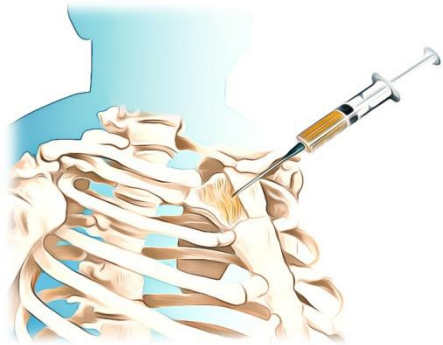


# THORAX CLINICALS

---

## STERNAL PUNCTURE

Because of its morphology and shallow depth in the chest, the sternum can be punctured readily in a needle biopsy procedure (sternal puncture) for aspiration of red marrow.



## CERVICAL RIB

Occurs in about 0.5% of humans. The importance of a cervical rib is that it may cause pressure on the lower trunk of the brachial plexus, causing pain down the medial side of the forearm and hand and wasting of small muscles of hand. It can also exert pressure on the overlying subclavian artery and interfere with circulation of upper limb.

## RIB EXCISION (SURGICAL REMOVAL OF RIB)

To gain entrance to the thoracic cavity, thoracic surgeons commonly perform a rib excision. A longitudinal incision is made through the periosteum on the outer surface of the rib, and a segment of rib is removed. A second longitudinal incision is then made through the bed of the rib, which is the inner covering of the periosteum. After the operation, the rib regenerates from the osteogenetic layer of the periosteum.

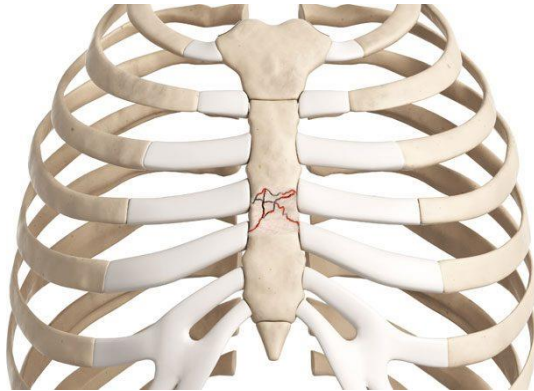
## THORACIC CAGE DISTORTION

The shape of the thorax can be distorted by congenital anomalies of the vertebral column or by the ribs. Destructive disease of the vertebral column that produces lateral flexion or scoliosis (sideways curvature of the spine) results in marked distortion of the thoracic cage

## STERNUM FRACTURE

The sternum is a resilient structure that is held in position by relatively pliable costal cartilages and bendable ribs. For these reasons, fracture of the sternum is not common. However, it does occur in high

speed motor-vehicle accidents. Remember that the heart lies below the sternum and may be severely contused by the sternum on impact.



## RIB CONTUSION

Bruising of a rib, secondary to trauma, is the most common rib injury. In this painful condition, a small hemorrhage occurs beneath the periosteum.

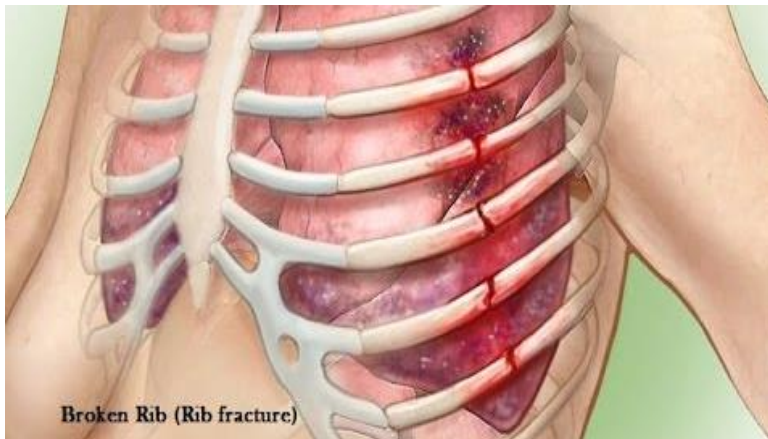


## RIB FRACTURES

Fractures of ribs are common chest injuries.

