PEDIATRIC TRAUMA:

Implications for Respiratory Care

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Rainbow Babies
& Children's Hospital

Disclosures

- none
- images

Objectives

- Review basic trauma management principles.
- Discuss thoracic trauma pathophysiology.
- Discuss thoracic trauma management.


Childrens

Why is this important?


Laramie
Award Winner
Medical Center

OKLAHOMA TORNADO: IN CONTEXT

The magnitude of the tornado that tore through Moore, Oklahoma, is hard to imagine. To put it in context, had the tornado touched down at Battery Park on the southern tip of Manhattan and continued in a straight northward direction it would have cut its 1.3-mile wide, 17-mile long path all the way to Yonkers. In the process it would have covered most of the east side of Manhattan island including all of Central Park. Moving at approximately 35 mph, all of this would have happened in around 30 minutes, much less than the one hour it takes to travel from Battery Park to Yonkers on MTA subway and buses during rush hour.

See more context on the magnitude of the storm below.

WIDTH

The 1.3-mile wide path is equal to

19 football fields laid end-to-end

AREA

The square miles that the tornado's path covered is equal to

96% of Manhattan

WIND SPEED

Tornado top winds **200+** mph

Hurricane Katrina estimated top winds

175 mph

Avg. speed of Daytona 500 winner

153 mph

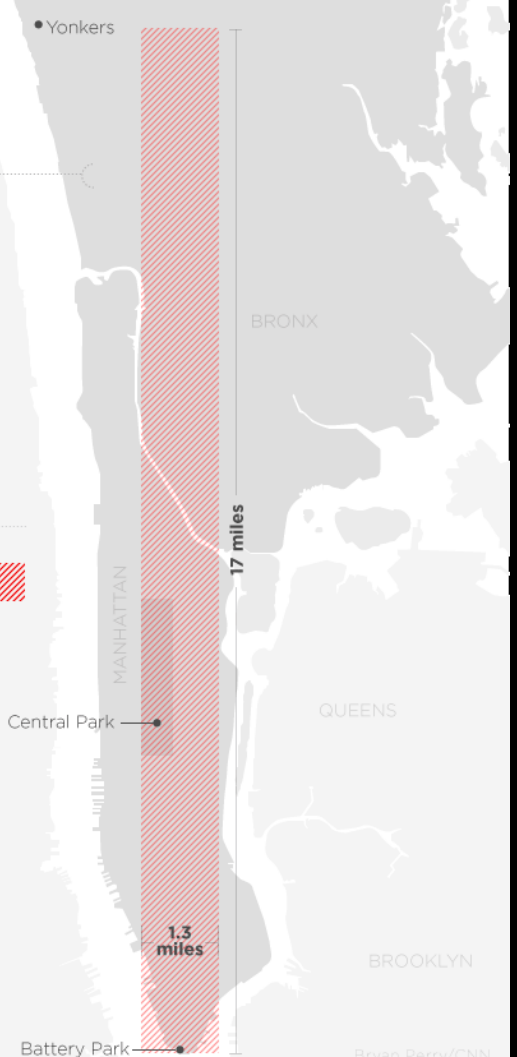
TRAVELLING SPEED

The storm travelled at a speed of

34 mph

slightly less than the speed limit on an average residential street

SPEED LIMIT 35



Sources NOAA, NASCAR, Metropolitan Transportation Authority

Bryan Perry/CNN


Janae Hornsby

Trauma Stats

University Hospitals
Cleveland | Ohio

Rainbow Babies
& Children's Hospital

Why is this important?

- How many children die per year from cancer?

2,000

Why is this important?

- How many children die from traumatic injuries per year?

20,000

- More than ALL OTHER causes of death combined!
- Global = 1 million pediatric injury deaths / year.

- 50,000 children are **permanently disabled**.
  - Most are due to head injury.

- #1 MVC #2 Peds vs Auto #3 Falls

Case #1

4yo penetrating chest injury

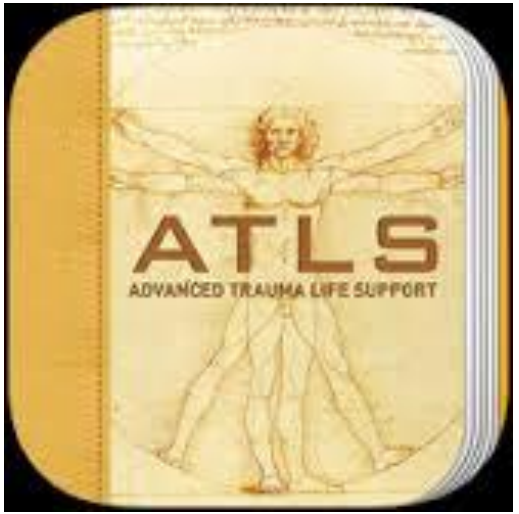
Case #1 – penetrating thoracic injury

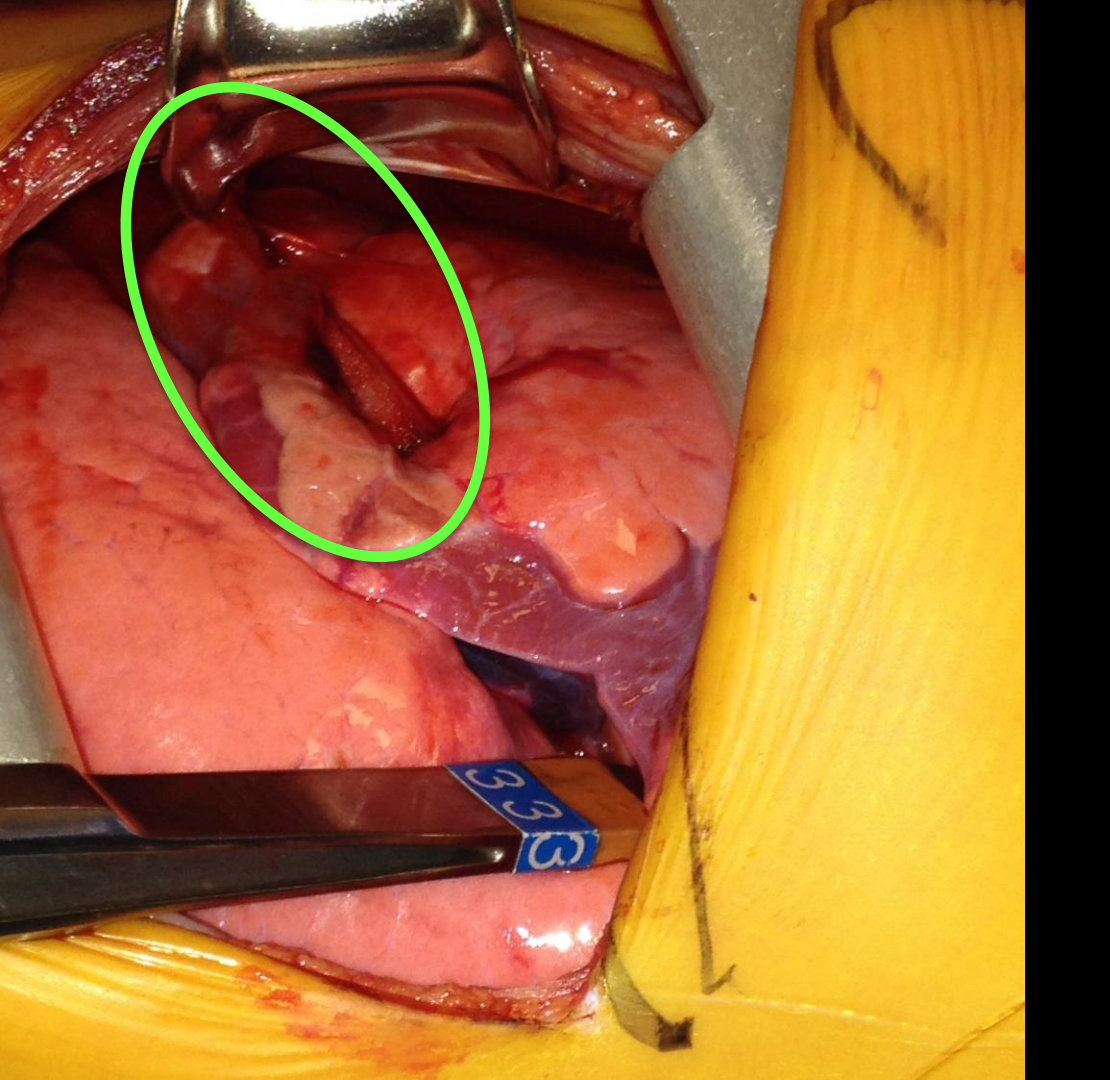
- 4yo M ran into a glass sliding door.
- Helicopter scene transport to a Level 1 peds trauma center.
- En route:
  - initially stable
  - progressive tachypenia
  - “large” amount of bleeding from left chest wound


SOFT-CUF®
REF 2501
12-19 CM

Case #1 – penetrating thoracic injury

- What are your priorities?
- *Primary Survey*
  - **A**irway, **B**reathing, **C**irculation
  - Adjuncts: IV access, O2, CXR, pelvis, FAST
  - Hard Stop
- *Secondary Survey*
  - Quick, focused head to toe physical

