Chest Tubes:
Placement and Management

Labib Debiane, MD, MS

Interventional Pulmonology
Director, Pleural Disease Program
Division of Pulmonary and Critical Care Medicine
Henry Ford Hospital

Assistant Professor of Medicine FTA
Wayne State University School of Medicine

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Disclosure

- None

Outline

- Introduction
- Indications / Contraindications
- Chest tube types
- Techniques for insertion
- Chest drainage systems
- Management
- Complications
- Education
- Summary

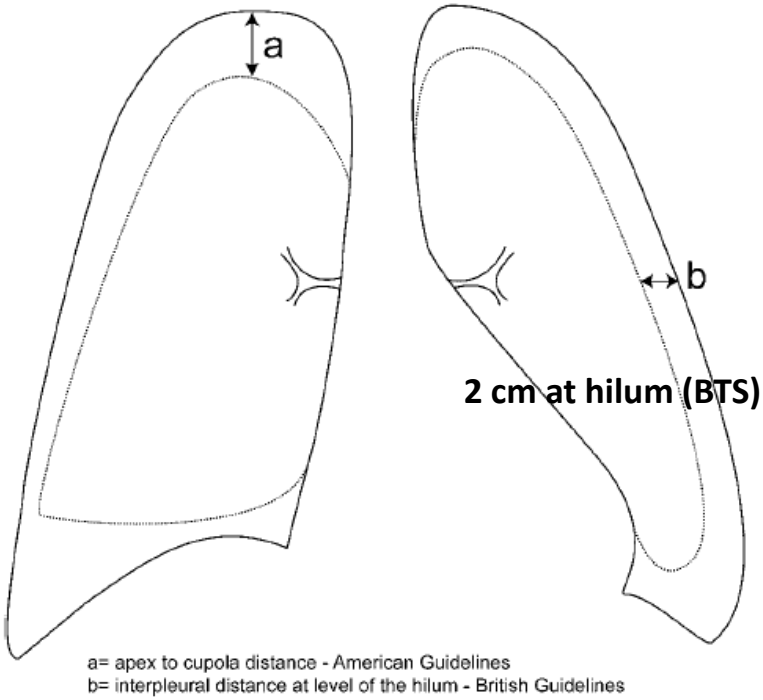
Introduction

- Chest tube placement = tube thoracostomy
- Common procedure in day-to-day medical practice
- Aims at draining the pleural cavity from **air**, **fluid** or **blood**
- Provides **access** to the pleural cavity to instill drugs (sclerosing agents, tPA/DNase, etc)

Indications

- **Pneumothorax**
  - **Large** size spontaneous pneumothorax
  - Clinically **unstable** pneumothorax (tension physiology)
  - **Recurrent** or **persistent** pneumothorax
  - **Traumatic** pneumothorax (iatrogenic and non-iatrogenic)
  - In patients on positive pressure ventilation (advisable)
  - Pneumothorax with pneumomediastinum/pneumopericardium

3 cm at apex (ACCP)



Dev SP et al. NEJM 2007;357:e15
MacDuff A et al. Thorax 2010;65(Suppl 2):ii18-ii31

Indications

- **Hemothorax**
- Hemo-pneumothorax
- Pleural effusion from esophageal rupture (**gastric leak**)
- **Malignant** pleural effusion (recurrent symptomatic)
- Treatment with sclerosing agents or post-thoracoscopic pleurodesis
- Recurrent pleural effusion (typically exudative and symptomatic)
- Parapneumonic effusions or **empyema**
- Chylothorax
- Postoperative care (eg. CABG, thoracotomy, or lobectomy)

Dev SP et al. NEJM 2007;357:e15

Contraindications

- **No absolute contraindications**

- **Relative contraindications** include:
  - Risk of bleeding
    - Use of anticoagulants
    - Bleeding diathesis
    - Abnormal clotting profiles
  - Overlying skin infection
  - Transudative pleural effusions due to liver failure or heart failure (caution)

Dev SP et al. NEJM 2007;357:e15

Types of Chest Tubes

- **Numerous** kinds
- Typically classified according to **size** and **method** of insertion
- Made of different materials
  - Polyvinyl chloride, polyethylene, and silicone
- Can be **straight**, **angled**, or **coiled** at the end (**"pig-tail"**)
- Can be **tunneled** or **non-tunneled**

Porcel J. Tuberc Respir Dis 2018;81:106-115

Straight and Angled Chest Tubes

Covidien Thoracic Catheter

https://www.4mdmedical.com/thoracic-catheter.html

Pigtail Chest Tubes (non-locking)

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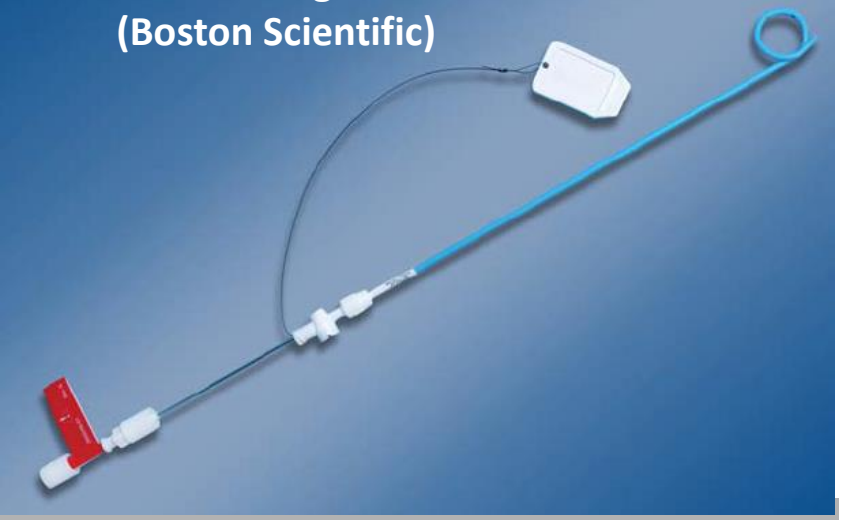
Locking Pigtail Chest Tubes

