The Relevance of… the Diaphragm

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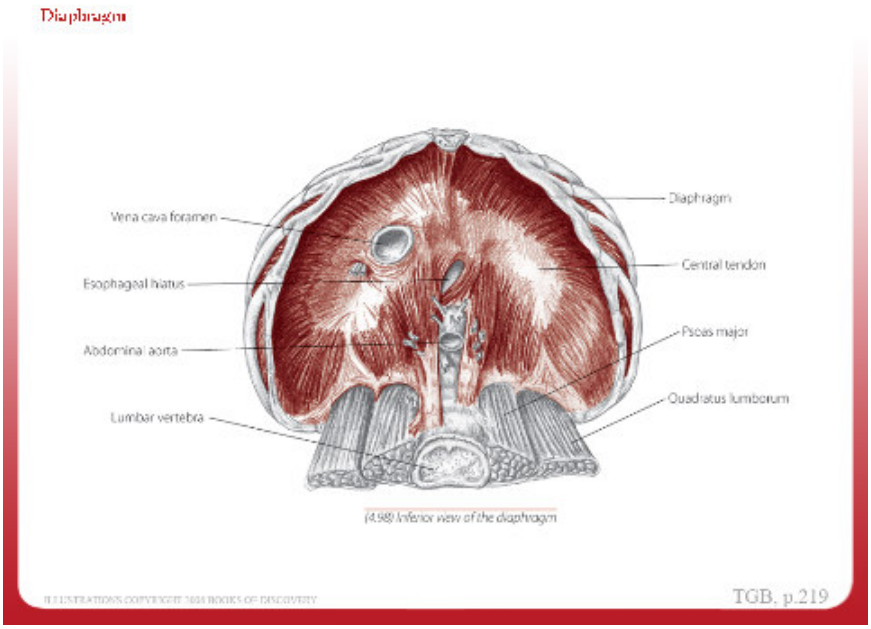
What is a diaphragm? The term itself comes from the greek *diá* which means 'through or across' and *phrágma,* a 'fence, partition or barrier'. The term is applied to a number of things but in our anatomical wonderings we are going to take a look at the anatomical respiratory diaphragm.

Did you learn about it in the 'muscles' component of a course? Or when studying the respiratory system? It could have been either - it is made up of skeletal muscle and its purpose is to facilitate breathing, by enlarging, with rib movement up and out, the space in the thoracic cavity to stretch open the lung tissue so they can fill with air.

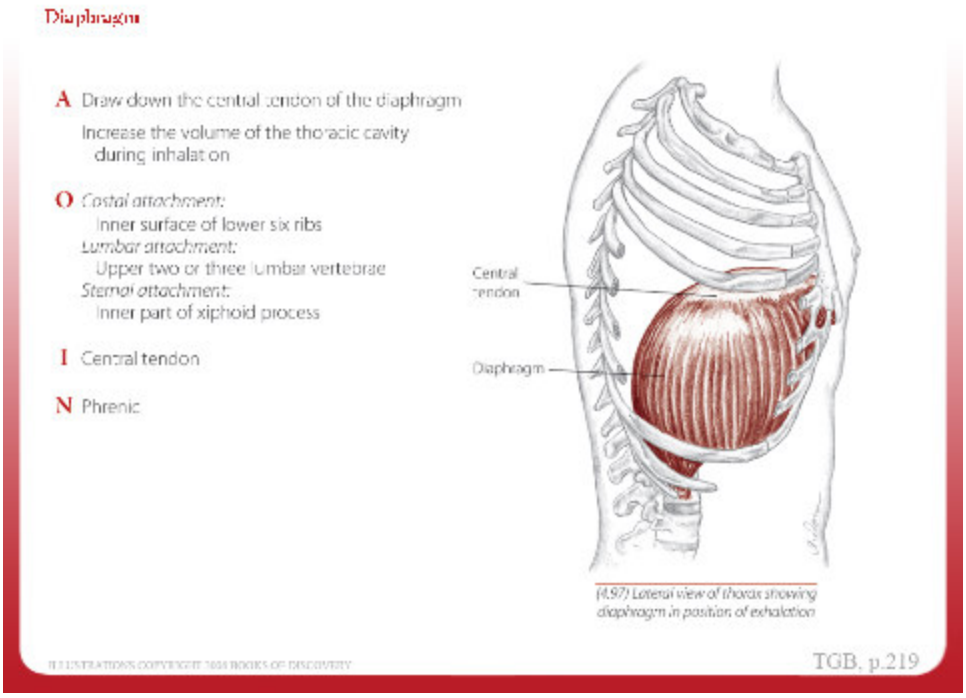
It attaches around the bottom of the rib cage from behind the xiphoid process, obliquely down along the inside of the costal cartilages. It has a slightly thicker piece of connective tissue to bridge the gap between the 10th costal cartilage and 11th then 12th floating ribs. As rib 12 heads towards the spine, a curve of connective tissue jumps from the rib to the transverse process of L1, leaving space behind it for quadratus lumborum - the lateral arcuate ligament (arcuate being Latin for 'curved like a bow); the medial arcuate ligament then leap-frogs psoas, from the transverse process of L1 to the anterior body of L2…