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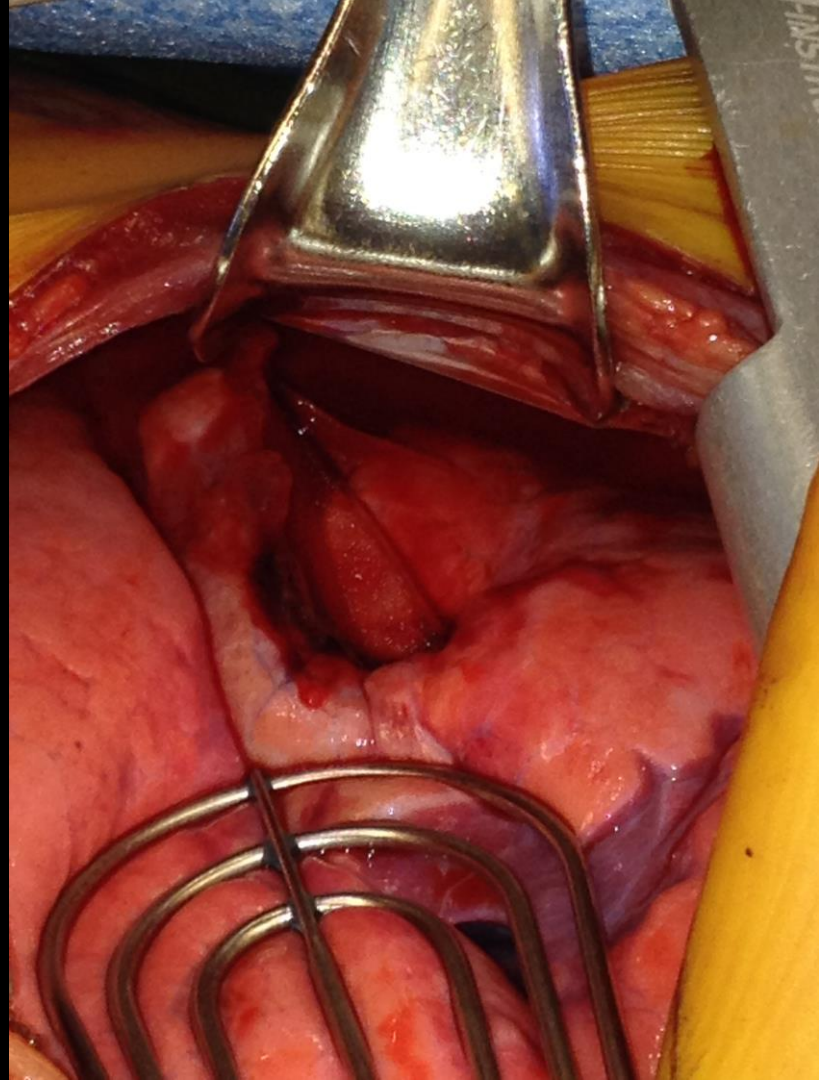
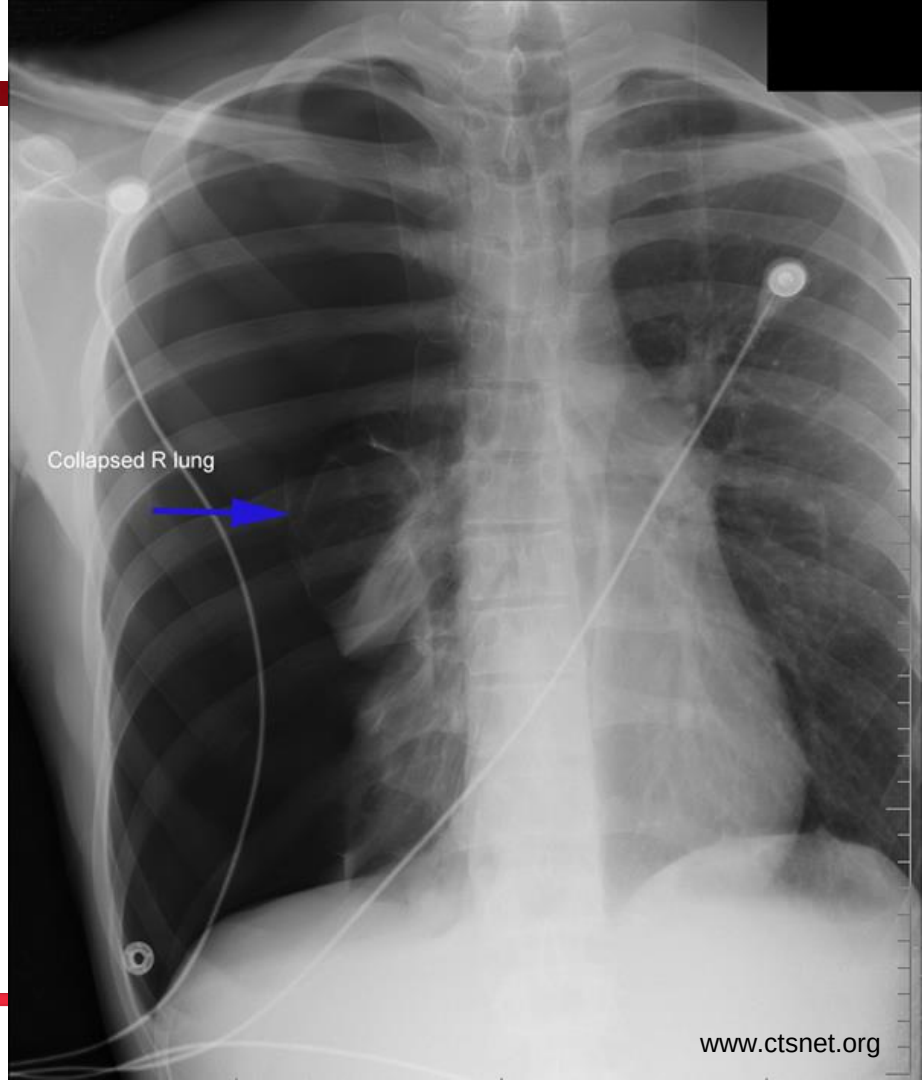


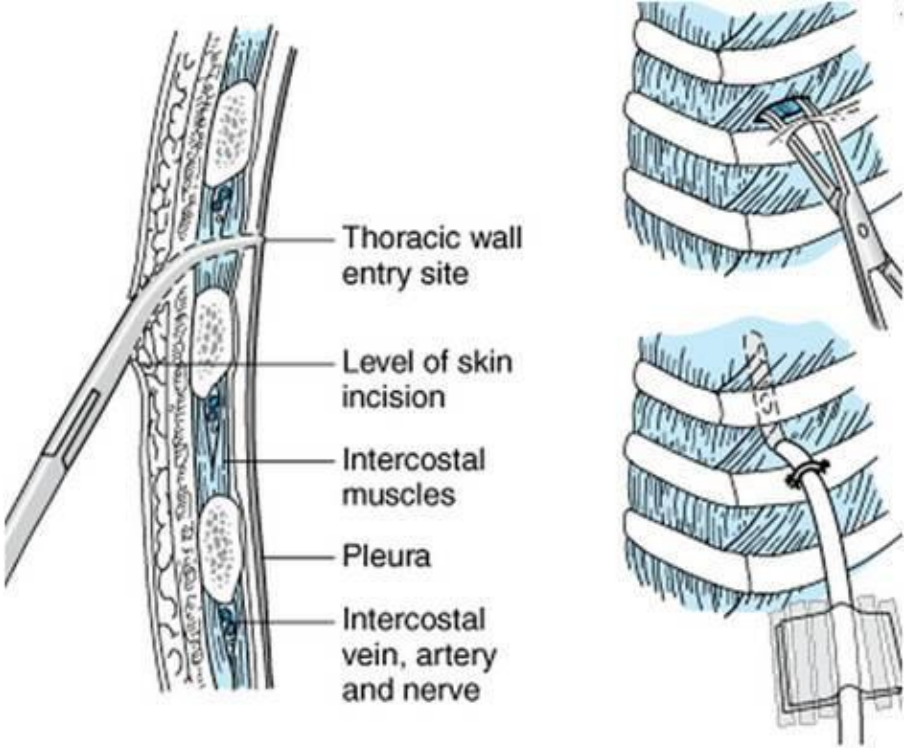

CM 1 2 3 4 5 6 7 8 9
INCHES 1 2 3
Cardinal Health

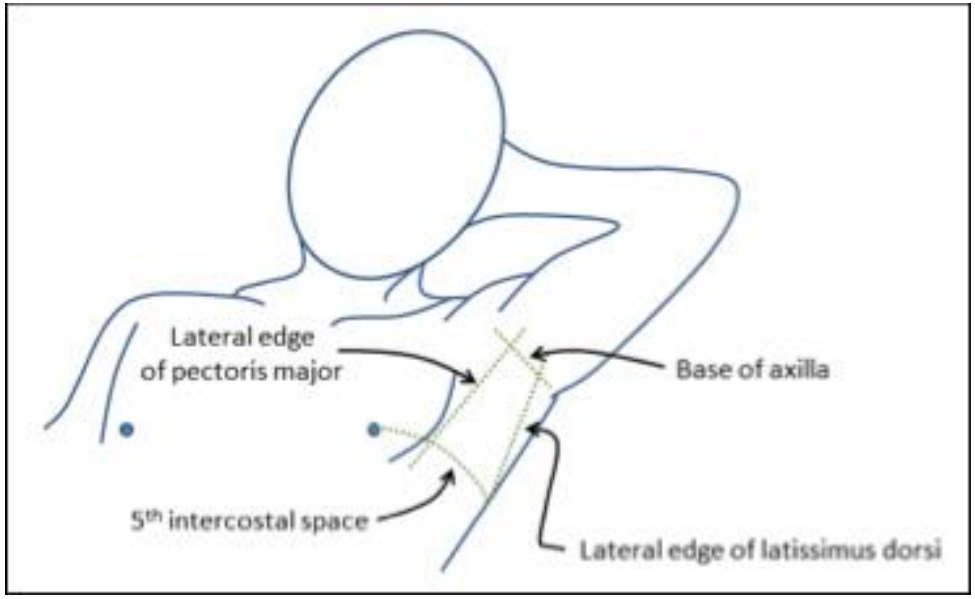
Penetrating Thoracic Injuries

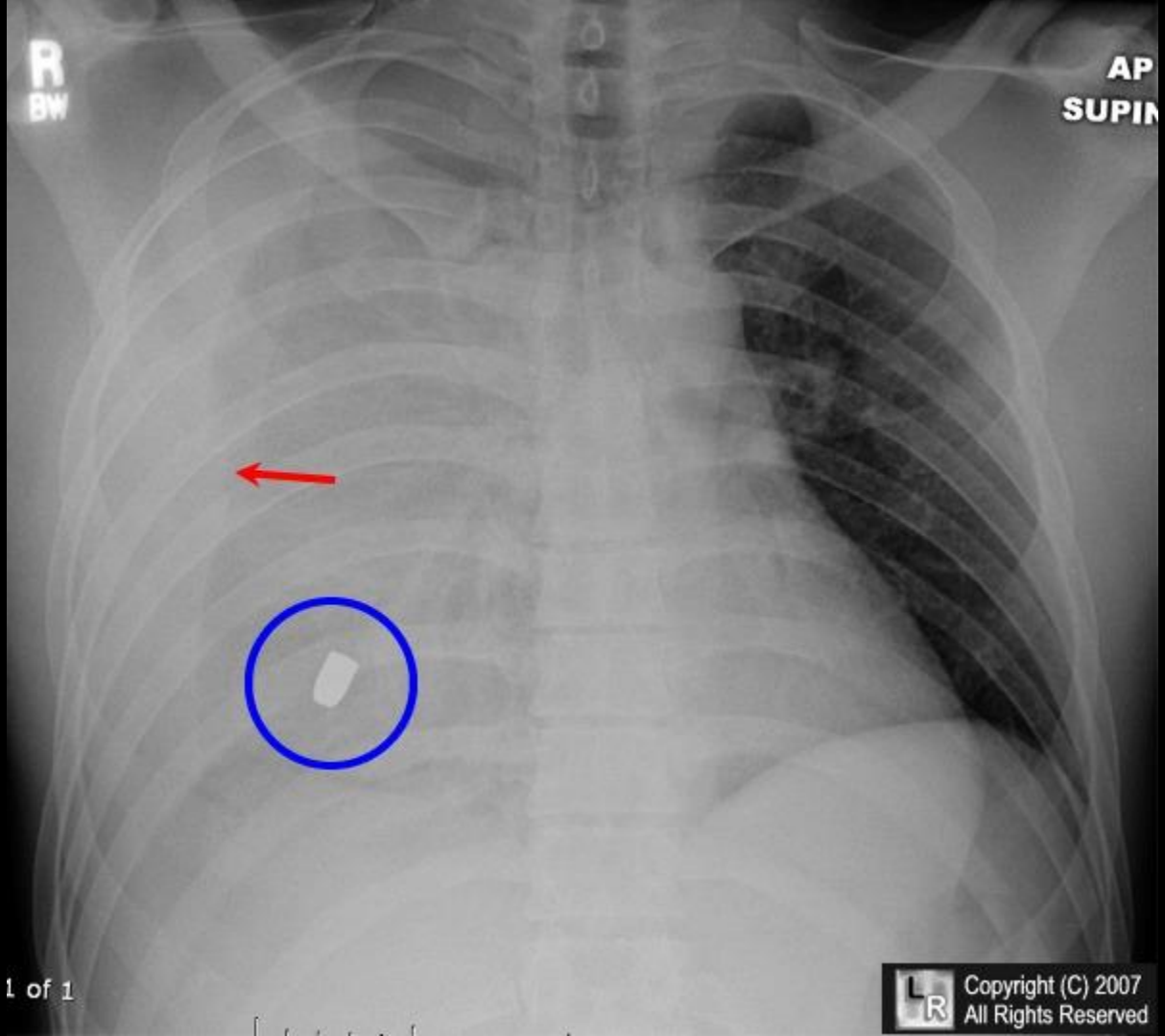
Pneumothorax

- Common with chest injuries.
- Treated with simple chest tube.
    - Tube thoracostomy