- In children, the ribs are highly elastic and fractures in this age group are rare
- In young people, the pliable chest wall can be easily compressed so that the underlying lungs and heart may be injured.
- With increasing age, the rib cage becomes more rigid, owing to the deposits of calcium in the costal cartilages, and the ribs become brittle. The ribs then tend to break at their weakest part, their angles
- The clavicle and pectoral muscles protect the first four ribs anteriorly and the scapula and its associated muscles do so posteriorly so these ribs are less likely to be fractured
- Ribs 5 through 10 are most commonly fractured ribs
- The 11<sup>th</sup> and 12<sup>th</sup> ribs float and move with the force of impact

- Because the rib is sandwiched between the skin externally and the delicate pleura internally, not surprisingly, the jagged ends of a fractured rib may penetrate the lungs and prevent as pneumothorax (collapsed lung)
- Severe localized pain is usually the most important symptom of a fractured rib. The intercostal nerves above and below the rib innervate the periosteum of each rib. To encourage the patient to breathe adequately, performing an intercostal nerve block may be necessary to relieve the pain.

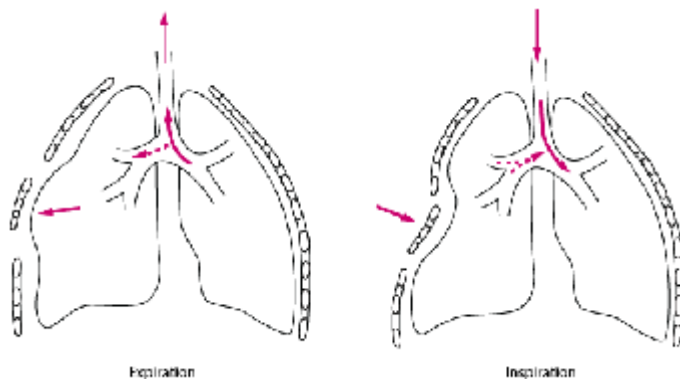


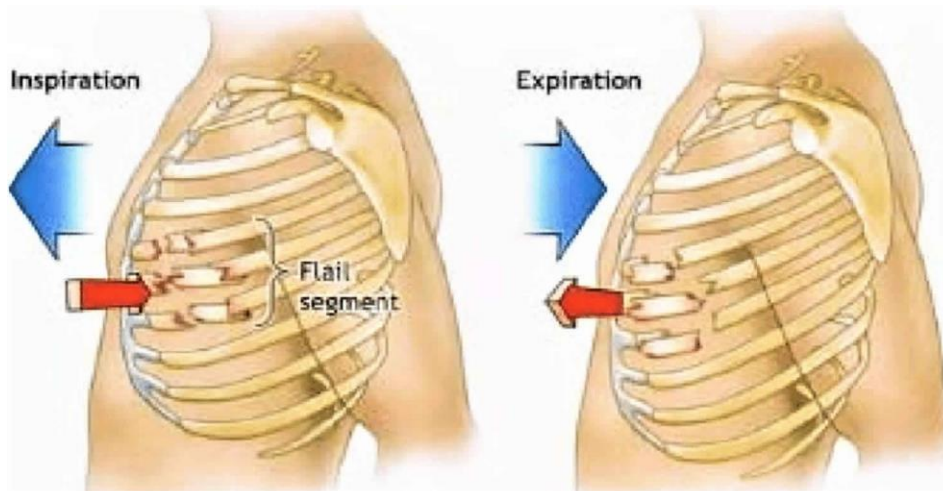
## FLAIL CHEST

In severe crush injuries, a number of ribs may break.

- If limited to one side, the fractures may occur near the rib angles and anteriorly near the costochondral junctions. This causes flail chest, in which a section of the chest wall is disconnected from the rest of the thoracic wall.
- If the fractures occur on either side of the sternum, the sternum may be flail.

In either case, the stability of the chest wall is lost, and the flail segment is sucked in during inspiration and driven out during expiration, producing paradoxical and ineffective respiratory movements.





### TRAUMATIC INJURY TO BACK OF CHEST

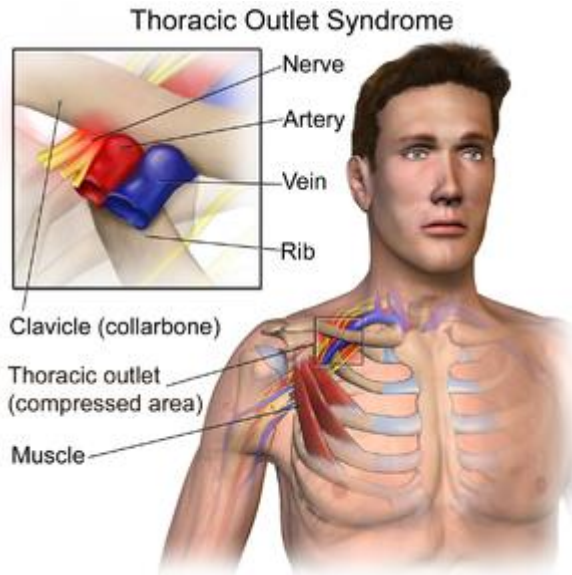
- In severe posterior chest injuries, the possibility of a vertebral fracture with associated injury to spinal cord should be considered.
- Scapula which overlies the upper seven ribs may only be fractured in case of severe trauma as it is covered with muscles.

