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THORAKOSKOPIEKURS
20. - 22. OKTOBER 2022
HALLE (SAALE)



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**ST. ELISABETH &
ST. BARBARA**

Chest tubes – Management of complications

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« Το προλαμβάνειν καλύτερο του θεραπεύειν »
Ιπποκράτης ο Κώς, 460-370 π.χ.



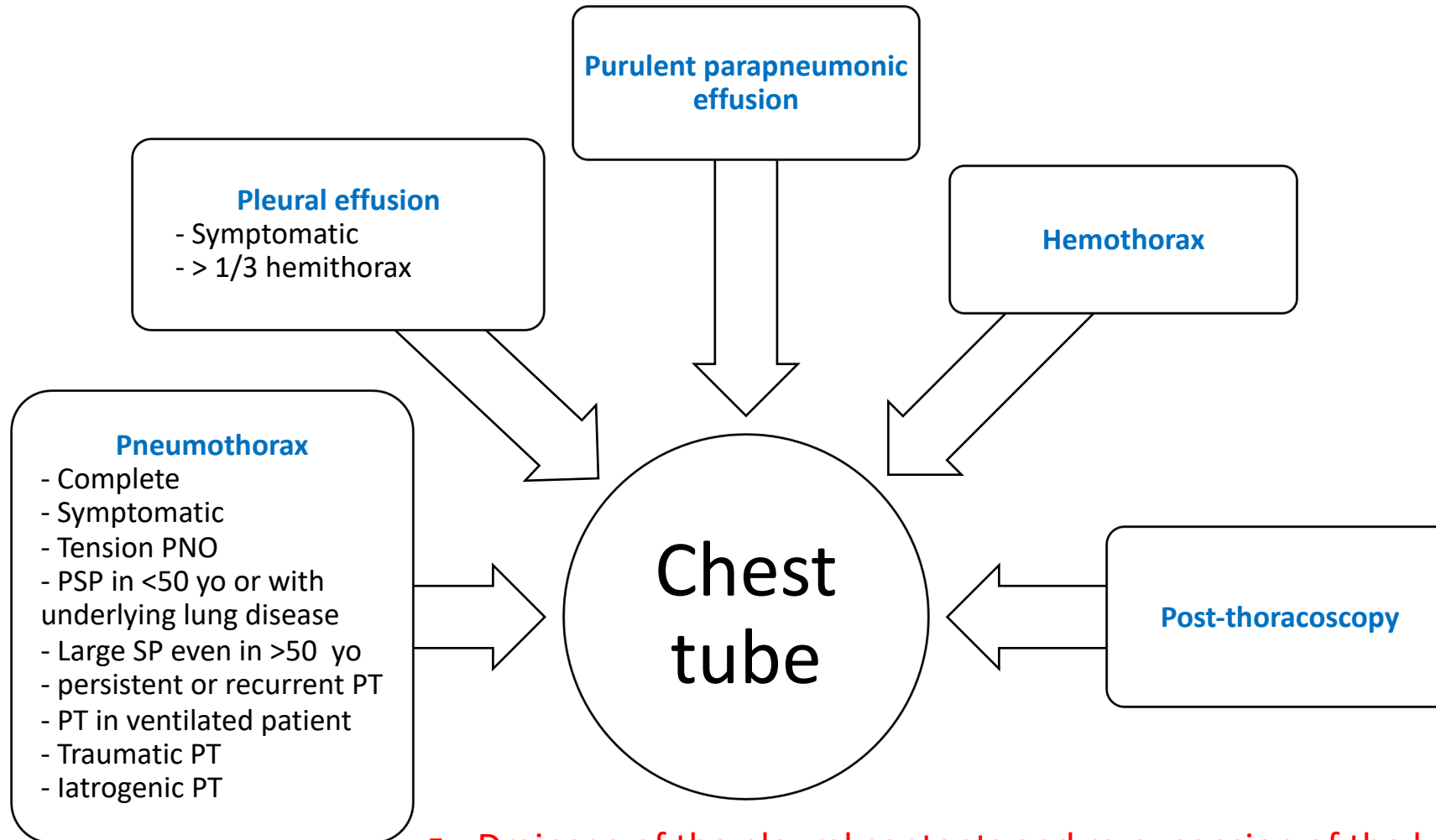
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- « Rather prevent than treat »
- Ippokrates the Coan, 460-370 b.c.

Chest tube indications

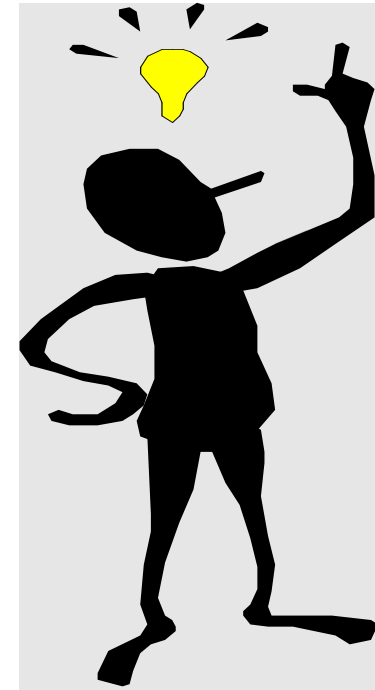


- Drainage of the pleural contents and re-expansion of the lung
- Restore hemodynamic and respiratory stability



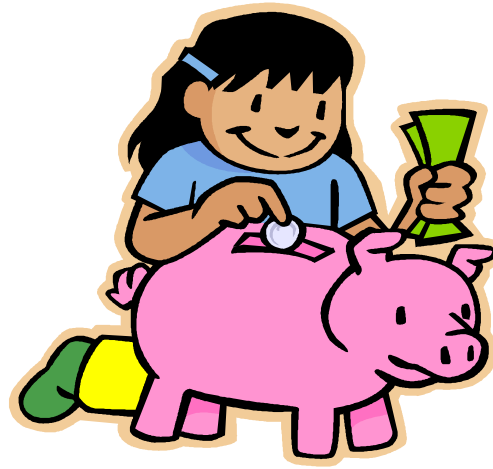
Need for insertion of a chest drain

1. Consent
2. Aseptic technique
3. Patient position
4. Premedication/local anaesthetic
5. Inserting the drain and the role of US guidance
6. Size and types of chest drain tubes
7. Complication and misplacement
8. Securing and dressing the chest drain
9. The drainage system
10. Removal of the chest drain