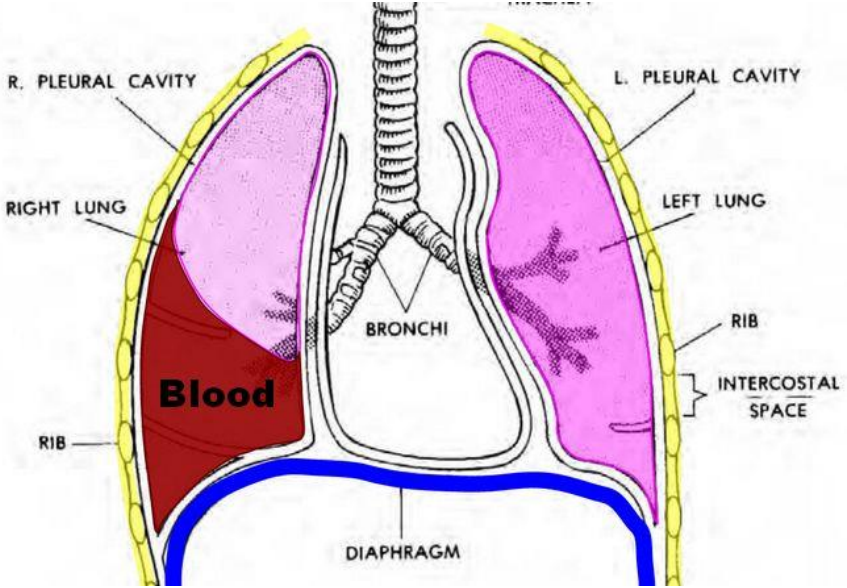






Hemopneumothorax

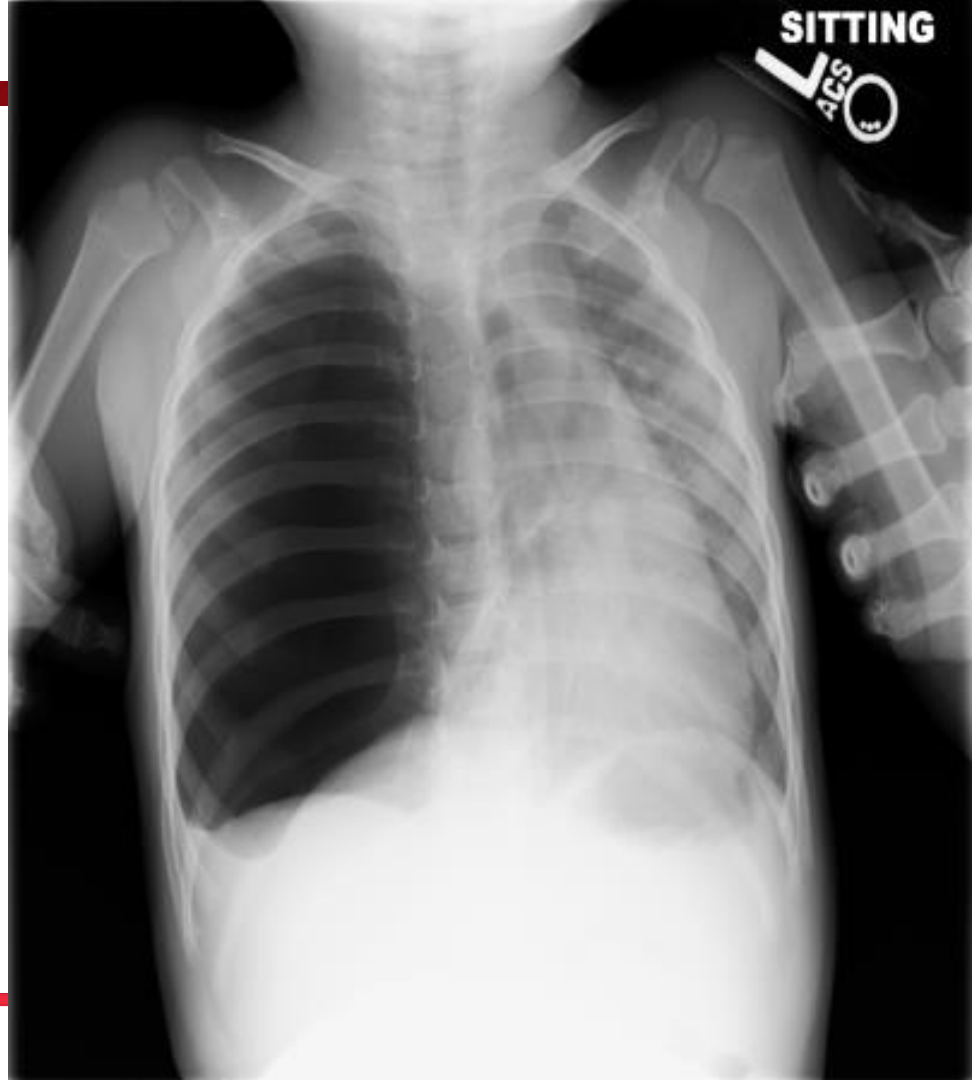
- More common in trauma
- Requires chest drainage
  - Short term effects
  - Long term effects
- When to operate?
  - Most heal on their own
  - Initial output >1200ml
  - >200ml / hour

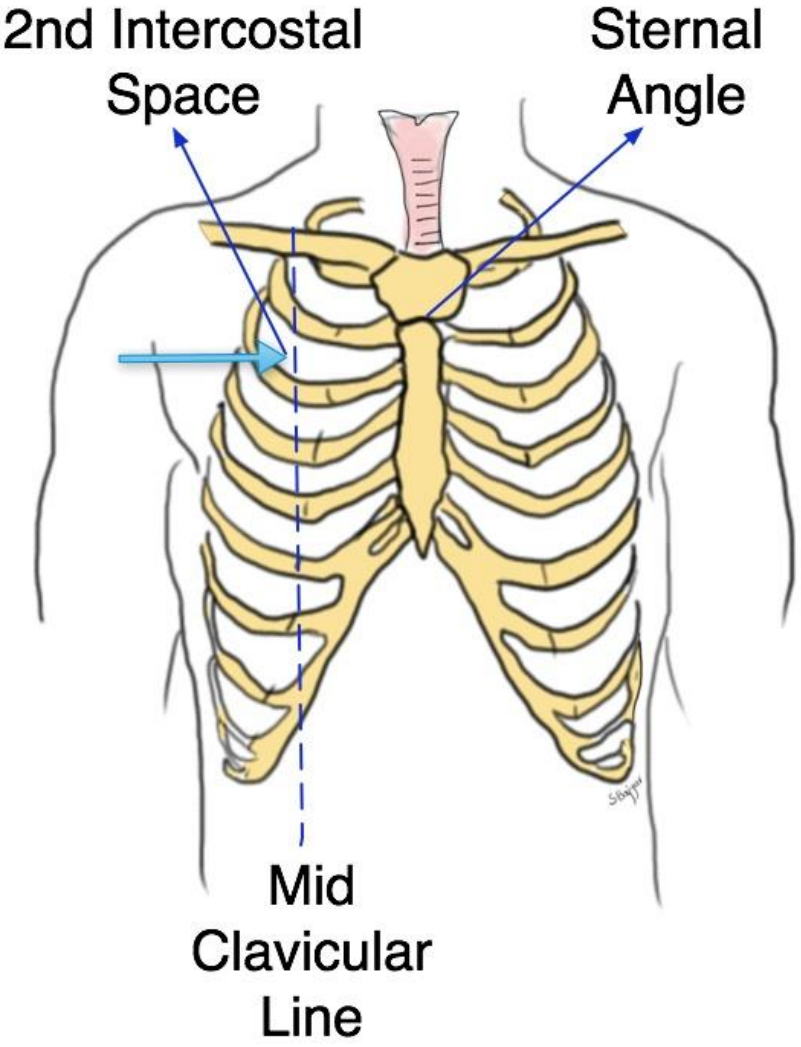


Tension Pneumothorax

- Clinical diagnosis
  - Hemodynamic instability
- Don’t hesitate to act quick.