Flexima™ Drainage Catheters (Boston Scientific)



Cook Medical Dawson-Mueller Multipurpose Drainage Catheter

ReSolve® Locking Drainage Catheters (Merit Medical)

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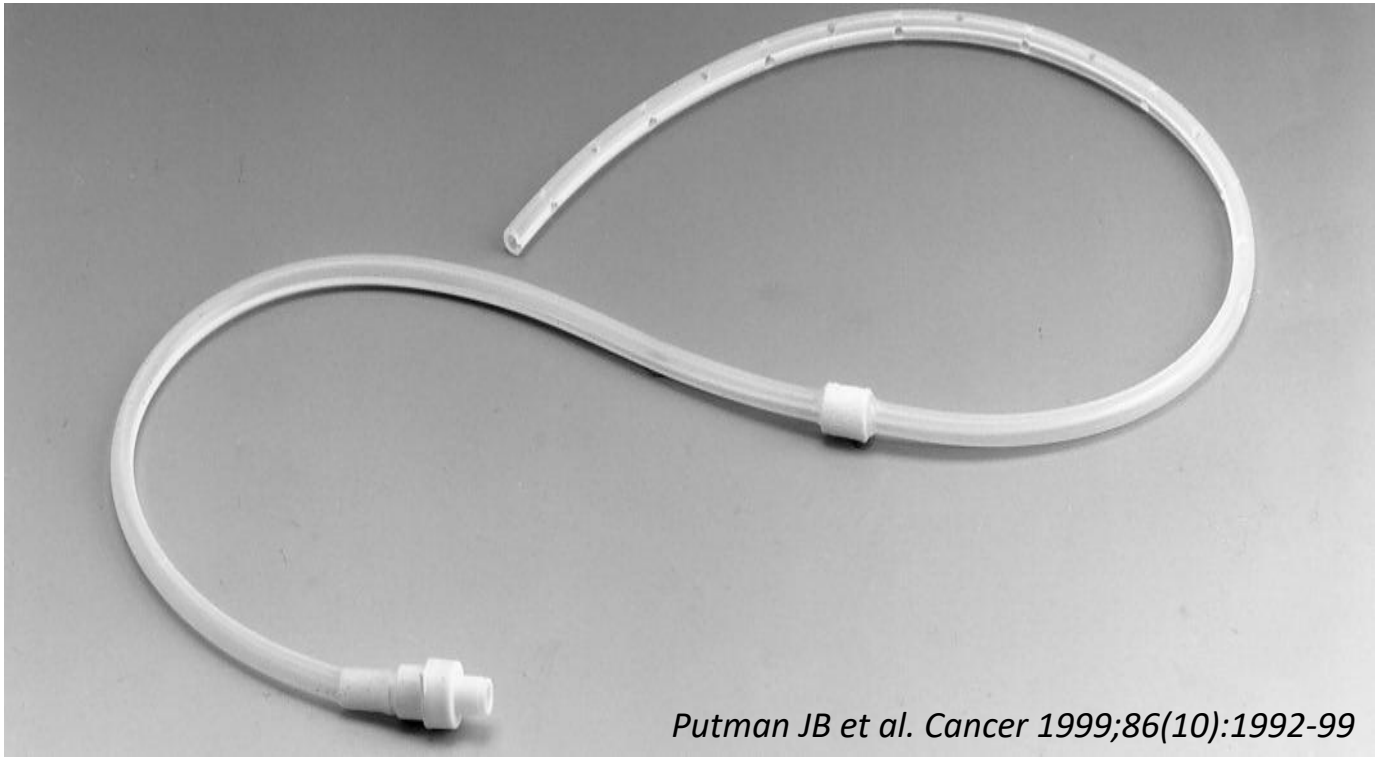
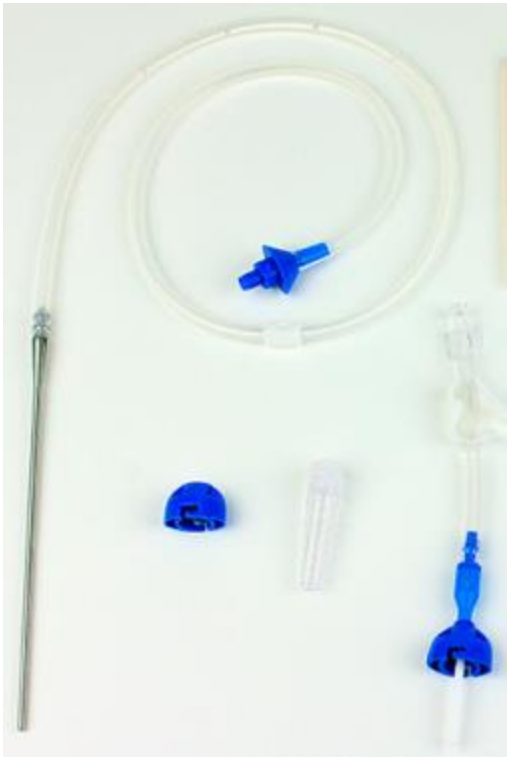
Tunneled Pleural Catheter

PleurX™ Pleural Catheter (by BD)



Putman JB et al. Cancer 1999;86(10):1992-99

Rocket® IPC™



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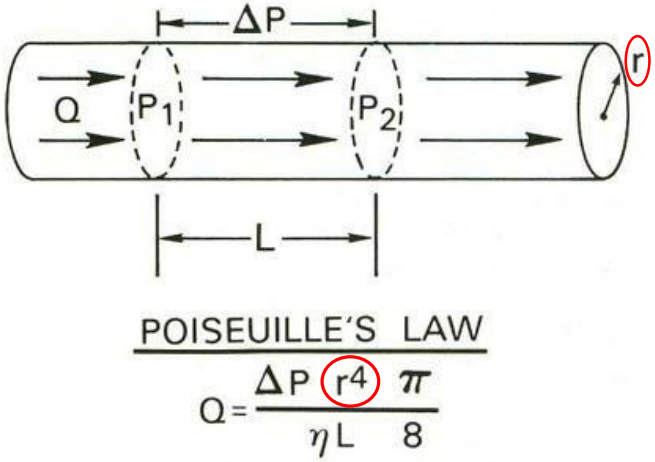
Chest Tube Size