Complications are costly

- To the patient
- To the physician
- To the hospital
- To the community

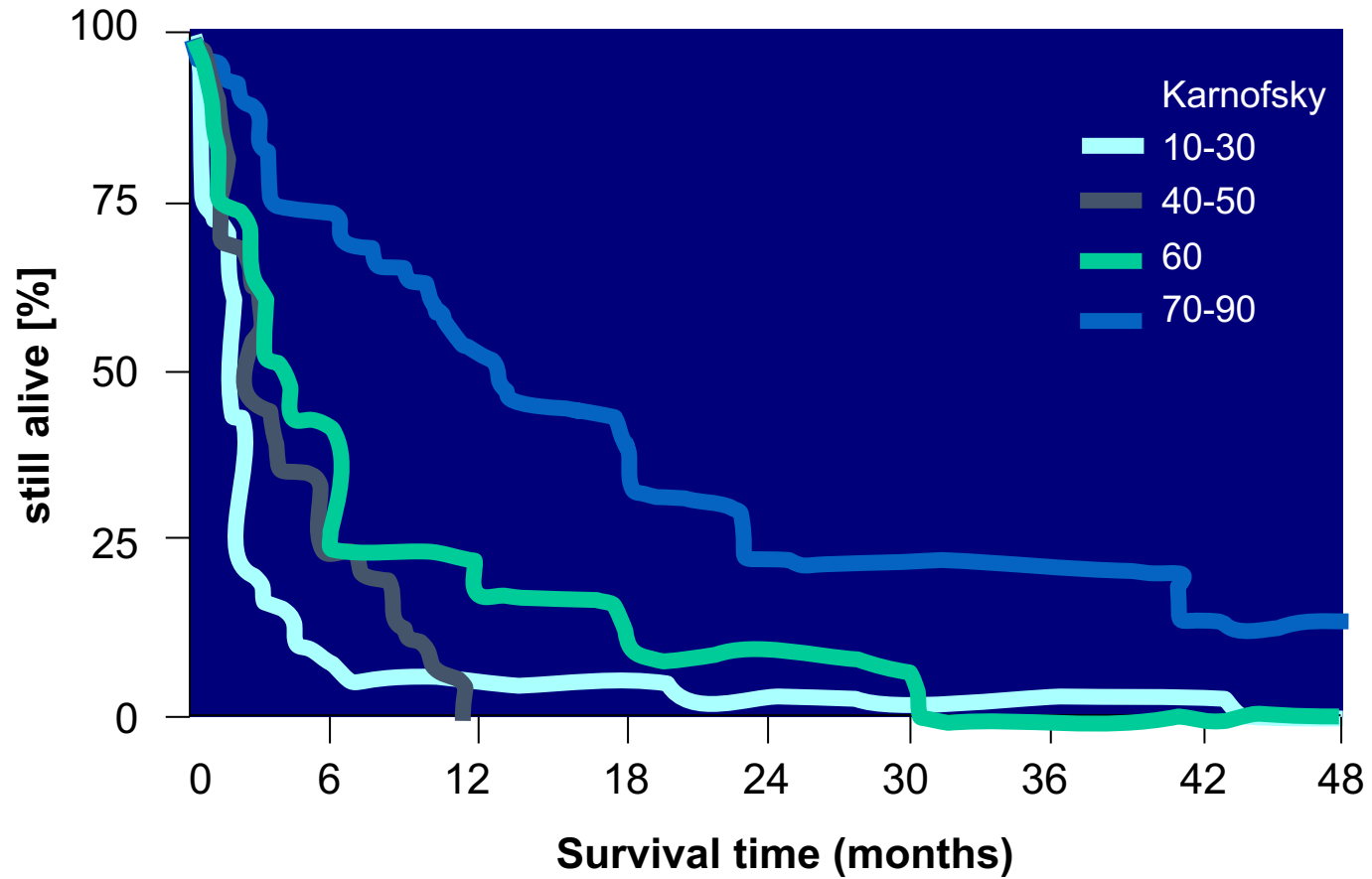


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General health status and survival in patients with malignant pleural effusion



Burrows et al. Chest 2000; 117:73

Size and types of chest drain tubes



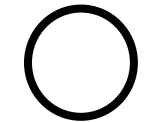
1. Small chest tubes (≤ 14 F)
2. Medium bore tube (16–24 F)
3. Large bore chest tubes (≥ 24 F)

Be aware of “French”

“French” is the outer diameter

Inner diameter varies for the same “French”

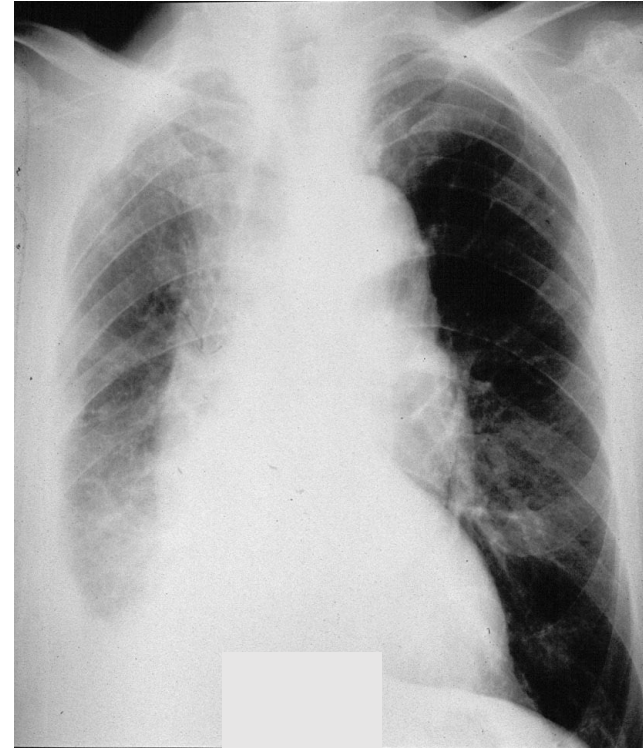
Fr=10



Fr=10

Absolute contraindication: Lack of pleural space

- **Lack of pleural space** due to:
 - Pleural thickening with symphysis
 - Suspected mesothelioma where the visceral and parietal surfaces are fused
 - Advanced empyema



Chest tube complications



Small drains ≤ 16 F

Complication	Total no.*	Calculated frequency	Range
Injury	582	0.2%	0–2%
Malposition	593	0.6%	0–9%
Empyema	395	0.2%	0–2%
Drain blockage	341	8.1%	2–18%

Large-bore drains ≥ 20 F

Complication	Total no.*	Calculated frequency	Range
Injury	1572	1.4%	0–7.9%
Malposition	1778	6.5%	1.1–31%
Empyema	1778	1.4%	0–2%
Drain blockage	115	5.2%	5.2%

Havelock Thorax 2010;65(Suppl 2):ii61

The procedure

- Pain control
 - Port of entry (either to enter or to close)
 - Efficient local anesthesia
 - Mild sedation
 - Depends on the goal
 - Good knowledge of neuroleptics

Analgesia post op :
Paracetamol
Morphine : 0,1 - 0,15 mg/kg

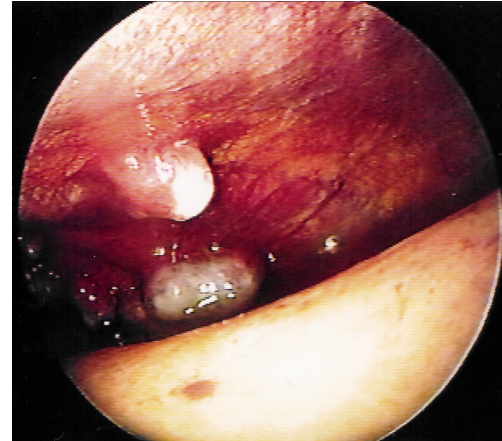
Lee P, Colt H. Anesth Analg 2007;104:198-200