- Should never be diagnosed by this

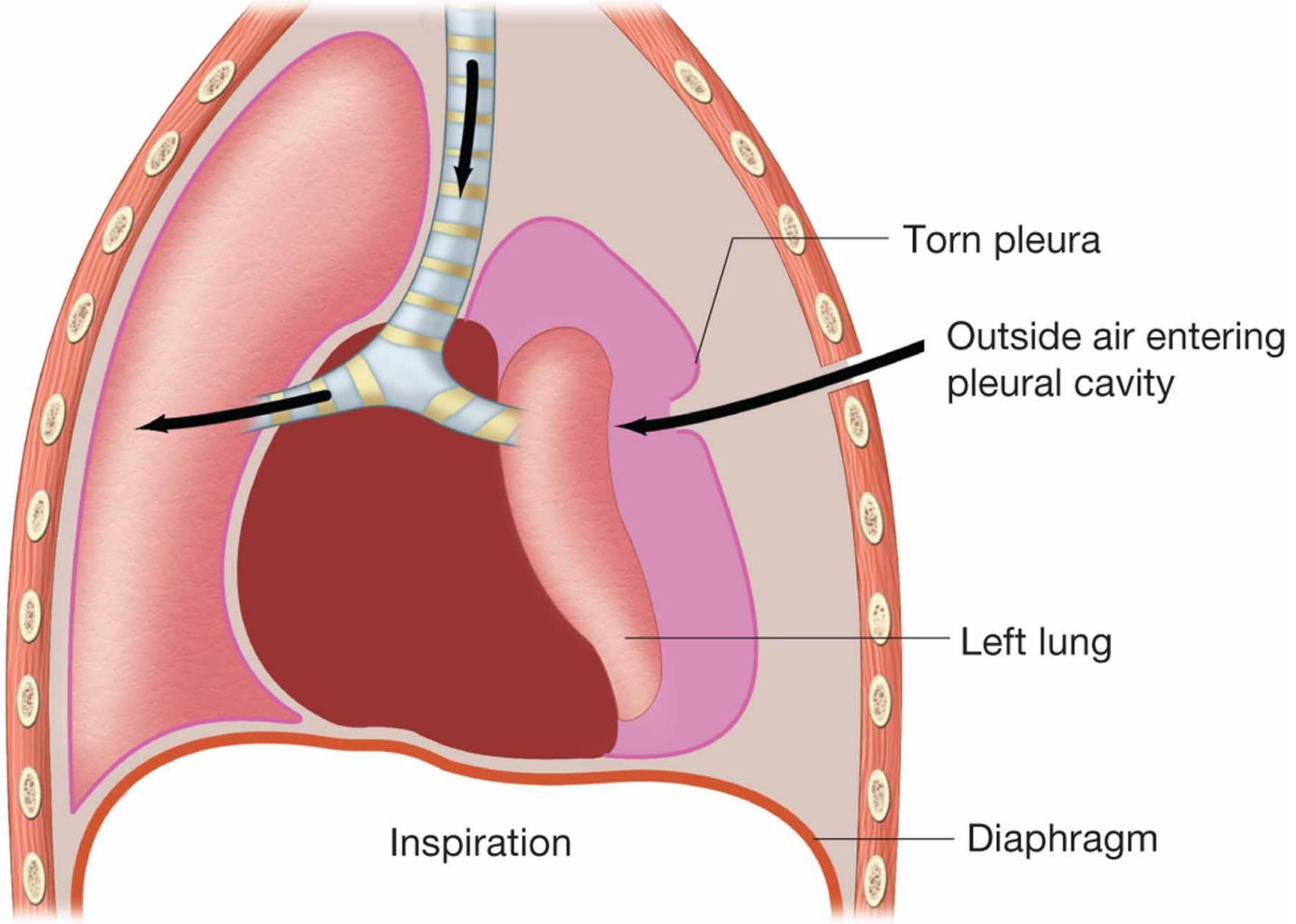


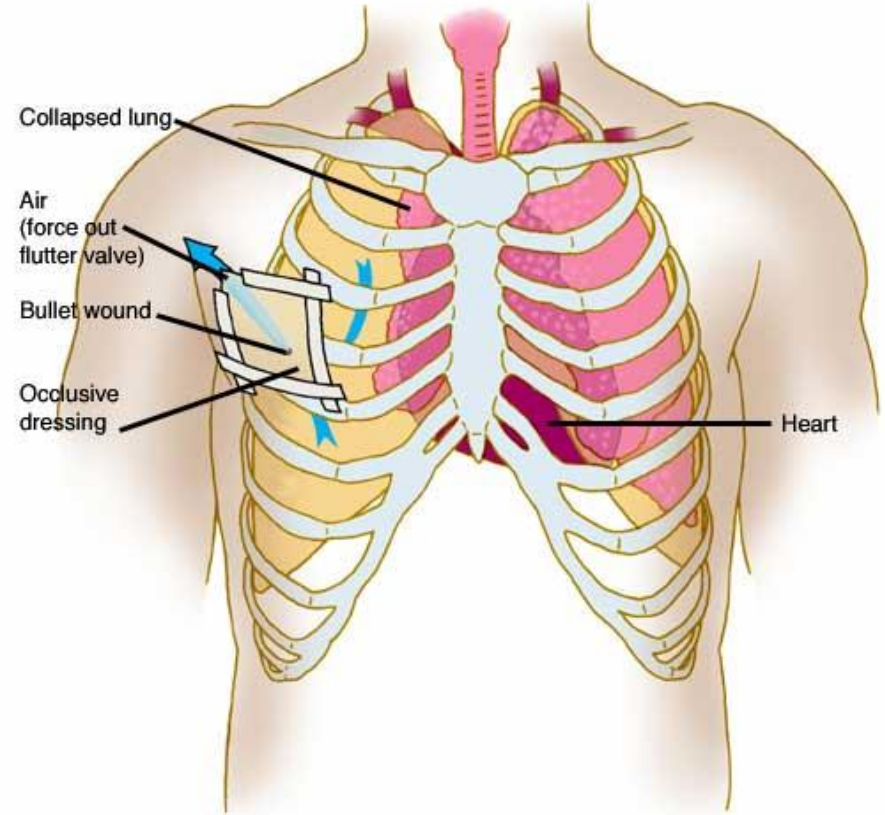

2nd Intercostal Space
Sternal Angle
Mid Clavicular Line

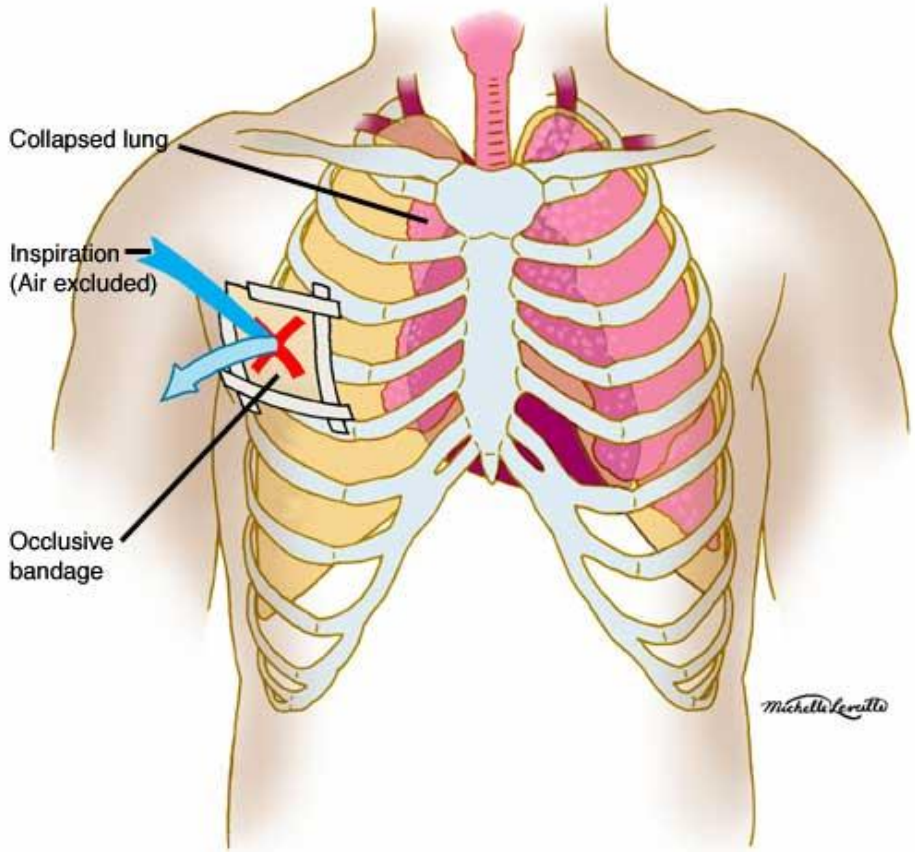
“Sucking chest wound”

- “open pneumothorax”
- Open vs Closed
- Closed -> develop of tension pneumothorax
    - Air comes in pleural space but can’t leave.

- Open -> wound > ¾ diameter of trachea


Torn pleura
Outside air entering pleural cavity
Left lung
Inspiration
Diaphragm





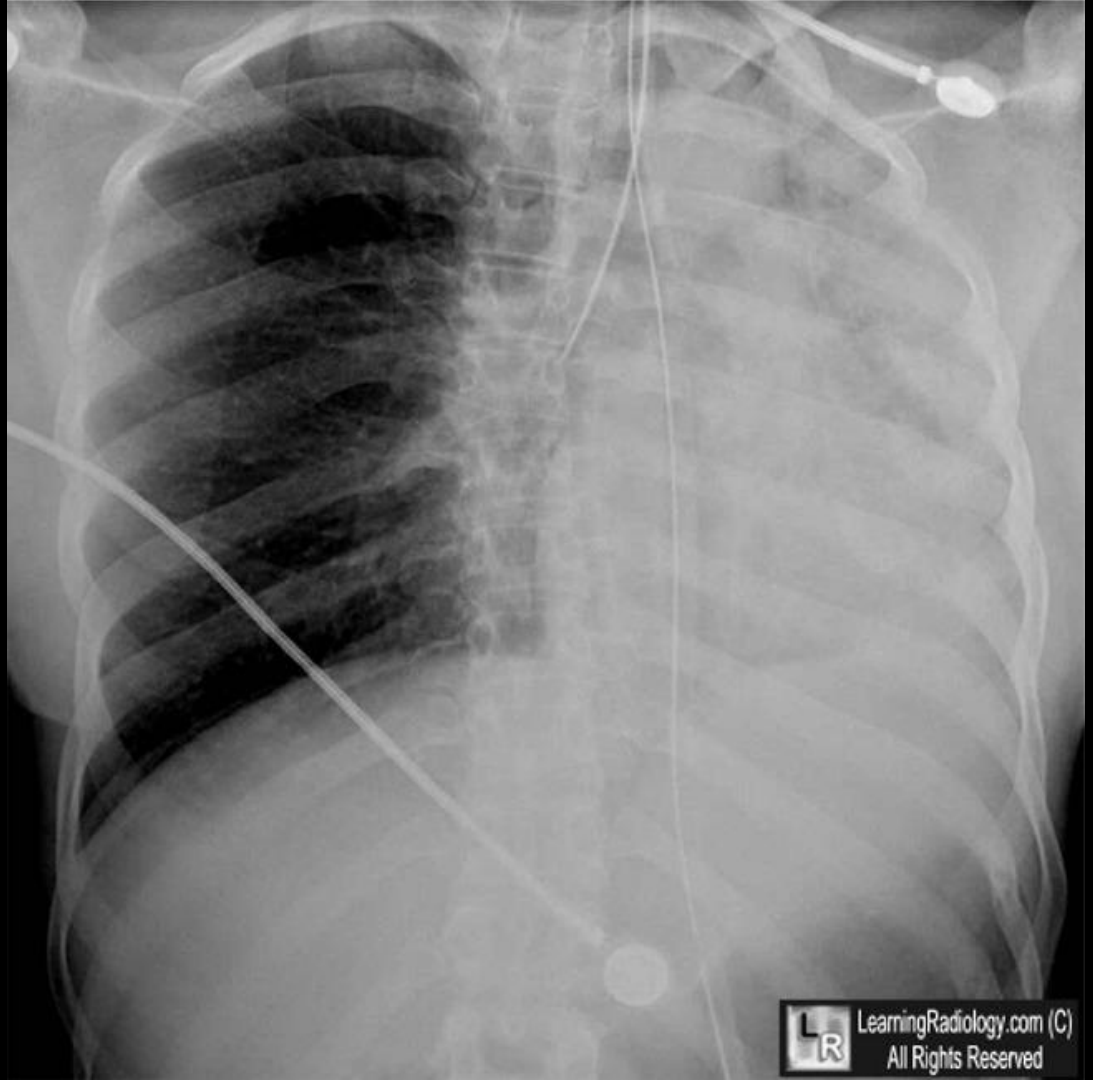
www.anatomyatlases.org/firstaid/ChestWound.shtml

Case #2 – blunt chest trauma

9yo F MVC

Case #2 – blunt chest trauma

- 9yo F high speed head on MCV.
  - Impaired driver crossed the midline.
- At the scene:
  - Unresponsive, palpable BP, min resp effort, obvious extremity trauma.
  - Intubated, large PIVs.
  - Helicopter transport.
- In the trauma bay:
  - Moved extremities to command, normal pupils, hypotensive, desating.



