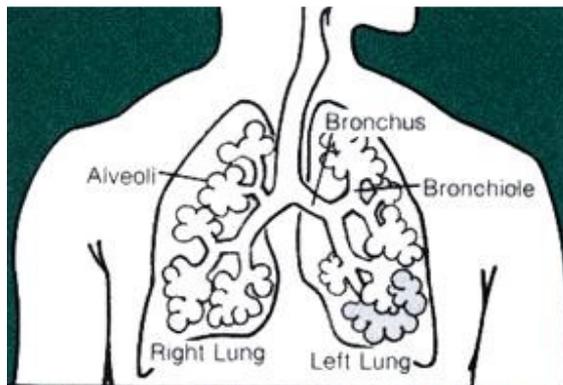


# INTERCOSTAL CATHETER (ICC) & UNDERWATER SEAL DRAINAGE (UWSD) Self-Directed Learning Package



Name: \_\_\_\_\_

Belmore ID: \_\_\_\_\_

Date: \_\_\_\_\_

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## **INTRODUCTION**

There are many reasons that patients develop a pneumothorax and require an Intercostal catheter (ICC). They may occur spontaneously, as a result of trauma, as a complication of a medical procedure or secondary to a disease process. A pneumothorax can be a life threatening condition that must be treated promptly and efficiently. Therefore, it is just as important that after insertion of an ICC that the underwater seal drain is managed appropriately.

It is important to understand:

- The reasons why an ICC is needed
- How to assist in the insertion of an ICC
- How to care for the patient with an ICC both during and post the procedure
- How to manage an underwater seal drainage (UWSD) unit
- The complications which may arise

## **LEARNING OBJECTIVES**

- To revise the normal anatomy of the thorax cavity
- To review the conditions that will require insertion of an ICC including:
  - Pneumothorax
  - Haemothorax
  - Haemopneumothorax
  - Tension Pneumothorax
- To discuss the procedure for inserting chest tubes
- To improve understanding and nursing management of underwater seal drainage (UWSD)
- To become familiar with the complications associated with ICC and UWSD.

## Disclaimer

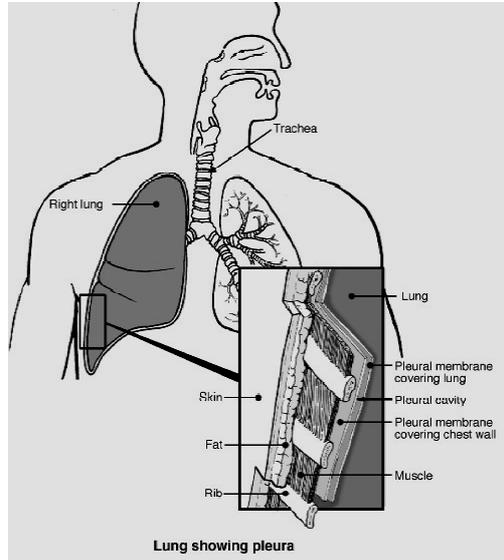
The information presented in this package was developed to support and assist Belmore Nurses Bureau employees to undertake professional development and remain current in their practice regarding ICCs & UWSDs. Variations including policies, practices and equipment may occur and it is the individual staff member's responsibility to be aware of the specific policies of each facility in which they work.

The information provided is an overview. Further reading and study is recommended for more detailed explanation of the background and rationales for the care/management outlined. Individuals utilising this learning package are responsible for defining their own scope of practice specific to ICC & UWSD care. This is dependent on their personal education and current experience.

This information does not constitute an exhaustive resource, or exclusive course of action. Care has been taken by the author to ensure the information included in this manual and resources used to compile it are accurate and up to date however, the author accepts no responsibility for any inaccuracies or the success of any recommendations detailed in the manual.