### TRAUMATIC INJURY TO ABDOMINAL VISCERA AND CHEST

Upper abdominal organs i.e. the liver, stomach and spleen may be injured by trauma to the rib cage. Injury to chest below the level of nipple line may involve abdominal organs as well as thoracic organs.

### THORACIC OUTLET SYNDROME

- The brachial plexus of nerves (C5 to C8 and T1) and the subclavian artery and vein are closely related to upper surface of first rib and clavicle as they enter the upper limb. Obstruction of thoracic outlet may compress these neurovascular structures in this area, a condition known as thoracic outlet syndrome.
- Most of the symptoms are caused by pressure on lower trunk of the plexus, causing pain down the medial side of forearm and hand and wasting of small muscles of hand. Pressure on blood vessels may compromise the circulation of upper limb.



## HICCUP

Hiccups are caused by involuntary spasmodic contractions of diaphragm. This involuntary contractions cause vocal cords to close very briefly, which produces the characteristic sound of a hiccup. It is a common condition in normal individuals and occurs after eating or drinking as a result of gastric irritation of vagus nerve endings. However, it may be a symptom of disease such as pleurisy, peritonitis, pericarditis, or uremia.

## DIAPHRAGM PARALYSIS

A single dome of diaphragm (i.e. hemidiaphragm) may be paralyzed by crushing or sectioning of the phrenic nerve in the neck. This may be necessary in the treatment of certain forms of lung tuberculosis, when the physician wishes to rest the lower lobe of the lung on one side.

Occasionally the contribution from 5<sup>th</sup> cervical spinal nerve joins the phrenic nerve late as a branch from the nerve to the subclavius muscle. This is known as the accessory phrenic nerve. To obtain complete paralysis under these circumstances, the nerve to the subclavius muscle must also be sectioned. A paralyzed hemidiaphragm assumes a hyperelevated posture rather than a depressed (flattened) posture.

## PENETRATING INJURIES TO DIAPHRAGM

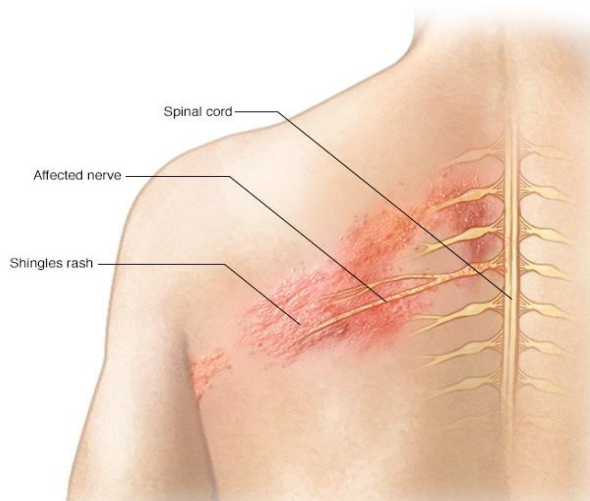
Penetrating injuries to diaphragm can result from stab or bullet wounds to the chest or abdomen. Any penetrating wound to the chest below the level of nipples should be suspected of causing damage to the diaphragm until proved otherwise. The arching dome of the diaphragm can reach the level of the fifth rib (the right dome can reach a higher level).

## REFERRED PAIN

Referred pain is pain perceived at a location other than the site of the painful stimulus/origin. For example, a pulmonary thromboembolism or pneumonia with pleurisy involving the costal parietal pleura could give rise to abdominal pain and tenderness and rigidity of the abdominal musculature. The abdominal pain in these instances is called referred pain.

## HERPES ZOSTER

Herpes zoster, or **shingles**, is a relatively common condition caused by the reactivation of the latent varicella-zoster virus in a patient who has previously had chickenpox. The lesion is seen as an inflammation and degeneration of the sensory neurons in the cranial or spinal nerve with the formation of vesicles and inflammation of the skin. In the thorax, the first symptom is a band of dermatomal pain in the distribution of the sensory neurons in a thoracic spinal nerve, followed in a few days by a skin eruption. The condition occurs most frequently in patients older than 50 years.