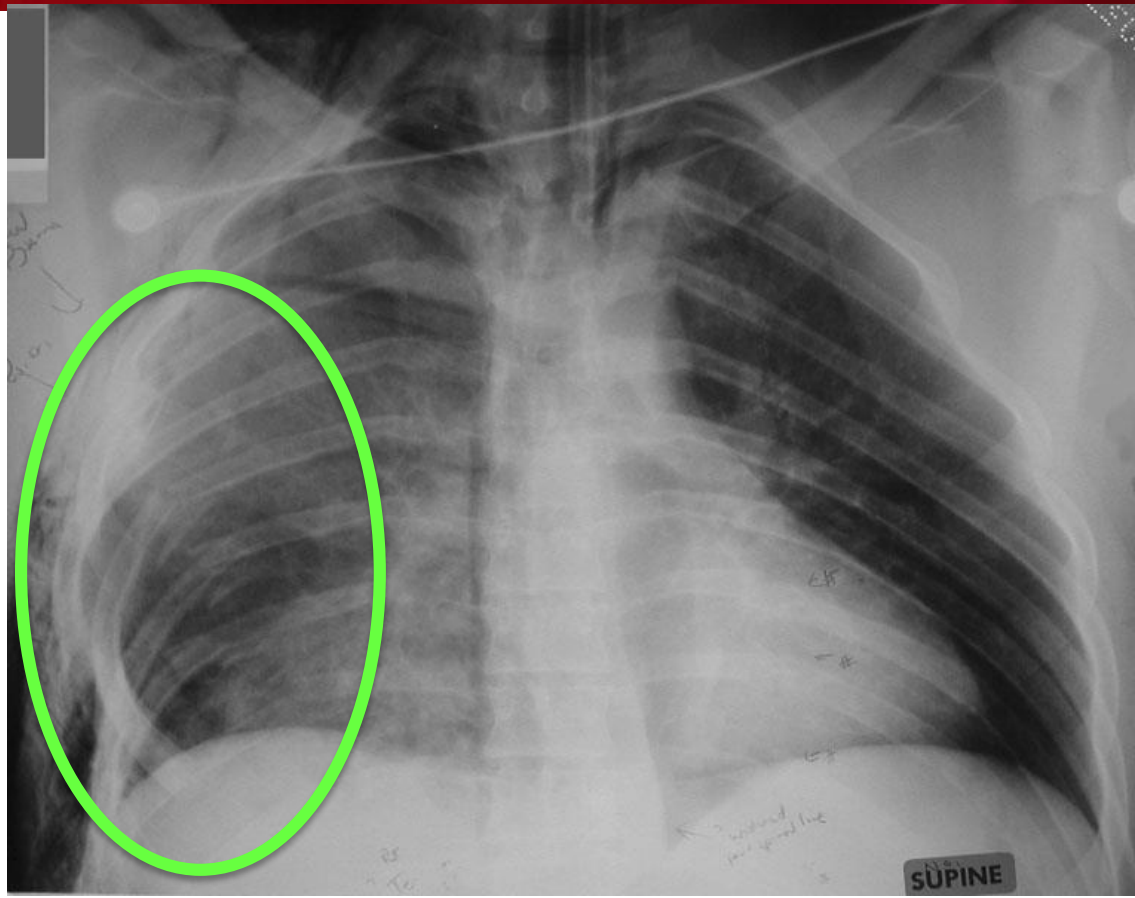
Flail chest

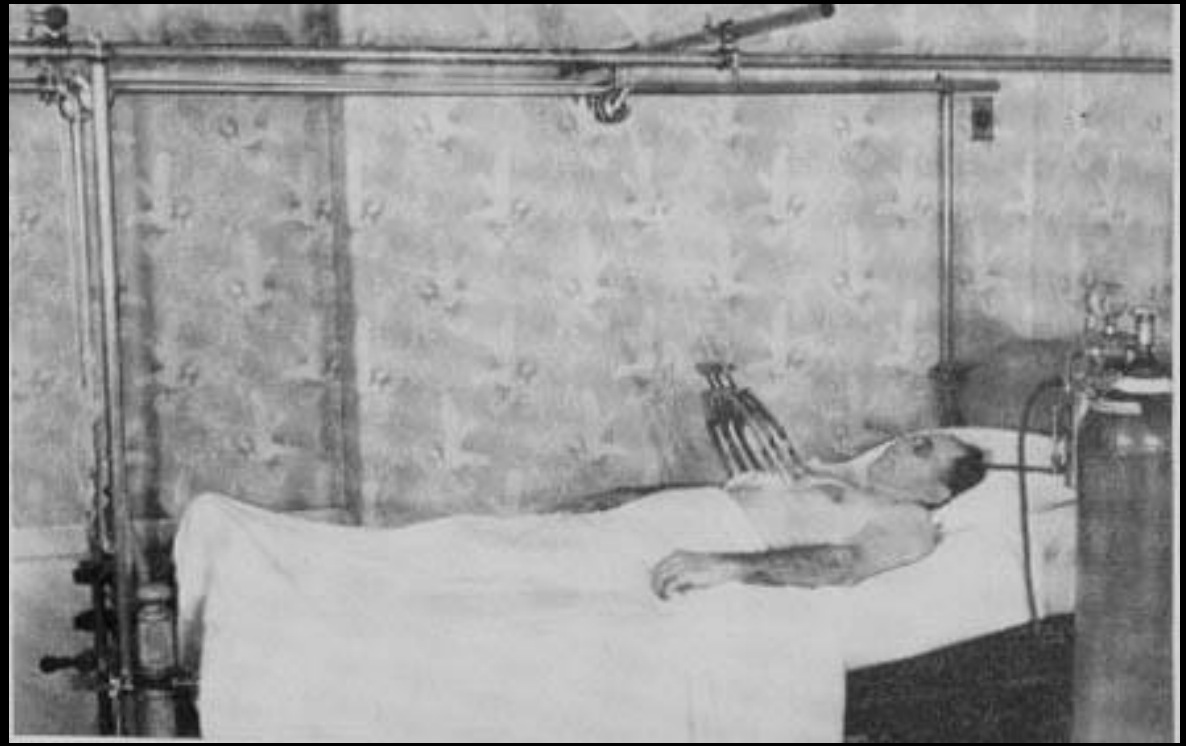
Multiple rib fx causing chest wall in stability.

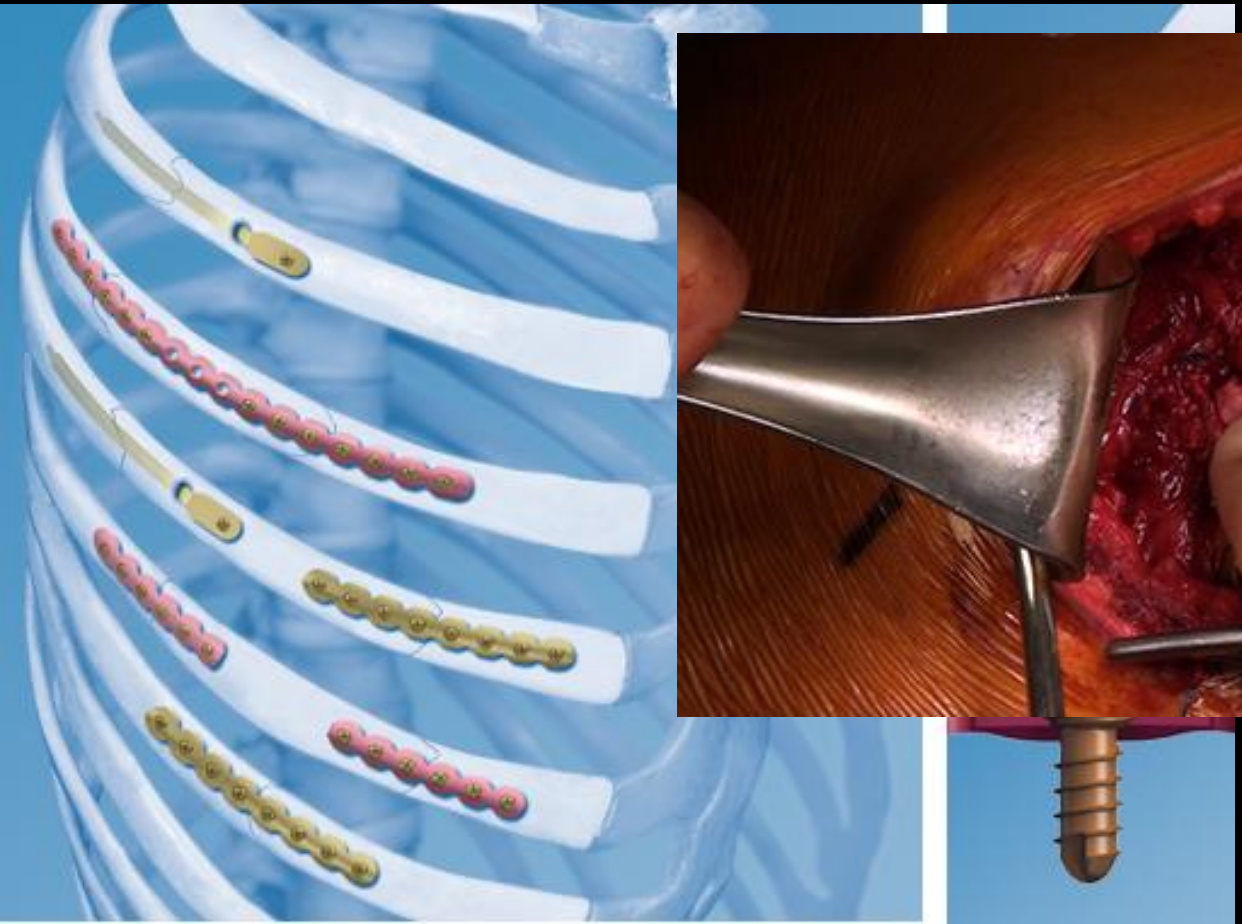
- “paradoxical motion”

