Cino Bendinelli

John Hunter Hospital

Newcastle, NSW

CONSERVATIVE TREATMENT OF FLAIL CHEST

Injury Conference Auckland
August 2014

Flail chest

- Definition and incidence
- Complications
- Treatment
- Pitfalls
- Future

Flail chest

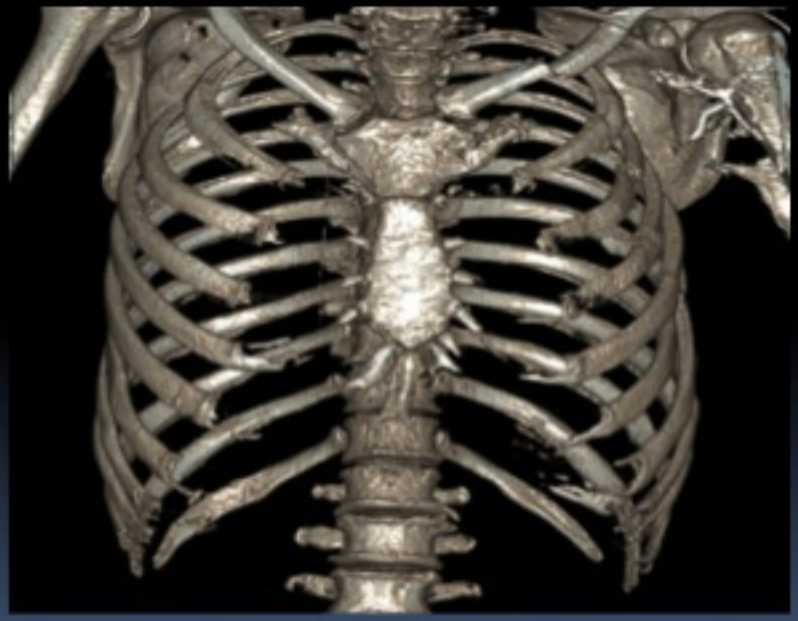
Defined as 4 consecutive rib # in 2 or more locations (bilateral and sternum)

Large enough for paradoxical motion visible with respiration

Flail chest

Defined as 4 consecutive rib # in 2 or more locations (bilateral and sternum)

Large enough for paradoxical motion visible with respiration



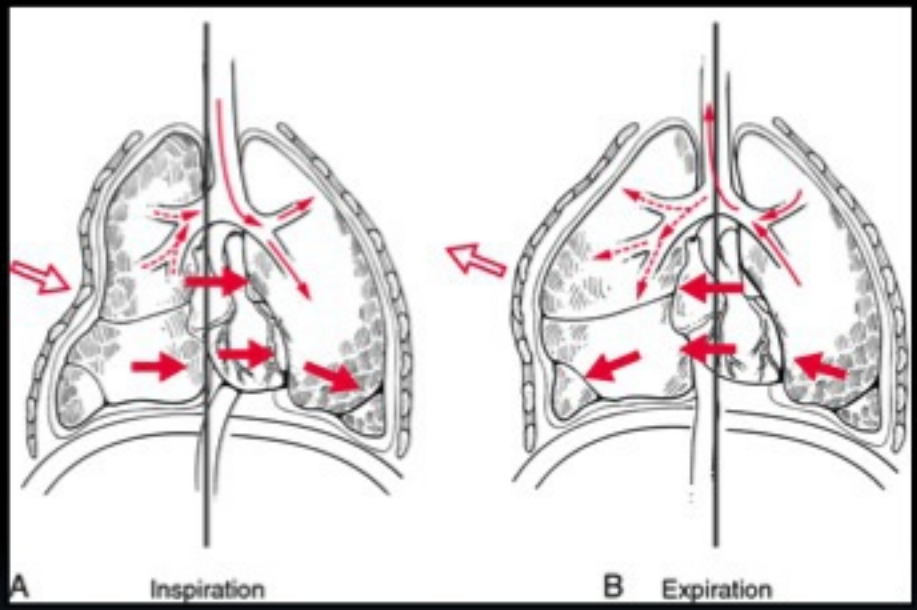
Flail chest

Defined as 4 consecutive rib # in 2 or more locations (bilateral and sternum)

Large enough for paradoxical motion visible with respiration

Aim of chest?