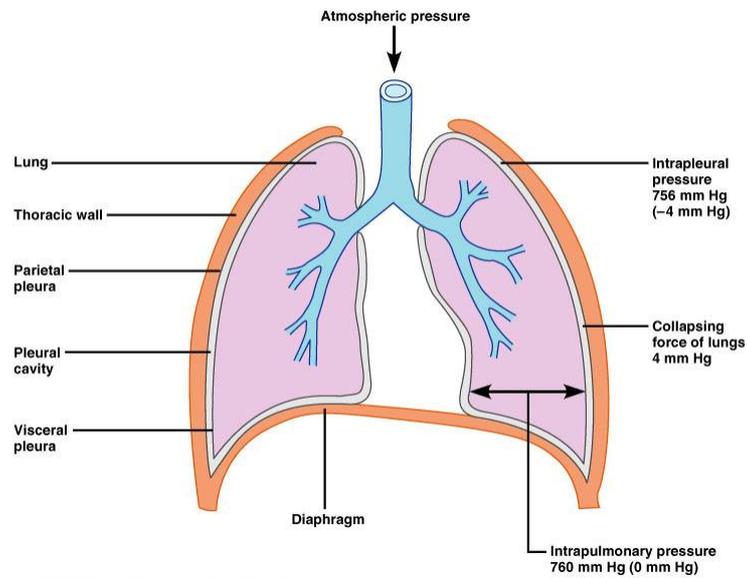
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## NORMAL LUNG ANATOMY



**Figure 1**

The lungs occupy the entire thoracic cavity except for the mediastinum, which houses the heart, great vessels, bronchi, oesophagus and other organs. Each lung is suspended in its own pleural cavity and connected to the mediastinum by vascular and bronchial attachments.



**Figure 2**

## Pulmonary Pressures

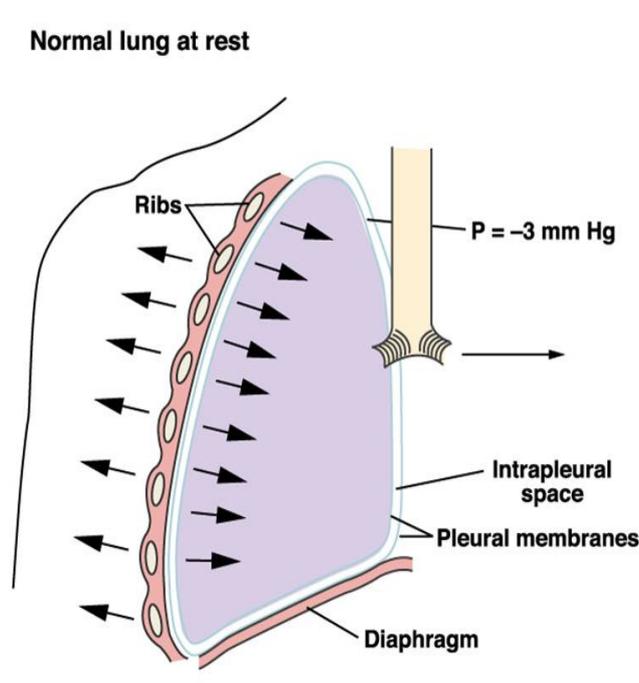
- **Atmospheric Pressure ( $P_{atm}$ )** – the pressure exerted by the air surrounding the body. At sea level it is equal to 760mmHg. For our purposes, we'll assume it to be constant and assign it a value of 0mmHg.
- **Intrapulmonary Pressure ( $P_{alv}$ )** – the pressure exerted by the air within the alveoli. It rises and falls during inspiration and expiration, but it always equalizes with atmospheric pressure.
- **Intrapleural Pressure ( $P_{ip}$ )** – the pressure within the pleural cavity. It is always lower than both atmospheric pressure and intrapulmonary pressure.

## Normal breathing

A thin serous membrane called the pleura adheres to the lungs, folds over and attaches firmly to the chest wall. The membrane covering the lungs is the visceral pleura, and the membrane lining the thoracic cavity is the parietal pleura. The area between the visceral and parietal pleurae is a potential space called the pleural space or cavity. Pressure in the space is usually sub atmospheric (-4 to -10 mmHg). Under normal conditions, a small amount of serous fluid is secreted by the pleura into the pleural space. This fluid acts as a lubricant, allowing the two layers to slide over each other easily without separating.