- Denoted in **"French" (Fr)**
  - 1 Fr = 1/3 mm
  - Usually refers to the outer diameter
- Chest tube sizes usually range between **8F** and **36 F**
  - Could be as large as 40F
- **Small-bore** chest tube vs **large-bore** chest tube
  - No universal definition
  - Threshold of **≤ 14 Fr** vs **< 20Fr**
  - IPC size is 15.5 Fr
- Some consider a group of medium-bore tubes (16–24F)
- Chest tube length: 30-40 cm

Porcel J. Tuberc Respir Dis 2018;81:106-115
Richtie M et al. Clin Pulm Med 2017;24(1):37-53

Chest Tube Size

- **Laminar Flow:** Hagen-Poiseuille Equation
  - Q = Flow rate *(ΔV/ Δt)*
  - ΔP= pressure gradient
  - r = radius
  - L = Length
  - η = fluid viscosity



- **Turbulent Flow:**
  - Difficult to characterize by an equation
  - Flow is proportional to r^5

Tahmassebi, Amirhessam. Fluid Flow Through Carbon Nanotubes And Graphene Based Nanostructures. August 2015. Thesis for: Master of Science in Physics, Advisor: Alper Buldum

Chest Tube Insertion Techniques

There are 2 widely accepted methods:

- **Blunt (surgical) dissection method**
  - Allow larger bore chest tubes
  - Allow quick access

- **Percutaneous method**
  (1) Seldinger technique
  (2) Trocar technique (less favored)

- Tunneled Indwelling Pleural Catheter: seldinger + tunneling

Richtie M et al. Clin Pulm Med 2017;24(1):37-53

Blunt (surgical) Dissection Method

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Skin marking then Scrub and Drape

Lidocaine 1% to anesthetize the skin and subcutaneous tract

https://www.ctsnet.org/article/technique-chest-tube-insertion

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Incision: 2-3 cm, parallel to rib

https://www.youtube.com/watch?v=rhN_QgKvTkE

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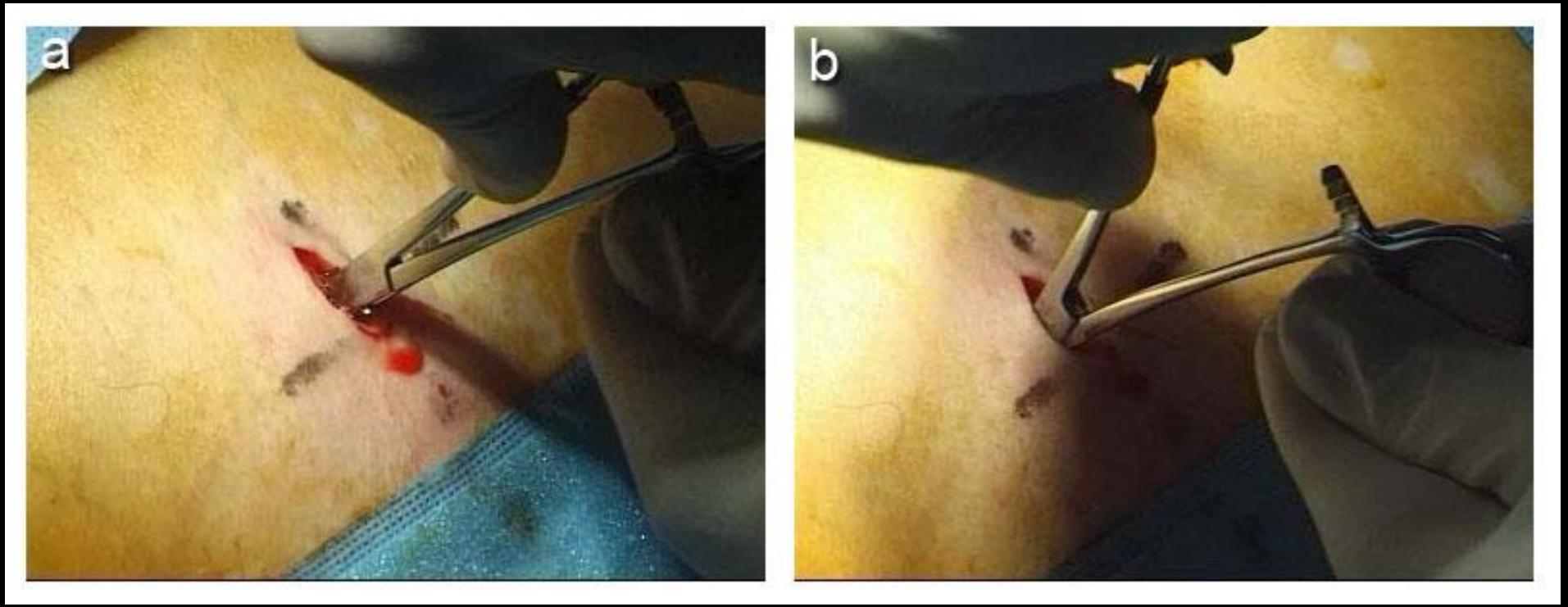
Blunt Dissection

Curved clamp (Kelly/Hemostat) or curved scissors (Cooley)



https://csds.qld.edu.au/sdc/Provectus/Chest_Drain/Insertion%20of%20large%20bore%20chest%20tube%20by%20blunt%20dissection%20in%20adults/unit-20022012053525881042/images/