Thomas R et al, Respirology 2015;20:327–32

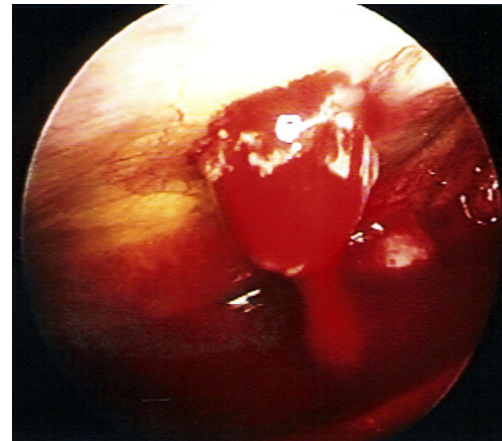


The procedure: bleeding

- >50ml
- Important bleeding is rare (<0.1%)
- Due to Port of entry
 - Wound of subcutaneous vessels
 - Wound of intercostal vessels
 - Mass perforation
 - Pleural neo-angiogenesis



Courtesy of Pr. F. Rodriguez-Panadero



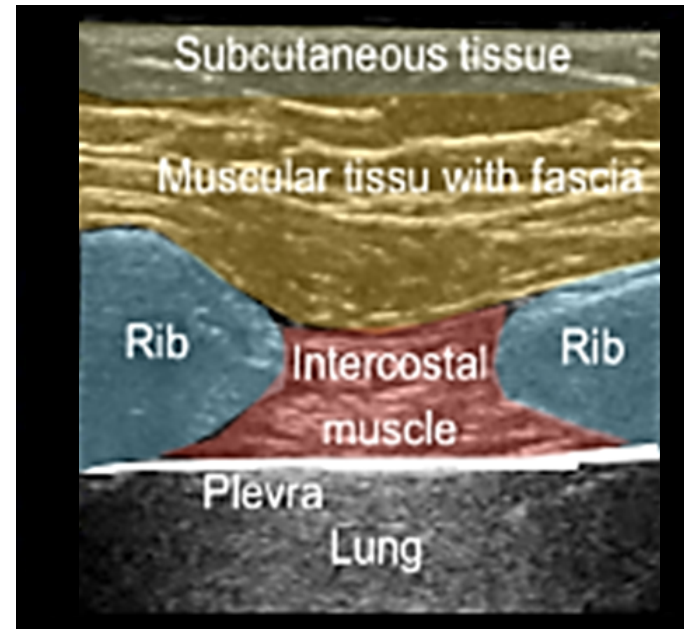
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The procedure

- Bleeding prevention
 - Port of entry
 - Knowledge of the anatomy
 - Use of chest u/s to avoid
 - Nodules or masses
 - Thickened and vascularized pleura
 - The diaphragm: it's a muscle
 - The lung



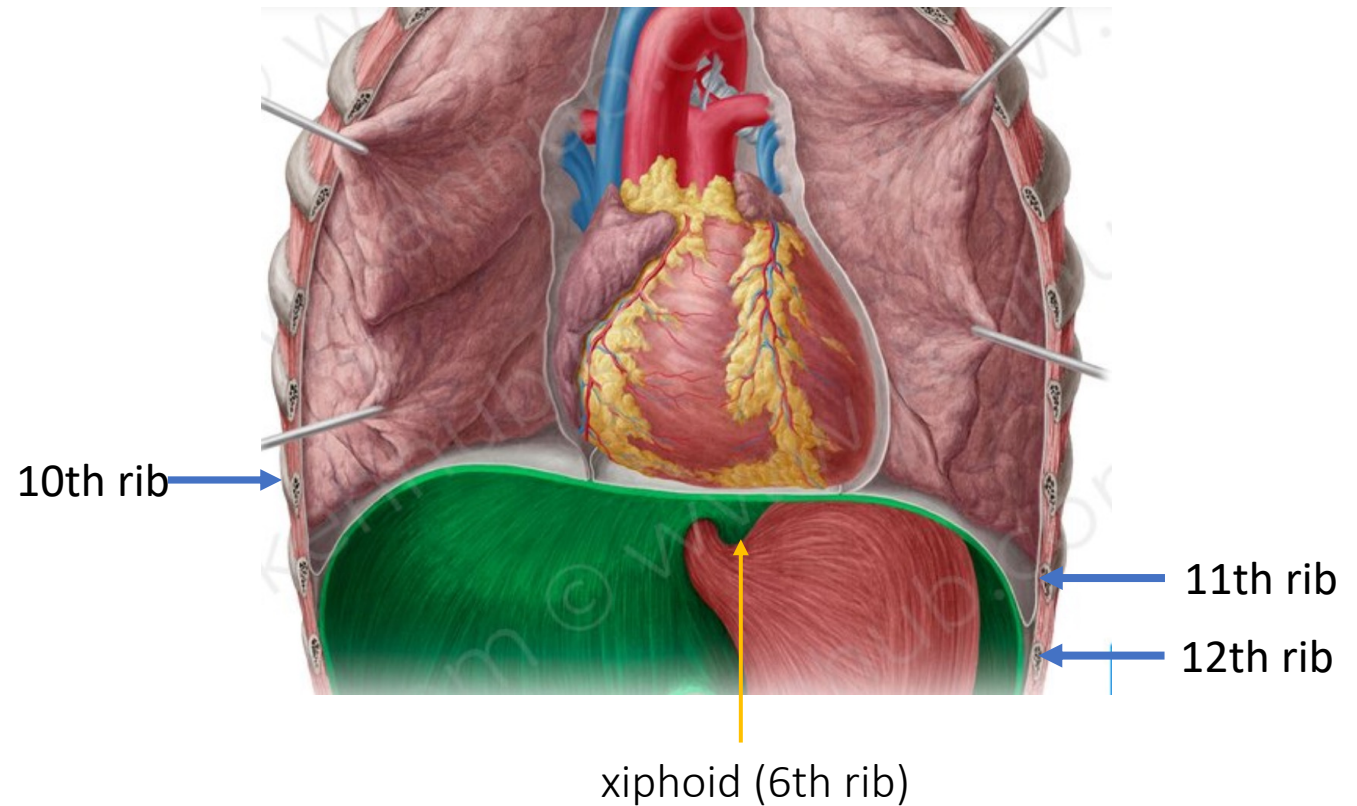
Potential Injuries and their prevention



- Avoid dangerous areas

- keep in mind that the diaphragm is elevated in the recumbent position (injury of spleen or liver possible)