- Ventilation
  - Diaphragm
  - Rigid chest wall



Facts and numbers

1% trauma patients with ISS>9
- 75% MVC
- 16% falls

50% lung contusion

45% chest tube

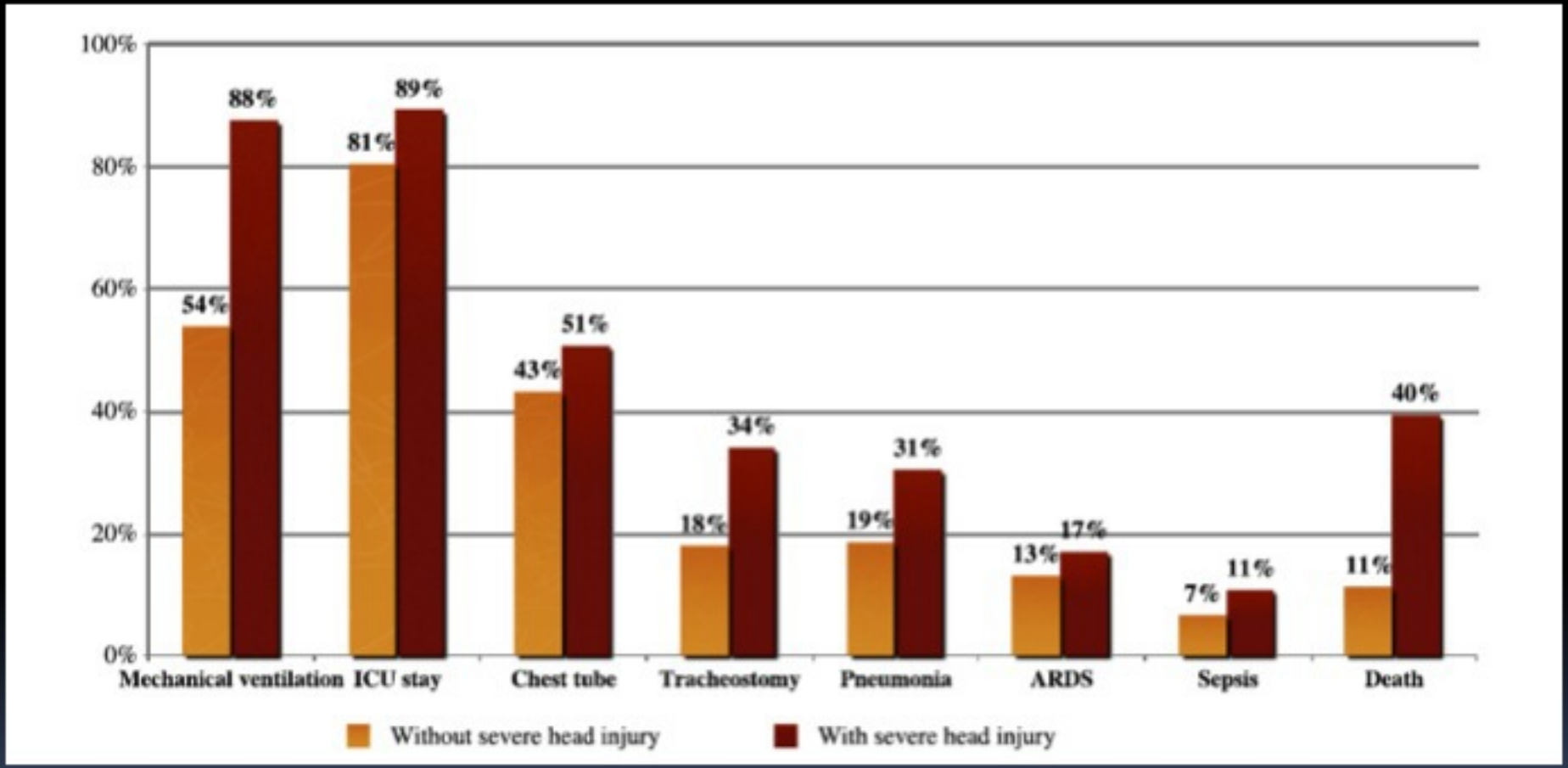
60% intubation

20% pneumonia

12 ICU LOS days

16% death

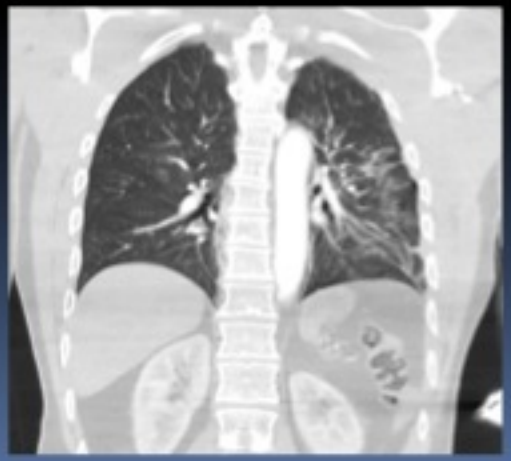
Dehghan. J Trauma 2013



Dehghan. J Trauma 2013

Pulmonary contusion

- 50% of patients
- Contribute perfusion mismatching and poor oxygenation
- Delayed radiologic evidence

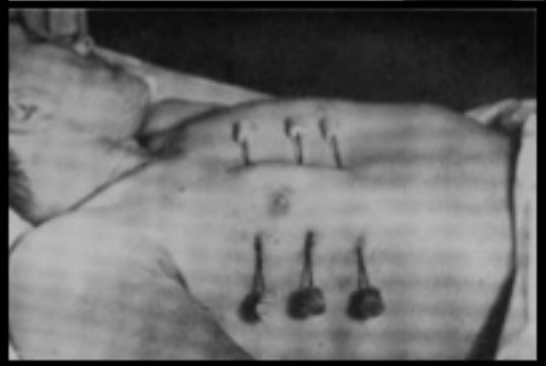


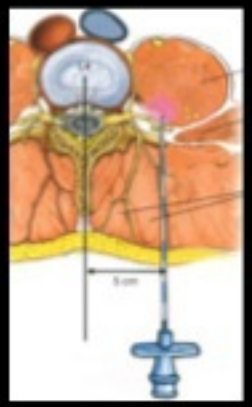
Causes of death:

- Pneumonia (sepsis, MOF)
- Tension Pneumothorax (barotrauma)
- Hypoxia

Treatment:

- Pain management with physiotherapy
  - Pulmonary toilette
- Positive pressure ventilation (pneumatic stabilization)
- Operative rib fixation





No treatment

Morphine O2

ICU Prophylactic ETI

Paravertebral block Pneumatic stabilization

Operative stabilization DC resuscitation

OUTCOME

-1950

1950-1960

1970-1980

1980-2000

2000-

Role of physiotherapy and pain control

PAIN

- Pain (and not mechanical failure) is the most common cause of poor inspiratory effort and pulmonary toilet
- Results in atelectasis as alveoli collapse
- Leads to pneumonia

Multimodal pain treatment

Patient-controlled analgesia (magic button):