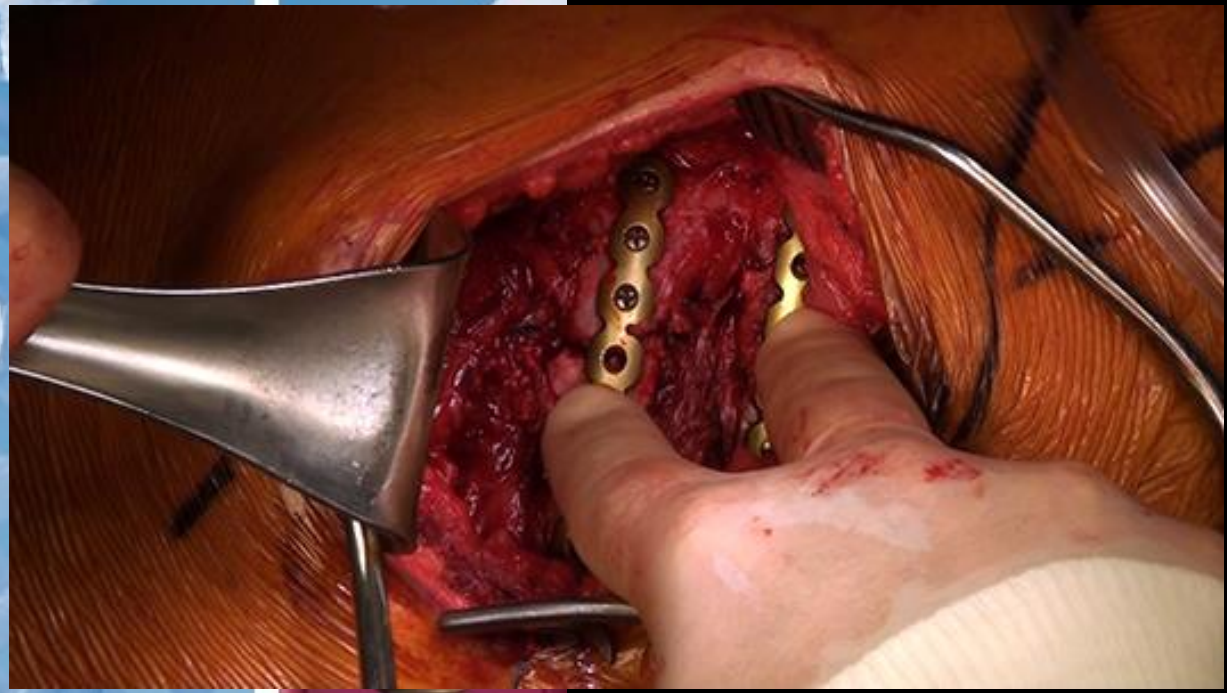
Treatment:

- pain control
- pulmonary toilet
- rib stabilization









Pulmonary Contusion

Pulmonary edema.

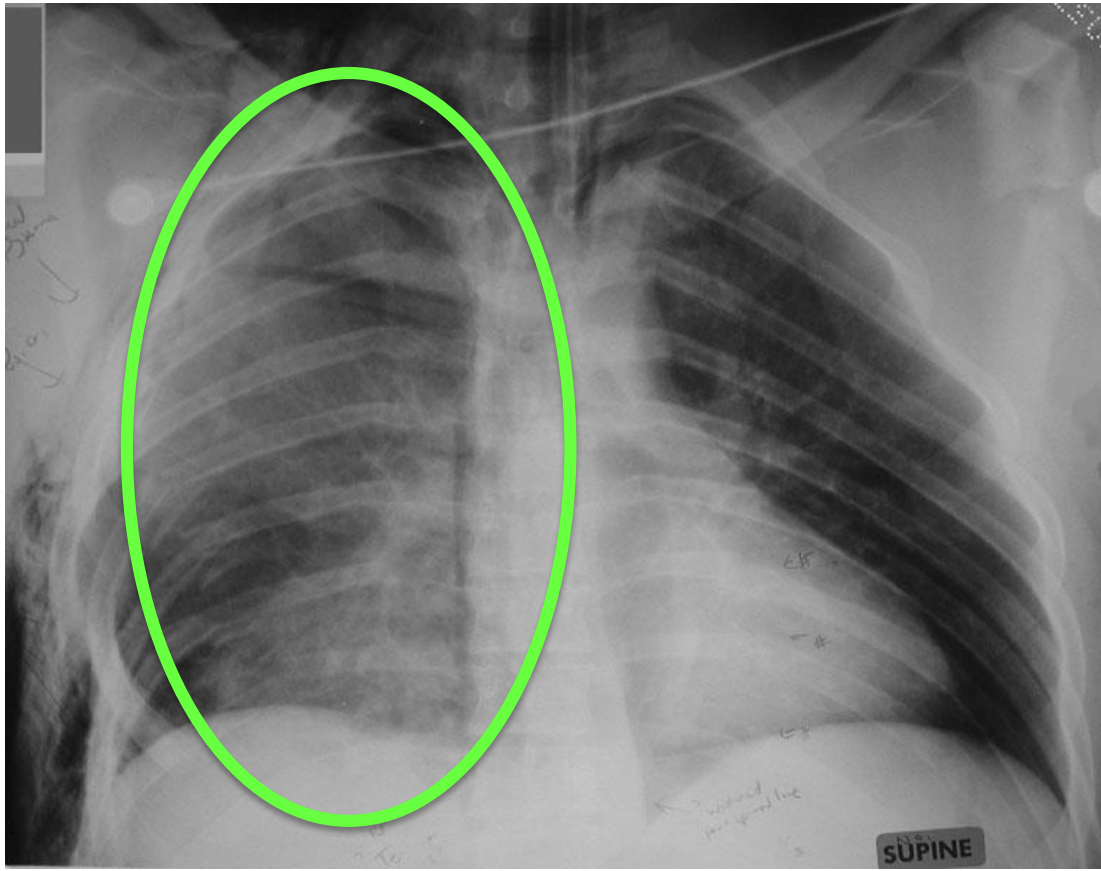
Peaks in 24-48 hours.

Treatment:

- Time and supportive care
- Careful fluid use

Complications:

- pneumonia
- ARDS

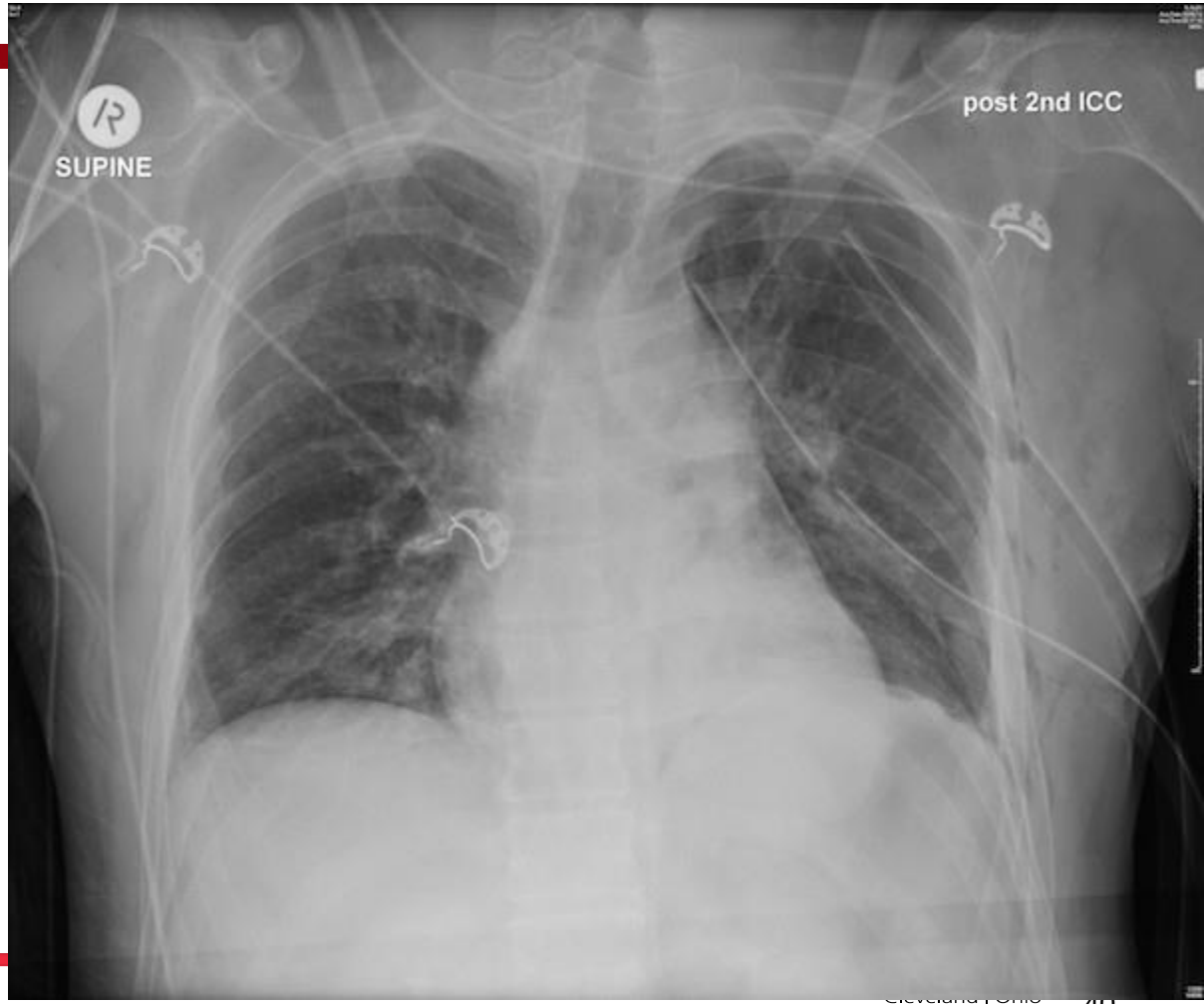


Massive air leak

Large bronchial disruption.

Difficult to control.