Standing position



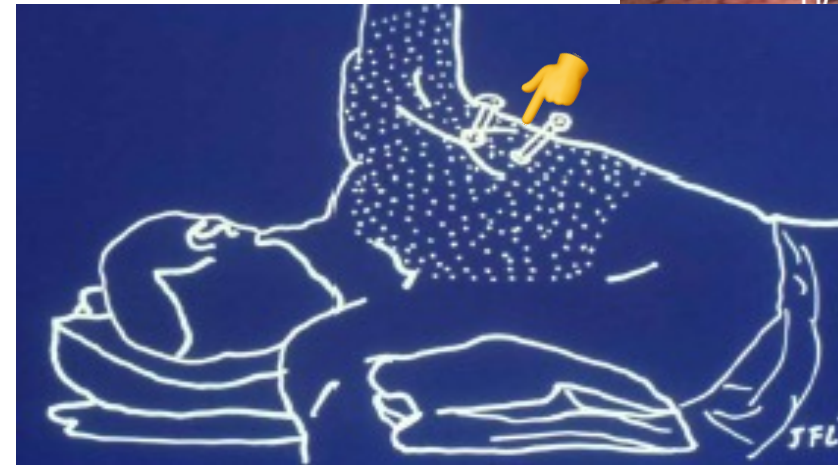
Potential Injuries and their prevention



- Injury to lung or other organs

- almost always avoidable by proceeding carefully (index finger limits depth of insertion of the trocar)

- When adhesions between chest wall and lung are present, an alternative introduction is the blunt dissection technique using a blunt (Kelly) forceps and the index finger



Prevention of diaphragmatic injury (port of entry)



- 4-5th intercostal space

- In the mid axillary line the 1st intercostal space palpated is the second
- The male nipple is generally situated near the level of the 4th rib

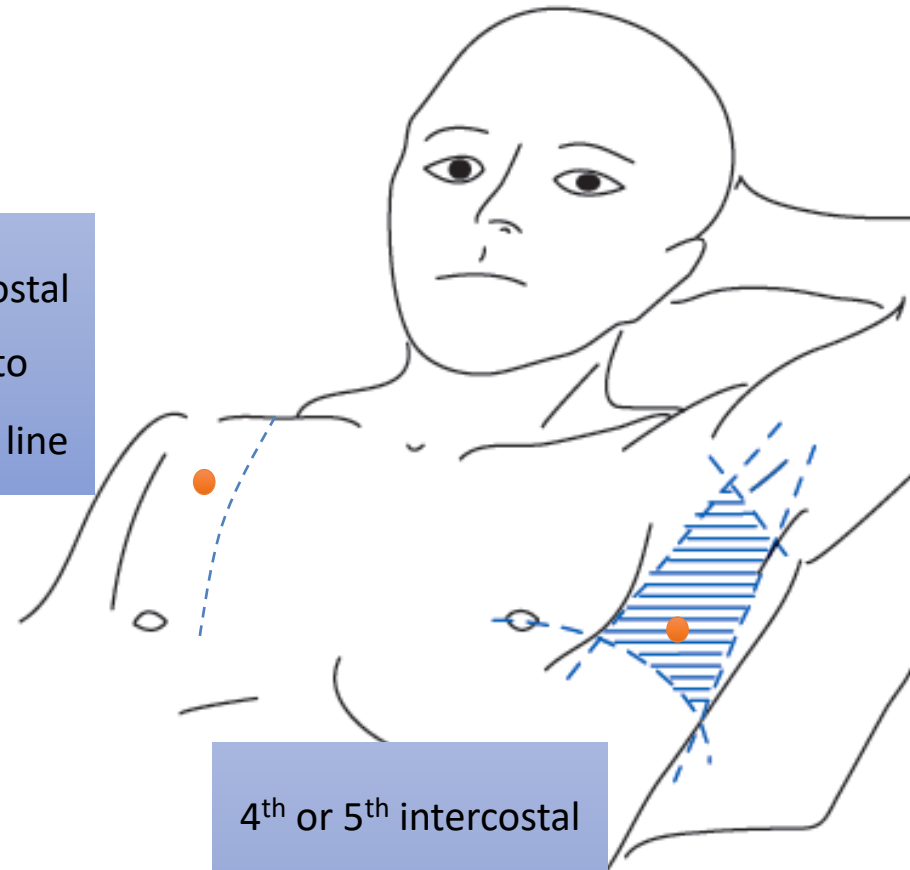




Inserting the drain and the role of US guidance

ANATOMICAL RECOMMENDED SITES OF PUNCTURE

2nd or 3rd intercostal
space lateral to
medioclavicular line



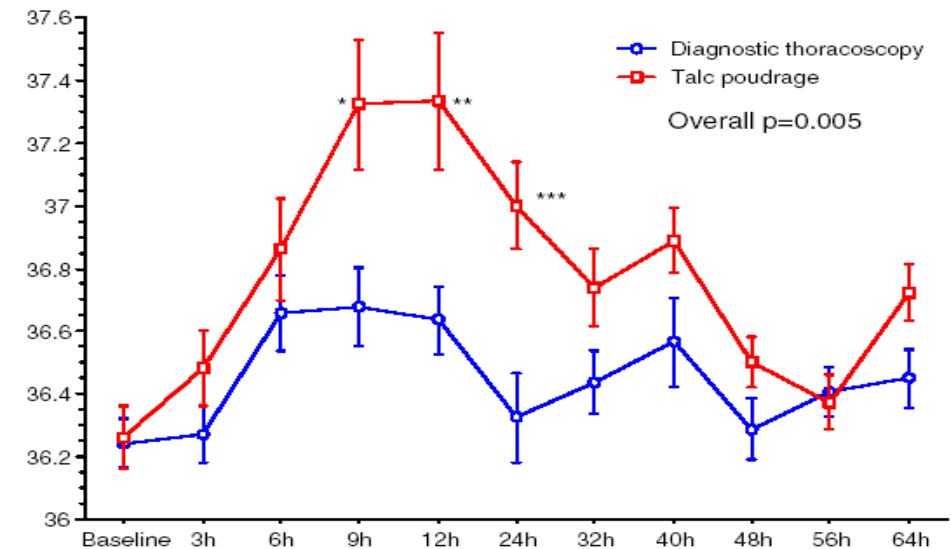
4th or 5th intercostal
space on
medioaxillary line

'TRIANGLE OF SAFETY':

- Anterior: lateral edge of pectoralis major
- Posterior: lateral edge of latissimus dorsi
- inferior: fifth intercostal space (nipple)
- Superior: the base of the axilla

After the procedure: fever

- The most frequent side effect
- Higher incidence in pleurodesis
- Is fever a complication? NO
 - With any intervention
 - More pronounced with pleurodesis
 - Well tolerated
 - No antibiotics for prevention