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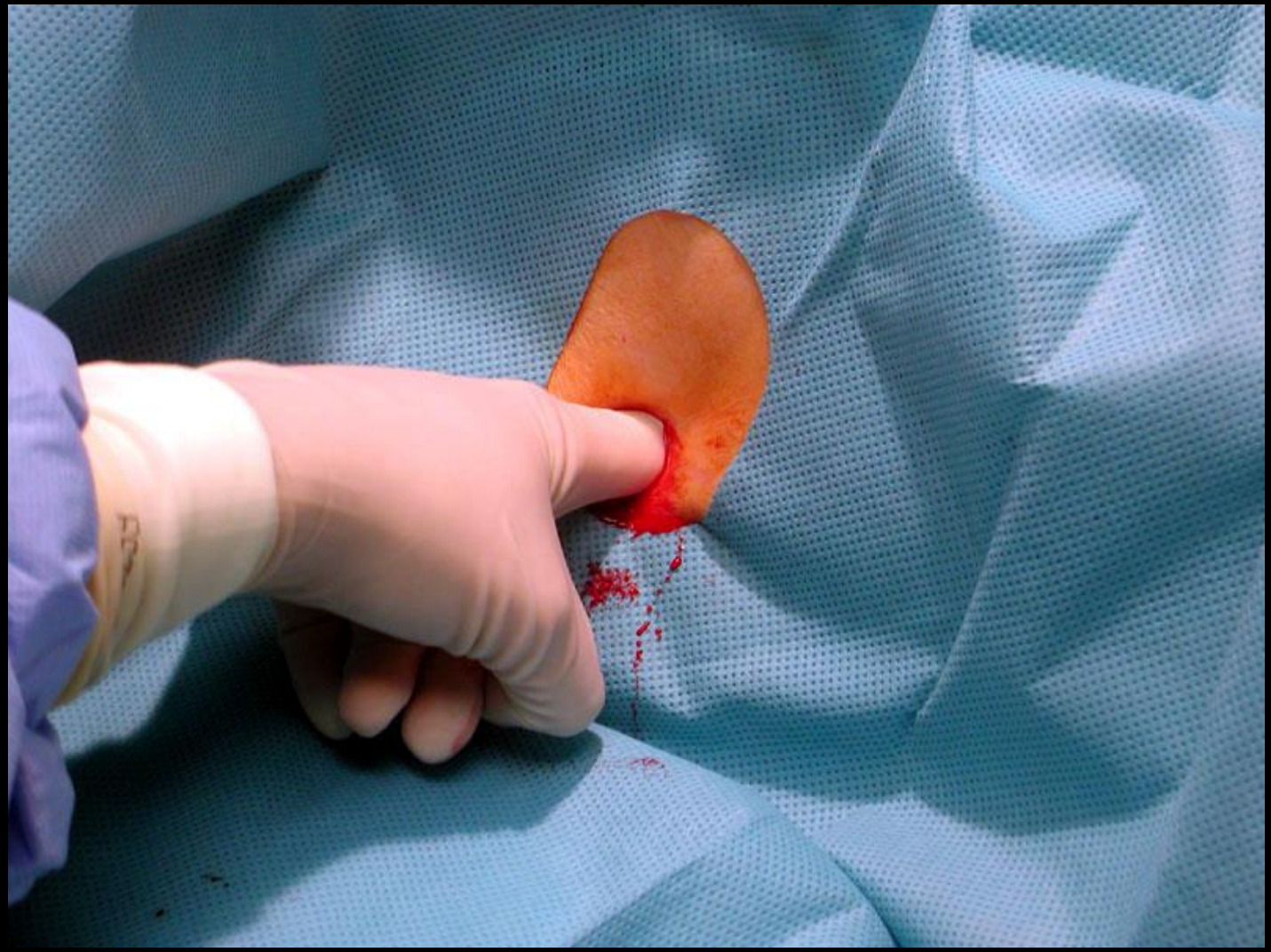
Tract Dilation and Pleural Cavity Inspection



http://neurocriticalcare.pbworks.com/w/page/48747193/Chest%20Tube

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Clamp chest tube at insertion end