- multiple chest tubes
- operation



Case #3 – Burn

6yo flame burn to chest

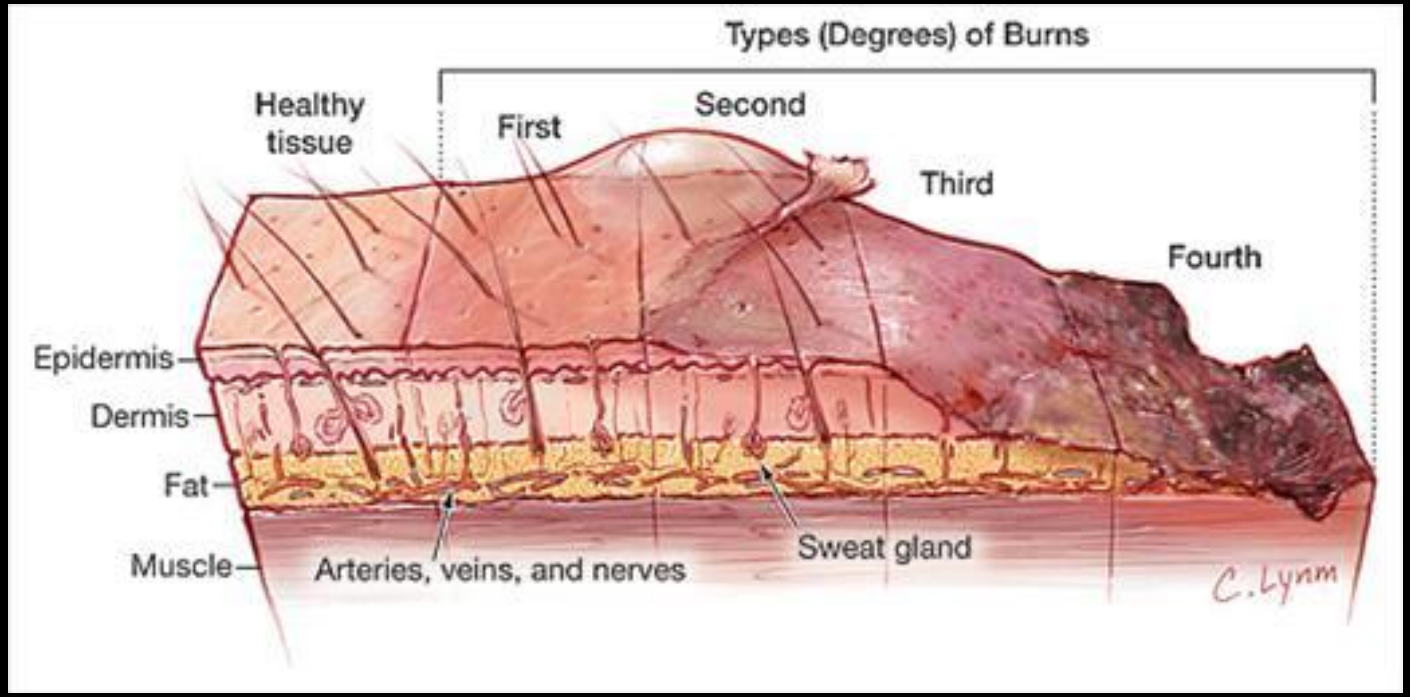
Case #3 – Burn

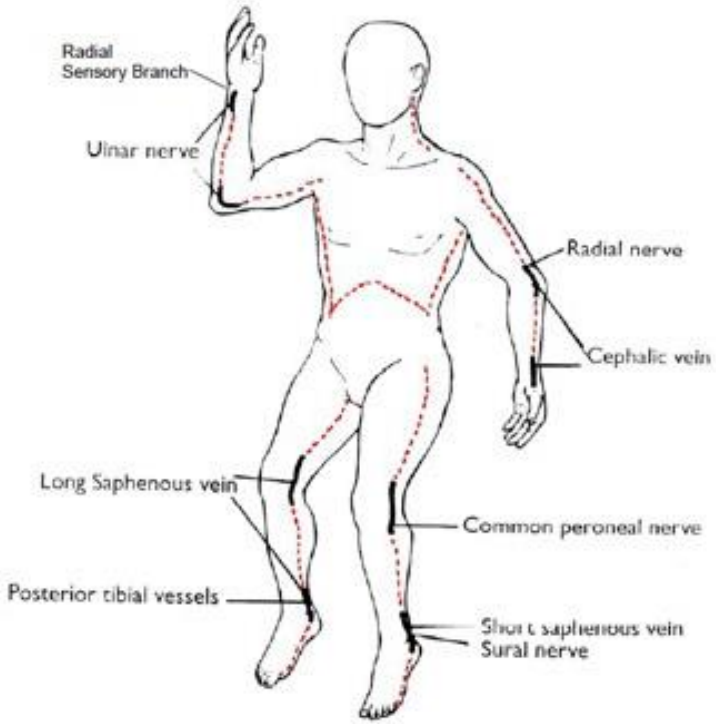
- 6yo M with flame burn to chest.
  - He and friends playing with lighter fluid.

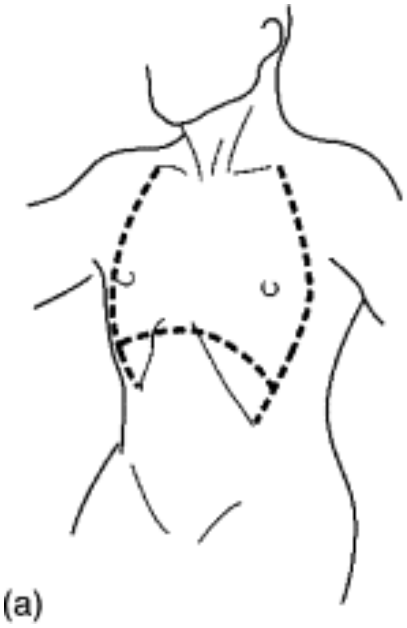
- In resus bay:
  - Tachycardic, nl BP
  - Painful to touch
  - Partial to full thickness burns through anterior chest and arms.

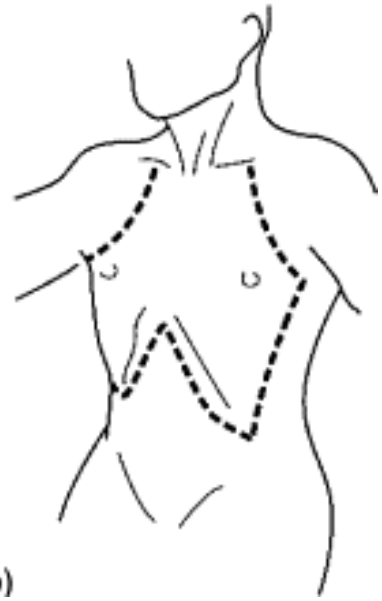
Case #3 – Burn

- What are there possible respiratory complications?
- Inhalation Injury
  - Careful mouth / airway inspection
  - Prophylactic intubation?
  - Smoke and enclosed spaces
  - Aggressive pulmonary toilet with frequent sucking, bronchs, etc.
  - Careful fluid management
- Restrictive Injury


Types (Degrees) of Burns
Healthy tissue
First
Second
Third
Fourth
Epidermis
Dermis
Fat
Muscle
Arteries, veins, and nerves
Sweat gland
C. Lynn


Radial
Sensory Branch
Ulnar nerve
Radial nerve
Cephalic vein
Long Saphenous vein
Common peroneal nerve
Posterior tibial vessels
Sural nerve


(a)


(b)

Case #4 – Multiple GSW to abdomen

15yo M GSW to abdomen

Case #4 – Multiple GSW to abdomen

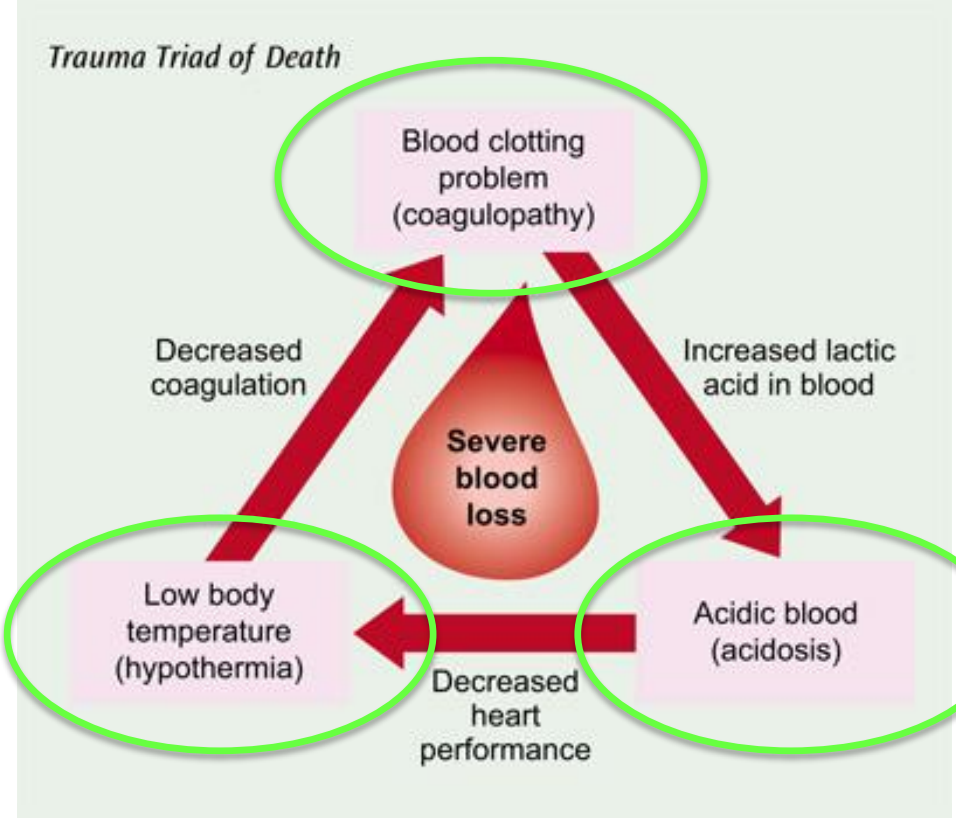
- 15yo M GSW to abdomen
- EMS scene run
    - Unstable en route, intubated, multiple PIVs, fluids
- In resus bay:
    - Min responsive, tachycardia, hypotension
    - Distended abdomen with 5 small wounds
- What are your priorities?

Case #4 – Multiple GSW to abdomen

- The overarching goal of trauma care =

STOP THE TRIAD OF DEATH

“Triad of Death”