Froudarakis M et al. Chest 2006;129:356-61

F. Rodriguez-Panadero, A. Montes-Worboys. Respiration 2012; 83: 91

Local seeding

- Consequences affecting quality of life
 - Pain
 - Discomfort
 - Cosmetic



Local seeding

- Tumor seeding through the chest wall is due to
 - Pleural tap
 - Closed or guided pleural biopsy
 - Trocar insertion
 - Chest drain
- More frequent in mesothelioma
 - Incidence 16-40%
 - All tumors may invade chest wall

Boutin C et al. Chest 1995; 108:754

Agarwal PP et al. Radiology 2006;241:589



Local seeding: RT

- **Not systematic to prevent**
- Target volume
 - The clinical target + 2.5cm margins for a needle or 3.5cm margins for trocar
- Beam
 - Electrons
- Dose
 - 21 Gy in 3 fractions in 1week



Tube-related empyema

- Possible causes
 - Instrument sterilization
 - Aseptic conditions and mistakes
 - Wound infection (port of entry)
 - Host conditions
 - Immunocompromized
 - Local hygiene
- Increased mortality due to
 - Resistant germs
 - Immunocompromized population
 - Comorbidities, poor ps



Management of tube-related empyema



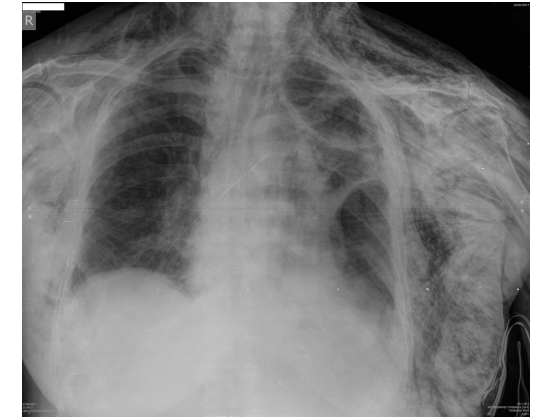
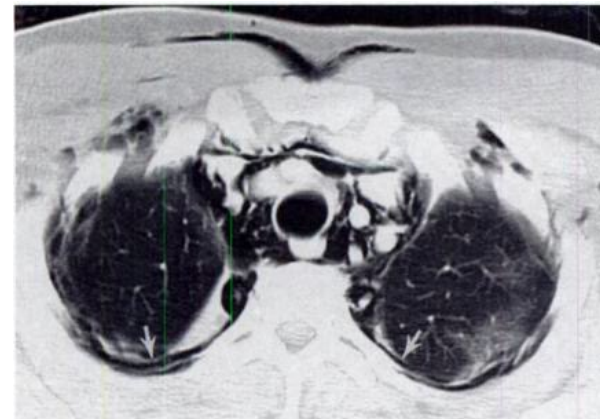
- Antibiotic treatment must cover
 - MRSA
 - Gram negatives
 - Anaerobics
 - Secondary adapt after antibiogram
 - Duration 3 w
- Fibrinolytics
 - Nosocomial infections?
 - DNase+ r-TPA (MIST-2 trial)

Maclayton DO, Hall RG. Ann Pharmacother 2007; 41:235

Rahman NM et al. NEJM 2011; 365: 518

Subcutaneous emphysema (SE)

- In general benign situation resolving spontaneously
 - >90% located chest wall only
- Due to
 - Cough during the procedure
 - Malfunction or misplacement of the post-procedure chest tube drain
 - Lung parenchyma leaking often adhered to the port of entry
- When extended prolong hospitalization and cost
 - Pneumothorax
 - Pneumomediastinum
 - Pneumopericardium
 - Life threatening
 - Increase intrathoracic pressure
 - Cardiac compression



Management of SE

- Spontaneous resolution
 - >90% of cases
 - Within a week
- Explain the situation to the patient and relatives
 - To relieve anxiety
- 1st action to take
 - Simply increase the chest tube drainage
- In case of life-threatening conditions
 - Cardio-respiratory support

