

Medicine for Managers

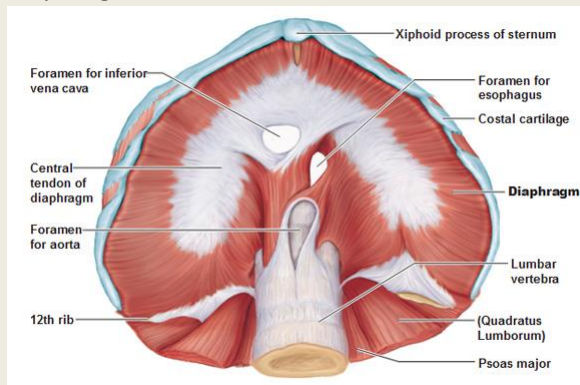
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Why Have I Got A Diaphragm?

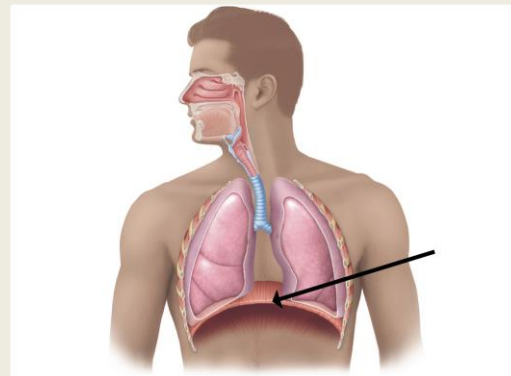
In simple terms the diaphragm is a sheet of muscle which is attached at the base of the thoracic cavity and which separates the structures in the thorax (chest) from those in the abdomen. Indeed its name is derived from the Greek word meaning a partition. However, its key function is much more than just a divider; it is vital to allow us to breathe.

The structure takes the form of a dome-shaped sheet of muscle with a central fibrous tendon. It operates differently from most other muscles in the body. Commonly a muscle connects two bones and, when the muscle contracts, the distance between the two bones shortens producing a movement. Similar movements occur when a muscle is attached to other structures, e.g. the eye. However, with the diaphragm, the muscle is oval and attached



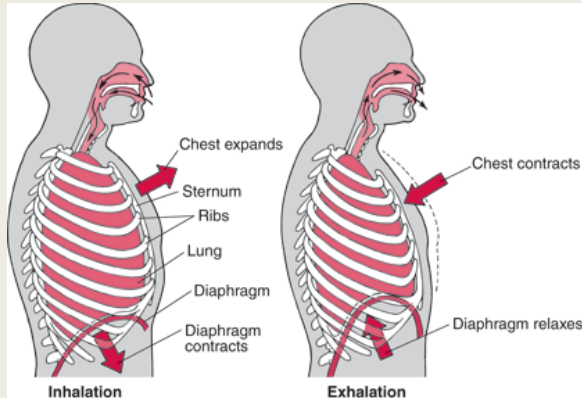
to the the lowest part of the breast bone (sternum) at the front, around the lower part of the ribs encircling the chest and to the first and second lumbar vertebrae at the back. The dome faces upwards.

In the centre of the diaphragm is a central tendon made of tough fibrous tissue. When the muscle of the diaphragm contracts, the distance that shortens is that between the bony attachments round the outside and the tendon in the centre. The only movement that the diaphragm can make is therefore for the dome to flatten out. Therefore as the diaphragm



contracts it moves downwards and increases the capacity of the chest cavity, creating negative pressure by causing the elastic lungs to expand and which is equalised by the lungs drawing in air. Such is the mechanism, together with movements of the ribs (as a result of contraction of the muscles between them – the intercostal muscles) of *inspiration* (breathing in). This is the active part of breathing. Once the

diaphragm and the intercostal muscles have completed their contraction and the lungs are fully expanded, the diaphragm and the intercostals relax, the elastic lungs recoil, pushing air out and the diaphragm returns to its dome-shape. This part of breathing, **expiration** (breathing out) is the passive part of breathing.



So, the diaphragm contracts and relaxes fifteen to twenty times a minute, day in and day out for most of us uneventfully for our whole lives.

The diaphragm does have some holes in it through which various structures pass between the chest and the abdomen. The oesophagus passes through a hole (**hiatus**) towards the back of the diaphragm and there are two further openings for the principal blood vessels going to and from the heart. The aortic foramen, through which passes the aorta carrying blood from the heart to the body, is situated in front of the vertebral column and the caval foramen, through which the inferior vena cava (the large vein carrying blood back to the part) passes upwards and is situated within the central tendon. A variety of nerves also pass through; those to the diaphragm itself, the large vagus nerve which sends nerve fibres all round the body, the sympathetic nerve trunk which controls autonomic functions (i.e. those of which we are unaware). Some have their own

small foramina, some pass through with larger structures.

Interestingly the nerve supply to the diaphragm is drawn from the neck, being supplied by the third, fourth and fifth cervical nerves. This rather strange anatomical arrangement occurs because the diaphragm is first formed in the embryo in the neck region and then is drawn down to its final position during embryonic development dragging its nerve supply with it. *This may result in a patient with disease in the upper abdomen feeling pain in the root of the neck or the shoulder.*

The diaphragm causes relatively little in the way of problems but there are some disorders which affect the structure. The most common symptoms associated with the conditions which can affect it are pain or discomfort, felt in the diaphragmatic region of the chest or abdomen or in the shoulder or neck, or difficulty in breathing. A patient with a disturbance in diaphragm function may struggle to take in enough oxygen, appearing breathless and showing signs of blueness.

Causes of disturbances in diaphragm function include:

- Congenital defects
- Acquired defects secondary to:
 - Injury or accident
 - Stroke
 - Multiple sclerosis
 - Muscle diseases
 - Infections
 - Radiotherapy damage

Congenital defects in the diaphragm used to be invariably serious or fatal but are now amenable to early surgical intervention although the largest herniations still have a 75% mortality rate. The incidence is about 1 in every 2,200

births. They generally occur because of failure of the various parts of the diaphragm to join together during embryonic formation.

Diaphragmatic hernias are relatively common in adults and occur when parts of the gut or stomach bulge through the diaphragm and enter the chest.

It may involve the lower part of the oesophagus, resulting in part of the acid producing stomach being located above the diaphragm and causing reflux of acid producing a **hiatus hernia**. In the more serious cases, surgery may be necessary.

Clearly, diaphragmatic failure due to nerve injury or degeneration will have its influence of function depending on the degree of nerve damage sustained.

Similarly, muscle degeneration or failure may have a variable impact.

If disorders of the diaphragm are suspected, the diagnosis may be made by:

- GP or physician examination, particularly to identify reduced breath sounds
- Chest X-ray
- Imaging (ultrasound, CT, MRI)
- Lung function tests
- Nerve conduction studies

Treatment depends on the specific nature of the disorder and the degree of disability, together with the general health of the patient. In general most diaphragmatic problems are managed by medication with surgery being reserved for the most serious.

Certainly, because of the issues surrounding the need in such procedures to open both the chest and the abdomen, surgery is directed towards

minimising operating time, incision size and hospital stay to reduce the risk of post-operative infection.

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