Insert chest tube into the pleural cavity with the aid of the clamp

http://neurocriticalcare.pbworks.com/w/page/48747193/Chest%20Tube

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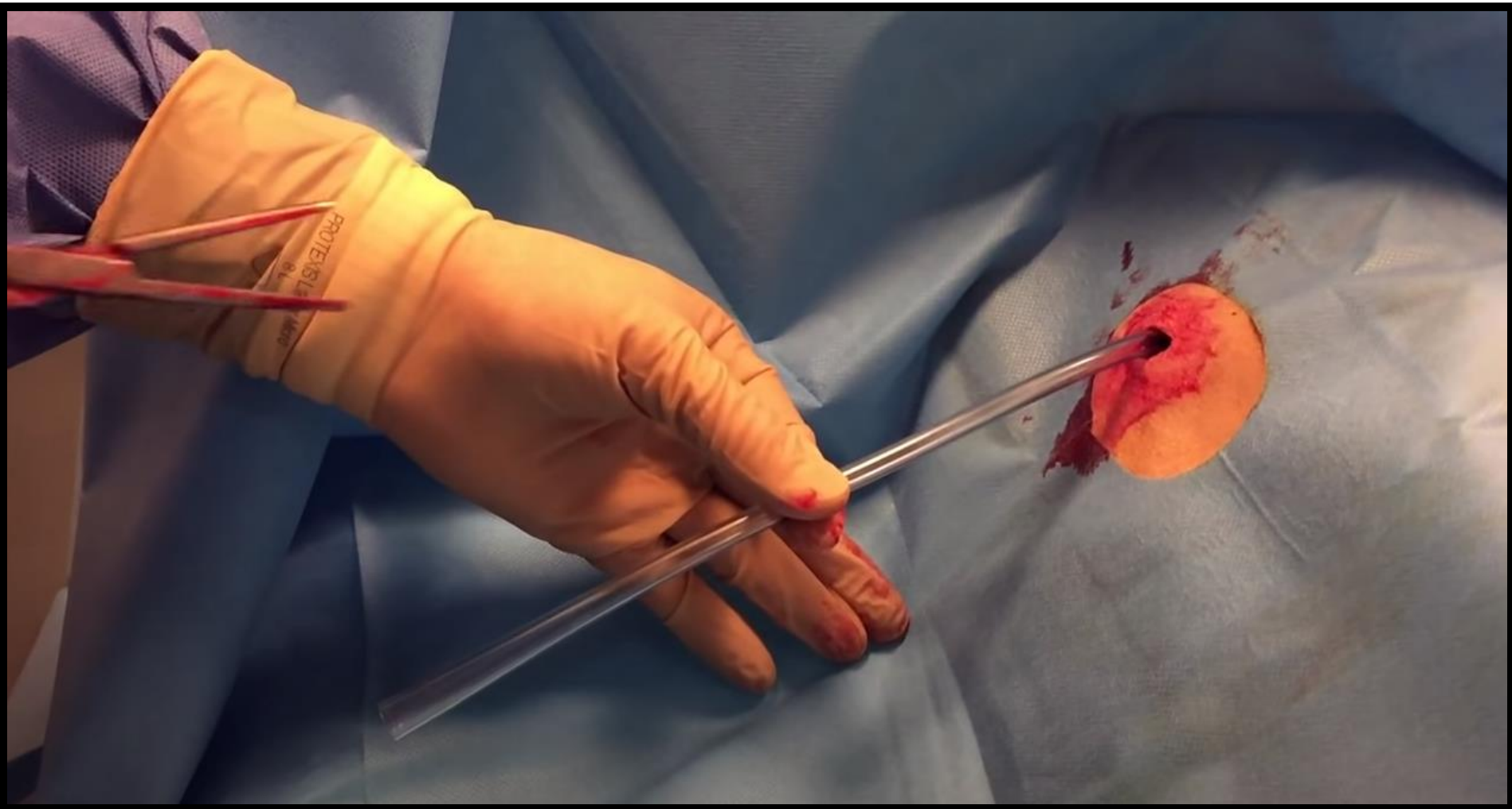
Watch of air condensation or fluid return



https://www.youtube.com/watch?v=rhN_QgKvTkE

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Anchoring Suture(s)

https://emedicine.medscape.com/article/80678-overview

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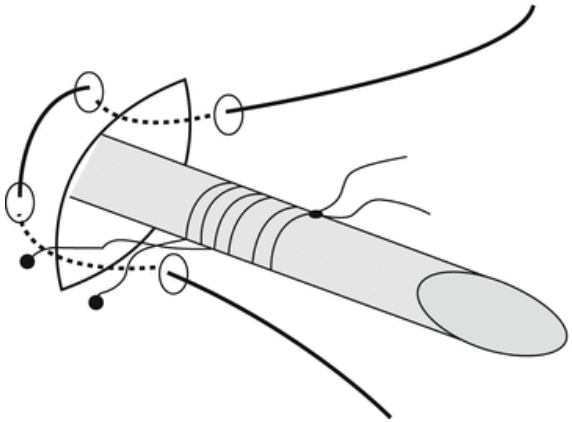
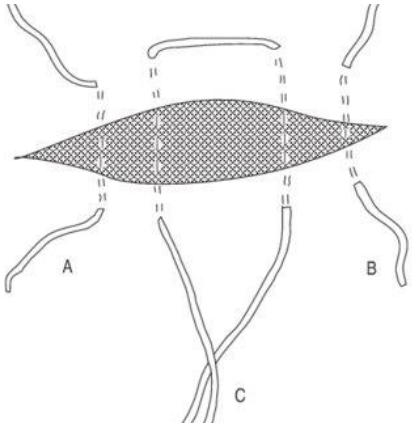
Various Types of Sutures

Purse String



Vertical Mattress

Simple Interrupted



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Seldinger Technique

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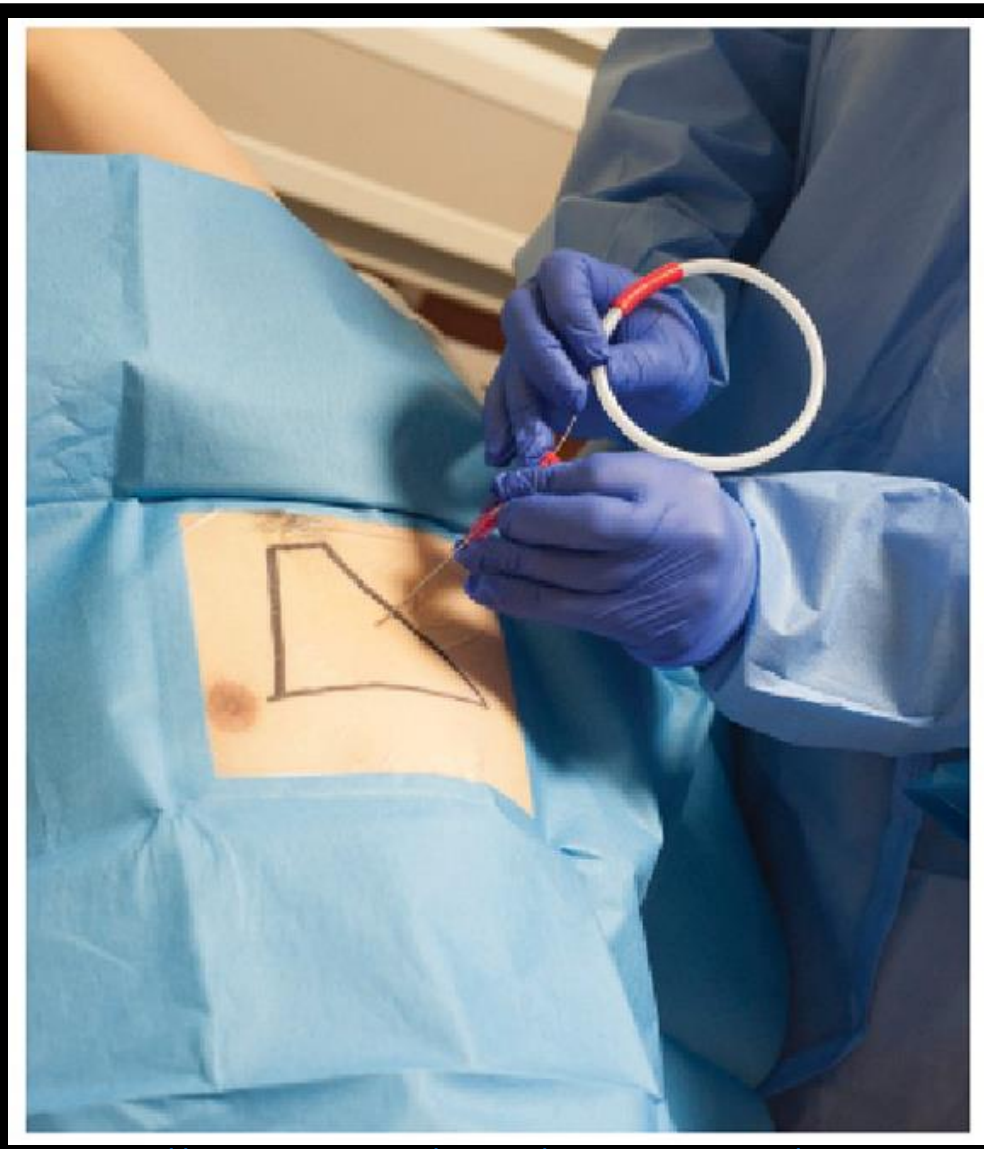
Technique