The elastic properties of the lungs and chest wall permit them to expand during inspiration and return to their resting volume afterward. Normal elastic recoil which is the tendency of the lungs to return to their resting state after inspiration depends on a balance between the outward recoil pressure of the chest wall and the inward recoil pressure of the lungs.

During inspiration, the diaphragm and intercostal muscles contract, air flows into the lungs, and the chest wall expands. As the lungs expand the pressure in the lungs is lower than that of the pressure outside the body, therefore air is sucked in from outside. During expiration, the muscles relax and the elastic recoil of the lungs causes the chest wall to lose volume until equilibrium between the recoil forces of the chest wall and lungs is reached. The pressure in the lungs is decreased and therefore forcing air out of the lungs.



**Figure 3**

Please circle the correct answer:

**Question 1**

During inspiration air enters into the lungs when:

- a) Atmospheric pressure is lower than intrapulmonary pressure
- b) Atmospheric pressure is higher than intrapulmonary pressure
- c) Intrapleural pressure is lower than atmospheric pressure
- d) Intrapleural pressure is higher than atmospheric pressure

**Question 2**

During expiration air exits the lungs when:

- a) Atmospheric pressure is lower than intrapulmonary pressure
- b) Atmospheric pressure is higher than intrapulmonary pressure
- c) Intrapulmonary pressure is lower than atmospheric pressure
- d) Intrapulmonary pressure is higher than atmospheric pressure

## CONDITIONS REQUIRING AN ICC

The conditions requiring insertion of an ICC include:

1. Pneumothorax (spontaneous, traumatic, open)
2. Haemothorax
3. Haemopneumothorax
4. Tension Pneumothorax

## PNEUMOTHORAX

### Pathophysiology

A pneumothorax is the collection of air in the pleural space. The negative intrapleural pressure now equalizes and becomes positive; therefore the affected lung partially or fully collapses.

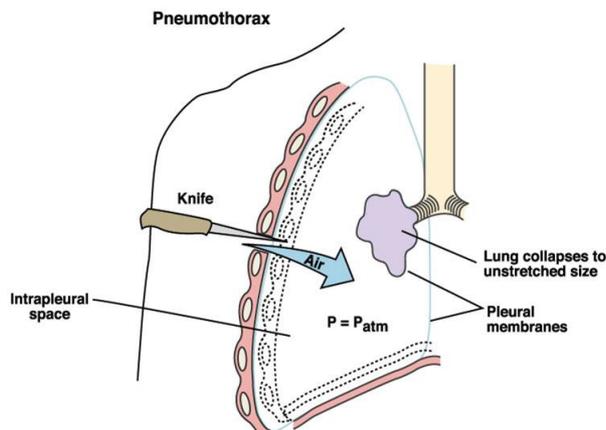


Figure 4

### Types of Pneumothorax

- a) **Closed/Spontaneous pneumothorax:** when air leaks into the pleural space due to disruption of the pleura without any apparent cause/trauma. Causes: rupture of a subpleural bleb/bullae (blister) on the surface of the lung; forceful coughing or pulmonary disease that erodes into the pleural space (Chronic Obstructive Pulmonary Disease [COPD], Cystic Fibrosis [CF], Tuberculosis [TB]). This condition is very common in young, tall, thin males (20-40yrs).
- b) **Traumatic pneumothorax:** due to injury to the lung. Causes: gunshot wound; stabbing; Motor Vehicle Accident (MVA); medical procedures (Central Venous Catheter [CVC] insertion, thoracentesis);

surgical procedures (such as lobectomy, bronchoscopy, Video Assisted Thoracic Surgery (VATS), mechanical ventilation or fractured ribs.