The attachments over the vertebral column are interesting. But first of all be aware that the muscular fibres from all the attachments are angled vertically, going upwards towards the lungs. Then see that some of the posterior fibres, the left and right crus, (crura (pl)), anchor to the vertebral column as low as L4. Cue the possible link between longer term breathing tightness, lung problems or diaphragm issues that can create too much tension in the lumbar spine. Do you have any patient with L1-L4 lower back problems that won't clear up from muscle or myofascial work? Think about the crura and diaphragmatic attachments!



How high up do you think it comes within the rib cage? Take a moment to consider or feel on yourself the lower edges of the rib cage all the way round. Then using the nipple as a helpful anatomical reference point, just 1cm below on the right side and about 2cms below on the left is the level of the central area when the diaphragm is relaxed. This means fibres are an average

of about 10 cms at the back and sides - depending obviously on your size - and it really is a dome. The vertical and obliquely angled fibres are heading for a central area of connective tissue into which they all attach - the central tendon. As the muscle fibres contract they are therefore pulling the central tendon downwards, flattening the diaphragm and helping to enlarge the thoracic cavity.



The diaphragm separates the thoracic and abdominal cavities, but some structures need to pass between the two. Which ones…? Most posterior, at the level of T12, is the aorta accompanied by the thoracic duct, though strictly speaking they pass behind diaphragm. At the level of T10 the oesophagus passes through a loop of a few muscle fibres. The oesophagus will generally be able to cope with the contraction of diaphragmatic muscle without having this impinge on food's progress through it (though a hiatal hernia can occur here if the stomach pushes its way upwards).

The other large structure to pass through is the inferior vena cava, bringing venous blood back from the lower abdomen and the legs. By the way, remember that the heart sat right above the diaphragm? The inferior vena cava actually drains almost immediately into the right atrium which lies posterior and on the right side of the heart in its somewhat tipped position. It importantly passes through the central tendon of the structure – why? So that as the diaphragm flattens and relaxes again, the tendon slides past it rather than any muscular fibres compressing it – a thin walled vein would otherwise struggle to stay open each time we breathe! A few other structures also slip through the fibres – autonomic nerves to the organs called the splanchnics and the azygos and hemiazygous veins that help return venous blood from the abdomen. Think about how tight diaphragmatic fibres may impact the nerve supply or venous drainage of the abdominal organs

The diaphragm is innervated by the phrenic nerve that, perhaps surprisingly, originates from the neck – C3, 4 and 5 to be precise – because of where it started from in embryological growth. This nerve also gives some fibres to the liver and gall bladder and because of this innervation, problems with the diaphragm, liver or gall bladder can refer or irritate within the spinal cord up

here and affect the nerves going to the right shoulder. Or, problems in the neck can create problems in these lower structures.

Breathing rate is also controlled by the autonomic nervous system, and just as the sympathetic ('fight or flight') system will speed it up, so the parasympathetic ('rest and digest') will slow it down. One conscious route into these systems is through our active control of breathing. As any yogi, meditator and others will tell you, conscious slow, controlled soft breathing automatically taps us into the parasympathetic system and turns off the sympathetic system. So as you are working with clients, use your knowledge of the diaphragm's structure and encourage soft deep breathes, relaxation of the abdominal muscles to allow space for the organs as the diaphragm flattens and gentle movement of this muscle as it relaxes high up into its domes. We are just one breath away from a little more relaxation!

Acknowledgement

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