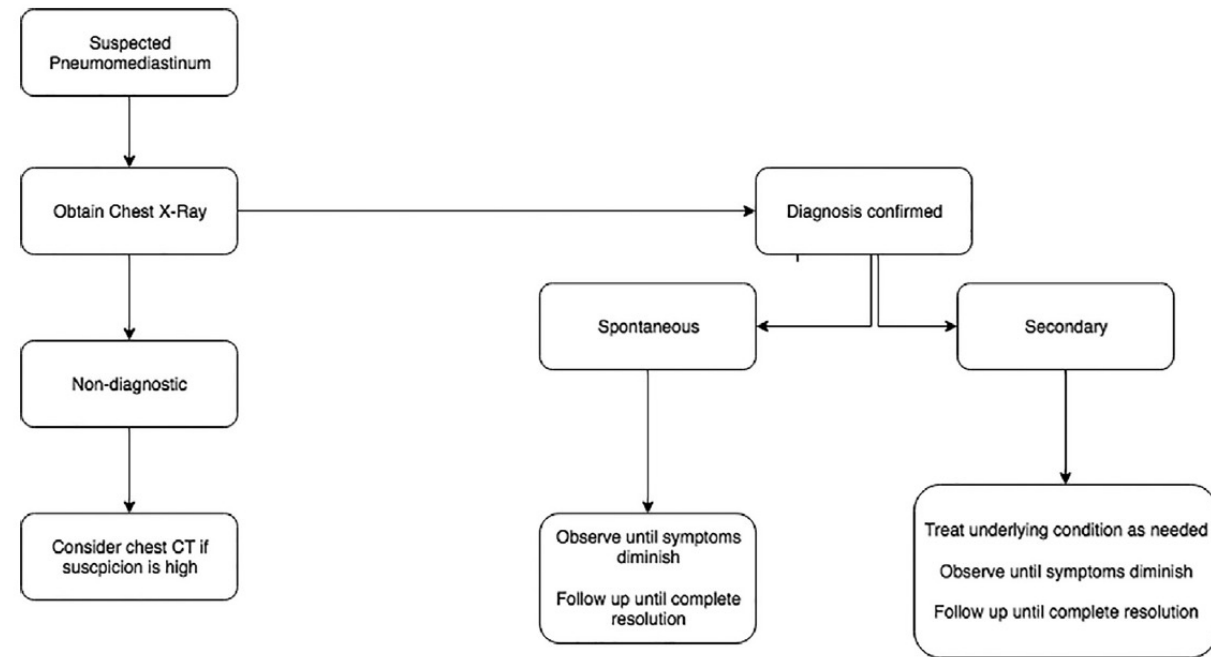


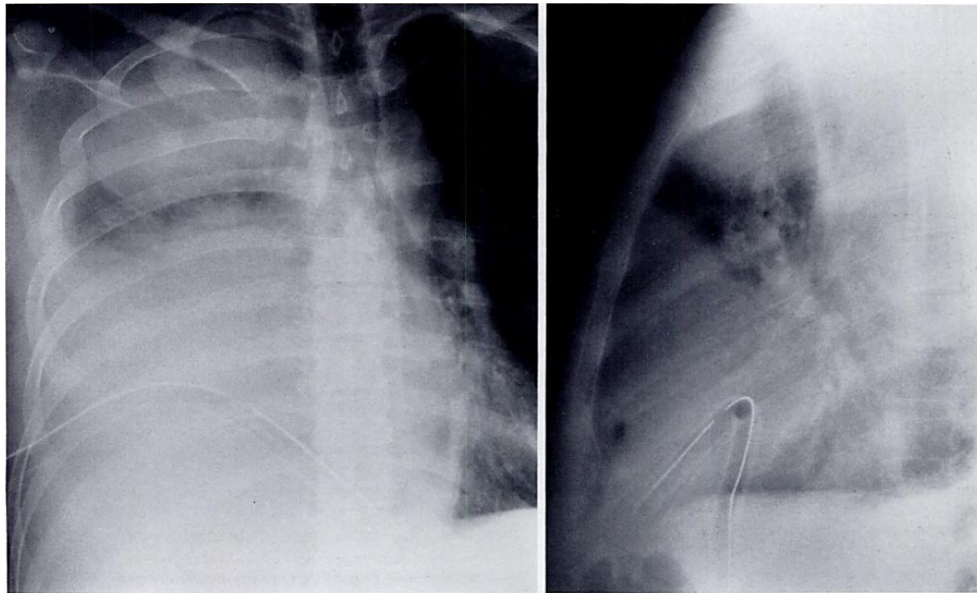
Fig. 5 Algorithm for the management of patients with pneumomediastinum.

Misplacement of chest tube 1

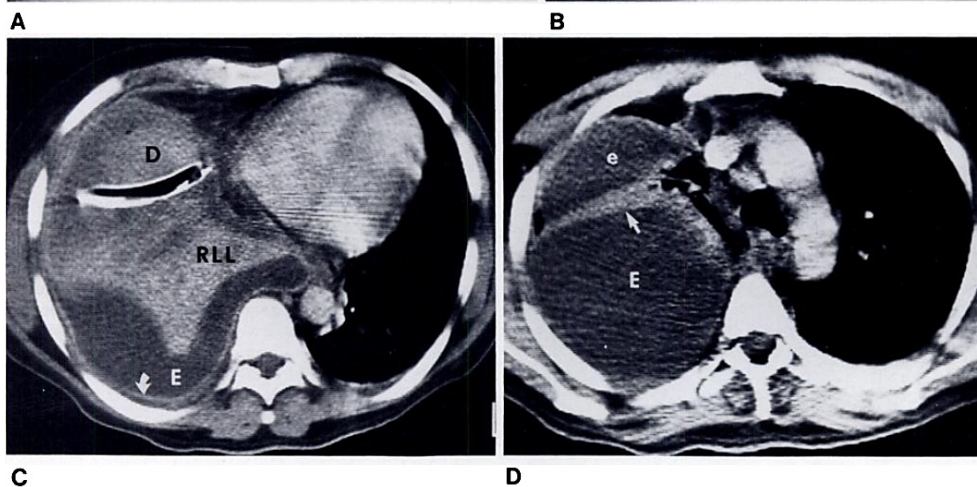
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Chest tube lies over dome of
diaphragm and anterior to empyema



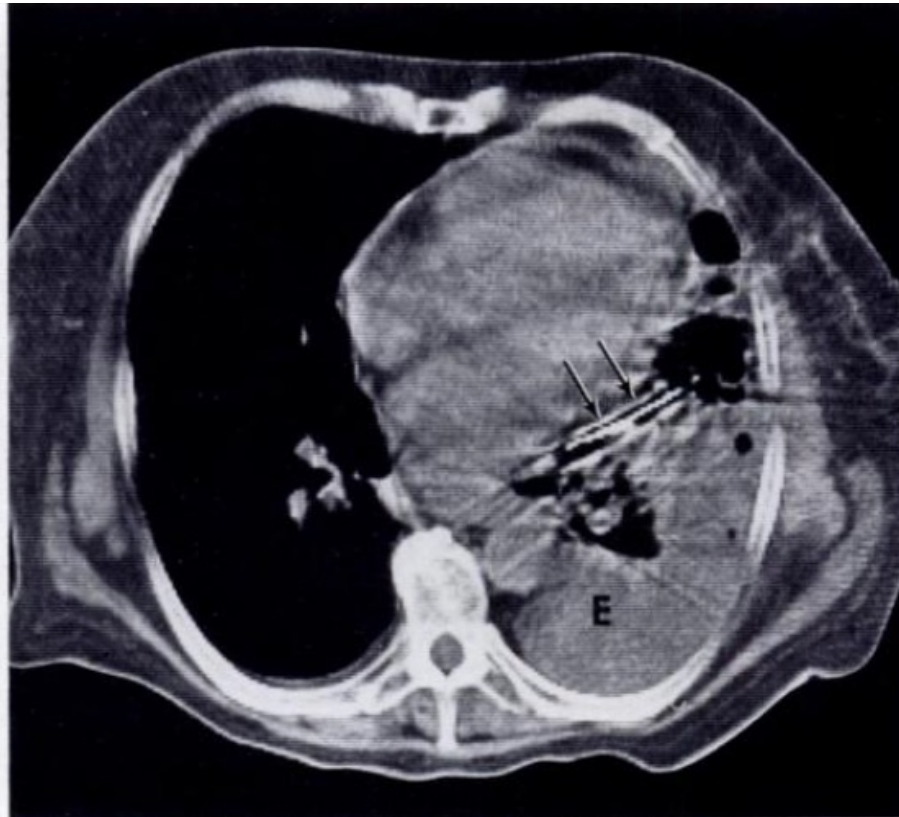
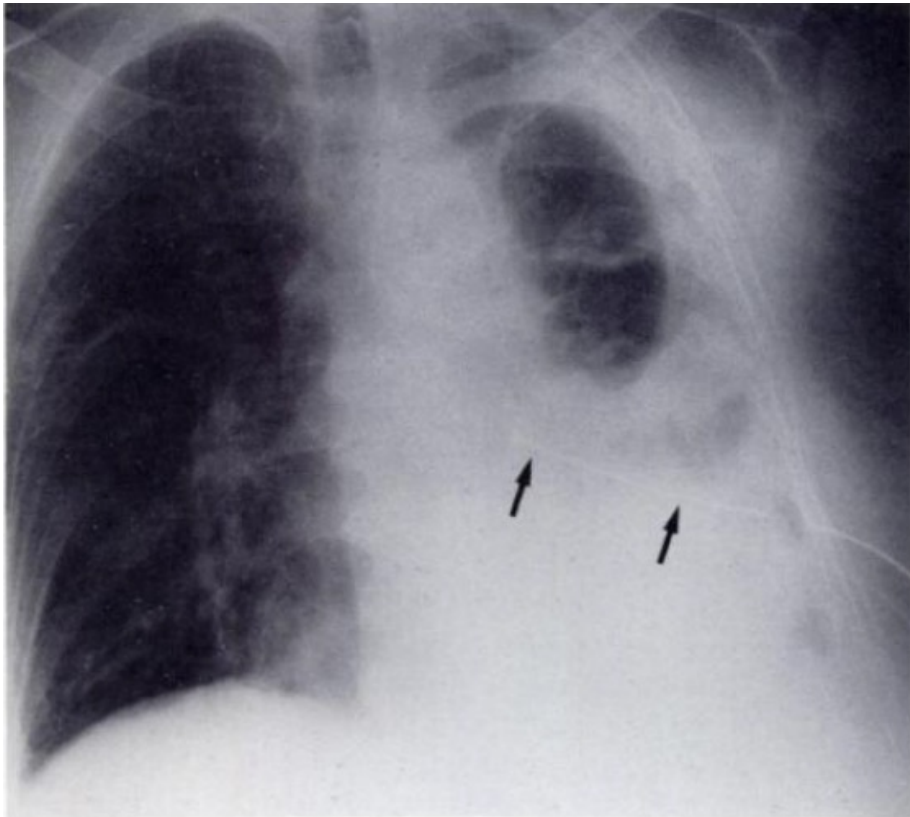
Stark Am J Roentgenol 1983;141:253