### Signs and Symptoms

The patient's severity of symptoms directly relates to the size of the pneumothorax and the speed at which it develops. In general signs and symptoms include:

- Chest pain- sudden onset, sharp, on the affected side
- Dyspnoea+/- tachypnoea
- Tachycardia
- Decreased chest movement on the affected side
- Decreased breath sounds on the affected side
- Pale, sweaty, anxiety, stress
- Decreased O<sub>2</sub> saturation
- Cyanosis (severe cases)

### Diagnosis and treatment

Diagnosis is confirmed by a chest x-ray (CXR). Treatment depends on the size of the pneumothorax. A very small simple pneumothorax approximately 10% may not require an ICC as they may resolve without intervention. These patients need observation and repeat chest x-ray to ensure the pneumothorax is resolving. However, most patients will require an ICC or pigtail to resolve the pneumothorax.



**Figure 5**

### Question 3

In the chest x-ray above which lung has a pneumothorax?

- a) Left
- b) Right

## **HAEMOTHORAX**

### **Pathophysiology**

A haemothorax is the collection of blood into the pleural space. As the blood moves into the pleural space it increases intrapleural pressure which leads to a decreased vital capacity. Causes include:

- Chest trauma
- Cancer
- Deficit in blood clotting
- Laceration from fractured ribs
- Ruptured artery
- Other: rupture of small blood vessel from the inflammatory processes such as TB or pneumonia

### **Signs and Symptoms**

- Same as a pneumothorax (see previous page)
- Signs of hypovolaemic shock (as can bleed up to 1500mls) including collapsed neck veins and hypotension

### **Question 4**

In the chest x-ray below which side is there a haemothorax?

- a) Left
- b) Right



**Figure 6**

## **HAEMOPNEUMOTHORAX**

A Haemopneumothorax is when there is both air and blood in the pleural cavity, usually caused by chest trauma.

## **TENSION PNEUMOTHORAX**

### **Pathophysiology**

A tension pneumothorax is the progressive build up of air within the pleural space, leading to a positive pressure in the chest cavity. As pressure continues to increase the lung on the injured side collapses and causes the mediastinum to shift to the opposite side. This shift exerts pressure on the heart and thoracic aorta which leads to a decrease in venous return and decreased cardiac output. If untreated the patient's heart and great vessels become compressed until the heart can no longer beat, leading to cardiac arrest.

Causes include laceration to the lung or an open pneumothorax with a flap.

### **Signs and Symptoms**

Signs and symptoms include:

- Distress
- Dyspnoea
- Sudden severe chest pain that extends to the shoulders
- Hypoxia (as a result of the decreased oxygenation and circulatory instability)
- Tracheal deviation - the trachea shifts away from the injured side
- Decreased or absent breath sounds on the affected side
- Distended neck veins
- Cyanosis
- Respiratory distress
- Percussion of the chest wall will reveal hyper resonant sounds caused by the trapped air

It is important to remember that a tension pneumothorax may develop suddenly or over a period of time (especially in patients with positive pressure ventilation). An unexplained tachycardia, hypotension and rise of airway pressure strongly suggest the development of a tension pneumothorax.

## Diagnosis and treatment

Diagnosis of a tension pneumothorax is done via clinical assessment (no time for a CXR!). The patient requires an urgent needle thoracostomy which converts the tension pneumothorax into a simple pneumothorax. The patient will then need an ICC inserted.

For an open pneumothorax (e.g.: open sucking chest wound) an occlusive dressing taped on three sides needs to be placed on immediately to prevent further air being entrained in the chest but allowing air to escape. There may be visible bubbling which is diagnostic.



**Figure 7**

This is a post-mortem chest X-ray of a left tension pneumothorax. There is deviation of the trachea away from the side of the tension, a shift of the mediastinum and depression of the hemi diaphragm.

### Question 5

Explain how a needle thoracostomy is done and what equipment is required.

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## **CHEST TUBE INSERTION**

The insertion of an ICC is a sterile procedure that is performed by medical staff with nursing assistance.

