

Respiratory Complications after

Spinal Cord Injury

The Respiratory System

When you breathe in, air is drawn in through your mouth and nose and is then carried into your lungs via the trachea (windpipe) which then splits into 2 branches called the bronchi, one for each lung. The bronchi continue to split into many smaller branches called bronchioles and the air eventually ends up in air sacs at the end called alveoli. Oxygen is then passed from the alveoli into your blood stream and carbon dioxide is passed back the way through your lungs and is what you breathe out through your mouth and nose.

Healthy lungs produce a small amount of mucus (phlegm) each day which we clear without even thinking about it. The main role of this mucus is to protect your lungs by trapping any dirt, debris or bugs.

Respiratory muscles bring about movements in your chest to allow you to breathe and clear your lungs and can be affected by spinal cord injury just like the muscles in your arms and legs (see Figure 2). These muscles can affect how big a breath you take in, or breathe out and also give you force behind a cough or a sneeze (see Table 1 for details on these muscles).

Table 1 - Muscles of the respiratory system.

Muscle	Spinal Nerve	Normal Function	After Spinal Cord Injury
Diaphragm	C3-C5	Contracts downwards to lengthen your thorax which pulls air down in to the lungs	If your diaphragm doesn't work well enough, you will need a ventilator to breath
External Intercostals	T1-T10	Lifts your rib cage up and out to make your breath deeper	Rib cage won't move as much when breathing in, resulting in smaller breaths. This may make you more tired or make it difficult to clear mucus.
Scalenes Sternocleidomastoid (Accessory Muscles)	C4-6 C2-3	Only used when breathing is stressed e.g. during hard exercise	Can assist breathing if your diaphragm is weak
Abdominals	T6-12	Contract powerfully during a cough to help push out anything in your lungs. Also maintains abdominal pressure making it easier for your diaphragm to function	Weak cough. Diaphragm has to work harder as it sits in a poorer position due to lack of abdominal pressure.
Internal Intercostals	T1-T10	Push your rib cage down and in to compress your lungs and push anything out.	Weak cough.

Am I likely to have problems with my respiratory system after SCI?

Generally speaking, the higher the level of your injury, the more severely it will affect your respiratory function.

- People with tetraplegia will be most affected (C1-C8) with some needing lifelong assistance with breathing.
- Low level injuries (below T12) are unlikely to be affected as there is no direct respiratory muscle paralysis but it is still important to keep active to maintain a healthy respiratory system.
- Motor complete injuries will be affected more severely than motor incomplete injuries.

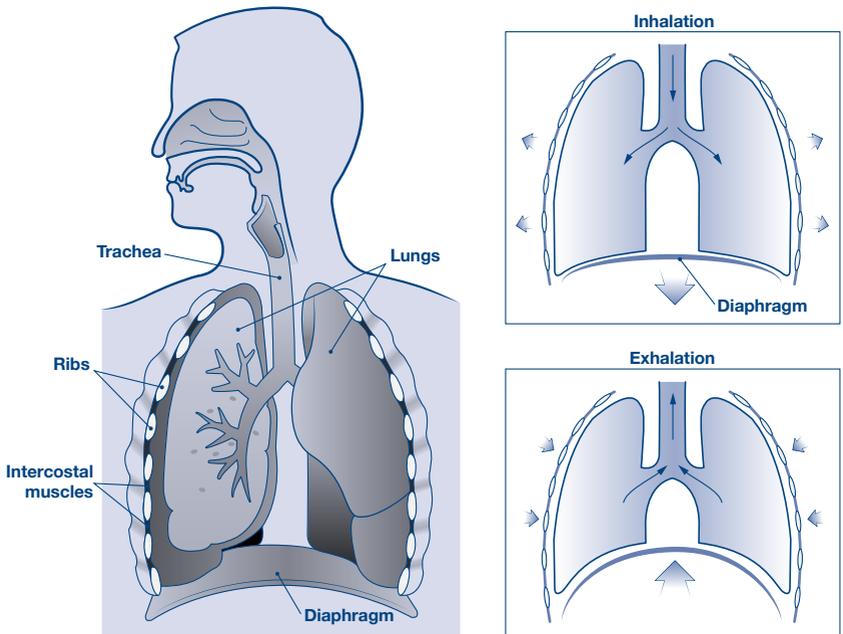
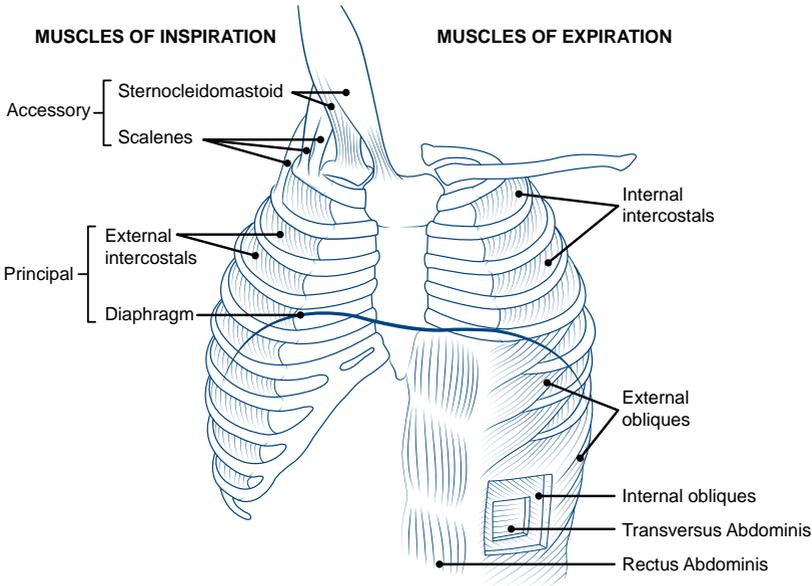