- Fentanyl / Morphine

Paracetamol + Non Steroidal anti inflammatory

Stool softener

Blocks

Ketamine / neuroleptics

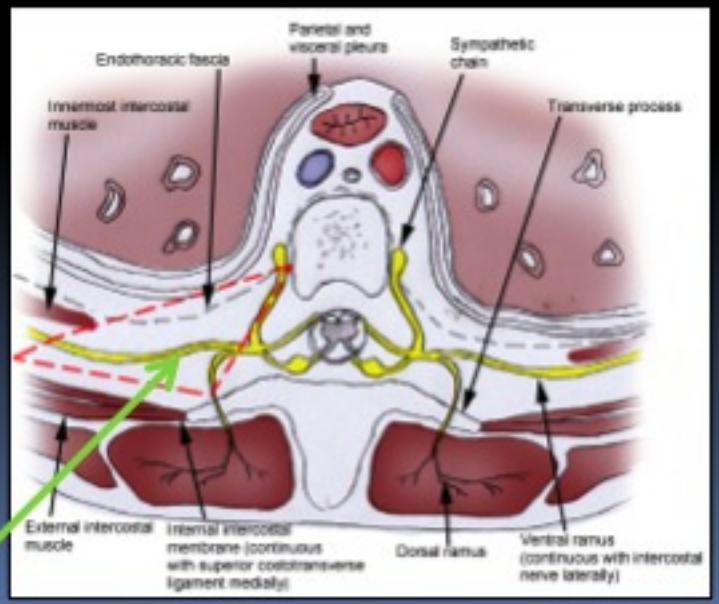
Thoracic epidural anaesthesia

- Good pain control
  - reduces pneumonia, LOS
- Complications (relative common):
  - Bilateral spreading
  - Hypotension
  - Motor deficit
  - Bleeding (contraindicated if any coagulopathy)
- Logistically demanding (not timely placed)

Paravertebral blocks

Unilateral block of spinal nerve (dorsal and ventral rami) and sympathetic chain ganglion

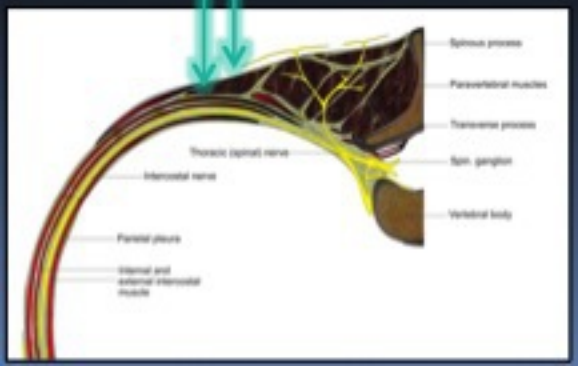
- Similar effect to epidural (RCT in thoracotomy)
- Less complicated
- Preferred
- Coagulopathy: OK



Continuous Intercostal Nerve Blockade

2 catheters on top of each broken ribs and elastomer:

- Placed by surgeon at the bedside under L/A
- Provide adequate pain control
- Improve pulmonary toilet
- Continued as outpatients (reduced LOS)



M. Truitt. J Trauma 2011

Positive pressure ventilation pneumatic stabilization

	NIV	ETI
Oxygenation	similar	
Barotrauma (pnx)	similar	
ICU LOS	similar	
Pneumonia	10%	50%
Pt compliance	yes	no
Costs	low	more

Surgical fixation

- 3 RCT
  - Reduced ICU stay, ventilation days
  - Similar long term outcome
  - Limits:
    - series over long period
    - vague inclusion criteria
    - different techniques
- Comparison with our experience:
  - Similar results to best (operative) arm