### **Equipment**

Please refer to hospital policy for the equipment required, but in general equipment includes:

- UWSD unit: prepare unit as per product guidelines (using sterile water included in packaging)
- Suction tubing (if required)
- ICC insertion pack (includes sterile gown, sterile towels, needle holder, Kelly forceps, Iris scissors, scalpel blade, 2 x tube clamps, 5ml syringe, 10ml syringe, 18g blunt drawing up needle, 2 x 23g needles, sterile gauze x5, kidney dish, suture, ICC connector)
- Intercostal catheter or pigtail (for a smaller pneumothorax may be used (ask doctor re: size))
- Local anesthetic
- Occlusive dressing x2 (10cm x 10cm)
- Sterile gloves
- Cable ties or tape (see hospital policy)
- Eye protection
- Antiseptic solution
- Rubbish bag

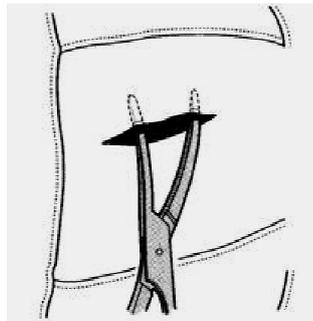
### **Patient preparation**

Ensure the patient is in a resuscitation cubicle prior to insertion.



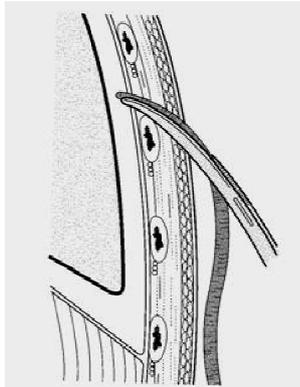


- Perform a set of baseline observations. Ensure adequate analgesia is given prior (and more doses available at bedside if needed and ordered)
- The insertion of an ICC is a sterile procedure. The doctor performs a surgical hand wash and puts on a surgical gown and gloves
- The area where the ICC is to be inserted is cleaned and draped appropriately with sterile towels
- Local anesthetic is infiltrated from subcutaneous tissue down to the pleura
- The appropriate size ICC is chosen and the stylet removed
- An incision is made in the skin parallel to the upper boarder of the rib below the chosen intercostal space. The RMO cuts down to the fascia
- Using curved artery forceps the track is developed by blunt dissection only. The forceps are inserted into the muscle tissue and spread to split the fibers as shown in figure 8



**Figure 8**

- Once the track comes onto the rib the clamp is angled over the rib and dissection continues until the pleura is entered
- The doctor may then insert a finger into the pleural cavity to widen the track and to explore for pleural adhesion
- The tip of the ICC is then held with the clamp and inserted along the track into the pleural space (figure 9). The ICC is directed posteriorly and superiorly



**Figure 9**

- Once in position the tube is then connected to an underwater seal drainage system (+/- suction) using an ICC connector
- The tube is sutured in place and a occlusive dressing sandwich is applied
- Cable tie or tape (as per hospital protocol) to secure tube to unit tubing
- Secure tubing to the patient
- Ensure patient is comfortable and assess need for ongoing analgesia
- A post procedure chest x-ray must be done to confirm the placement of the tube
- Document procedure in the patient's history, including date and time of insertion, tube size, insertion site, type of suture used, patient's respiratory status, analgesia administered and UWSD observations. Use of a continuous USWD chart with observations should be used

**Question 8**

Please list 3 complications that can arise as a resulting from inserting an ICC and describe the signs and symptoms that would indicate the complications.

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**UNDER WATER SEAL DRAINAGE (UWSD)**

All chest tubes are connected to an UWSD unit to prevent air and/or fluid entering the chest and allow for drainage of air, fluid and/or blood from the pleural cavity.