Figure 1 – Respiratory system and function of diaphragm when breathing

Figure 2 – Different muscles involved in breathing.



(a) Inspiratory muscles and their actions (left)
expiratory muscles and their actions (right)

What happens immediately after SCI?

Some people need ventilation at the time of their injury but this may be due to a number of other factors such as reduced consciousness, chest trauma or other injuries. Ventilation involves a machine giving you support to breath through a tube. We may insert the tube into your mouth or nose before passing down your trachea to your lungs. This tube may be changed to a tracheostomy tube (see information on Tracheostomies below) which is a tube that goes directly through your neck via a surgical cut to your windpipe.

Once the doctors feel you are well enough, they will gradually reduce the amount of support the ventilator is giving you and allow you to build up strength in your respiratory muscles. If this is successful, you will spend increasing periods off the ventilator before we remove the tube. This process can last from days to months.

In other cases, people are breathing well initially after injury but after a few days their respiratory muscles tire as they are not

functioning normally. They may need a period of ventilation to allow them to rest and build up their strength again.

Tracheostomies

Tracheostomies are for people that are likely to be on a ventilator for more than a couple of weeks. This is because it is more comfortable for the patient and may make it easier to gradually reduce the use of the ventilator. If you are well enough, the nurses can place a speaking valve over the tracheostomy to allow you to speak and you may be able to eat and drink. Speech and language therapists will assess and monitor the strength of your swallow to determine what is safe for you to eat and drink. If you eat and drink when your body is not ready, it may go down the wrong way into your lungs rather than your stomach and cause infection.

What happens if I can't get off of the ventilator?

Unfortunately for some people, they may always need 24 hour support from a ventilator as the diaphragm is not strong enough to keep you breathing. If this is the case, we will gradually reduce the use of the ventilator to a small portable one that works from a battery and allows you to get out and about.

Some people may only need overnight ventilation. In this case, you have enough strength to breath during the day but your muscles can't manage overnight when the muscle tone in your respiratory system relaxes. Having a period of overnight ventilation can give you more energy during the day and, in some cases, this may be via a face mask rather than an invasive tube.

Why is it harder to cough and clear mucus after SCI?

This can happen for a number of reasons, the main reason being weakness in the abdominal and internal intercostal muscles. Also, if you are unable to take a deep breath in, it is difficult to get air behind the mucus to cough it up. If you are unable to clear your own mucus, you may need an assisted

cough. This is where someone places their hands over your tummy and pushes up and under your diaphragm as you cough to replicate the force that is normally created by your abdominals. It is also possible to assist yourself with a cough if you can pull your forearm in against your tummy.

If you can't clear your chest with an assisted cough alone, you may need respiratory physiotherapy where varying pressures, springs or shakings are performed over the rib cage by someone to loosen your mucus. A cough assist or suction machine may also be necessary to help clear your chest.

What can I do to help my respiratory function?

If you smoke, give up! Smoking is harmful to your chest and will make your breathing more difficult and mucus harder to clear.

Regular exercise will help maintain a healthy respiratory system. We also advise you to get the flu jab at your GPs surgery each year.

If you suspect you may have a chest infection or notice any change in your breathing contact your GP as soon as possible.

If we know you have problems with your respiratory system after SCI, we will have a management programme in place to help keep your lungs healthy. Please follow the advice the respiratory care team or your physiotherapist gives you. If you are on medications for your chest (inhalers or nebulisers), take them as prescribed as they open up the airways in your chest and help you clear mucus. If you use a cough assist machine, use it every day or if you need chest physiotherapy, do this every day, this will stop mucus building up and your rib cage from getting stiff.

What are the signs of a chest infection?

If you have a chest infection you may feel short of breath, tightness in your chest and have a raised temperature or cough. The mucus in your chest will become thicker and your lungs will produce more mucus to help clear your lungs of infection. You may also notice that mucus becomes yellow, green or brown. Healthy mucus is clear or white. If you think you have a chest infection, change position regularly to help move the mucus out of your chest and drink plenty fluids as the mucus will be harder to clear if you are dehydrated.

-  If you have any questions about your chest, speak to your consultant, the respiratory care specialist nurse or your physiotherapist.