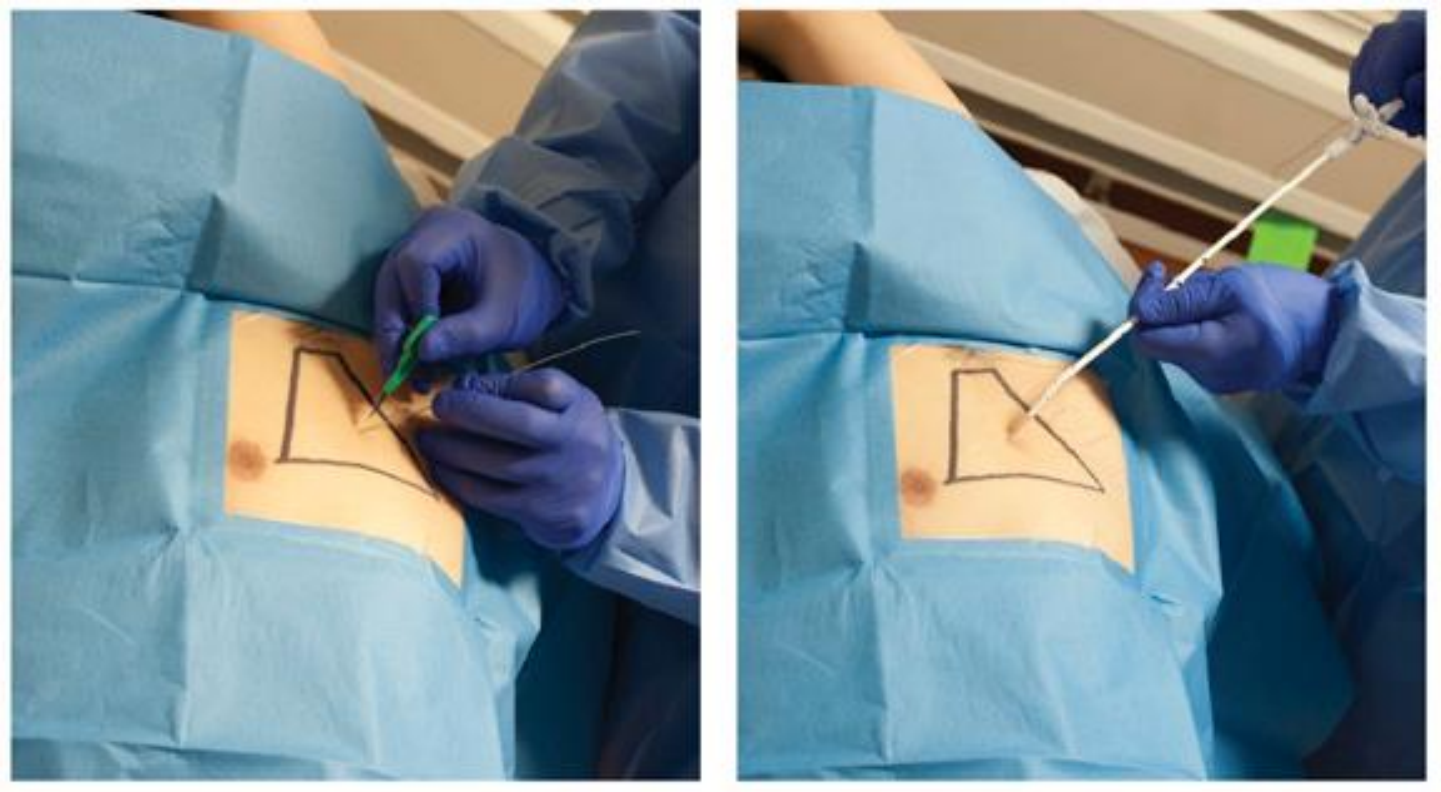
- 18-gauge needle passed into the pleural space
- Guidewire introduced into the pleural space and the needle withdrawn



https://epmonthly.com/article/pigtail-insertion/

Technique

- 0.5 cm incision
- Dilate the tract
- Advance chest tube over the guidewire then obturator and guidewire are removed
- Anchoring sutures