Tanaka. J Trauma 2002
Granetzny. Car Thor Surg 2005
Marasco. J Am Coll Surg 2013

Surgical fixation

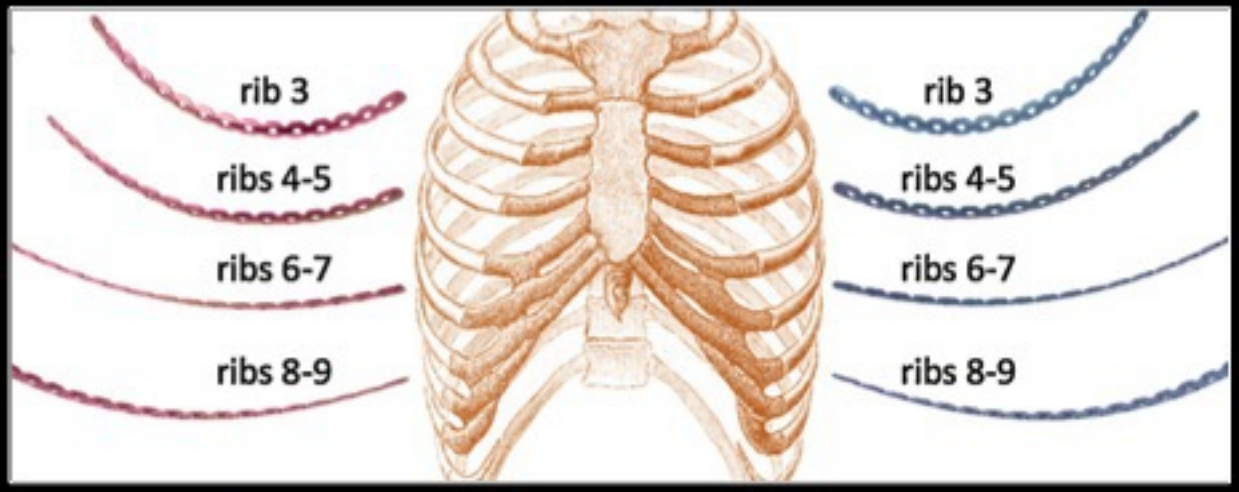
Severe TBI excluded

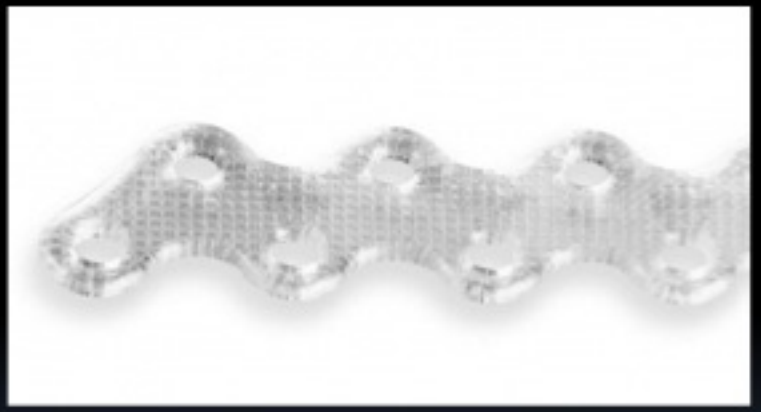
Table 3. Outcomes

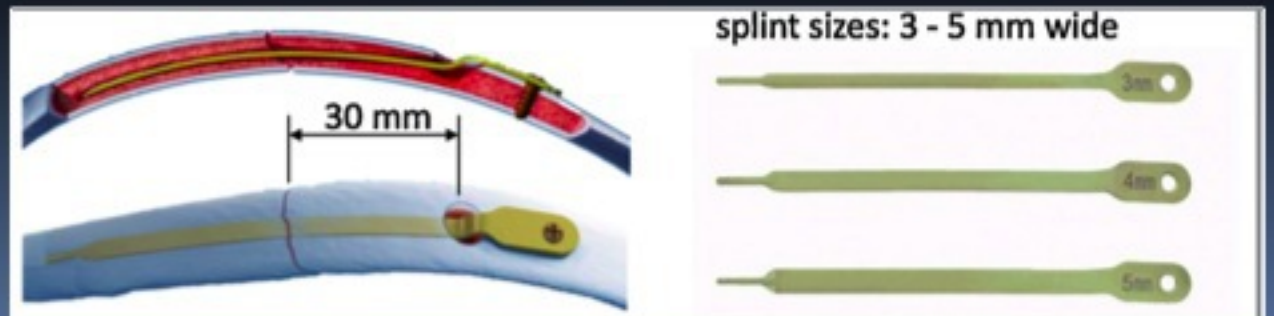
Outcomes	Operative group (n = 23)	Nonoperative group (n = 23)	p Value
Duration of ICU stay prerandomization, h, mean ± SD	61.6 ± 36.1	81.3 ± 84.2	0.31
Duration of ICU stay between randomization and surgery, h, mean ± SD	49.4 ± 35.9	N/A	
Duration of IMV postrandomization, h, mean ± SD	151.8 ± 83.1	181.0 ± 130.2	0.37
Duration of ICU stay postrandomization, h, median (IQR)	285 (191–319)	359 (270–581)	0.03
Total ICU stay, h, median (IQR)	324 (238–380)	448 (323–647)	0.03
Failed extubation, n (%)	3 (13)	1 (4)	0.61
Received NIV postextubation, n (%)	13 (57)	19 (83)	0.05
Duration of NIV postextubation, h, median (IQR)	3 (0–25)	50 (17–102)	0.01
Tracheostomy, n (%)	9 (39)	16/23 (70)	0.04
Patients requiring blood product transfusion, n	18	19	0.78
Packed cell transfusion during inpatient stay, mL, median (IQR)	620 (0–3,100)	1,240 (620–3,100)	0.39
Total blood products transfused, mL, median (IQR)	930 (620–1,860)	900 (500–1,395)	0.57
Readmission to ICU, n (%)	2/23 (9)	2/23 (9)	0.99
ICCs required, n, median (IQR)	2 (1–4)	2 (1–4)	0.99
Pneumonia, n (%)	11/23 (48)	17/23 (74)	0.07
Duration of hospital stay, d, median (IQR)	20 (18–28)	25 (18–38)	0.24
In hospital mortality, n	0	1	0.87

ICC, intercostal catheter; IMV, invasive mechanical ventilation; IQR, interquartile range; NIV, noninvasive ventilation.