Misplacement of chest tube 2

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Chest tube lies in major fissure and abuts pericardium

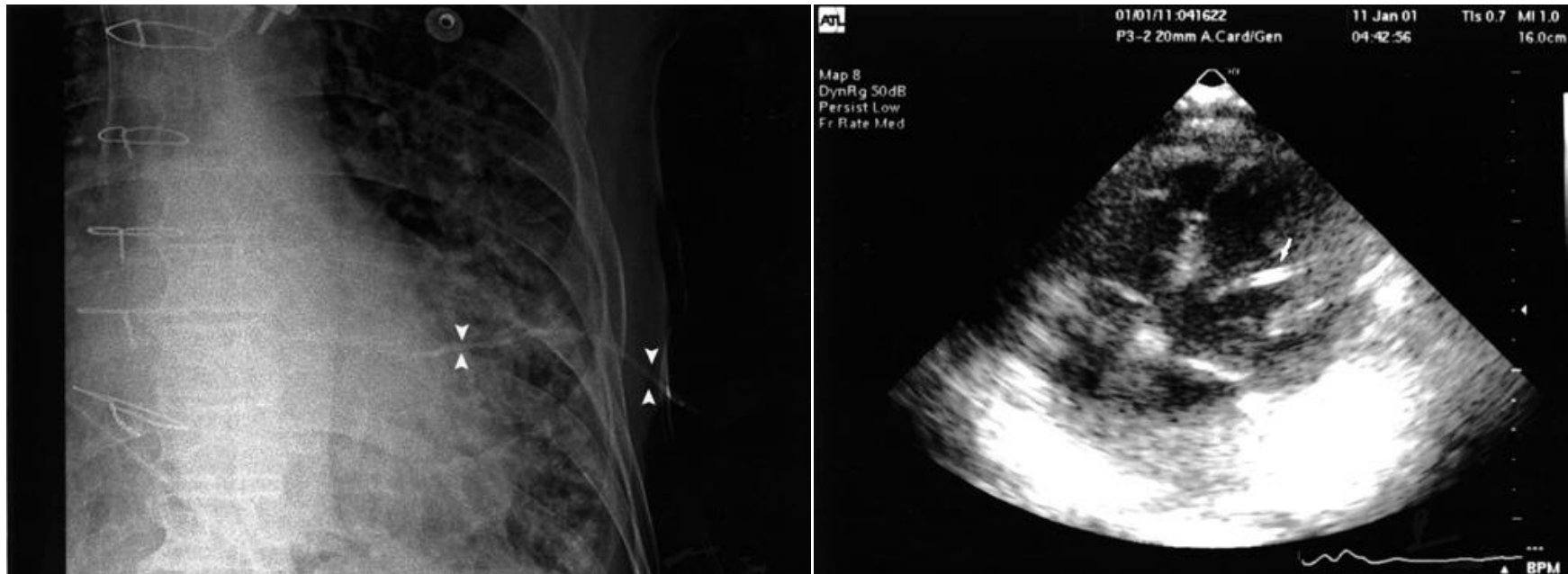
Stark Am J Roentgenol 1983;141:253

Misplacement of chest tube

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Pleurocath© inserted in left ventricle

Stark Am J Roentgenol 1983;141:253

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How to prevent complications

General rules

- Knowledge
- Skills
- Education
- Program set up



Requirements to prevent complications:

Knowledge and skills

- Knowledge
 - Thoracic anatomy
 - Physiology and pathophysiology (of pleura and not only..)
 - Respiratory diseases
 - Pharmacology
- Skills



Required basic skills for thoracic procedures: education



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- Local anaesthesia
- Chest Ultrasound
- Thoracocentesis (diagnostic and therapeutic)
- Chest tube placement and pleural drainage
- Pleurodesis techniques

Required basic skills for thoracoscopy: *study with the experts*



- Skill courses on animals/models/corpses prior to clinical practice is mandatory
 - Theoretical background: review of pleural anatomy physiology, pathophysiology, imaging, various procedures and diseases
 - Get used with instrumentation and procedure
 - Student-tutor interaction important
 - Small number of participants



Requirements to prevent complications:

Program set-up



- Endoscopy suite
 - Appropriate equipment
- Trained personnel
- Selection of patients
- Post-procedure follow-up



Endoscopy suite

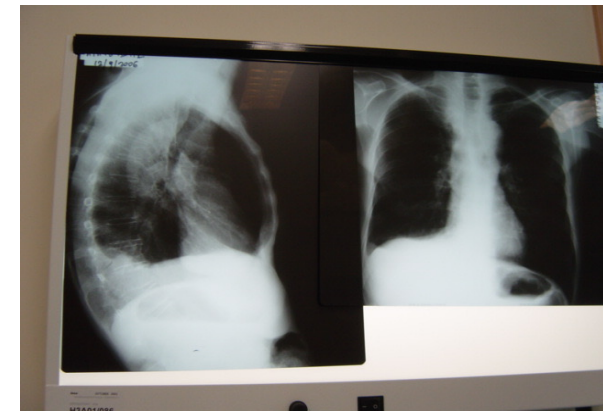
Overhead lighting



Aspiration equipment to collect fluid



A procedure table



A viewing box

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Endoscopy suite

- Cardiovascular and respiratory monitoring
- Resuscitation devices
- Oxygen supplementation
- Chest tube with seal, “light surgical” instrumentation



Trained and dedicated personnel

- Because
 - Time saving
 - Important for the outcome
 - Know how to react when trouble (automatisms)
- Before starting
 - Teach the team
 - Be sure the team know their roles
- Start with easy cases