https://epmonthly.com/article/pigtail-insertion/

Pleural Drainage Systems

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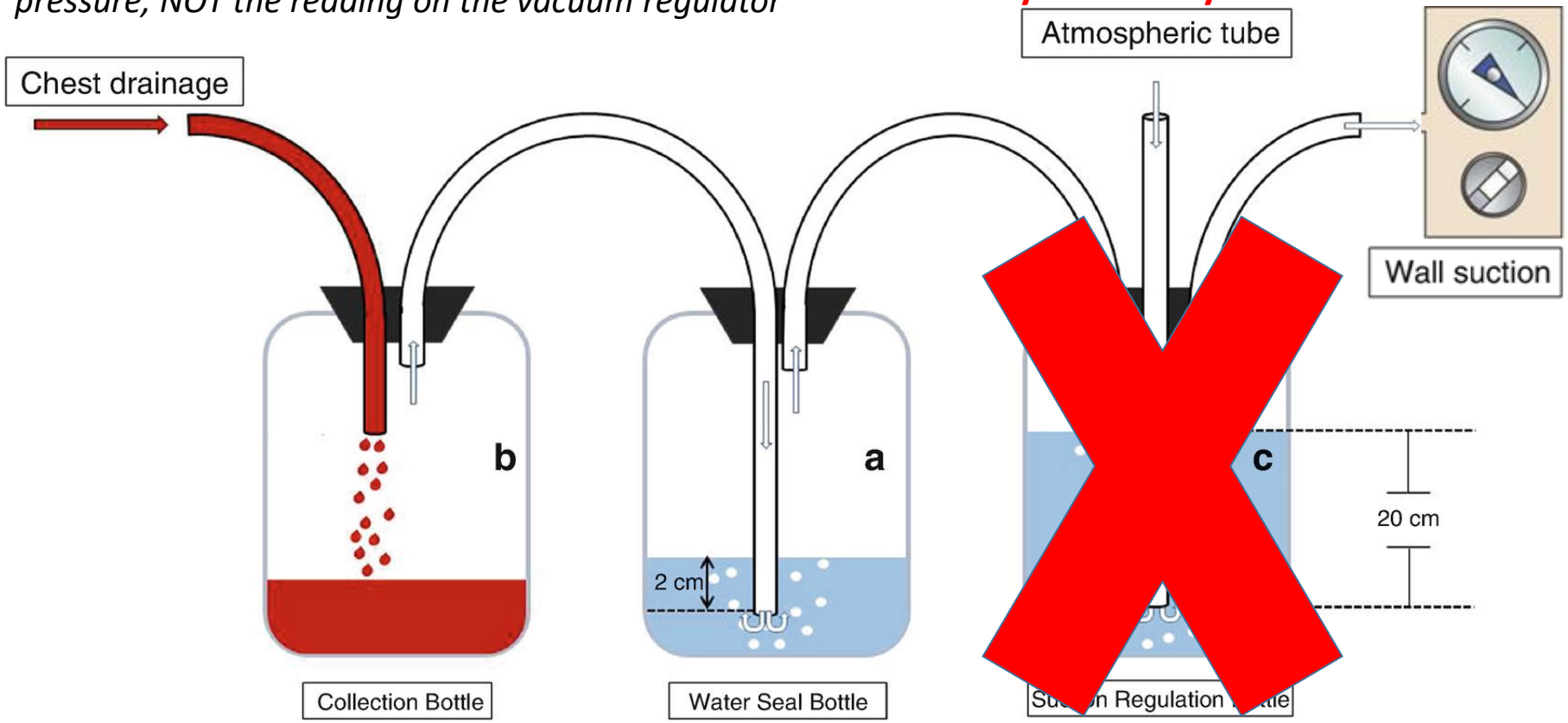
3-Chamber System

REMARK: *Depth of water determines amount of negative pressure, NOT the reading on the vacuum regulator*

Not needed with newer Dry Suction systems



Adopted and modified from: Chevrollier G.S.et al (2018) Fundamentals of Drain Management. In: Palazzo F. (eds) Fundamentals of General Surgery. Springer, Cham

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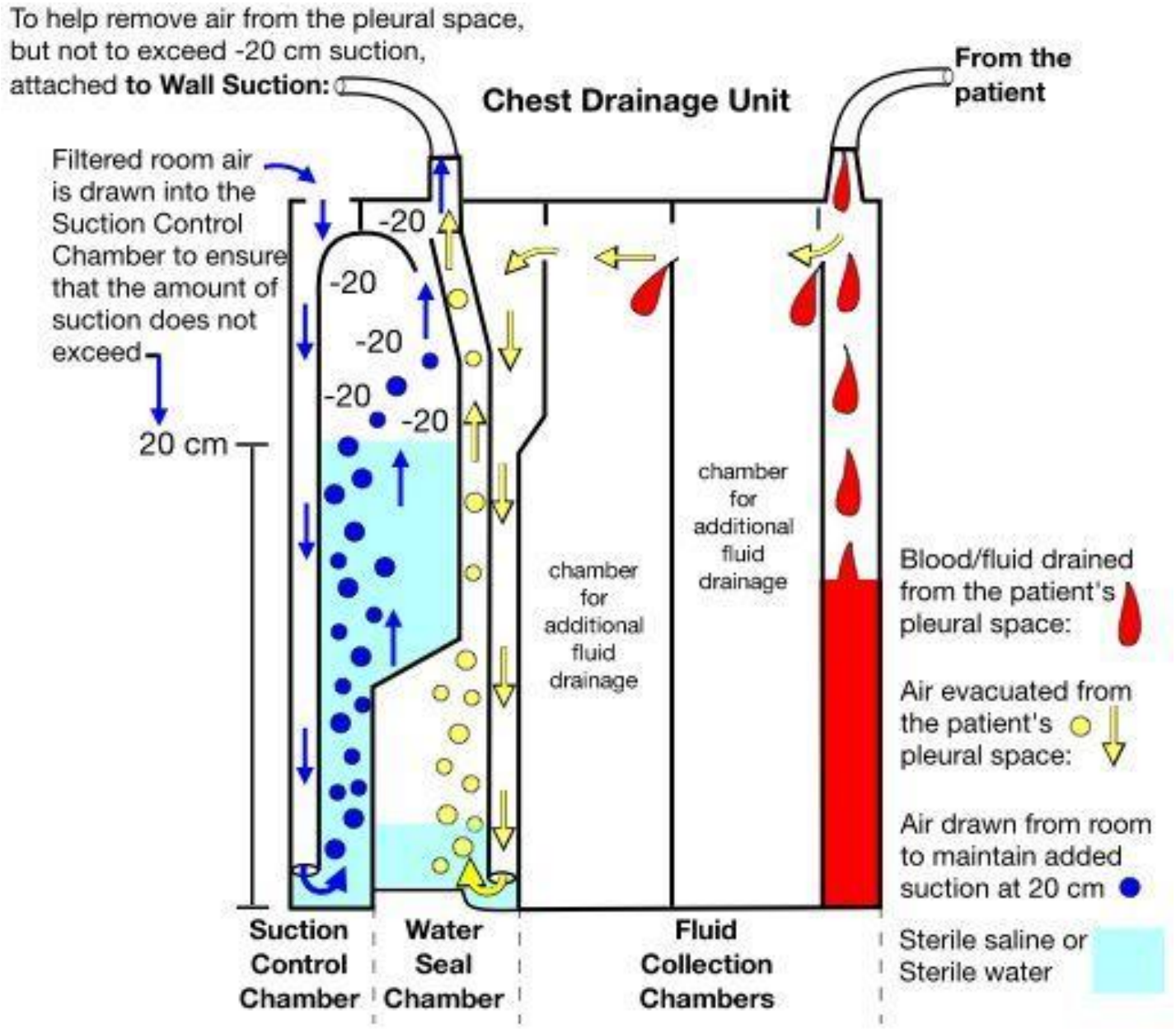