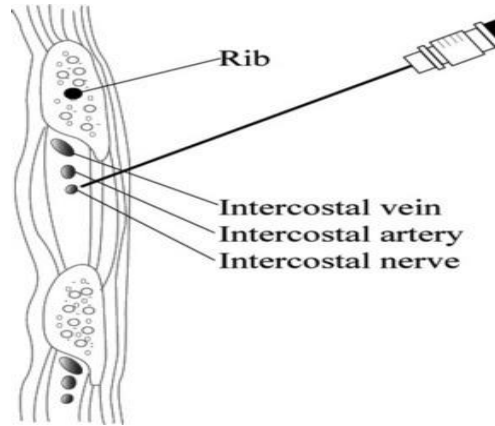


## INTERCOSTAL NERVE BLOCK

Intercostal nerve block is indicated for repair of lacerations of the thoracic and abdominal walls, for relief of pain in rib fractures, and to allow pain-free respiratory movements.

### PROCEDURE:

- To produce analgesia of the anterior and lateral thoracic and abdominal walls, the intercostal nerve should be blocked before the lateral cutaneous branch arises at the midaxillary line
- The ribs may be identified by counting down from the second rib or from the 12<sup>th</sup>.
- The needle is directed towards the rib near the lower border, and the tip comes to rest near the subcostal groove, where the local anesthetic is infiltrated around the nerve.



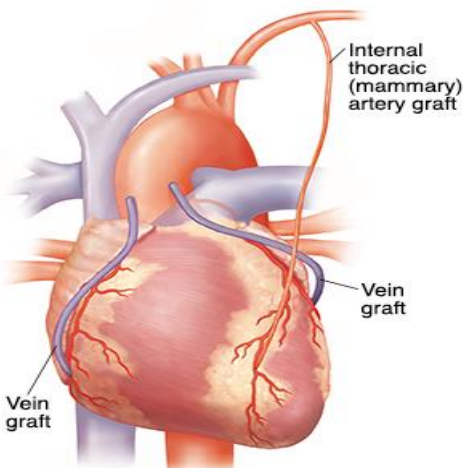
#### COMPLICATIONS OF INTERCOSTAL NERVE BLOCK:

Complications include pneumothorax and hemorrhage.

- Pneumothorax can occur if the needlepoint misses the subcostal groove and penetrates too deeply through the parietal pleura.
- Hemorrhage is caused by the puncture of the intercostal blood vessels. This is a common complication, so aspiration should always be performed before injecting the anesthetic. A small hematoma may result.

## INTERNAL THORACIC ARTERY IN CORONARY ARTERY DISEASE TREATMENT

In patients with occlusive coronary disease caused by atherosclerosis, the diseased arterial segment can be bypassed by inserting a graft. The graft most commonly used is the great saphenous vein of the leg. However, the myocardium can be revascularized in some patients by surgically mobilizing one of the internal thoracic arteries and joining its distal cut end to a coronary artery.



## ARTERIAL ANASTOMOSIS

The anterior intercostal arteries and the lower nine posterior intercostal arteries typically anastomose with one another at approximately the costochondral junctions. These important connections create collateral circulatory routes that potentially allow blood flow to bypass obstructions in thoracic aorta or the proximal part of subclavian artery. These anastomoses are notably prominent in circumventing the constriction present in postductal coarctation of aorta.

## THORACIC WALL LYMPH DRAINAGE

- Lymph drainage of skin of anterior chest wall passes to the anterior axillary lymph nodes
- Lymph drainage of skin of posterior chest wall passes to the posterior axillary lymph nodes
- The lymph drainage of the intercostal spaces passes forward to internal thoracic artery, and posteriorly to the posterior intercostal nodes and para-aortic nodes in the posterior mediastinum

## NEEDLE THORACOSTOMY

Needle thoracostomy is creating and maintaining an opening into the thoracic cavity by using a needle. This may be necessary in patients with tension pneumothorax (air in pleural cavity under pressure) or to drain fluid (blood or pus) away from the pleural cavity to allow the lung to reexpand. It may be necessary to withdraw a sample of pleural fluid for microbiological examination.

### ANTERIOR APPROACH

For the anterior approach, the patient is in the supine position. The sternal angle is identified, and then, the second costal cartilage, the second rib, and the second intercostal space are found in the midclavicular line.

### LATERAL APPROACH

For the lateral approach, the patient is lying on the lateral side. The second intercostal space is identified and anterior axillary line is used.