Marasco. J Am Coll Surg 2013


rib 3
ribs 4-5
ribs 6-7
ribs 8-9
rib 3
ribs 4-5
ribs 6-7
ribs 8-9




30 mm

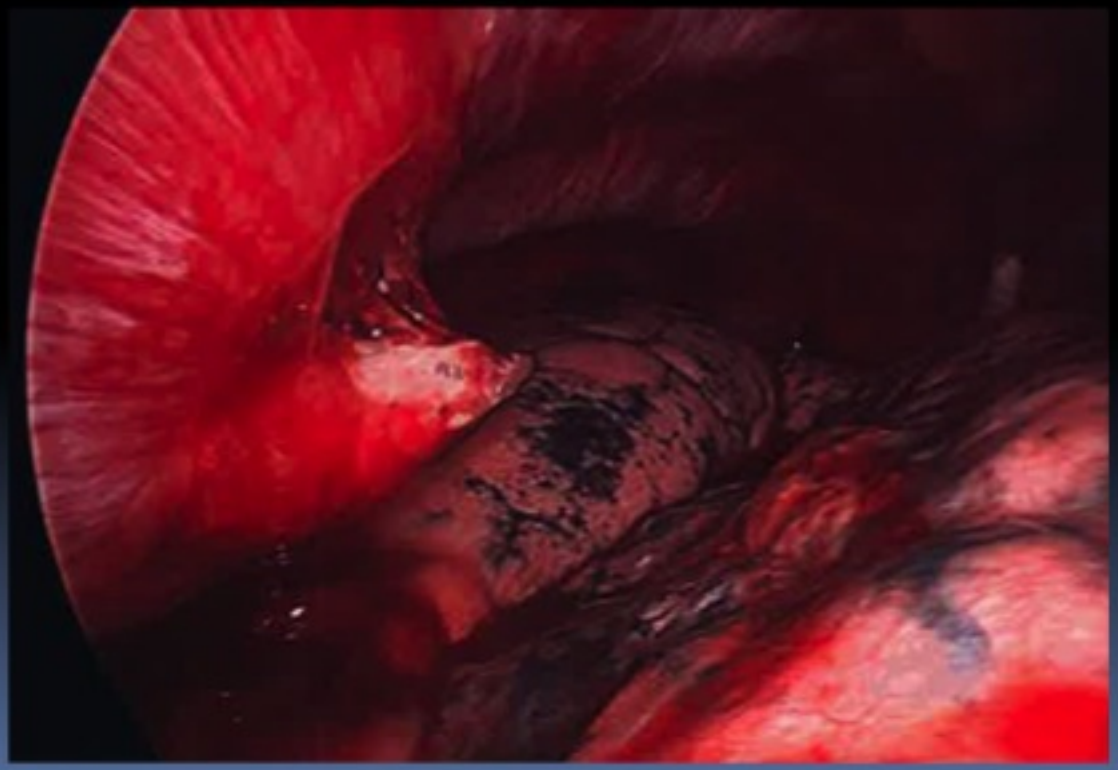
splint sizes: 3 - 5 mm wide
3mm
4mm
5mm

Surgical fixation

- Proper RCT required (power calculation: 300 pt)
- Patient selection:
  - Non union
  - Flails
  - Pain
  - Deformity
- Timing to repair
- Method of repair

Recurrent haemothorax

Thoracoscopy
Rib reduction/fixation



Future….

Better blocks

Better pneumatic stabilization

Better patient selection

…in the mean while

Provide what available in a timely fashion

Move from treatment of complications to complication prevention


Remember to
cough every
15 minutes to keep
chest clear

Questions?