https://i.pinimg.com/736x/5f/ac/20/5fac20847534c253b8c9604fed6c0e72.jpg

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Types of Chest Drainage Units

- Dry Suction/Dry Seal **(A):**
  - Mechanical suction regulator
  - Mechanical check-valve
- Dry Suction/Wet Seal **(B):**
  - Mechanical suction regulator
  - Water seal
- Wet Suction/wet Seal **(C):**
  - Water column regulator
  - Water seal

A

B

C

Adopted from a Chest Tube Management course (08/30/2007)
https://lms.rn.com/getpdf.php/1933.pdf

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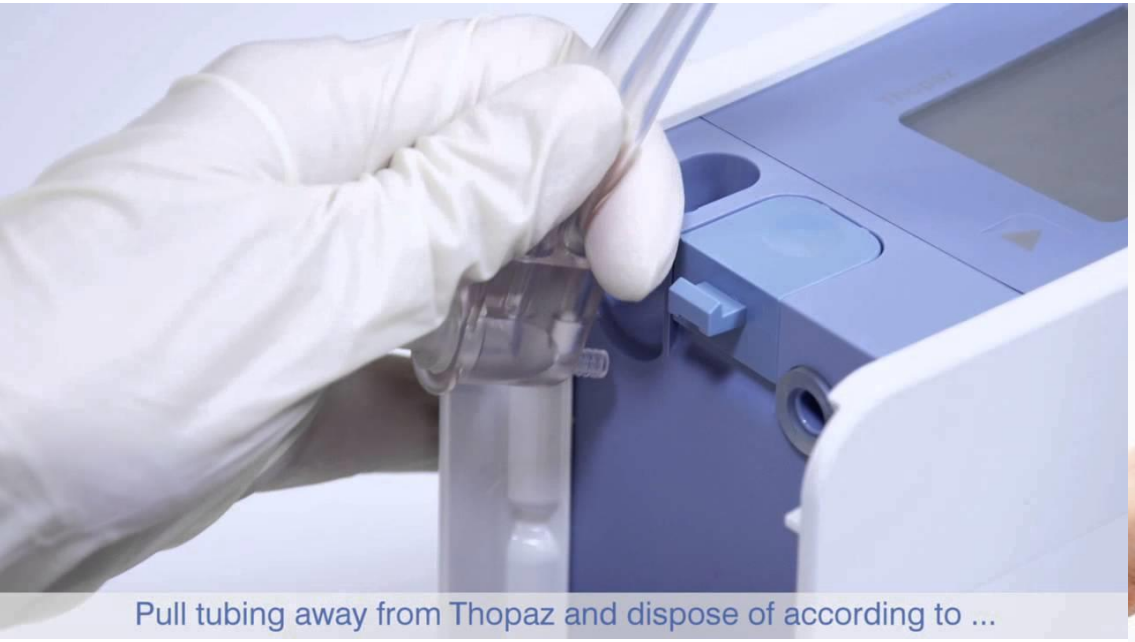
Thopaz® - Digital Drainage



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Criteria for Chest Tube Removal

- Varies by provider to provider (not evidence based)
- Depends largely in disease process and provider's expertise
- Clamping test not necessary (due to associated risks)

Chest Tube Complications

- **Insertional:**
  - Pain
  - Misplacement
  - Puncture of solid organ
  - Puncture of intercostal artery
  - Insertion on incorrect side
  - Subcutaneous emphysema
  - Bronchopleural fistula

- **Positional:**
  - Drain failure (dislodgement, kinking, blocked) → could lead to tension physiology

- **Infection:**
  - Wound infection
  - Pleural space infection

https://www.slideshare.net/pknishadpk/chest-drains

Chest Tube Management and Care

- **Pain** control
- Chest tube **site care** (skin exam, dressing change)
- Keep drain **lower** than level of the chest
- Absolute **avoidance** of “unattended” chest tube clamping
- **Minimize** length of suction tubing
- Travel with a **portable suction** when indicated
- Suction port should be **OPEN** to air during water seal drainage
- **Encourage** movement (avoid atelectasis)
- **Educate** patient/nurses
- **Proper communication** with teams

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Take Home Points

- Be familiar with indications/contraindication of tube thoracostomy
- Practice, practice, practice your technique
- Be actively involved in the management of patients with chest tubes
- Maintain excellent communication with primary teams, consultants, and nursing staffs

Thank You

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