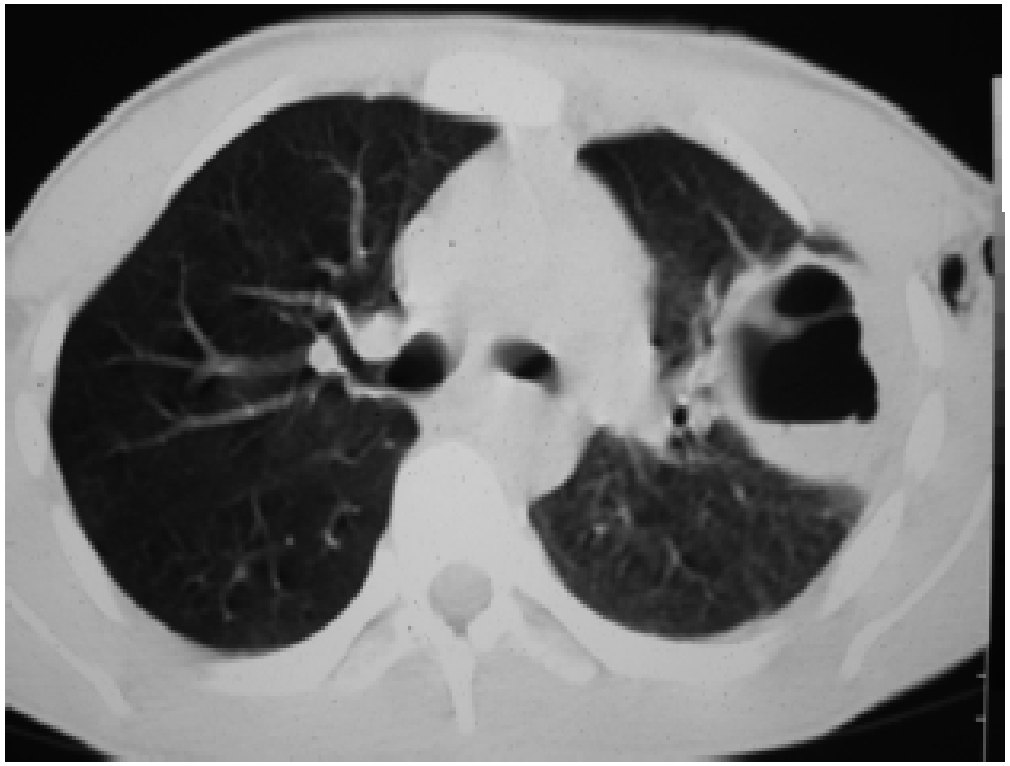


Table 1: The general characteristics of the TPP cases reported in the last 10 years.

Study	n	Age	Sex	Etiology	Hemo and/or pneumothorax	Treatment of TPP	Resolution time of TPP
Stathopoulos et al (2002)	1	16	Male	Motorcycle accident	1	Conservative	2 months
Melloni et al (2003)	10	27 (18–44)	Male 9 Female 1	Traffic accident 10	8	Conservative 9 Emergency lobectomy 1	5 (3–6) months
Athanassiadi et al (2003)	14	(13–24)	Male 11 Female 3	Traffic accident 14	6	Conservative	6–11 weeks
Watanabe et al (2005)	1	34	Male	Sport injury	1	Conservative	43 days
Crausman RS (2006)	1	38	Male	Industrial machinary	-	Conservative	?
Celik B and Basoglu A (2006)	1	28	Male	Mototrcycle accident	1	Conservative	?
Chon et al (2006)	12	17.7 (2–48)	Male 11 Female 1	Traffic accident 9 Fall down 2 Battery 1	11	Conservative	85.6 days
De et al (2007)	1	19	Male	Traffic accident	1	Conservative	?
Cai MH and Lee WJ (2007)	1	26	Male	Motorcycle accident	1	Conservative	?

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