The skin is prepared in the usual way, and a local anesthetic is introduced along the course of the needle above the upper border of the third rib. The thoracostomy needle will pierce the following structures as it passes through the chest wall:

- a) skin
- b) superficial fascia (in the anterior approach, the pectoral muscles are then penetrated)
- c) external intercostal muscle
- d) internal intercostal muscle
- e) innermost intercostal muscle
- f) endothoracic fascia
- g) parietal pleura

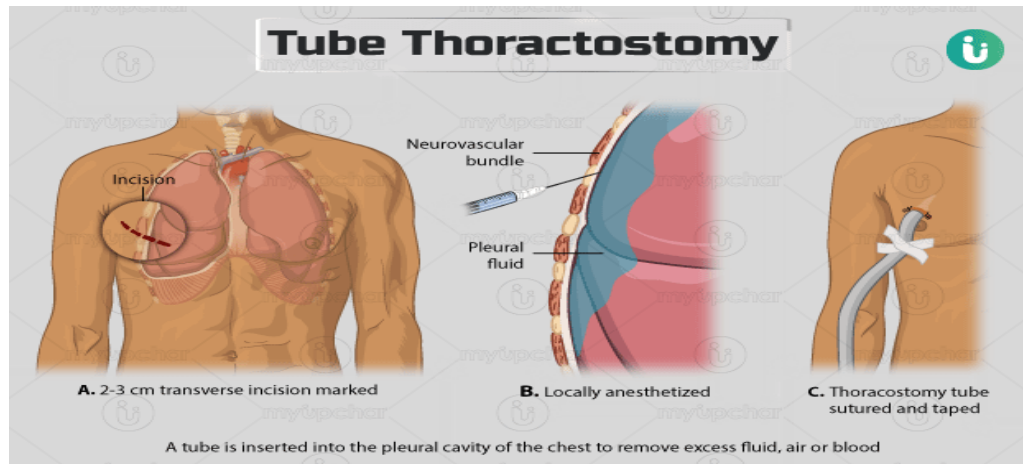


The needle should be kept close to the upper border of the third rib to avoid injuring the intercostal vessels and nerve in the subcostal groove.

## TUBE THORACOSTOMY

The preferred insertion site for a tube thoracostomy is the fourth or fifth intercostal space at the anterior axillary line. The tube is introduced through a small incision. The neurovascular bundle changes its relationship to the ribs as it passes forward in the intercostal space. In the most posterior part of the space, the bundle lies in the middle of the intercostal space. As the bundle passes forward to the rib angle, it becomes closely related to the costal groove on the lower border of the rib above and maintains that position as it courses forward.

The introduction of a thoracostomy tube or needle through the lower intercostal spaces is possible provided that the presence of the domes of the diaphragm is remembered as they curve upward into the rib cage as far as the fifth rib (higher on the right). Avoid damaging the diaphragm and entering the peritoneal cavity and injuring the liver, spleen and stomach.



## THORACOTOMY

Thoracotomy is making an incision through the thoracic wall into the pleural space. This may be a lifesaving procedure in patients with penetrating chest wounds with uncontrolled intrathoracic hemorrhage. After preparing the skin in the usual way, the physician makes an incision over the fourth or fifth intercostal space, extending from the lateral margin of the sternum to the anterior axillary line. Whether to make a right or a left incision depends on the site of the injury. The chest should be entered from the left side for access to the heart and aorta. The following tissues will be incised:

- skin
- subcutaneous tissue
- serratus anterior and pectoralis muscles
- external intercostal muscle and anterior intercostal membrane
- internal intercostal muscle

- f) innermost intercostal muscle
- g) endothoracic fascia
- h) parietal pleura

Avoid the internal thoracic artery, which runs vertically downward behind the costal cartilages about a fingerbreadth lateral to the margin of the sternum, and the intercostal vessels and nerve, which extend forward in the subcostal groove in the upper part of the intercostal space.

## **ANATOMIC AND PHYSIOLOGIC THORACIC CHANGES WITH AGING**

- The ribcage becomes more rigid and loses its elasticity as the result of calcification and even ossification of the costal cartilages. This also alters their usual radiographic appearance.
- The stooped posture (kyphosis), so often seen in old age because of degeneration of intervertebral discs and bodies, decreases the chest capacity
- Disuse atrophy of the thoracic and abdominal muscles can result in poor respiratory movements
- Degeneration of elastic tissue in the lungs and bronchi results in impairment of movement of expiration

These changes, when severe, diminish the efficiency of respiratory movements and impair the ability of the individual to withstand respiratory disease.

## **RIB AND COSTAL CARTILAGE IDENTIFICATION**

When examining the chest from the front, the sternal angle is an important landmark. Its position can easily be felt and often is seen by the presence of a transverse ridge. The finger moved to the right or to the left passes directly onto the second costal cartilage and then the second rib. All other ribs can be counted from this point. The 12<sup>th</sup> rib can usually be felt from behind, but in some other persons, it may prove difficult.