www.open.edu/openlearn

Damage Control Principles

1. Stop the bleeding.
2. Control GI spillage.
3. Move quick to resuscitation.

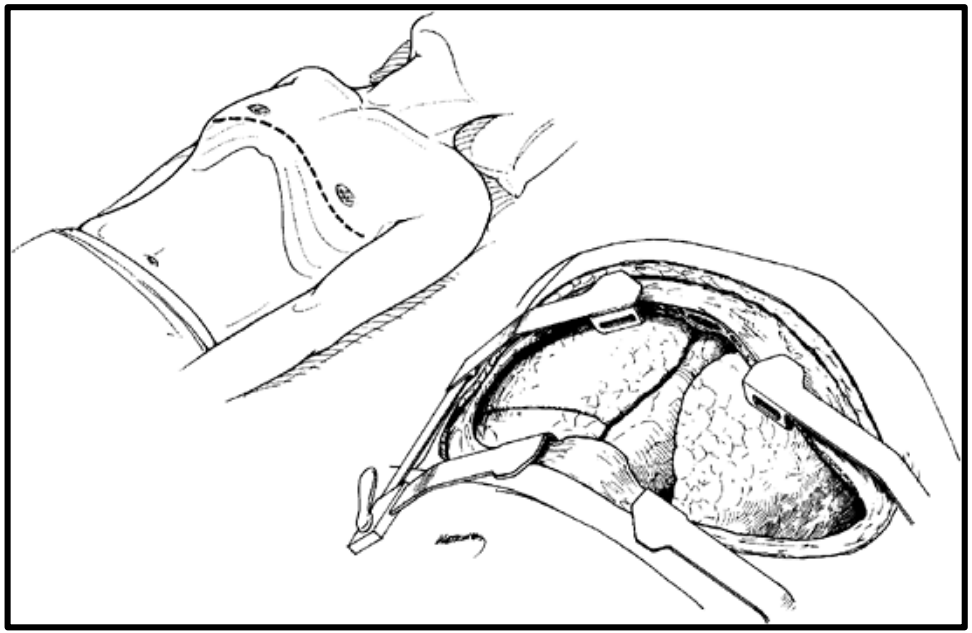
Damage Control Principles

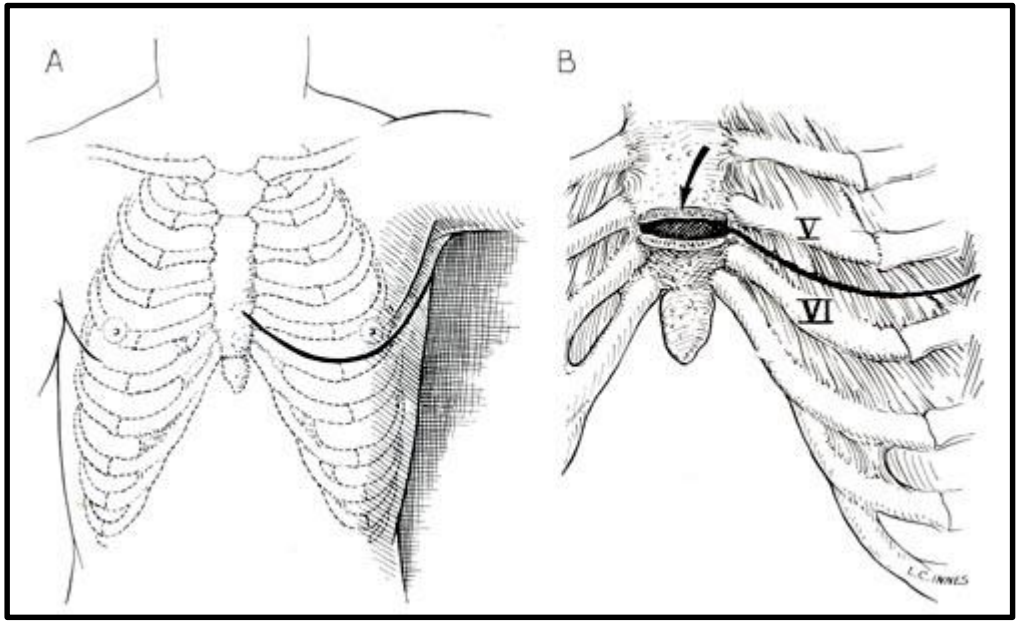
Abdomen

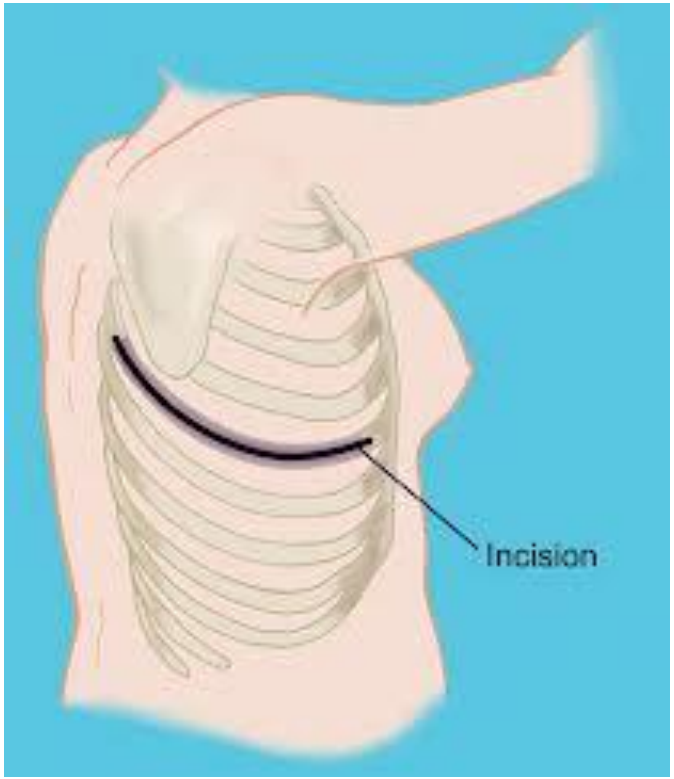
- Quick Control
- Packing
- No bowel repair

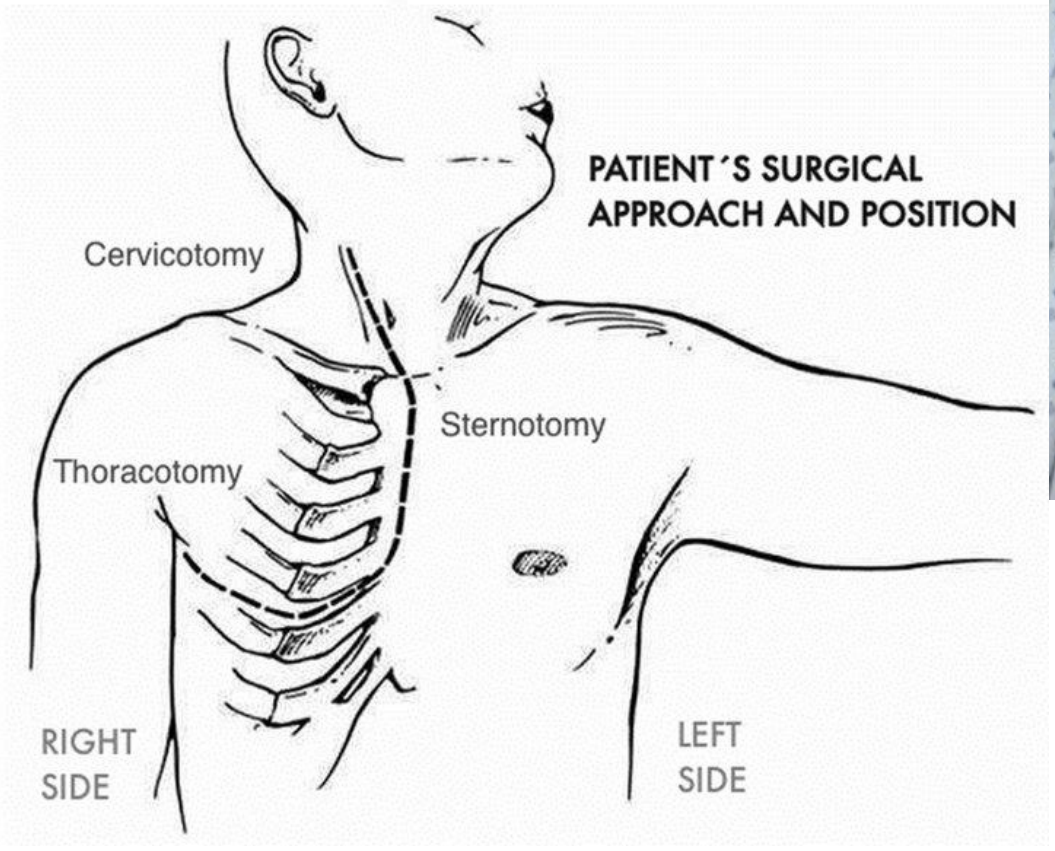
Damage Control Thoracotomy

- Similar principles to abdomen.
- Control:
  - Bleeding
  - Inspect pericardium
  - Large air leaks
  - Preserve oxygenation



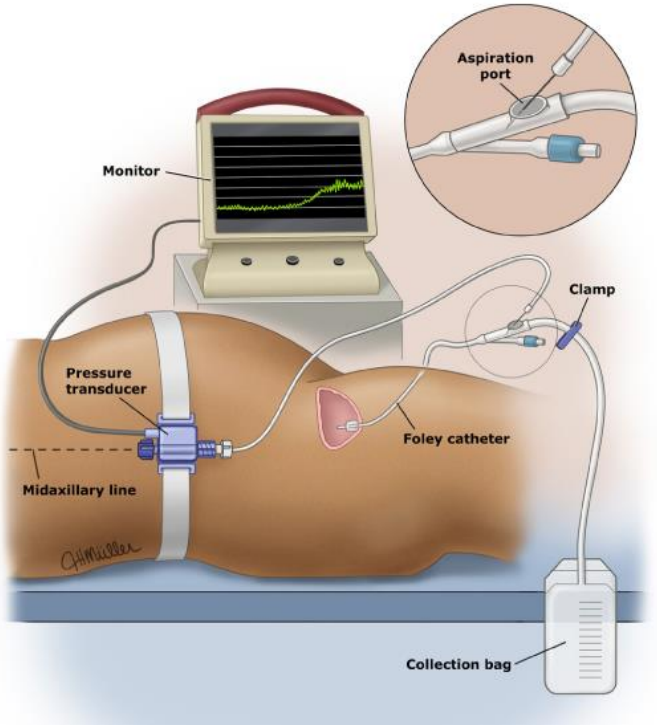

A
B
V
VI
L.C. INNES


Incision


PATIENT´S SURGICAL
APPROACH AND POSITION
Cervicotomy
Sternotomy
Thoracotomy
RIGHT
SIDE
LEFT
SIDE

Abdominal Compartment Syndrome

- Increased pressure in a fixed space
- Increased intrabdominal pressure
  - Normal 5-7 mmHg
  - Intraabdominal hypertension >12mmHg
  - ACS is IAP >20 mmHg + organ dysfunction
- Causes
  - Direct abdominal trauma
  - Tissue edema (capillary leak)
- Treatment
  - Medical management
  - Decompressive laparotomy



What Happens to the Body's Organs?

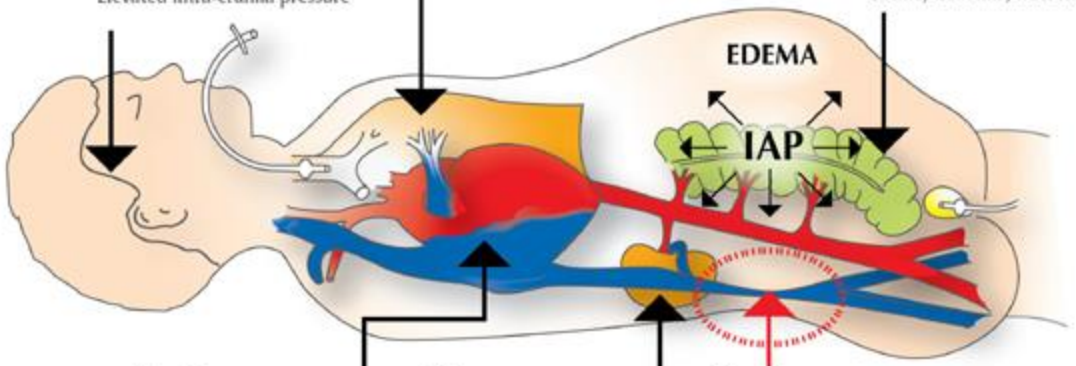
A Vicious Cycle

Fluid resuscitation for critical illness

Total body fluid third spacing/edema

Elevated intra-abdominal pressure due to bowel edema

Vena cava compression



Reduced blood return to heart (preload)

Reduced cardiac output

Reduced blood flow to organs

Multi-system organ dysfunction/failure

Rainbow Pediatric Trauma Center

Who we are…

- **Mike Dingeldein** – Trauma Medical Director
  - Annie Bacevice – Co-Director for PEM
  - Karen Lidsky – Co-Director for PICU

- Lynn Horton – Trauma Program Manager
  - Moni James – Interim Outreach & Education Coordinator
  - Jenn Edwards – Trauma Registrar
  - Val Bey – State Registrar

Thank you.