There are many different brands of UWSD systems. In general the unit is made up of 3 chambers:

- 1. Suction control chamber: the unit is connected to low wall suction. The suction level is set by the Dr (usually 10-20cm H<sub>2</sub>O) and dial up on the drainage unit. There are wet and dry suction systems available, although most hospitals have moved to dry suction units. The level of suction set is what controls the amount of suction that is applied to the system, not how much suction is obtained from wall suction.
- 2. Water seal chamber: this consists of a tube submerged under 2cm of water that functions as a one-way valve. As the patient breaths spontaneously the bubbles pass through the water as they exhale. When the patient inhales the water barrier stops air going into their chest. The underwater seal is achieved by filling the underwater seal chamber with sterile water until the 2cm line is reached. The cap over the access port should also remain **closed** at all times.
- 3. Drainage collection chamber: this is where fluid from the patient's chest drains into. This reservoir must remain below the patient's chest level to ensure gravity flow.

It is important that the patient who has an ICC with underwater seal drainage be monitored and any changes be reported.

- **'Swinging'**: to check for swinging in the unit disconnect from the suction. The fluid should rise in the tubing of the water seal unit on inspiration and fall on expiration. On inspiration the hole in the chest wall sucks the water up and on expiration the pressure forces the air out through the seal. The water seal allows the air to escape but does not allow air to return. If swinging stops it means that there is either an obstruction or that the lung has re-expanded.
- It is normal for **bubbling** to occur in the water seal chamber during expiration. If there is continuous bubbling during inspiration and expiration then this indicates there is a leak in the system or if the bubbling ceases then the pneumothorax may have resolved or there may be a blockage.

- The amount of **drainage** and the quality of drainage should be noted and documented 4 hourly. Please mark on the unit itself and in the patient's history. If there is a sudden increase in the amount or drainage or if it becomes heavily blood stained you must inform medical staff.

### **NURSING CARE**

- Check the insertion site at least once a shift. The dressing should be left intact if dry and clean. If there is exudate or bleeding this should be reported to the RMO. Palpate around the site to check for surgical emphysema.
- Ensure the tubing is free of kinks and the unit is secure to either the bed (using the handles provided on the unit) or on the ground (using the foot plate).
- If there is a clot in the tubing do not strip the tubing as this causes high pressures in the pleural cavity. Instead gently milk/squeeze the tubing to free the clot.
- Vital signs should be taken and documented as per post op orders and then at least four hourly (see hospital policy).
- It is important to monitor the patient's pain and ensure they receive adequate analgesia as chest drains can be quite uncomfortable.
- Patient's should be encouraged to mobilize and do hourly deep breathing and coughing exercises to aid drainage and to decrease the risk of complications including pneumonia and atelectasis.

#### Question 9

Immediately following insertion of an ICC or upon receiving a patient with an ICC in-situ explain the assessment that you would perform on the patient?

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#### Question 10

Explain why it is important to keep the drainage system below the level of the patient's chest?

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**Question 11**

What information should be documented by the nurse in regards to the UWSD?

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**COMPLICATIONS**

Accidental disconnection of the chest drain is a common complication. If this occurs:

- Clamp the drain tube
- Swab the ends of the catheter and drainage unit with an alcohol swab and reconnect ASAP
- Unclamp
- Check levels of the chest drain
- Perform a set of vital signs
- Respiratory assessment
- UWSD unit assessment
- Notify medical staff immediately
- Change the drainage unit if the patient is stable
- Document

If the ICC itself falls out this is a medical emergency. A CODE BLUE should be called as another tube needs to be quickly inserted. Place a piece of gauze taped down on 3 sides on the ICC wound site and continually monitor the patient.

**Question 12**

What equipment should the nurse have at the bedside of a patient with an ICC?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Even though the nurse is expected to have Kelly clamps by the bed side. It is never recommended that the ICC is clamped except when changing over drainage units or removing the ICC after the pneumothorax has resolved.

Question 13

Explain the complications that may arise from clamping off the ICC

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Please refer to individual hospital policies for the procedure of removing an ICC.

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<http://www.trauma.org/thoracic/index.html>

❖ **Package initially prepared by Lisa Carlyon. Edited by Di Bissett 27/11/10.**