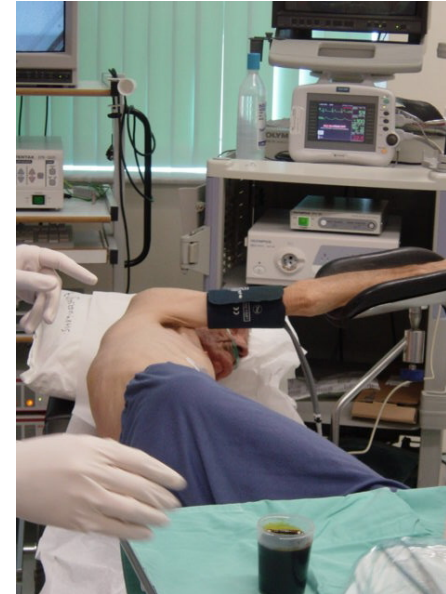
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Before starting: pre-procedure review

- **Remember:** Patients who require Thoracoscopy are *usually* ill
- Assess risk and benefit
- Patient: history and commorbidities
- Cardiac status
- Chest X-ray or CT
- Consent
- Uncooperative patient
- Blood tests
 - Coagulation
 - PT > 50%
 - Platelets > 70000
 - Blood gazes
 - PaO₂ > 50mmHg
 - PaCO₂ < 50mmHg



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Aseptic technique

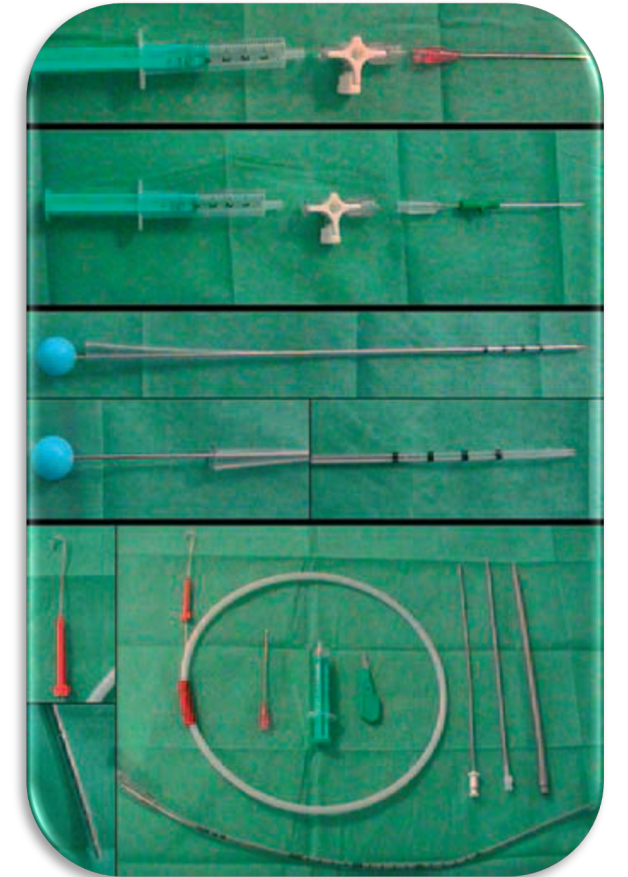
EQUIPMENT (AVAILABLE IN KIT FORM):

- Sterile gloves and gown
- Skin antiseptic solution (eg, iodine or chlorhexidine in alcohol)
- Sterile drapes
- Gauze swabs
- A selection of syringes and needles (21 & 25 gauge)
- Local anaesthetic (eg, lidocaine 1%)
- Scalpel and blade
- Suture (eg, 0 or 1-0 silk)
- Instrument for blunt dissection if required (eg, curved clamp)
- Guide wire and dilators for Seldinger technique
- Chest tube
- Connecting tubing
- Closed drainage system (including sterile water if underwater seal being used)
- Dressing

Laws Thorax 2003;58:ii53

Millikian Am J Surg 1980;140:738

Fallon J Trauma 1992;33:110



Premedication/local anaesthetic

TO REDUCE PAIN ASSOCIATED WITH CHEST DRAINS, ANALGESIA SHOULD BE CONSIDERED AS PREMEDICATION AND SHOULD BE PRESCRIBED FOR ALL PATIENTS WITH A CHEST DRAIN IN PLACE

Chest tube = Painful procedure : 50% experience pain 9-10 on a 10 level scale

PREMEDICATION:

- *IV anxiolytic*: midazolam 1-2 mg titrated to achieve adequate sedation
- *IV analgesic*: 2.5 mg intravenous morphine given immediately prior to the procedure or 10 mg oromorph 1 h prior to the procedure

No single technique has been shown to be clearly superior. Monitorisation because of respiratory depression.

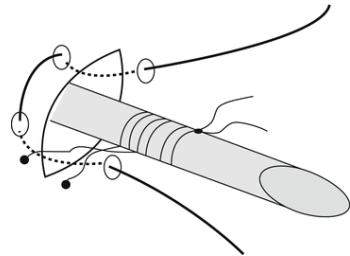
- *Atropin SC*. Vasovagal reactions following tube insertion may be avoid. No controlled trial recommendations.

LOCAL ANAESTHESIA:

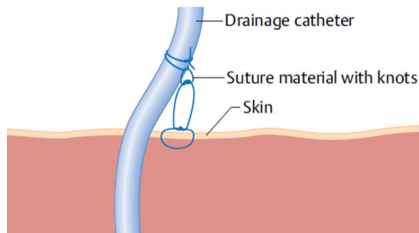
- *Lidocaine* 1-2% should be infiltrated prior to the procedure, paying particular attention to the *skin, periostium* and the *pleura*



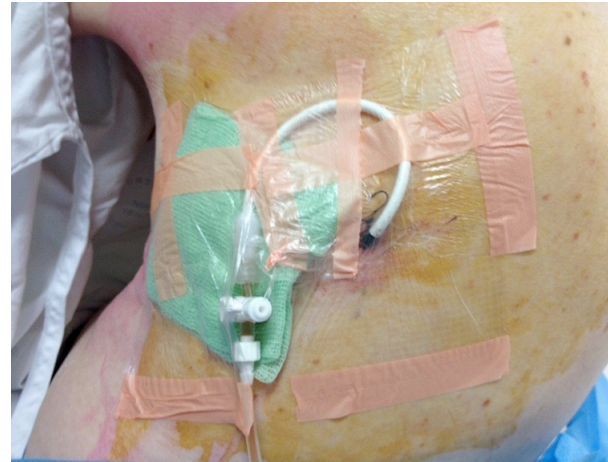
Securing and dressing the chest drain



large-bore chest tubes



small chest tubes



Dressing applied to a pleural drain insertion site:

- allows easy inspection of the tube exit site from the skin
- tube exiting from the center of the dressing with only a small combine (if necessary) below the tube exit site to cushion the tube away from the patient
- not excessively bulky as this will prevent close observation and access to the drain site
- Transparent (better)

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Conclusion

- Chest tube insertion has some complications
- Management of these complications in most of the cases is conservative or minimally invasive
 - Except for empyema and organ perforation
 - Early intervention probably the best solution
- Rather prevent than treat
 - Education / skills
 - Teamwork
 - Adequate facilities



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Thank you
marfroud@gmail.com

